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Port Sustainability Management System for Smaller Ports in Cornwall and Devon

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PORT SUSTAINABILITY MANAGEMENT SYSTEM FOR SMALLER PORTS IN CORNWALL AND DEVON

by

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Abstract

Port Sustainability Management System for smaller ports in Cornwall and Devon

Many smaller ports in Cornwall and Devon (CAD) are situated in environmentally sensitive habitats and generate benefits for stakeholders and local communities. Such ports are often embedded in tourist based economies. Increasing environmental legislation is placing a strain on the resources of smaller ports making compliance a threat to profitability and thus the future of some ports and local economies. Over-reliance on environmental management systems (EMS) across the ports industry has predominated over the importance of holistic sustainability. This project develops and disseminates a port sustainability management system (PSMS) in CAD, assisting ports to plan marine and maritime operations more sustainably, to facilitate mitigation of potential risks, to increase knowledge and awareness of port sustainability, and to promote the adoption of a proactive stance towards sustainable port management.

A constructivist philosophy suited a multiple methods research design which included ethnographic content analysis (ECA), statistical verification of qualitative coding, nine scoping interviews, and eight semi-structured interviews during the main phase of data collection. The seven Harbour Masters (HMs) in this phase represented all port governance types found in the UK. Charmaz's grounded theory (GT) methodology guided the collection and analysis of primary data

between August 2012 and February 2013 to create new theory using an inductive constructivist approach. Validation by fifteen of the thirty local HMs during industry testing revealed numerous advantages and benefits of deploying PSMS which is estimated to generate £50,000 worth of benefits per port annually, and £3,865,005 for the 15 participating ports over 5 years.

A new model of smaller port sustainability has emerged. PSMS has eleven pillars of sustainability which underpin the spectrum of port operations. Within this model, each pillar is equally important in contributing to the overall sustainability of a port, and neglect of one could jeopardise sustainability overall and potentially cause a chain reaction with other pillars.

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List of Abbreviations

Abbreviation	Meaning
AONB	Areas of Outstanding Natural Beauty
AoS	Appraisal of Sustainability
BPM	Business Process Management
BPR	Business Process Re-engineering
BWE	Ballast Water Exchange
CA	Content Analysis
CAD	Cornwall and Devon
CC	Cornwall Council
CHC	Cattewater Harbour Commissioners
DCC	Devon County Council
DEFRA	Department for Environmental Forestry and Rural Affairs
DfT	Department for Transport
DHM	Deputy Harbour Master
EC	European Commission
ECA	Ethnographic Content Analysis
EIA	Environmental Impact Assessment
EM	Environmental Management
EMS(s)	Environmental management system(s)
EO	Environmental Officer
ERDF	European Regional Development Fund
ESPO	European Sea Ports Association
EU	European Union
FHC	Falmouth Harbour Commissioners
GGPPMO	A Guide to Good Practice on Port Marine Operations
GT	Grounded Theory
H&S	Health & Safety
HA	Harbour authority
HM(s)	Harbour Master(s)
IFCA	Inshore Fisheries and Conservation Authority
IMS	Integrated Management System
ISO	International Standards Organisation
JNCC	Joint Nature Conservation Committee
KTP	Knowledge Transfer Partnership
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MMO	Marine Management Organisation
MO(s)	Maritime Operation(s)
NE	Natural England
OECD	Organisation for Economic Co-operation and Development
OFQ	Observation for further enquiry
ONS	Office for National Statistics
PA	Port Authority
PDCA	Plan, Do, Check and Act
PERS	Port Environmental Review System
PMSC	Port Marine Safety Code

PPP	Policies, Plans and Programmes
PPPY	Per Port per Year
PSMS	Port Sustainability Management System
QMS	Quality Management System
REP	Requirements for Environmental Planning
RQ	Research Question
SAC	Special Area of Conservation
SDM	Self-Diagnosis Method
SDN	Sustainable Development Needs
SMEs	Small and medium-sized enterprises
SMS	Safety Management System
SOSEA	Strategic Overview of Significant Environmental Impacts
SW	South West
SWRPA	South West Regional Ports Association
TBL	Triple bottom line
TF	Theoretical Framework
THC	Teignmouth Harbour Commissioners
TPN	Truro, Penryn, Newquay
TQM	Total Quality Management
UK	United Kingdom
UKTI	United Kingdom Trade and Investment
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
WCED	World Commission on Environment and Development

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Last but not least, this work is dedicated to my parents, who showed me the meaning of strength, the value of courage, and the importance of perseverance.

Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University research award without prior agreement of the Graduate Committee.

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CHAPTER 1: INTRODUCTION

1.1 Research background

The United Kingdom (UK) hosts over 700 ports (Ports UK, 2014). Many are small and possess insufficient resources or technical expertise to engage a specialist to assess the potential impact of their operations on port sustainability. Increasingly complex legislation and more stakeholders make compliance a burden. Environmental legislation rarely focuses on the needs of smaller ports and those that are situated in environmentally sensitive areas; smaller ports in Cornwall and Devon (CAD) are facing increasing legislative and regulatory pressures to restrict activity in protected areas of the harbour at any cost, which often results in the creation of special management plans that can be resource intensive for smaller size organisations (Fal and Helford SAC, 2012). Combined with increasing stakeholder pressures calling for ports to prioritise environmental issues, port managers are facing difficulties in maintaining ports as commercially viable and sustainable for the longer term. Non-compliance can result in regulatory agencies imposing monetary penalties in accordance with the 2008 Regulatory Enforcement and Sanctions Act (OECD, 2009), which in turn threatens local jobs that depend on ports to attract tourists and keep local economies viable, making sustainable economic growth of ports imperative for local communities. The European Regional Development Fund (ERDF) Convergence for Cornwall and Isles of Scilly seven year initiative was aimed at facilitating economic growth, helping to build a stronger economy and to create and maintain sustainable jobs based on sustainable port operations

(Gov.UK, 2007). As part of that aim, this PhD project was devised to help ports to sustainably safeguard their commercially important operations and local employment through the use of a Port Sustainability Management System (PSMS). PSMS was created to help unlock resources through newly found knowledge, efficiency and awareness of port sustainability (e.g. Dinwoodie et al., 2012) that would either help to generate two new jobs in each port or to release scarce resources in each port to this value.

As key nodes in international supply chains, large commercial ports are essential elements in logistics networks (Panayides and Song 2009; Martin and Thomas 2001; Slack and Frémont 2005) and play a pivotal role in any economy. The importance of smaller and medium ports involves diversity. They include small fishing ports that are significant locally and creating employment; leisure based ports which accommodate visiting yachts and provide facilities for boat mooring (SWRPA, 2013); and ports with strategic regional importance for bunkering (Dinwoodie et al, 2012), import and export of goods (DCC, 2004), and the like. Individually they are essential inputs to local port communities and support local jobs, local trade and serve as a foundation for the local economy. Diversity of smaller ports is also the result of each port having an operational niche (Tuck, 2007). According to the ONS (2014), since 2009 the expenditure by UK residents on visits across the country has increased from £47 to £57 billion (17%) as a result of fewer trips abroad. These figures indicate that there have been more holidays spent in the UK by British tourists, a proportion of which would have included visits to the smaller and medium ports in the SW which play an important role in helping to retain money in the UK economy instead of being spent during holidays overseas. Preserving heritage in port communities can be considered to have potential for developing tourist activities (Howard and Pinder, 2003) and possibly to encourage development, benefitting local economies. Port heritage plays an important educational purpose, as learning from the past offers a powerful tool for future development.

Environmental impacts such as noise, invasive species introduced during ballast water exchanges, waste, sewage, sludge and oil spills, dust, air pollution, soil displacement and sedimentation are present in every port (OECD, 2011); however the scale of potential environmental impacts is significantly less in smaller ports compared with the major port hubs. Due to the importance of leisure and tourism business for smaller ports and their communities, local stakeholders are putting increasing pressure on the port authorities to minimise port environmental impacts. In most cases the visual pollution of port operations creates changes in landscapes and scenes with the creation of port structures and continual operations (UN, 1992:6); and can prompt stakeholders to take a strong stance in favour of environmental management (EM) without necessarily having sufficient understanding of the subject or associated costs. Lack of knowledge and understanding of marine ecosystems as discovered during data collection, the effect of port operations on those ecosystems and the lack of management tools in place is part of a traditional management approach which is explained in section 4.2; that causes port managers to take a reactive stance towards policy issues (Dinwoodie et al., 2012), bad press and strong stakeholder opposition in an attempt to settle conflicts and achieve consensus. The creation of bad press and formation of opposition groups can be attributed to proactive local communities that want to preserve status quo (e.g. BBC News Cornwall, 2012), without realising the potential impacts of ports not being proactive with development. The presence of a reactive management approach was discovered in previous academic study to be one of the key factors for smaller port closure (Tuck, 2007).

As discovered during this research, most environmental management systems (EMSs) deployed by ports are resource intensive, require specialist expertise to implement and may not be fit for purpose in smaller ports. Given the scarcity of resources in many smaller ports and the unsuitability of existing management systems to help address smaller port sustainability as a whole rather than focus only on elements of EM, a new approach is required. A less resource intensive approach, more focused towards acquiring and managing knowledge that would assist all smaller ports to examine the processes of managing port sustainability practices and move towards a proactive stance, is required.

The importance of sustainable development has been highlighted by the UN report in 1987 entitled *Our Common Future*, and since then various attempts have conceptualised sustainability and sustainable development into a management framework. The most popular model was the triple bottom line (TBL) that emphasised the importance of economic, environmental and social bottom lines required for an organisation to be sustainable (Ginemez et al., 2012; Tullberg 2012; Elkington, 1997). TBL represents a generalisation of principles rather than a definition of sustainability and its application is rarely successful.

Insufficient knowledge and understanding of sustainability in ports underpins miscommunication and misunderstanding between ports and their communities. In Cornwall in 2012, average full-time wages were lower than the national average, and average weekly household expenditure per person in the South West as a whole was more than double compared with UK average, mostly as a result of expensive transportation (Cornwall Council, 2012:3). By default, environmental issues predominate, and coupled with limited resources in smaller ports, as a result of such state of the regional economics have generated a need for sustainable port management to help safeguard current business, protect jobs and facilitate sustainable port management.

1.2 Aims, objectives and actions

The aim of this research is to create and disseminate a generic PSMS to smaller ports in CAD.

Unlike existing port management systems that either focus on environmental impact mitigation or risk management; PSMS is aimed at managing port sustainability as a whole. This has been achieved by focusing on one of the elements ports have in common, specifically on Maritime Operations (MOs), which are not port specific and are replicated elsewhere. Prior to primary data collection, MOs were defined as routine procedures that ships and vessels undertake whilst in port, and this view was later updated with the addition of primary data and the creation of MOs taxonomy (see section 4.4). The importance of MOs and the link with PSMS is outlined throughout chapter 9.

This aim was achieved through the following objectives (O1-O5):

O1: Categorise the requirements for environmental planning in CAD ports

O2: Analyse the sustainable development needs of CAD ports

O3: Synthesise how smaller ports manage environmental sustainability

O4: Assess the attitudes of CAD port practitioners towards PSMS

O5: Propose and evaluate a model to disseminate PSMS in CAD ports

The objectives (O1 – O5) will be achieved through actions including:

- Literature reviews and desk research to identify legislative requirements for port authorities to engage in sustainable port planning.
- Desk research relating to port sustainability management practice in smaller ports, in the UK and Europe.
- A survey of harbour authorities in CAD to investigate
    - Perceptions of their current sustainable development needs;
    - Practise relating to the management systems deployed to investigate environmental assessment and management;
    - Attitudes towards PSMS, perceptions of potential benefits, and any implementation issues
- The industrial benefit arising from the implementation and mechanisms for monitoring and reviewing implementations.

1.3 Research methodology

A lack of previous knowledge of MOs and port sustainability necessitated an exploratory study, within the overall context of applied research which adopted an inductive approach which deployed mixed qualitative and quantitative methods. The essence of applied research is the application of knowledge that is immediately relevant to the participating organisation or society as a whole (Broadsky and Welsh, 2008; Saunders 2012). Ackoff's (1962) classic text outlined six criteria of conducting applied research which have been addressed in sections 8.2 and 9.1.1. Viewing reality as subjective and socially constructed, a constructivist philosophy has been adapted from the outset seeking to construct an understanding rather than an explanation of the reality (Costantino, 2008; Saunders et al., 2012). Under the constructivist philosophy, a researcher "co-constructs" his understanding "with that of the participant through their mutual interaction" within the research setting Costantino (2008:119).

Offering a common set of nomothetic activities amongst ports, the ubiquitous nature of MOs facilitates the development of a PSMS whereas idiographic study of unique port operations would not. A comprehensive literature search was required to update a definition of MOs based on the recent research based on the port of Falmouth which identified anchoring, bunkering and ballast water exchange (BWE) as MOs there (Dinwoodie et al., 2012). The Knowledge Transfer Partnership (KTP) between Falmouth Harbour Commissioners (FHC) and Plymouth University predates this Ph.D. project, and enabled FHC to develop a systematic approach towards their organisational management, where the element of accrued knowledge has contributed towards increased annual profits, and the organisation was empowered to develop missing knowledge and expertise with regards to understanding of potential environmental impacts (Tuck, et al. 2011). KTP is explained in much more detail in section 4.1. The original idea of this project was to use MOs as the terms of reference to generalise on the process developed at FHC and to assist with proactive sustainability management by creating a generic system for smaller ports in CAD. In order to analyse collated data, which conforms to no particular standard i.e. extracts from various academic journals, books and industry documents and update the definition of MOs; ethnographic content analysis (ECA) was appropriate. It is “a systematic, analytical but not a rigid approach” and is flexible to allow for the definition of MOs to be updated (Altheide, 1996:16). Whilst using this method, the research is “steered by variables and categories” during the initial stages of ECA, and during latter stages orientated towards discovery and comparisons (ibid:16). Once the relevant extracts of text had been compiled that mentioned MOs, coding was undertaken by two coders and the level of intercoder reliability was computed.

Next, Grounded Theory (GT) guided analysis and collection of data using semi-structured interviews with port practitioners. The main stage of data collection took place using a constructivist approach to GT as defined by Charmaz (2006). Under the constructivist paradigm, the views of “social actors” i.e. Harbour Masters (HMs) within an applied context constituted “acceptable knowledge” (Saunders et al., 2012). Literature reviews preceded data collection following Charmaz’s (2006) view that some grounded theorists have ended up writing a careless or insufficient review when prior literature analysis is omitted. Rather than acquiring bias towards the subject, reviewing prior literature would help to set the stage for what the researcher was going to address. This suggestion about setting the scene was incorporated into the GT methodology, as the constructivist GT process begins with data, whereby researchers use materials along with observations and interactions to construct data (Charmaz, 2006). Having been described as a “method in process” whereby GT emphasises data analysis that also informs data collection strategies at an early stage, the ontological view of subjective and socially constructed reality has allowed for rich data to emerge from data collection and to help formulate new and relevant theory (ibid).

The final stage of the methodology used the knowledge management (KM) criteria outlined by Chan and Chao (2008) to build PSMS v1; however due to the nature of applied research and having to be relevant to the practitioners, this was later revised. Despite that, many principles were still incorporated into later versions of PSMS. Incomplete correspondence with the KM system, specifically issues associated with collective and systematic capture, screening, categorisation and storage of useful knowledge shifted the final version of PSMS into a hybrid system (see chapter 9). PSMS is still based on KM principles, incorporates credible and relevant knowledge, and addresses most of the Chan and Chao (2008) criteria; however the hybrid element was essential to make PSMS immediately relevant for the industry as per the notion of conducting applied research. System testing was conducted to authenticate the quality of GT research which yielded theoretical constructs used to build PSMS and to test the quality, applicability and relevance of the final output for the industry. A very positive industry response makes the research conducted credible, original, and resonant with the industry’s needs and useful.

1.4 Outline of the research report

Thus far, research background of the research problem, aims and objectives along with research methodology have been outlined in this chapter. The remainder of this section outlines the detailed structure of the whole thesis. Figure 1.1 outlines a visual representation of the thesis structure.

C**hapter two** presents a literature review surrounding the areas of sustainability, EM and the strategies for adapting those principles in the industry. The ports sector is introduced along with the evolution of environmental impacts found in ports, and discussion of the application of theoretical principles. Existing guidelines, methods and systems for managing environmental impacts in ports are analysed. Several small ports examples illustrate the unsuitability of existing methods. This chapter concludes with the summary of reasons why a universal EMS for smaller ports has failed to emerge and identifies the gap for a new discourse which this research has attempted to address.

The diversity of CAD ports is outlined in **chapter three** along with the analysis of port governance models found in the UK ports and their impact on a port's *modus operandi*. Environmental designations found in CAD ports are explained and their significance for ports operations is analysed. The specifics of CAD, operational remits of various ports and the funding initiative behind this research project are presented. Chapter three concludes with the argument for a proactive measure to manage sustainability as a whole, rather than simply looking at environmental impact mitigation.

In **chapter four,** ECA was used to analyse extracts of academic and industry related literature to update the definition of MOs. The use and purpose of the port marine safety code (PMSC) as published by the Department for Transport (DfT) is explained along with the concept of conservancy that ensures the harbour is "fit for use as a port "(DfT, 2013:62). Application of Total Quality Management (TQM) and Business Process Re-Engineering (BPR) strategies are discussed using examples from academic literature and a local case study of the port of Falmouth.

The evolution of thought and viewing of the nature of the problem which was adopted is presented in **chapter 5** in the form of theoretical frameworks (TF). From the outset a clear distinction is made between a conceptual model and a TF and the reason why the latter was chosen. Each stage of thinking has been recorded during this project in TFs which are presented in chapter 5 along with the rationale and contribution to understanding of the subject area. The final TF presents the model of 11 dimensions of port sustainability that PSMS is based on and four pressures and influences that can affect a port's abilities to address those sustainability criteria.

Chapters six and seven detail the methodology used and the process of using GT during the main data collection stage. More background on ECA is presented along with the research setting of smaller ports in CAD. Detailed reflection on the methods of all stages of data collection is presented including scoping, main data collection, draft PSMS and system testing stages. Chapter six covers the origin and background of GT as one of several methods used, whilst chapter seven details how GT was used to analyse data obtained from the main data collection phase. A detailed evolution of codes and ideas is presented along with the contribution of memoing towards reaching higher levels of abstraction and selecting theoretical codes.

Findings and results are explained and presented in **chapters eight and nine**. Chapter eight summarises the commercial operations in the ports interviewed during the main data collection stage. Chapter nine provides a detailed evolution of PSMS along with evidence and rationale for modifications. Chapter eight addresses objectives O1 to O3 and concludes with the theory of evolving sustainable practices of smaller ports. Chapter 9 presents the output of the whole project including the evolution of thinking and creation of PSMS. Appendices D-S trace how PSMS evolved from a purely practical and infeasible concept with regards to system ownership and financing; to a theoretical model, and finally into a practical system that has been tested by the industry. Testing results are contained within chapter nine together with the criteria of testing the quality of research conducted.

Chapter ten discusses the results presented and contains an overview of the whole research, how answering each of the research objectives provided an individual contribution towards the creation of PSMS v5, the implications for theory, industry policy, and a breakdown of benefits to CAD ports.

The conclusion in chapter eleven provides three recommendations for the industry and future work based on the results received from industry testing.

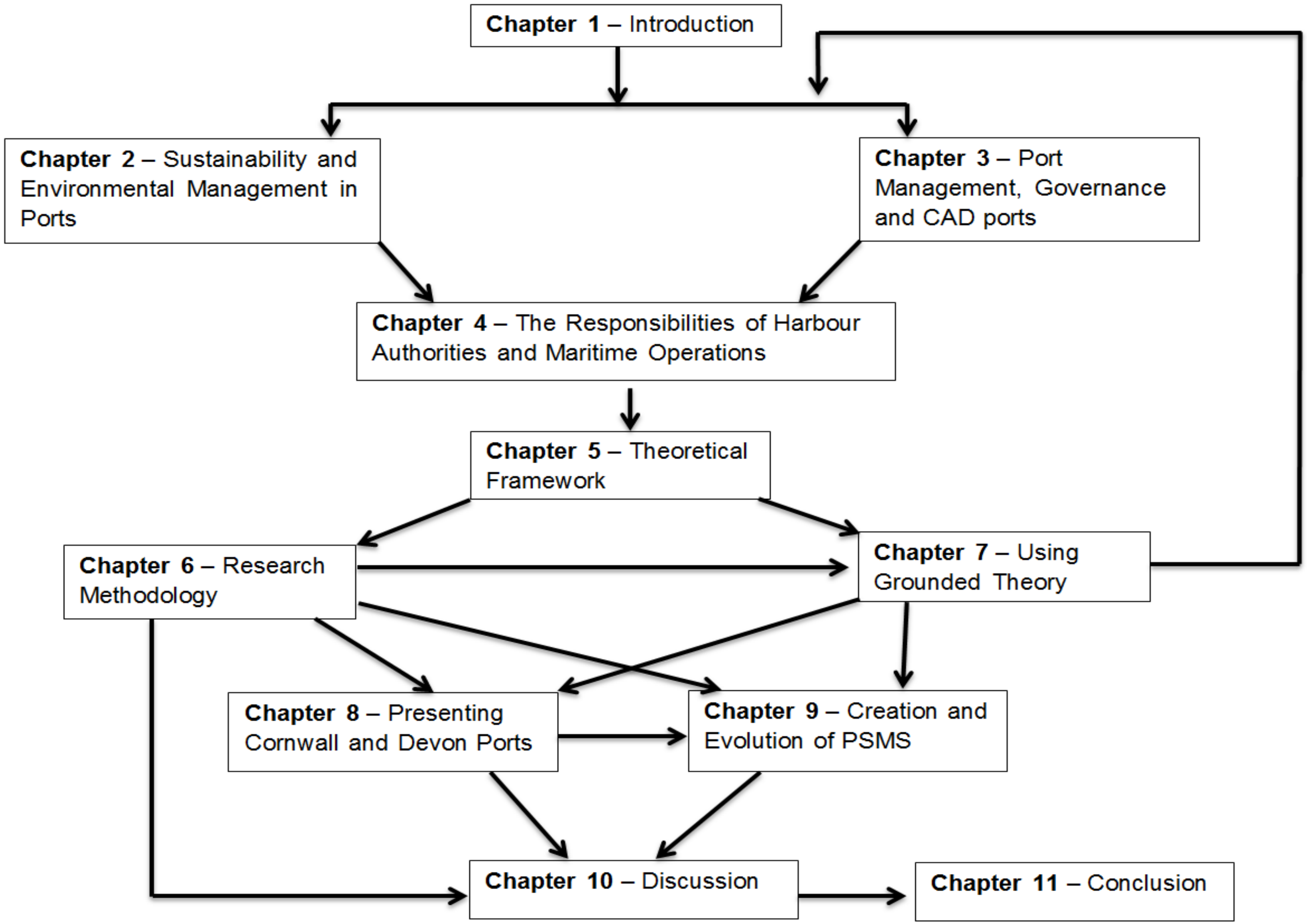


Figure 1.1 Thesis Structure

CHAPTER 2: SUSTAINABILITY AND ENVIRONMENTAL MANAGEMENT IN PORTS

2.0 Introduction

Numerous attempts have been made to integrate principles of sustainable business management into the daily operations of organisations. Growing awareness of environmental concerns has been driving the demand for environmentally-friendly practices (Gadenne, et al., 2009). A range of external influence groups have been identified by Gadenne et al (2009:45) namely “legislators, environmental groups, financial institutions and suppliers” which influence organisations to undertake EM practices. Excessive attention to one concept creates an apparent panacea that many use for political or commercial gains, and detracts from other efforts to stimulate change (e.g. Elkington 1997; Ginemez et al., 2012).

Few processes for developing environmental awareness in ports have been identified and limited awareness of current environmental practices is likely as a result of outsourcing or external EM practices (Dinwoodie et al., 2012). All ports in CAD are small and medium enterprises (SMEs) according to the definition provided by the European Commission (EC) which defines such organisations having less than €50 million turnover with fewer than 250 employees or have less than €43m in their balance sheet total (EC, 2013). The process whereby SMEs become aware of environmental issues by owning an environmental process rather than outsourcing it is critical (Dinwoodie et al., 2012). As a result, the element of continuous improvement within an organisation can promote the awareness of existing contingency plans, facilitate communication of knowledge with employees and consequently improve safety (ibid). Embedding of environmental awareness into organisational practices by implementing a framework based on an Input-output model developed in conjunction with Falmouth Harbour Commissioners (FHC) required an understanding of the business processes to meet environmental obligations (Dinwoodie et al, 2012). The use of input-output model, the benefits of using that approach and the case study of FHC are analysed in section 4.3.

Another study focused on environmental awareness and practices in SMEs suggested a model that can potentially be applied to smaller ports, many of which can be classed as SMEs. These organisations dominate many industries and create extensive employment and revenue. At the start of 2012 in the UK, there were 4.8m SMEs which employed 23.9m people and had a combined turnover of £3.1 trillion (FSB, 2013). However, few SME owners consider that they impact the environment significantly (Gadenne, et al., 2009). Gadenne, et al., (2009:49) combined theoretical concepts, namely "external influences, moderating variables, environmental awareness and attitudes; and environmental practices" into a model of external influences on environmental awareness and practices in SMEs which will be discussed later.

This chapter introduces the evolution of sustainability as a concept from a theoretical definition of sustainable development to practical application using management systems. Growing concerns regarding environmental issues restrict many perceptions of sustainability (e.g. UN, 1992; OECD, 2008). Environmental awareness is discussed together with some strategies for adopting environmentally friendly practices. The ports industry is introduced in generic terms to illustrate an industry-specific approach towards the application of sustainability through the use of EMSs.

2.1 Sustainability and the Brundtland report

The term sustainability can become a slogan. The World Commission on Environment and Development produced a report in 1987 entitled “Our Common Future” (also known as the Brundtland report), which defined a sustainable development as one which “meets the needs of the present generation without compromising the ability of future generations to meet their own needs” (UN, 1987:15). Nowadays this concept is widely discussed, but a global initiative in which all must contribute is required for success. Gareth Hardin in *The Tragedy of The Commons* wrote that “the rational man finds that his share of the cost of the wastes he discharges into the commons is less than the cost of purifying his wastes before releasing them”, and that “we are locked into a system of “fouling our own nest”, so long as we behave as independent, rational, free-enterprisers” (1968:1245). Prioritising costs remains of central importance today.

Having proposed an agenda for global change, many governments and institutions began to incorporate the sustainability principles into their products, processes and policy planning (OECD, 2008). Despite successful local projects informing people about the necessity of waste reduction and regeneration of urban spaces, practical applications of sustainability require a change in habits and attitudes of both people and institutions (ibid). Four causes of threatened future outlined in the original WCED report were poverty, growth, survival and economic crisis (UN, 1987). Whilst trying to reduce poverty and improve living standards, technologies and products that have made development possible come at a great cost to the environment, making the impact on the commons “greater than ever before in human history”(ibid:28). Decreasing poverty and rising populations place a great strain on natural resources and generate higher concentrations of CO_2 emissions and “endanger the survival of the Earth” (ibid:29). Previous concerns focused solely on the effect that development had on the environment require revision and attention to the impact of environmental degradation that “can dampen economic development” (ibid:31).

Despite the supposed adoption of sustainable development, increased demand for resources and greater environmental pollution (OECD, 2008) have propagated environmental disasters including the BP Horizon oil spill with an estimated $8.7B economic impact on the Gulf of Mexico’s economy and loss of 22 000 jobs (American Progress, 2013). The same sources report that following the Exxon Valdez oil spill in 1989, the herring fisheries have still not recovered (ibid). These examples contradict the essential notion of not compromising the ability of future generations to meet their own needs, but instead a cycle of causes that threaten the future has been created. “Sustainability” becomes a theoretical proposition that requires adjustment for practical application depending on the country and the industry (OECD, 2008).

2.1.1 Triple bottom line

The application of sustainability is usually operationalized using the concept of Triple Bottom Line (TBL) (Ginemez, et al, 2012), first developed by John Elkington in 1994, and disseminated in 1997 (Tullberg, 2012). Elkington reported hundreds of companies signing because “the basic challenge was of “greening”, of making business more efficient and trimming costs” (Elkington, 1997:71). In the Figure 2.1 conceptual representation of TBL true sustainability attains only where all three dimensions intersect. Unless societies move towards the same goal, not much will happen as Rome (2006:137) explains: “firms alone cannot become sustainable in an economic, environmental and social sense, as they merely contribute to more sustainable patterns of production and consumption within society”.

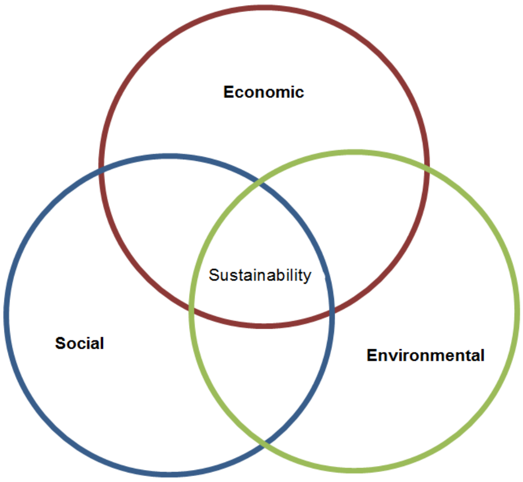


Figure 2.2: Triple Bottom Line,

Source: Based on Elkington (1994; 1997)

The concept of TBL suggests that financial gains can be made in the process of engaging in environmentally and socially responsible behaviour (Ginemez et al., 2012). At the source level, economic sustainability has been implemented as organisational production costs, environmental sustainability as the use of resources and environmental footprint; and social sustainability as provision of equality, quality of life and accountability among governing structures (ibid). Where there have been local successes, social justice is often overlooked by businesses when thinking about TBL and focusing on economic prosperity and environmental quality (Elkington, 1997). Ginemez et al (2012) categorised sustainable practices into internal and external arguing that the former approach of management programmes had a positive impact on environmental performance and on social responsibility (ibid:151). An example of such practices would be an implementation of new manufacturing policies and processes whereby reducing the amount of pollutants can improve working conditions and have a positive effect on the quality of life of that community (ibid). Such practices could represent those local successes that the WCED's *Our Common Future* report was referring to as examples of sustainability successes (UN, 1987). External practices such as codes of conduct and supplier collaboration as detailed by Ginemez et al., (2012) are being monitored by those companies that have put together expensive initiatives aimed at tackling environmental and social issues along their supply chains. Such initiatives can be very successful if the company possesses a strong brand and wants to be associated with, albeit in some cases such initiatives can also be perceived as "greenwashing", marketing and PR. Despite reasons for scepticism, some authors (e.g. Simpson and

Powel, 2005; Carter and Rogers, 2008) have discovered that these monitoring practices can have a “positive impact on environmental performance” (Ginemez et al., 2012:152).

2.2 Environmental awareness and adaption for SMEs

Considering that the individual turnovers of two of the biggest ports in CAD are less than £5m per year each (FHC, 2012; Fowey Harbour Accounts, 2012), it can be stated that all ports in CAD are SMEs. The following section will review environmental awareness, management and adoption of environmentally friendly practices by SMEs.

From a study of SMEs and their environmental awareness practices, three major motivation factors for environmental awareness and responsiveness have been identified; specifically competitiveness, legitimation and individual concerns which aim to reflect ethical and managerial issues of SMEs (Gadenne, et al., 2009). Competitiveness is often associated with economic gains as a result of adoption of environmental practices, and having been used as one of the marketing strategies for increasing market share (Porter and van der Linde 1995), the majority of SME managers reflected on environmental responsibility being a financial burden (Simpson et al., 2004). Creating awareness among SME managers can be done through legitimation, the second major motivator identified by Gadenne, et al., (2009) and known to result in establishing better environmental practices and procedures (Williamson, et al., 2006). An earlier study suggested that SME managers value the clarity of legitimation since it states exact requirements being placed upon the SMEs and facilitates equality with those SMEs that did not undertake environmentally friendly practice and managed to obtain economic advantage over those that did (Tilley, 1999). Individual concerns for the environment can result in EM practices being created when SME managers choose to do so regardless of whether they were obliged by law or not, or whether they thought it could have resulted in additional revenue (Gadenne, et al., 2009).

Parallels with the ports sector are apparent. Firstly, port(s) operating with suppliers whose company brand is associated with, or which have adopted a proactive stance on environmental protection, can result in demands to adopt a process that would lead to an environmental certification, such as ISO14001 (Gadenne, et al., 2009). As discussed by Dinwoodie et al., (2012) depending on whether such process is outsourced or created internally, the level of environmental awareness would vary. Secondly, Perry (2001) asserted that associated waste minimisation and cost saving was the biggest reported benefit for SMEs from certification, as awareness would increase pending the process of certification and reducing waste. The ports sector has to comply with the updated Port Waste Reception Facilities Regulations 2003, applicable to all harbour and terminal authorities (DfT, 2013). This measure creates sufficient awareness of waste and its environmental impact; however the process of dealing with waste through stakeholder collaboration engenders additional environmental information and may convince ports to invest in environmentally friendly measures (Gedenne, et al., 2008). Being part of a community that is aware of each other’s business plans may encourage environmental passivity, in that knowledge of who is not undertaking any environmental initiatives may deter others from being proactive and investing time and resources, and leaving them less environmentally aware (ibid). Thirdly, as suppliers of services, ports must be assured of potential benefits which environmental practices might generate including positive impacts on business arising from collaborating with business partners who have adopted a proactive stance on environmental concerns, resulting in cost benefits and increased environmental awareness for the port(ibid).

Figure 2.2 conceptualises the flow of influence and awareness of SMEs. The external influences category combines current and potential suppliers, customers and legislation (Gadenne, et al., 2009). An environmental practices category includes “measures of environmental systems, conservation and support as dependent variables” (ibid:49). A moderating variables concept relates to factors preventing environmentally-friendly initiatives which include “lack of time, lack of financial resources, lack of information, age and education of owner manager” (ibid:50). This arrangement of concepts was verified with several SMEs during the study of Gadenne et al., (2009) to ensure accuracy.

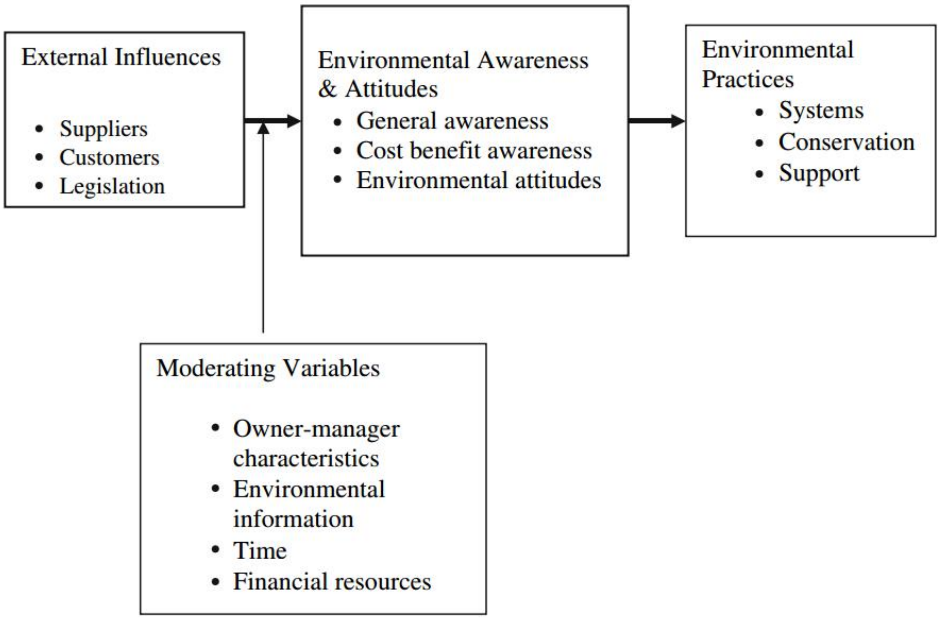


Figure 2.2: A model of external influences on environmental awareness and practices

Source: Adapted from Gadenne et al (2009:49)

If applied to the ports sector, when a moderating variable of financial resources is applied but does not affect the flow of progressions according to figure 2.2, then those ports could end up creating EMSs internally or outsource them. However if smaller ports lack the financial resources to engage with environmentally friendly practices either internally or through hiring consultants, they possess insufficient environmental information to move fully into the "Environmental Awareness and Attitudes" category, where only partial awareness can be generated. For example, in order to move on to the systems stage under "Environmental Practices", SMEs and port managers must have general and cost benefit awareness of environmental issues before forming a perception of those general issues concerning the environment (Gadenne, et al., 2009). Having formed those attitudes, an organisation can then proceed with the creation of environmental practices and engage with conservation and support activities (ibid). Using that logic, not having cost benefit or general awareness, poor environmental attitudes can be formed based on incomplete information which might not result in the creation of comprehensive and relevant environmentally friendly practice.

2.2.1 Strategies of adaption

After developing an environmental awareness and forming a set of attitudes towards environmental issues, various strategies are available to adapt environmentally friendlier practices into formalised systems for management. Inter alia, the main strategies are Total Quality Management (TQM), Business Process Re-Engineering (BPR), and an ISO standard to create an EMS. Of the latter, only ISO14001 was specifically created as a set of guidelines for an EMS, although TQM and BPR advocate principles which when adjusted are transferable and applicable into an EMS.

TQM

TQM which aspires to achieve “zero defects via continuous improvements” requires two approaches. Firstly, there is a gradual implementation of improvement activities, where every employee is included in the improvement process and secondly improvements using the efforts of “reducing variation in production processes” (Naslund 2008:272). TQM emphasizes the importance of customer satisfaction from the perspectives of availability, delivery, maintenance, reliability and cost (Al-Mashari and Zairi, 2000). In essence, TQM represents a business process approach, which if used systematically, could lead to greater competitive standards (ibid).

According to Gunasekaran et al., (1998:948) "…total quality will create a positive spiral in the company. Happy employees will do a better job, i.e. better products and services which will satisfy more customers". Prajago et al., (2005) described two views of TQM, the first of which promotes unification of mind-sets and perceptions within an organisation via a "homogeneous" culture. Alternatively, a "pluralist" view which encompasses cultural elements can also promote standardisation and control, instead of only focusing on flexibility (Watson and Kurokonda, 1995). There have been mixed findings with regards to the effectiveness of TQM, evidenced by US, UK and Australian firms (Baird et al., 2011). Two thirds of US firms reported "zero competitive gain" from TQM (ibid:790). In the UK a majority of companies did not gain any tangible results (Soltani et al., 2005). Australian companies also reported a mixed reaction to the effectiveness of TQM (Taylor and Wright, 2003). Such findings pose important questions for companies contemplating the adoption of TQM (Baird, et al., 2011). TQM initiatives failed because those factors that are essential for successful implementation were not in place (Curry and Kadasah, 2002). One factor for successful implementation of TQM is the need for change in the attitudes of the workforce along with organisational culture (Sohal and Terizovski, 2000; Sohal et al., 1991). Studies have suggested that ignorance towards cultural aspects of TQM have led to unsuccessful implementation (Becker, 1993; Oakland 1995). Distinct groups of thought interlinking TQM practices and organisational culture include one argument suggesting that "TQM practices bring cultural change", and the other that "it is organisational culture that affects TQM implementation and its results" (Prajago et al, 2005:1106). Baird et al., (2011) examined the relationship between six organisational cultural factors, namely outcome orientation, attention to detail, teamwork/respect for people, innovation, stability, and aggressiveness, and the adoption of TQM practices. They concluded that outcome orientation, teamwork/respect, and innovation factors displayed a considerably positive correlation with the extent of using TQM practices (ibid:804). The degree of data accuracy and quality, as well as reporting, was related to outcome orientation and teamwork/respect (ibid). The latter was associated with "three out of the four core TQM practices" (ibid). A key finding was that managers should recognise the "tremendous effect" which employees can influence whilst being "the most valuable asset in quality management program" (ibid:804). One way of doing so is by motivating staff to actively contribute skills and knowledge within their business towards a joint effort of enhancing organisational success in its striving for quality (ibid).

If applied to EM, the newly combined organisational focus along with better teamwork and respect should aim at delivering higher quality products and services to the end customer (Al-Mashari and Zairi, 2000), which include environmental issues and management measures. Such an approach would endeavour to create a bespoke system for managing information to suit the needs of a particular organisation, and would require that institution to undergo a process of change, to align organisational goals with those of their customers in order to deliver a high quality output.

BPR

One view of EM in the context of organisational change reveals that many current job functions, work flows and organisational structures might have been inherited rather than designed (Hammer, 1990). Business process re-engineering (BPR) involves identifying and rejecting some of the existing processes and then finding creative new ways to accomplish work, an “all or nothing proposition with an uncertain result” (ibid:105). In their study of engineering to order companies, Cameron and Braiden (2004) suggested that implementation of BPR can be challenging due to organisations having both, “micro” and “macro” processes. In this example, macro engineering due to complex product and “intercompany networks” required for realisation made BPR very difficult; however micro BPR and successful “reconfiguration of several internal processes” was achieved (ibid:270).

Ligus (1993) stated that an effective BPR project can achieve a 30-35% reduction in the cost of sales, 75-80% reduction in delivery time, 60-80% reduction in inventories as well as 65-70% reduction in the cost of quality (cited in Shen and Chou, 2010:64). A survey of companies in the Australian financial services sector which have implemented BPR found that an organisation has much better chances of achieving higher profitability if BPR is thoroughly integrated into the company’s business strategy (Terziovski et al.,2003). Shen and Chou (2010:69) researched implementation success factors of BPR amongst logistics companies in Taiwan, finding that “around 70.83% of BPR projects had fewer than 10 project members and 54.17% of BPR project’s budgets were less than 5 million TWD” (New Taiwan Dollarsequivalent to around £104 000). For both implementers and non-implementers of BPR, factors such as “top management support, identification of BPR opportunities, employee involvement, and effective communication are viewed as among the five most important considerations for BPR success” (ibid:72). Despite similar views on success factors, the empirical findings of the researchers have indicated that in all major logistics related operations, companies that have adopted BPR performed considerably better than non-adopters (ibid).

Change is the key message derived from the BPR approach which needs to be applied to outdated processes and functions in order to strive for innovation. Further, trying to re-engineer too much could result in a failure, as re-engineering intercompany networks is difficult, specifically if all these networks directly or indirectly contribute to an environmental impact. To re-engineer macro environmental processes, an organisation must have significant brand value, market share and potentially be an industry leader in order for other companies to be willing to work together on changing their practices and adhering to the new requirements. Unlike macro BPR which requires a huge effort from all collaborating partners and is unlikely due to resource and cost constraints, micro BPR as argued by Cameron and Braiden (2004) aims to reconfigure internal processes and has much higher chances of success. In terms of EM, updating processes of information flow, introducing environmental monitoring, creating a process of environmental checks and controls, facilitating a new discourse with environmental stakeholders are possible applications of BPR to EM that would require micro process re-engineering and could succeed.

ISO

Following the ISO 9000 quality management standard, ISO established an ISO14001 standard as a framework for EM (Yin and Schmeidler, 2009). By establishing better controls over a company's operations with environmental impact and certifying those organisations with the ISO 14001 standard, ISO promised to reduce their environmental footprints (ibid). The basic principle of ISO lies on the premise that nothing important has been left out and everyone in the organisation is clear about their role and tasks associated with it. This approach assists the "certificate holder to manage pollution created by his activities" (Saengsupavanich, et al., 2009:155)

ISO claims that the ISO14001 standard "does not state the requirement for environmental performance", but instead maps out a structure companies can follow in order to set up effective EMS's (ISO, 2013). That statement becomes a strategic tool on which an EMS would be based. Representing a set of guidelines which promote continual improvement, companies can then use those generic principles to start recognising and identifying how their practices affect the environment, and eventually integrating environmental and business management resulting in better control over environmental impacts (Beal, 2002).

The process of compliance begins with identifying all major environmental impacts which a company has control over and those that can be influenced (ISO14001, 2004). The ISO14001 standard claims that only those requirements are included which can be "objectively audited", and organisation requiring an EMS on a broader range should refer to ISO 14004 (ISO14001, 2004).

Figure 2.3 illustrates five major elements in the ISO14001 standard, summarised in table 2.1 below.

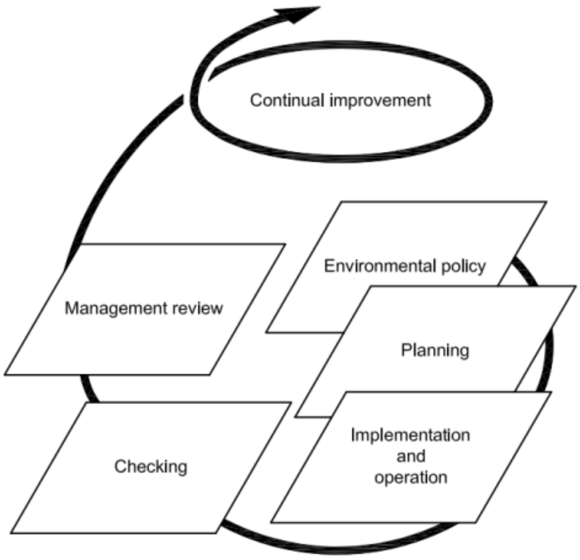


Figure 2.3: EMS model for ISO14001 standard

Source: Adapted from ISO 14001(2004:vi)

Principle	Description
(a) Environmental Policy	Defining organisational environmental policy, ensuring within the defined scope it: 1) is appropriate, 2) includes commitment to continual improvement and pollution prevention, 3) includes commitment for compliance, 4) provides a framework for environmental objectives and targets, 5) is documented, implemented and maintained, 6) is communicated to all working for an organisation; 7) is publicly available
(b) Planning	Organisation shall **establish, implement and maintain (EIM) a procedure(s)**: 1) <u>Environmental aspects</u> (i.e. to identifying environmental aspects; to determine the impact scale of those aspects by documenting information and keeping it up to date). 2) <u>Legal and other requirements</u> (i.e. access applicable legislation; determine the impact of those legal requirements on environmental aspects; use those requirement to EIM its EMS 3) <u>Objectives, targets and programme(s)</u> (i.e. implement and maintain documented measurable environmental objectives and targets; establish a programme for achieving those objectives and targets)
(c) Implementation and operation	1) <u>Resources, roles, responsibility and authority</u> (i.e. ensure availability of resources to EIM and improve an EMS) 2) <u>Competence, training and awareness</u> (i.e. ensure competent people are undertaking roles with potentially significant environmental impacts) 3) <u>Communication</u> (i.e. EIM procedures for internal communication among various levels and functions; procedures for responding to external communication) 4) <u>Documentation</u> (i.e. EMS shall include: environmental policy aims and objectives; scope and main elements of EMS; ISO required documents, records) 5) <u>Control of Documents</u> (i.e. EIM procedure for documents for approving, reviewing and updating; ensure availability, legibility and relevance of documents) 6) <u>Operational Control</u> (i.e. identify and plan those operations that have significant environmental impact) 7) <u>Emergency preparedness and response</u> (i.e. EIM procedure to identify potential emergency and accidents that can have environmental impact; prepare response)

(d) Checking	1)Monitoring and Measurement (i.e. on regular basis key aspects of operations with significant environmental impacts) 2)Evaluation of Compliance (i.e. EIM procedure for evaluating compliance with legal requirements) 3) Nonconformity, corrective action and preventive action (i.e. EIM procedure for dealing with actual and potential nonconformities; procedure for taking actions) 4) Control of records(i.e. maintain records to demonstrate ISO conformity) 5) Internal Audit(i.e. ensure EMS audits are conducted at planned intervals)
(e) Continual Improvement	Management Review - review organisation's EMS at planned intervals to ensure its continuing suitability, appropriateness and effectiveness.

Table 2.1: Five major element of ISO14001 EMS model

Source: Adapted from ISO 14001(2004)

A major element throughout the ISO14001 standard is record keeping and ensuring that everything can be audited. Table 2.1 is a brief summary of ISO14001. The strategic nature of ISO14001 tool is evident as principles can be applied across a number of industries. Although being more in control of operations with significant environmental impact as stated by the ISO14001 requirement, a company undergoing the process, or recently certified, may not control all of its controllable impacts if it relies on collaboration with many other partners.

The origin of the Plan, Do, Check, Act cycle (PDCA) can be traced back to Shewhart's (1939) research and originally stood as "hypothesis (plan), experiment (do), evaluation (check)" (Meiling, et al., 2013:1). The cycle was formalised by the Japanese automotive industry in 1950 and further developed by William Deming in 1986 (Meiling, et al., 2013). The methodology of ISO is based on the complete PDCA cycle (table 2.2).

Action	Description
Plan	Establish the objectives and processes necessary to deliver results in accordance with the organization's environmental policy
Do	Implement the processes
Check	Monitor and measure processes against environmental policy, objectives, targets, legal and other requirements, and report the results
Act	Take actions to continually improve performance of the environmental management system

Table 2.2: PDCA Cycle

Source: Adapted from ISO14001:2004(vi)

Being conceptualised as a circle, the PDCA methodology links well with the notion of continual improvement, a major element of the ISO14001 methodology (see figure 2.3). Since many organisations manage their operations using a process approach, the ISO 14001 argues that the PDCA cycle can be applied to all processes within an organisation (ISO14001, 2004).

2.2.2 Models of port environmental management

Moving on from generic systems that can be adapted by SMEs in general, this section looks at applying EM principles within the ports sector and the generic models currently available for that. Port EM systems are explained in section 2.4

For ships coming into port to behave in an environmentally conscious manner and to minimise their environmental impact, the vessel company/operator must want to deal with that particular port and to cooperate in a joint effort of tackling environmental impacts. This would require a port owner/operator to apply external i.e. macro BPR, which can be difficult due to intercompany networks involved (Cameron and Braiden, 2004). Vessel owners/operators might not be so considerate to have their intercompany networks affected by macro BPR if the port of call is a much smaller institution with minimal market share and power to demand their terms (ibid). Considerable adjustment and customisation of generic management strategies such as BPR, TQM and even ISO is required to suit a particular industry along with having an effective EMS to ensure successful management and reduction of environmental impacts. Among BPR, TQM and ISO, only ISO was intended to be used as an EMS; however these guidelines are generic for any industry and are not port specific. Implementation of ISO to ports is explained in section 2.4.1

Guidelines for EM

Lack of a standardised EMS model for ports may stem from port diversity, variety of strategic tools, no legislative requirement for an EMS, and other factors. Despite the lack of standardisation, guidelines for port EM have considered the magnitude of port environmental impacts and suggested tools to help mitigate them.

Paipai et al., (2000:199) provided guidelines intended to address a general consensus within the ports industry regarding “environmental objectives and targets which are meaningful and measureable”. These guidelines can have a positive contribution towards environmental performance with or without a formal EMS (ibid) (table 2.3).

1) Port and Harbour development and operational activities, potential environmental impacts associated with environmental legislation
a) Port activities are divided into *development* and *maintenance* activities, the former relating to construction, land reclamation with which most ports are familiar; and the latter representing operational activities such as cargo handling, equipment maintenance. b) These two operational groups are likely sources of environmental impacts which are normally local; however river and estuarine impacts can have a regional scale. c) Operational impacts last the duration of port operations, unless resulting in irreversible environmental alteration or loss of environmental resources
2) Magnitude and significance of environmental impacts
a) (2) Depends on parameters, namely "the nature, extent, intensity and frequency of the activity", level of sensitivity, environmental resource health and control measures (p.200). b) Contaminants can follow more than one way to reach environmental targets c) Successful environmental protection depends on the understanding of how harbour operations impact environmental targets and the pathways that contaminants take.
3) Environmental Management Tools
a) The aim of EMS is to ensure continual improvement in environmental performance b) Certification with an ISO14001 and EMAS standard(s) does not automatically imply successful EM c) Bespoke EMS tackling environmental impact by addressing operations with potentially significant impact, identifying actions to minimise impact and improving communications could result in successful port EM.
4) Common non-conformities with elements of EMS
a) For ports seeking accreditation, non-conformities can result in failing to be accredited b) On its own, failure to "systematically record training events" is a minor non-conformity (p.201) which can become a major one, if not addressed c) A number of minor non-conformities consequently can also fail accreditation
5) EM practices and programme
a) Generic guidance is provided with the aim for ports to create bespoke EMS b) More specific guidance aimed at people tasked with the implementation of EM practices
6) Current status on port EM
a) Many ports introduced EM programmes to help safeguard environmental vitality b) Research suggesting evolving culture of adapting best practice and "practicable and effective guidelines" through the ports industry (p.201)

Table 2.3: Guidelines for port EM
Source: Based on Paipai, et al. (2000)

The guidelines note that accreditation with recognised standards does not guarantee successful EM practices because practical guidelines for the ports sector were still emerging. If guidelines are used to create a bespoke EMS and all relevant measures are addressed to minimise and control environmental impacts (point 3c table 2.3), this approach could result in a successful EMS. The examples used to illustrate maintenance and development activities in point (1a) are not comprehensive. However a preliminary conclusion emerges from this analysis that immense diversity of port operations, functions and activities along with factors such as scale, environmental sensitivity, and resource availability are fundamental reasons why standardised EMSs are not appropriate for this sector because of their prescriptive nature and ambiguities which would be required to ensure comprehensiveness. More pragmatically, ports may use practical and applicable guidelines formalised on a set of existing practices to develop a bespoke EMS with higher probability of success which would then be either incorporated into the wider bespoke PSMS or underpin an in-house PSMS to address all issues relevant for that particular port.

EM framework

The closest to a standardised EMS model was developed by ABP Research and Consultancy (Whitehead, 2000). Reflecting ISO14001 standards, the framework refers to sections which do not match the current standard by category and sub-category numbers; (Figure 2.4).

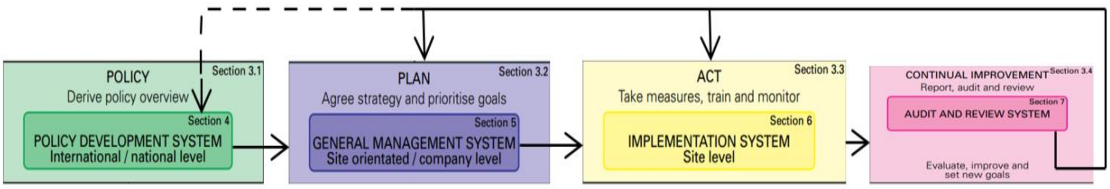


Figure 2.4: EM framework for ports and related industries

Source: Based on Whitehead (2000:24)

Compared with ISO14001 standards, the EM framework in figure 2.4 has combined *checking* and *management review* from ISO14001 under audit and review system. Above each system name is a title of a generic component, which the system beneath aims to achieve. Four systems are emphasised in this framework – one under each section, to achieve a particular goal.

Policy development system is aimed at leading an organisation to a specific strategy, including the development of an environmental policy which could be used as “guideline for environmental practices”, and would serve as a vehicle for influencing legislation at a company, national or international levels (Whitehead, 2000:24). This system consists of identification and prioritisation of environment concerns, and creation of a policy statement used to influence environmental planning (ibid).

General management system consists of two goals, the creation of an organisational environmental strategy along with development and prioritisation of achievable environmental goals (ibid). Components include an information system, management processes for strategy development, goals and priorities; sources of contamination, and evaluation and review of goals and strategy (ibid). Goals should be specific, measureable, achievable, and realistic, within a time-scale (ibid).

Implementation system is a process by which “actual improvement or prevention of harm to the environment occurs” (ibid:28). Key elements to successfully implement environmental goals are:

A. Formulation of the methodology to achieve a set goal,

B. Defining and documenting exact processes,

C. Communicating the requirements,

D. Executing agreed processes (ibid).

Audit and review system consists of environmental audit and review, combination of which provides a “mechanism for defining both corrective action and ultimately continual improvement” (ibid:30). Audit can be carried out internally by company staff at fixed intervals, and externally as an independent overview and verification. The important element here is the feedback loop which must continue until the “environmental audit indicates that procedures have been followed” (ibid:30).

The EM framework presented in this section represents a more prescriptive set of guidelines. This framework adds a visual dimension to the ISO14001 requirement, making it more comprehensible. Incorporation of environmental considerations into an overall port management system is required for sustainable development. The next section will focus on environmental impacts in ports and explain why EM in ports is often perceived as sustainability and why a new dialogue is required for smaller ports unable to meet the rising costs of EM initiatives.

2.3 Ports sector and the environment

Over 90 per cent of world trade is carried by sea, with ports serving as hubs to receive and deliver goods (IMO, 2013). Since 1970 the total amount of seaborne cargo globally has increased from 2566 million tonnes to 8408 in 2010, (UNCTAD, 2011). Considering such a vital importance for global and domestic trade, one would expect to see the topic of port sustainability to have major importance for island nations and those countries that solely depend on import and export of goods. However, a quick search of the Department for Transport (DfT) website using a keyword “sustainable” revealed 98 publications in the transport sector, reaffirming the importance of the sustainability concept for government and policy makers. None of the search results was a dedicated report on the ports sector (DfT, 2013). Significant numbers of academic publications have addressed the important role of ports in the context of supply chain management (see Panayides and Song, 2009) emphasizing the economic sustainability and opportunities for development.

Because some ports are owned privately and others by the government, their business models differ ranging from making profit to serving another purpose e.g. addressing stakeholder needs (Talley, 2009). Objectives of government owned ports, on a local, state, or federal levels can comprise supporting local employment, economic development and prosperity of the region, enabling the region’s best commodities to be exported (ibid). As key nodes in international supply chains, ports are essential elements in logistics networks. Ports have to evolve from traditional functions of loading and discharging cargo in order to improve their efficiency and become essential links of global logistics and distribution chains (Panayides and Song, 2009). Although relatively few ports handle containers, academic and industry related research tends to feature them, focusing on for example improving the efficiency of major container terminals, because of their contribution to the national economy. Issues concerning the ports industry's level of sustainability have become a significant worry in many countries (Faisal, 2010). Academic literature highlights the "dual" aspect of environmentally friendly supply chains which combine economic efficiency together with environmental protection (Diniz and Fabbe-Costes, 2007). In contrast, Kohn and Brodin (2008:230) argued that strategic decisions that companies make in terms of logistics have "detrimental environmental consequences".

Within the EU, 74% of imported and exported goods, alongside 37% of exchanges by volume are transported using ports (EC295, 2013). In the UK, approximately 96% of all trade enters the country using ports (UKTI, 2013). Currently 20% of all goods coming to the EU by sea are handled in three ports, with an increasing divide between the busiest and other ports, which threatens the development of "short sea shipping as an alternative to saturated land routes" (EC295, 2013:4). The hinterlands and surrounding areas of the EU's busiest ports face the risk of road congestion "to the detriment of citizens living there" (ibid:4). It is estimated that EU cargo volumes shipped will rise by 50% by 2030 from 3.7 billion tonnes in 2011(ibid). To accommodate such growth the infrastructure of ports must continue to evolve and avoid becoming obsolete. The EC recognises that within the EU port system, "no two ports operate in exactly the same way" saying that diversity of ports is a respected feature and imposing uniformity is not on EC's agenda (ibid:5). This diversity of ports results in congestion of hinterlands and concentration of environmental impacts of shipping in particular areas surrounding ports. Changes relating to financial transparency of public funding in ports are thought to help increase investor confidence and help ensure a level playing field considering that port costs for some goods may exceed "30% of total door to door logistics costs"(ibid:7).

2.3.1 Environmental impacts of ports

Much of the academic discussion relating to the ports sector in particular has been centred on the environmental issues of sustainability. Environmental impacts such as noise, invasive species introduced during ballast water exchanges, waste, sewage, sludge and oil spills, dust, air pollution, soil displacement and sedimentation are present in every port (OECD, 2011). What differs is the scale, frequency of occurrence and measures put in place to address those issues promptly.

UN review

A UN (1992:6) guidebook of the Environmental Impact Assessment (EIA) of port developments identified nine groups of environmental impacts (Table 2.4).

Code	Category	Examples
(a)	Water quality	Industrial effluent can cause serious effects on organisms; and municipal sewage may cause intolerable bacterial contamination of the harbour.
(b)	Coastal hydrology	Port location may alter the current patterns caused by wave diversion. Such changes could have impact on small ships navigating around structures. Changes in wave and current patterns would have started to occur with the creation of the port.
(c)	Bottom contamin ation	Port location could impact sediment disposition resulting in the contamination of the seabed. Other affecting factors are pile structures which shade the seabed and affect local habitat
(d)	Marine and coastal ecology	Port location affects aquatic flora and fauna through changes in (a), (b) and (c). Falling water quality usually causes the overall number of species to reduce, and increasing numbers of one or two species. Continual reduction in water quality may result in complete obliteration of all kinds of species.
(e)	Air quality	This mostly affects commercial ports, as the main contributors are soot and dust from dry bulk cargo handling and storage, as well as construction works on land and road traffic. Vessels and various port activities emit harmful substances.
(f)	Noise and vibration	Vessel traffic, port activities and specifically cargo operations cause disturbance to the local community
(g)	Waste manage ment	A number of waste types likely to be disposed of at sea, including dredge spoil, liquids and solids that are likely to be disposed of in the port aegis, including wastes mentioned in (a).
(h)	Visual quality	Changes in landscapes and scenes with the creation of port structures and continual operations.
(i)	Socio cultural impacts	Impacting on people’s life styles, growing population in areas considered by some as holiday places, possible relocation of citizens due to expansion and construction of port facilities.

Table 2.4: Impacts of Location of Port

Source: Based on UN (1992:6) report

The UN (1992) suggested various measures to mitigate the adverse effects of impacts. (See point (a) table 2.4) Regarding point (a), regulating industrial effluent, and planning a sewage treatment system (UN, 1992:9), a concept of

EM has been introduced to manage a basic pollution level of the area (ibid). (b) Modelling and simulating coastal changes and prevention of beach erosion through construction of sea walls, jetties, offshore breakwater and periodical beach nourishment (ibid). (c) Removing contaminated sediment and introducing an EM process to manage water quality and pollution levels. Similarly to (a) and (c), EM was suggested for marine and coastal ecology (d) alongside an understanding of the characteristics of fragile species and minimising operational impacts in those spawning areas for aquatic species, and planting green plants around the port was suggested to protect terrestrial habitats (ibid). No specific measures have been put forward for (e), (f), and (g); however the EM concept seems relevant in (e) and (g) which require a set processes to monitor and regulate amounts and types of air particles and waste in the port area. As for (f), possibly establishing a discourse with the port management and agreeing to certain terms could be one way of mitigating noise and vibration impacts felt in the hinterland and surrounding communities. Tackling visual impacts (h) was suggested through blending the port infrastructure with the surroundings and planting greenery around the port area to reduce the unpleasant view. If a need for resettlement should arise (i), a proper development plan is required well in advance to include issues such as race composition, cultural gaps, community conservation, preservation of heritage and others (ibid).

The impacts listed above are based only on port location. Other impacts include construction works and dredging, and port operations (UN, 1992). Construction impacts include water contamination with rubble and construction waste; changing of current patterns because of dredging;

disturbing seabed habitats through suspended and placed sediment; air pollution with dust and emission particles; and generation and disposal of waste material through dredging (ibid). Ship traffic impacts include ship discharge impacting water quality; leakages of oil and oily wastes impacting marine ecology; emission of gasses, smokes and soot affecting air quality (ibid).

ESPO Environmental Review

ESPO (2009) has published results of surveys conducted in 1996, 2004 and 2009 with EU ports. Numbers of participants varied, with 281, 129 and 122 ports respectively taking part (ibid). Twenty eight UK ports participated along with 19 other EU Maritime States (ibid). The majority of respondents, 33% were from an Estuarial port, 21% had an engineered coastline, 16% were located in the embayment, 14% were river based, 11% had marine inlets and only 5% had a protected coast (ibid:3). The findings were ranked based on the order of importance at the time (table 2.5).

	1996	2004	2009
1	Port development (water)	Garbage / Port waste	Noise
2	Water quality	Dredging: operations	Air quality
3	Dredging disposal	Dredging disposal	Garbage / Port waste
4	Dredging: operations	Dust	Dredging: operations
5	Dust	Noise	Dredging: disposal
6	Port development (land)	Air quality	Relationship with local community
7	Contaminated land	Hazardous cargo	Energy consumption
8	Habitat loss / degradation	Bunkering	Dust
9	Traffic volume	Port development (land)	Port development (water)
10	Industrial effluent	Ship discharge (bilge)	Port development (land)

Table 2.5: EU Ports sector environmental priorities
Source: ESPO (2009:4)

Table 2.5 indicates the evolving nature of environmental impacts and concerns. Colours in the figure highlight the same issues identified during different surveys. Port waste was not a top issue in 1996 but noise and air quality although mentioned in the UN (1992) report, were ranked as 5 and 6 respectively in 2004 and later became the main environmental priories for the EU ports sector (ESPO, 2009). Respondents included four categories of commercial ports, namely those handling under 1 million tonnes, 1-10, 10-25, and over 25 million tonnes of cargo annually, (ESPO, 2009). A classification of environmental priorities was based on the port size, (table 2.6) below (ibid).

	< 1 million tonnes (24 ports)	**1 - 10 million tonnes** (47 ports)	**10 - 25 million tonnes** (23 ports)	**> 25 million tonnes** (28 ports)
1	Garbage/ Port waste	Dredging: operations	Air quality	Air quality
2	Noise	Air quality	Port development (water)	Noise
3	Dredging: disposal	Energy consumption	Noise	Garbage/ Port waste
4	Dredging: operations	Noise	Dust	Dredging: operations
5	Energy Consumption	Dust	Relationship with local community	Port development (land)
6	Dust	Dredging: disposal	Garbage/ Port waste	Relationship with local community
7	Relationship with local community	Garbage/ Port waste	Energy consumption	Dredging: disposal
8	Bunkering	Relationship with local community	Port development (land)	Conservation areas
9	Ship waste	Ship waste	Ship waste	Port development (water)
10	Cargo spillage (handling)	Port development (land)	Dredging: disposal	Climate change

Table 2.6: The effect of port size on the main environmental concerns

Source: ESPO (2009:5)

In table 2.6, Bunkering and Cargo spillage categories are unique to smaller ports. Bunkering operations are highly visible but infrequent, increasing the concerns of the managing authority and stakeholders. The impacts of cargo spillage in smaller ports may be relatively more dramatic and thus noticeable in a smaller port.

The environmental priorities of 122 ports also depended on their geographical location (ESPO, 2009) (Table 2.7).

	Estuary (40 ports)	**Engineered coastline** (26 ports)	**Embayment** (39 ports)	**River** (17 ports)
1	Conservation areas	Air quality	Air quality	Dredging: disposal
2	Dredging: operations	Garbage/ Port waste	Noise	Dust
3	Dredging: disposal	Noise	Energy consumption	Noise
4	Relationship with local community	Energy consumption	Garbage/ Port waste	Dredging: operations
5	Port development (land)	Port development (water)	Dust	Garbage/ Port waste
6	Port development (water)	Ship waste	Dredging: operations	Relationship with local community
7	Air quality	Hazardous cargo (handling/storage)	Relationship with local community	Environmental risk assessment
8	Noise	Dredging: operations	Ship waste	Ship waste
9	Garbage/ Port waste	Ship exhaust emissions	Dredging: disposal	Energy consumption
10	Dust	Relationship with local community	Port development (land)	Port development (land)

Table 2.7: Association between port geography and environmental concerns
Source: ESPO (2009:6)

There are over 90 estuaries in the UK, each having very complex ecological characteristics, i.e. they are "… habitat complexes which comprise an interdependent mosaic of subtidal and intertidal habitats, which are closely associated with surrounding terrestrial habitats" (DEFRA, 2013). Estuary ports named conservation areas as their top environmental concerns. The increased importance of dust over energy consumption testifies to those ports having very sensitive habitats and requiring much more effective measures for environmental protection. Air quality concerns in embayment port locations, may reflect less wind and sheltered anchorages which reduce the rate of air exchange and make air pollution more noticeable.

The ESPO report notes that the environmental impacts of ports vary with the location, size and type of port. Port diversity also implies the creation of bespoke EMS for every individual port, instead of trying to adapt existing systems.

Academic and International views

Gupta et al. (2005:134) identified the most likely port impacts as destruction of coastal habitat; navigational safety threatened by unregulated mariculture; surface water quality deterioration; production of sewage, bilge and wastes as a result of operations; effect on human and fish health due to noise and contaminated water; oil pollution and air pollution. Representing the second and third most important priorities for the estuary ports in table 2.7, Gupta et al., (2005:134) stated that dredging can impact the marine environment, through deterioration of aquatic resources including estuaries, "resuspension and settlement of sediments", reintroduction of toxic particles into the water stream which affects fish and shellfish; increased turbidity resulting in less light penetration and "associated photosynthetic activities", temporary depletion of oxygen, loss of habitat, "changing shoreline structure" and other effects. This long but incomplete list of impacts represents an environmental chain of effects arising from a single operation, in which many potential impacts are yet to be identified and assessed. Sources such as "dust and particulates from traffic, site clearing", excavation and construction operations; vehicle, vessel and construction equipment emission; cargo handling; urbanisation and the reaction between the sun and fertiliser all contribute to the deterioration of air quality in ports (Gupta et al., 2005:134). Another chain reaction arises from port industrialisation, i.e. commercial functions that keep ports in business, create and support jobs and generate an economic contribution towards the local, national and social economies. OECD (2011) further documented the environmental impacts of international shipping and the role of ports which were unaffected by economic recession (Ohanian, 2010). An additional component of water quality deterioration (Gupta et al., 2005) was the use of antifouling paint on a ship's hull to "reduce friction between ship hulls and surrounding water" (OECD, 2011:5).

Managing continuously reoccurring environmental impacts would require incorporating a systematic approach into the daily practices of the port. The use of EM processes was suggested by the UN (1992) and section 2.2 explored various strategies for adopting environmentally friendly practices in ports. A bespoke EMS based on general principles and guidelines should result in a more successful management and control of environmental impacts, than a generic EMS. However, to address port sustainability as a whole, a standalone EMS is insufficient, requiring an approach inclusive of other aspects of port management. Using the example of a recent research project, a long-standing EMS in FHC "testified to good practice", however only through further application of business process thinking, the importance of stakeholder management and engagement was discovered, which was incorporated into the sustainability management system of the port (Dinwoodie, et al., 2012:122). Using the definition of sustainable development provided in section 2.1, as one that "meets the needs of the present generation…" (UN, 1987:15); although EM is an important concern, it is not the only "need" that port sustainability systems need to address, and the case study example with FHC is evidence of that. Therefore, the principle of incorporating other elements of port management along with a process for EM is essential to sustainably address those "needs" as a whole, instead of selecting some.

The next section will focus on port specific EMSs based on a set of industry guidelines and will critique their suitability for application in smaller ports.

2.4 Environmental management systems in ports

Methodologies are commonplace to mitigate the climate change impacts of international shipping (Leonardi and Browne, 2010). The case for maritime EMS is well-rehearsed. In 1999 Lindau wrote "there is more to environmental protection than the prevention of oil spills… environmental credibility has a commercial value" (Seaways, Nov 1999:6). Giles and Dolan (2011:1) pinpointed common shortfalls in EMS relating to: "1) identifying environmental aspects and impacts; 2) setting effective targets and objectives for addressing the environmental impacts that have been identified; 3) creating effective action plans for achieving those targets and objectives". They highlighted shortcomings that many EMS failed to focus on environmental impacts from all operations, featuring only high-profile impacts (ibid). Artene et al.'s (2011) exegesis of the philosophy of EMS confirmed Giles and Dolan's observation that prevention of problems is the prime focus of EMS rather than detection. As for the influence of EMS on competitive performance, Iraldo et al. (2009:1445) noted that a "new philosophy" must take over at every level of organisation for EMS to be an efficient tool. Given that an EMS is just one part of the overall management system of the organisation, changing the philosophy of an entire organisation might prove unpopular financially (ibid), however higher levels of system integration into the business and operational processes has an economic rationale behind it (Grubic et al, 2010). Implementing any degree of system integration entails some level of organisational learning, which was suggested as another way of addressing environmental challenges facing companies today (Kim and Han, 2012). For an organisational system to be able to cope with unforeseen circumstances and increase corporate resilience to external factors, a degree of flexibility must be inbuilt into the system's design (Ishfaq, 2012).

2.4.1 Ports and ISO14001

In order to get certified with the ISO14001 standard, a company must adhere to a set of specific guidelines which include inter alia defining the organisation's environmental policy, implementing and maintaining procedures and documentation, ensuring the availability of required resources, identifying and planning operations, and ensuring that internal audits are conducted at planned interval (ISO, 2004:1-17). ISO14001 standards underpin EMS development in many ports but few are available for public viewing, because governance issues are involved. Ports governance is complex (Talley, 2008), with many different governance models and the EC now acknowledges and respects port diversity (EC295, 2013). A certified ISO14001 EMS can be classed as a competitive advantage for some ports which may remain hidden from public view as certain governance models discourage sharing of information. Some large private ports provide an environmental statement that indicates their organisational stance, but reference an EMS for internal use only. For ports run solely for profit, sharing commercially sensitive information is not a common practice. Municipal ports are run for the benefit of the community, owned by local councils (DfT, 2006) and offer an EMS accessible to all, for example in the ports of Truro, Penryn and Newquay (TPN) (Port of Truro, 2012). Being originally created in 1995 and updated in 2012 (ibid), these ports had 17 years of experience of working with ISO14001 EMS and it would be appropriate to compare and contrast how some sections of the ISO14001 manual correspond with the TPN EMS.

Firstly, the word “commercial” is mentioned seven times in the entire document in the sentences that discuss present situations (Port of Truro, 2012). Being run for an alternative purpose than sole profit, and situated at the top of the estuary which DEFRA (2013) defined as “…habitat complexes…”, the EMS for ports of TPN from the outset acknowledges the need for conservation and lists all environmental statuses they were assigned. The ISO14001 manual gives only general guidance of what the environmental policy statement should include, however once the content has been established by the port authority undergoing the certification process, depending on the level of their environmental sensitivity the amount of new environmental responsibilities can vary significantly. In the case of TPN ports, having four environmental designations and an estuary habitat located in the port vicinity entails a much stricter and more rigorous EM practices than for instance if a port had an engineered coastline, then conservation activities would not even feature in the top 10 environmental concerns unlike an estuary port, for which that is a top environmental priority (see table 2.7, section 2.3.1).

Having identified 13 activities that have a direct impact on the environment (Port of Truro, 2012), section 9 of TPN EMS outlines documentation procedures those ports will undertake as per ISO14001 requirement number 4.4.4(e), specifically "…control of processes that relate to its significant environmental aspects" (ISO, 2004:6). One environmental impact identified by TNP ports was oil/fuel spills in the harbour which are caused by harbour users and can occur at any time in virtually any area. For those harbours that have a very environmentally sensitive habitat, oil spills can put conservation efforts at risk and pose threats to certain species, compared with other ports where small scale spills can be classed as normal occurrence and would require less preventative action.

These examples illustrate how much adaptation an ISO14001 guideline would require, and the work required to remain certified within the ISO14001 standard. For ports with an engineered coastline (see ESPO, 2009), or with significant commercial traffic, the likelihood of sensitive habitats in the vicinity of the port is slim, let alone in the area of port operations; therefore a set of different environmental impacts is likely to be identified as stipulated in table 2.7 requiring a set of different preventative measure. Depending on how many direct environmental impacts are identified, managing those can either be an onerous or a helpful process with regards to time and resources spent, making the ISO14001 EMS more appropriate for larger ports possessing sufficient commercial revenues to cover the resource intensive requirements of a guidelines-based EMS.

2.4.2 EMAS

An alternative to ISO14001 is a European Eco-Management and Audit Scheme (EMAS) established by European regulation and updated by regulation 1221/2009, enforced in January 2010 (IEMA, 2013). European Commission claims that EMAS goes further than ISO by incorporating additional benefits such as employee involvement, public reporting through EMAS environmental statements, performance improvement checked by environmental verifiers and legal compliance (EMAS 2011:15). According to the official website, over 4500 organisations and around 8500 sites are registered with EMAS worldwide (EMAS, 2013). EMAS emphasises that in order for a company to be registered, it has to manage both direct and indirect environmental aspects (Iraldo et al., 2009:1446). Having conducted an empirical study on companies that adopted EMS, Iraldo et al., (2009) found that by including environmental targets into daily activities and operations and by thinking of an EMS as an integral part of the organisation, companies can achieve higher environmental performance. Furthermore, company size plays a significant role in the success of an EMS as large organisational size is a “strong determinant of its good environmental performance” (ibid: 1450). What gives larger organisations an edge for a better environmental performance is the availability of resources, high degree of competence, know-how and cultural awareness.

EMAS also adopts the PDCA approach, and claims to benefit companies by cutting costs and achieving savings through the optimisation of raw material, transport, water and energy usage, and rationalisation of recycling packages

(EMAS, 2013). An EMAS toolkit for SMEs is available to view online and provides a description of requirements and examples for every section of the guideline (ibid). The system consists of 11 sections, sections 4-6 covers the *Planning* aspect of developing an environmental policy and programme, and carrying out initial review (ibid). Section 7 addresses *Doing,* specifically 7 sub clauses of how to structure and EMS (ibis). Section 8 is about *Checking*, in particular, ways of controlling and monitoring environmental performance and management systems (ibid). Finally, *Acting* is covered by sections 9-11 and addresses issues of how to review an EMS, communicate and report environmental performance, and how to get official recognition (ibid).

A few EU ports have been involved with EMAS, including Livorno in Italy, which wanted to improve and reduce the environmental impacts of economic activities (EC, 2013). The purpose was to increase environmental awareness in the port sector by disseminating project information (ibid). By providing an opportunity for environmental certification, many port companies started the process of ISO14001 certification, to safeguard the environment in the Cinque Terre National Park (EC, 2013).

2.4.3 EcoPorts and ESPO

Other tools to assist EM in ports include the Self-Diagnosis Method (SDM), an EcoPorts tool to self-audit environmental issues (Darbra et al., 2004); the Port Environmental Review System (PERS), which consists of guidelines and example documents for implementing EMS (ESPO, 2009); and Strategic Overview of Significant Environmental Aspects (SOSEA) tool for ports to identify and rank “significant” environmental aspects of ports (Darbra et al., 2005). Excluding SOSEA, SDM and PERS are intended to steadily lead the port towards meeting the ISO or EMAS requirements and become certified. Although according to the creators, all of the EcoPorts tools can also be considered to be independent methods (Darbra et al., 2004), the progression of those management systems and their relationship with the ISO and EMAS standards is shown in figure 2.5 below. There are 10 ports in the UK that are members of EcoPorts, five of which are ISO14001 certified, and further two are PERS certified (EcoPorts, 2013). Those five ISO 14001 certified ports are: Port of London Authority, Port of Felixstowe, Harbour of Rye, Dover Harbour Board and Belfast Harbour Commissioners (ibid).

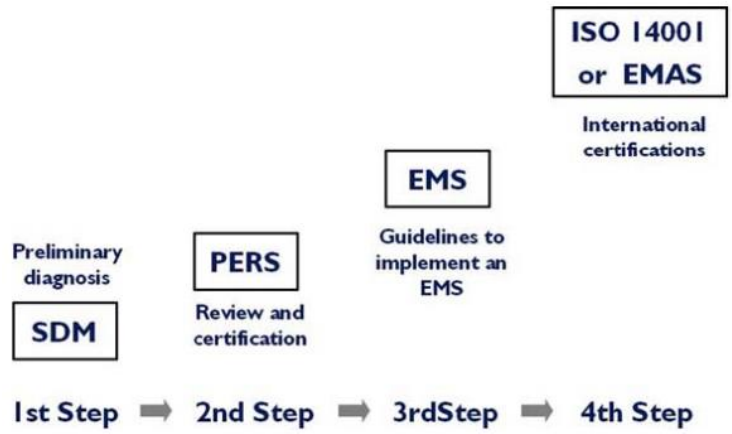


Figure 2.5: Connection between EcoPorts tools and international standards
Source: Darbra et al., (2004:424)

Two ports that are PERS certified are Peterhead and Milford Haven port authorities. Out of the seven UK ports which are members of EcoPorts network; aside from Rye Harbour all remaining ports are major commercial ports that are essential for the British economy, industry and trade. Rye harbour is owned by the Environment Agency and is used as a “fully commercial harbour with a large fishing and leisure fleet” (Gov.Uk Rye

Harbour, 2014). The costs associated with the implementation of port EMS are discussed in section 2.4.4. Because of ethical agreement with the interview participants which includes confidentiality undertakings, the application of figure 2.5 to CAD ports along with their progress on the "ladder" towards ISO14001 or EMAS cannot be published.

SDM

SDM is the first of the EcoPorts tools which was created to assist port managers in frequent reviews of environmental performance in their ports (Darbra, et al., 2004). By serving as a comparison between previous assessments, it allows for benchmarking port performance against previous scores and to establish areas for improvement (ibid). This methodology is based on a checklist principle, the main goal of which is to "review management activities and procedures with regards to the environment", and current processes in place for dealing with significant environmental impacts (ibid: 423). This tool claims to address the following areas of port management: a) environmental policy; b) management, organisation and personnel; c) environmental training; d) communication; e) operational management; d) emergency planning; e) monitoring; f) auditing and review (EcoPorts, 2011). The relationship between SDM and ISO14001 is not random, and according to the authors of SDM, every section corresponds to a relevant ISO14001 segment (table 2.8; Darbra et al., 2004).

SDM Section		ISO14001 Section
1. A	Environmental policy document	4.2
1. B	Environmental policy scope	4.2
1. C	Environmental regulations and port activities	4.3.1, 4.3.2
1. D	Objectives and targets	4.3.3
1. E	Resources and budget	4.4.1
2. A	Responsibilities of the EM representative	4.4.1
2. B	Responsibilities of key personnel	4.4.1
2. C	Individual environmental responsibilities	4.4.1
3	Environmental training	4.4.2
4. A	Internal communication	4.4.3a
4. B	External communication	4.4.3b
5. A	Management programs and action plans	4.3.4
5. B	Standard operating procedures and working instructions	4.4.6
5. C	EM manual	4.4.4
5. D	Environmental documentation management	4.4.4, 4.4.5
6	Emergency planning	4.4.7
7. A	Environmental monitoring	4.5.1–4.5.3
7. B	Monitoring of management program	4.5.1–4.5.3
8. A	Environmental audit	4.5.4
8. B	Review	4.6

Table 2.8: Correspondence between SDM and ISO14001 structures
Source: Darbra et al., (2004: 424)

Having completed the SDM checklist, the port then joins the EcoPorts network and acquires access to a wider range of tools, including SDM review and PERS (EcoPorts, 2011). SDM review provides analysis of the following port areas: (a) a projection of the port's answers against the European benchmark of performance (ibid); (b) a GAP analysis between the port's current organization and performance and the requirements of established EM standards (ISO14001, PERS); (c) a SWOT (Strengths, Weaknesses, Opportunities, Threats) identification of the port's EM performance; (d) an analytical report containing expert advice and recommendations on the current status and the further development of the port's EM program (EcoPorts, 2011). Once results have been obtained they could then be used in annual reports and communication with stakeholders, and incorporated into formal management review systems (ibid). Unfortunately, because an example of a completed, or a blank SDM system were not available for public viewing, the suitability and applicability of this system could not be compared with other management methods for ports.

PERS

A second tool is PERS certification, which EcoPorts (2012) described as a "wedge" that would enable a port to maintain the progress gained on its way towards ISO14001 certification and prevent it from "rolling down" and starting over. EcoPorts also present PERS as a methodology that would help to kick-start a port EMS which could be used for "proof of performance" within the EcoPorts environment improvement programme (ibid:9). PERS consists of six topics, namely: 1) Environmental policy statement; 2) Register of environmental aspects and legal requirements; 3) Documented responsibilities; 4) Conformity review; 5) Environment report; 6) Example of best practice (SuPorts Project, 2012).

The main features of PERS include:

- PERS was designed to support the ESPO environmental review implementation of recommendations (Darbra et al., 2004)
- The system defines "a basic standard of good practice for the port sector" (ibid: 422). Authors claim that experience attained from using PERS can be beneficial for those ports that are intending to achieve higher level, a widely recognised environmental certification such as ISO or EMAS, since PERS closely follows the structure of those standards (ibid).

- PERS provides a non-compulsory feature of certification for ports (ibid). Being able to provide evidence of “their good practice just as ISO and EMAS do” is one of the main benefits of PERS (ibid: 423).

The Port of Cork in Ireland achieved a PERS certified EMS in 2006. Prior to finding out about the EcoPorts network in 2003, the port exhibited a reactive environmental performance and perceived EMS development as unachievable (ibid). Undergoing EMS creation and PERS certification resulted in the promotion of environmental concepts internally, having a positive impact on the relationships with regulatory authorities, and a publication of environmental report also in 2006 (GreenPort, 2008). As part of their environmental awareness, Cork identified 15 activities which interacted with the environment, including administration and planning, stakeholders and tenants and past activities among the common causes such as bunkering and dredging (ibid). The creation of EMS is claimed to have positively impacted the port through an increase of awareness and respect with its tenants, improvement in port credibility, introduction of environmental obligations through the use of licenses, reduction in community complaints through proactive stakeholder liaison, and a direct response to the issues raised (ibid).

Cork provides a good example of the effectiveness of the EcoPorts methodologies for particular ports, since after obtaining a PERS certification the port went on to update its PERS certification and submit and receive an ISO14001 application (Port of Cork, 2013).

SOSEA

Previous attempts at a "first step" needed to be simplified, leading to the creation of SOSEA (ibid). Whereas SDM and PERS were intended to be used as stages of progression towards ISO14001 or EMAS certification (see figure 2.5); standing on its own SOSEA guides ports in prioritising actions and gathering information for their legal and environmental responsibilities as well as providing a base with the potential to implement an EMS (ibid). The SOSEA tool was designed to fill a gap not tackled by SDM or PERS, specifically recording aspects as "significant impacts" in the following three scenarios: 1) if ports have an obligation imposed by legislation or regulation; 2) if the landlord authority is "deemed capable of bringing reasonable influences to bear on a tenant", 3) if local, regional, or national importance can be attributed to an aspect in question (Darbra et al., 2005:867). SOSEA tools support the existing EcoPorts methodologies and adds an element of "compliance with regulation through voluntary self-regulation" (ibid:867).

SOSEA is also conceptualised as a checklist methodology and consists of three elements, each having a different aim:

1) Environmental Activities and Aspects Matrix, which represents "all possible interdependencies between a set of defined activities and each environmental impact" (ibid: 868).
2) The significant Environmental Aspects Questions, which were designed to analyse management processes of previously identified significant environmental aspects (ibid).

3) Strategic Perspective of Environmental Aspects summarises all gathered information into one table, along with the reasons for interest to a particular port.

Benefits of SOSEA include the provision of evidence about important port aspects and their environmental impact, attainment of awareness and knowledge which the authors stated was “essential for future implementation of a certifiable EMS” (ibid: 872).

2.4.4 EMS related costs

The cost element of ISO 14001 varies among companies that provide those services. A quick Internet search for a quote revealed a number of companies offering ISO140001 certification and audit services, and whilst a majority have a “get a quote” facility on their website and do not reveal their fees, two companies were found that had their ISO14001 fees posted online. For an institution with an annual turnover of under £500k, Certified Quality Systems (CQS, 2013) offer their services at a fee of £1495 and a £550 audit cost. QMS International (2013) offer their services at a £999 assessment fee and a further £399 audit fee. Taking for example Teignmouth Harbour in Devon, in 2012 on turnover of just under £400k, the port has made £109k gross profit and a net loss of £30k, and in 2011 - £2k net profit on a turnover of £400k and gross profit of £134k (THC, 2012). Based on the figures provided, in 2011 Teignmouth Harbour had a profit margin of 0.5% (calculated as net profit x 100 /turnover). At a larger scale, Dart Harbour in 2011 turned over £1.37m, gross profit of £556k and net profit of £251k (Dart Harbour, 2011) a margin of 18.3%. These are two trust ports situated 20 miles apart. With ISO14001 certification, the cost of assessing and auditing alongside running the port in accordance with ISO systems is costly where very small profits fluctuate year on year. The intended target audience of ISO14001 systems is unlikely to include smaller ports.

After applying the SDM, which is a "user-friendly environmental checklist" from EcoPorts with a "validity of two years", a port is then invoiced the sum of €495 for reviewing costs (EcoPorts, 2013). After joining the network, new members gain access to PERS which is "an only port sector specific EM standard" and for an additional €995 have their application reviewed by Lloyds Register (EcoPorts, 2013). Out of 57 members of EcoPorts, 13 are PERS, and 25 are ISO 14001 certified (EcoPorts, 2013). Twelve ports and harbours from the UK are members of EcoPorts. The two PERS certified are Milford Haven which handles 29% of UK's seaborne trade in oil and gas with a net profit of £5.5M in 2011(MHPA, 2013); and Peterhead which recorded £2.6M profit in 2011 (Peterhead Port, 2013). By comparison, within CAD FHC, a larger port recorded £368k profit in 2011 (FHC, 2013) whilst others recorded a loss. Milford Haven and Peterhead are fundamentally different in scale and have an EMS to support their scope of operations. Port of Cork's account for 2011-12 indicated a €21m turnover with €1.4 m profit, (Port of Cork, 2012). In 2012 FHC recorded a profit of £79k. This analysis implies that in figure 2.2 a lack of financial resources can be a barrier to investment in costly EMS practices, requiring a new discourse for a non-resource intensive way for smaller ports to manage their environmental impacts as part of an overall approach to port sustainability.

Most of the 900 operational ports in Great Britain are small (Ports.Org, 2013). Container ports such as Southampton and Felixstowe, with the latter having a £256m turnover and £41m profit in 2012 (Worksmart, Org, 2013), contrast with small trust ports such as Teingmouth with a profit of £2k in 2011 and a loss of £30k in 2012 (THC, 2012). Probably over 800 small UK ports require affordable processes for managing their environmental impacts and sustainability.

2.4 Conclusion

Two decades of EM in ports have failed to create a universal system to mitigate the impacts of commercial and leisure activities. Reasons include the scale and type of port operations, port location, governance type, income streams and the degree of local environmental sensitivity and each reason could impact port profitability, opportunities for development and could potentially hinder attempts to establish a functioning EMS due to cost constraints and new requirements of the port authority. The main cost constraint is the reactive attitude towards managing environmental impacts that the current EMS philosophy is based on. Preventing environmental impacts comes at a significant resource cost which not many ports can afford. Having specific responsibilities outlined in the ISO14001 system, ports would be required to adhere to their own statements and act accordingly, which could be very expensive and potentially bankrupt an organisation if a serious environmental accident was to occur.

A new discourse is required to help smaller ports manage sustainability, an approach that would be proactive and emphasise early stage problem detection and prevention, rather than a costly reaction ex-post.

The next chapter will focus on port management and governance, specifically on the types of ports found in the UK

CHAPTER 3: PORT MANAGEMENT, GOVERNANCE AND CAD PORTS

3.0 Introduction

Despite the location and scale of operations, ports must be sustainable in each dimension of their mission statements which define the remit of organisational business against what stakeholders expect (Lynch, 2012). Issues such as organisational structure, community culture and sensitivity of local environmental habitat can restrict a port's ability to become sustainable; therefore putting the future of those ports and their communities at risk. Several key factors have been identified, namely port location and governance type that can have a direct impact on CAD ports and their level of sustainability, specifically the amount of additional compliance the port will be subject to as a result of sensitive habitats present within their statutory limits (Natural England 2013, DEFRA, 2013). This chapter will consider each issue that affects the ability of CAD ports to develop harbours in a sustainable way, will analyse and compare mission statements between ports of different size, discuss mandatory and voluntary compliance functions and introduce the diversity of EU and UK port governance models. CAD ports will be introduced and discussed.

Ports in the UK facilitate growth and the economy depends on them for 96% volume of the overall British import/export requirement (UKTI, 2013). Approximately 32m international and 38m domestic passengers use British ports for global and local voyages (ibid). Ports are also crucial to the regions they are located in (ibid), interlinked with trade and business in their hinterlands. In 2011, the UK ports sector provided direct employment for

117,200 people mainly in transport related activities, but also 16% dealing with cargo handling and storage, and 10% in maritime insurance and similar roles (ibid:11). Ports contributed £7.9B to the UK economy making Britain the "2nd biggest earner worldwide from services and income as a proportion of world exports with 7.4%", (ibid:12).

The contribution of smaller ports to the local economy is uncertain. Aside from one, each port named in Table 3.1 has leisure facilities which attract British holidaymakers, encourage increased tourist expenditure in their local areas and as a result reduce the amount of money spent abroad. All but one port in the sample have fishing activities which spawn many businesses, and support local economies. Fishing also supports many local restaurants (Looe Marine Conservation Group, 2014), which enhance the attractiveness of these locations as holiday destinations and benefit the wider region.

Table 3.1 lists a sample of CAD ports of size, type and scale relevant to this research along with ownership type and estimated port usage. Information has been adapted from UK Port's database which, in some cases, can be outdated and ambiguous. For instance, commercial port usage would normally refer to handling some form of cargo, however Padstow Harbour Commissioners (PHC), include sand extraction, large scale fishing, repair facilities and boat chartering in this group (PHC, 2013). This example illustrates the diversity of smaller ports in CAD and combined with complex models of ownership and limited resources makes generic models for sustainability management inappropriate.

Port	County	Ownership	Port Usage			
			Commercial	Leisure	Fishing	Ferry Terminal
A&P Falmouth	Cornwall	Private	✓			
Bideford	Devon	Municipal	✓	✓	✓	✓
Brixham	Torbay, Devon	Municipal		✓	✓	
Bude	Cornwall	Municipal		✓	✓	
Cattewater	Plymouth, Devon	Trust	✓	✓	✓	
Dartmouth	Devon	Trust	✓	✓	✓	
Falmouth	Cornwall	Trust	✓	✓	✓	
Fowey	Cornwall	Trust	✓	✓	✓	
Ilfracombe	Devon	Municipal		✓	✓	✓
Hayle	Cornwall	Private	✓	✓	✓	
Looe	Cornwall	Trust		✓	✓	
Mevagissey	Cornwall	Trust		✓	✓	
Newlyn	Cornwall	Trust		✓	✓	
Newquay	Cornwall	Municipal		✓	✓	
Padstow	Cornwall	Trust	✓	✓	✓	
Paignton	Torbay, Devon	Municipal		✓	✓	
Penzance	Cornwall	Municipal	✓	✓	✓	✓
Penryn	Cornwall	Municipal		✓	✓	
Port Isaac	Cornwall	Trust		✓	✓	
St Ives	Cornwall	Municipal		✓	✓	
Torquay	Torbay, Devon	Municipal		✓	✓	
Teignmouth	Devon	Trust	✓	✓		
Salcombe	Devon	Municipal		✓	✓	
Truro	Cornwall	Municipal	✓	✓	✓	

Table 3.1: Sample of Cornwall and Devon ports
Source: Based on Ports.Org (2013)

3.1 Port mission statement

All port activities are driven by their mission statement. Aspects like values, strategies, and management principles are included in a mission statement that sets out the remit of operations for a port authority. Lynch (2012:16) characterised mission statements as defining the organisational business "against the values and expectations of the stakeholders". By defining values and expectations, a mission statement communicates to stakeholders, both internal and external, the direction of the company, "reasoning and values that lie behind it" (ibid:247). Whilst formulating a mission statement, consideration should be given to five criteria, namely:

1. Nature of the company's business,
2. Include the answer to (1) from a customer inclusive perspective;
3. Positioning basic organisational values and principles as an equal opportunity employer with a respect and consideration for the environment;
4. Aiming to be a leader in a chosen field and, if possible, incorporating the element of sustainable competitive advantage;
5. Summarising and justifying a chosen approach (Lynch, 2012).

Theoretical application of mission statements for businesses of all types and sizes does not translate well into the ports industry since not every port is being run for commercial gains. For example, comparison between the mission statements of the Port of Southampton, a large commercial private port, and Fowey Harbour, a medium size commercial trust port in Cornwall revealed significant differences. Taking into account numerous services and functions that major ports such as Southampton provide with regards to cargo handling, the following comparison demonstrates the role of mission statements in ports of different size. Port of Southampton is owned by ABP, and its container terminal operated by DPWorld whose mission statement states that: *"We provide our customers with fast, reliable and secure services* *to move containers through the strategically located port of Southampton"* (DPWorld Southampton, 2013). The port's vision statement aims to be the "leading UK container terminal", and emphasises continuous commercial improvement to enhance their customer service (ibid). Having identified a number of port environmental impacts in the previous chapter, Port of Southampton reflects on the environment once in the 11th value statement (out of 11) saying "…recognising our influence on the environment…"(ibid). It is not unusual for a large private organisation to aim at maximising profit and improving customer service. These principles coincide with the mission statement considerations listed by Lynch (2012). ABP's mission statement of Southampton varies from the one of DPWorld and states that: "…To facilitate the open use of the port by legitimate stakeholders and to ensure no damage is caused to the marine environment through the activities of the Port" and that "…the waters under the control of the ABP Harbour Authority (HA) are managed efficiently and effectively to maintain navigational safety" (ABP Southampton, 2013). Claiming to have no damage to the marine environment in a large commercial port can be explained either through the absence of marine species in operational areas due to port location or as a result of continuous commercial traffic which changed the biodiversity of the port. ABP's Masterplan for Southampton Port goes into detail about EMS, sustainable operations and environmentally designated areas which border the vicinity of the port and its surrounding land, and are not located directly in path of the vessels (ABP, 2009). Stakeholder concerns for destroying wildlife at Dibden Bay to build a new container terminal for the port of Southampton have fuelled concerns and as a result the project was rejected by the government in 2005 (CPRE Hampshire, 2014). Dibden Bay has been designated with two SSSI's (Natural England Dibden Bay, 2014) sending a message that commercial gain and necessities will not be prioritised over the health and the quality of wildlife habitat.

The Port of Fowey is located on the south coast of Cornwall and is a Trust port run by a board of locally elected commissioners. The Port's mission statement claims that: "*The Fowey Harbour Commissioners will adopt practices and put in place controls to ensure that wherever possible the Harbour is operated safely and efficiently so as the safeguard the harbour, its' users and stakeholders and that those measures protect the environment of the harbour*" (Fowey Harbour, 2012). Having areas designated as an AONB and currently in the process of having an MCZ designated in the estuary, Fowey harbour is home to a variety of estuarine habitats which are sensitive to human activities (ibid). A combination of having an environmental status and being a trust port resulted in the mission statement emphasising safety, environmental protection and a new concept from the mission statement of Southampton port which is safeguarding. DEFRA (2002:9) explained safeguarding as "protecting the maritime area against the adverse effects of human activities so as to safeguard human health and conserve marine ecosystems", and if possible, to restore "marine areas which have been adversely affected". Differences in priorities between large commercial ports that play a significant role in developing the UK economy, and smaller commercial ports that have a regional economic and biodiversity impact, support local jobs and are home to a variety of marine and terrestrial habitats, some unique, are predictable.

Similarly to Fowey, Salcombe harbour's mission statement emphasises the needs of the users and the environment, specifically "The Board is committed to running a safe, efficient and welcoming harbour that caters for the needs of harbour users and the environment" (Salcombe Harbour, 2013:13). Fowey and Salcombe are examples of trust and municipal ports in CAD that prioritise stakeholder benefit and environmental considerations over commercial gains which require a new discourse on sustainability and the approach to managing environmental impacts in CAD ports.

The next section will discuss the issues of mandatory and voluntary compliances that caused many CAD ports to include environmental considerations into their mission statements and take into account the impact on day to day operations.

3.1.1 Mandatory compliance

Safety is of paramount importance to ports and the responsibility for maintaining safety in UK ports is governed by a number of acts, namely the Pilotage Act 1987, Merchant Shipping Act 1995 within marine legislation framework; and general acts such as Health and Safety at Work Act 1974, and the Dock Regulation 1988 (DfT, 2012). PMSC was introduced in 2000 following the "Sea Empress" disaster and subsequently reviewed in 2009 and 2012 (ABP, 2013). This document "establishes a measure by which HAs can be held accountable for their legal powers and duties to run harbours in safety" (ibid). This code was developed to enable harbour authorities across the UK to improve safety and manage marine operations to nationally agreed standards (DfT, 2012). PMSC applies the “well-established principles of risk assessment and safety management system” to port marine operations and applies to all HAs “in the UK that have statutory powers and duties” (DfT, 2012:6). Intended primarily for the “duty holder” meaning a person accountable for the marine safety in the harbour aegis, this could be one or multiple members of the harbour board (ibid). When implemented in full, PMSC claims that there should be a reduction in the risk of incidents occurring within the limits of the HA as well as to provide “some protection for the duty holder if an incident does occur” (ibid:9). This is achieved through defining the roles and responsibilities of key people involved in the navigational safety of the port and through a legal requirement to have an SMS “based on formal risk assessment” (ibid:9). Statutory aspects of the PMSC may be capable of adaptation to elements of sustainability management, and provide a management infrastructure for other initiatives including the environment, namely oil spill contingency plan which is subject to approval by the MCA, and a waste disposal plan (DfT, 2012).

Other environmental measures required are subject to port area. Depending on location, some ports are located in environmentally sensitive areas and have been classed with either one or multiple designations: Marine Conservation Zone, Special Area of Conservation, Area of Outstanding Natural Beauty, Heritage Coast, and Site of Special Scientific Interest. Table 3.2 provides a summary of environmental designations that are present in CAD ports. Detailed analysis of these designations is outlined in Appendix A.

Designation	Designating Body	Brief Description
MCZ (Marine Conservation Zone)	Department for Environment, Food and Rural Affairs (DEFRA)	MCZs will protect a range of nationally important marine wildlife, habitats, geology and geomorphology (DEFRA, 2013).
SAC (Special Area of Conservation)	EU Commissions Habitats Directive	Conservation of the 189 habitat types and 788 species (DEFRA, 2013)
AONB (Areas of Outstanding Natural Beauty)	Natural England	Area of high scenic quality which has statutory protection in order to conserve and enhance the natural beauty of its landscape(Natural England, 2013)
HC(Heritage Coast)	Natural England	Conserve, protect and enhance the natural beauty of the coasts, their marine flora and fauna, and their heritage features(Natural England, 2013)
SSSI (Sites of Special Scientific Interest)	Natural England	SSSIs are the country's very best wildlife and geological sites. (Natural England, 2013)
SPA (Special Protected Areas)	DEFRA	Protection of rare and vulnerable birds and for regularly occurring migratory species

Table 3.2: Summary of UK environmental designations

Although there are more environmental designations present in the UK, the ones listed in table 3.2 have a direct impact on most CAD ports (see DEFRA Map, 2013). Profitable activities such as commercial shipping and large scale leisure business could threaten the conservation efforts of those designated sites. In SW England there are 90 SACs, 18 HCs (Natural England, 2013), and nearly half of UK's MCZs by area (DEFRA, 2013) which significantly restricts the commercial maritime activity permitted. For those ports which are run for the benefit of stakeholders, changing their mission statements and operating not only for commercial gains, but as part of a global conservation effort to preserve and safeguard biodiversity, marine ecosystems and human health is one of the ways forward. Not many port stakeholder groups have direct interest in port operations, but many have wider interests which are associated with ports having a cleaner environment suitable for attracting holiday makers. Operating sustainably in a tourist based economy, environmental concerns form an important part of sustainable port practices and play a significant role in day to day port operations. If not addressed on time by being proactive, dealing with environmental issues reactively can drain all available resources and bankrupt a smaller port. This section has helped to understand why many smaller ports in CAD, including Fowey and Salcombe that were used as an example earlier have included environmental issues into their mission statements and why port managers are endeavouring to safeguard their harbours.

3.1.2 The voluntary nature of port engagement with EMS

An EMS still remains a voluntary initiative. OECD (2011) reported on the survey conducted in 2007 by Comitos and Slack which surveyed 800 ports and found that only 11% (85) had any form of EMS in operation. Table 3.3 summarises a comprehensive overview of EU port's attitude towards environmental policies and plans.

72 %	Had an environmental policy
62%	Make it available to the public
58%	Aim through their policy to improve environmental standards beyond those required under legislation
69%	Provide environmental information through their website
43%	Produce a publicly available Annual Environmental Review or Report;
69%	Have their own environmental specialist(s)
48%	Have a form of EMS;
77%	Carry out monitoring within the port area;
60%	Have identified environmental indicators;
36%	Publish factual data by which the public can assess the trend of its environmental performance
33%	Measure or estimate their carbon footprint;
51%	Take measures to reduce their carbon footprint;
57%	Have a programme to increase energy efficiency;
20%	Produce some form of renewable energy.

Table 3.3: Overview of EU port's attitudes towards environmental policies
Based on ESPO (2009) review
Source: OECD (2011)

It is evident that large proportions of ports view environmental issues as part of their daily operations and voluntarily consider them as integral to their operations.

In CAD, few ports have information about environmental consideration and initiatives available online for public access. Several reasons could be attributed to that, namely unsuitability of existing EM practices to particular harbour's needs, lack of resources to commit publicly, uncertainty about the port's future, etc. Based on publicly available information, several ports stand out with their proactive approach towards environment which are summarised in table 3.4.

Port/ Authority	Location/ Ownership	Environmental Considerations / Policies
Falmouth	Cornwall / Trust	Informing public about port's commitment to SAC's conservation target
		Engaging with academic research for environmental monitoring
		Environmental monitoring buoys: First monitors water quality; Second meteorological conditions
		Encourages volunteers to record and collect data about rocky shore marine life around UK as part of Marine Life information network.
Truro	Cornwall / Municipal	Truro port has a certified ISO14001 EMS which was first completed in 1995 and updated in 2012. This system outlines port's environmental aspects, targets and objectives, operational control and verification procedures.
		Port also provides information regarding invasive species and ways for the port users to contribute in tackling this issue
Fowey	Cornwall / Trust	Fowey harbour has a detailed estuary management plan which details ways of identifying and pursuing opportunities for habitat conservation, education and public awareness, supporting voluntary initiatives, etc. The plan is not intended as statutory, and is built on the best practice of existing organisations to provide a framework for decision making.

Table 3.4: Sample of proactive environmental activities in CAD ports

Whilst those ports with commercial cargo have adapted a proactive stance towards EM, other CAD ports have not. Website quality is no indicator of organisational attitudes but some stakeholders may be influenced by website data, even though some ports in the region do not have dedicated web pages.

This PhD project aims to bridge the gap between those ports that can and cannot afford to have dedicated management tools to assess and manage port sustainability issues, including EM. Several key issues that PSMS aims to address are to provide all ports with a mechanism that can be used for evaluating sustainability practices and enhancing communication with stakeholder groups. Having a tool that can be used to demonstrate how well ports are performing on certain aspects and highlight weaknesses that need to be addressed can facilitate a better dialogue with interested stakeholder groups in order to work together to help improve the overall level of port sustainability.

3.2 Legal powers and duties of Harbour Authorities

HAs can be founded in a number of different ways i.e. trust ports are established through an Act of Parliament; municipal ports are founded as a part of local authority and some ports are companies that have been registered under the Companies Act 1985 (MMO, 2010). The powers and duties of HAs stem from the legislation. Most HAs are governed by their own local legislation which is specific to each individual port and was tailored to reflect the needs of that particular authority (UK Marine SAC, 2014). Having previously argued about port diversity and the need for a new discourse because of that, operating under an individual set of rules and legislation is part of that diversity, making each port unique from a legislative standpoint.

In 2010, MMO conducted a Harbour Revision Order for Great Yarmouth Harbour which is a private port, and part of that process was a summary of powers and duties of HAs under general legislation. A short review of those powers summarised by MMO illustrates the varied role of HAs, and sustainability issues that need to be addressed. MMO (2010) recommends that all HAs keep under review the extent of their powers and jurisdiction (Table 3.5):

Type of Duties	**Legislation**	**Description**
Health and Safety at Work	Health and Safety at Work Regulations 1999	HA has a "duty to carry out a risk assessment of the risks to the health and safety of both employees and non-employees arising out of the conduct of the harbour undertaking" (MMO, 2010: 2)
Lighting and buoying responsibilities	Part VIII of Merchant Shipping and Maritime Security Act 1997	Each statutory HA is the local lighthouse authority (LLA) for its area. "Under section 198, a LLA may be directed by the general lighthouse authority which is Trinity House in England and Wales "to lay down buoys, or alter lighthouses, buoys and beacons in its area" (ibid:2).
Waste Management	Merchant Shipping (Port Waste Reception Facilities) Regulations 1997	Statutory HAs have a "duty to prepare and implement waste management plans for their harbour" (ibid:2).
Oil Pollution	Section 137(2)(d) of the Merchant Shipping Act 1995	"The Secretary of State can give directions to a harbour authority (here defined as a body empowered by an enactment to make charges on ships) as respects ships or their cargoes where an accident has occurred in a harbour" (ibid:2).
Power to charge dues	Section 26 of the Harbours Act 1964	Apply only to a statutory HA "which is entitled to charge dues on vessels exercising the public right of navigation in the harbour". Merchant and Shipping act 1995 defined a statutory HA as "a HA within the meaning of the Harbours Act 1964".
Wrecks	Section 252 of the Merchant Shipping Act 1995	"Power where a vessel is sunk, stranded or abandoned in or near to the approaches of a harbour so that it is, or is likely to become, a danger to navigation to take possession of, raise, remove or destroy the vessel (or part of it, including

		any equipment, cargo, stores or ballast), to light and buoy it until raised or destroyed and to sell and reimburse the authority from the proceeds of sale" (MMO, 2010:3).
Dangerous Vessels	The Dangerous Vessels Act 1985	"Gives power to the harbour master to give directions to prohibit vessels from entering the harbour or to require the removal of vessels from those areas where those vessels present a grave and imminent danger to the safety of any person or property, or risk of obstruction to navigation. It does not apply to pleasure boats of 24 metres or less" (ibid:3).
Environmental duties	Section 48A of the Harbours Act 1964	"Imposes a duty on authorities to have regard in the exercise of functions to environmental considerations (including facilities for visiting archaeological, architectural and historic features)"(ibid:3).

Table 3.5 Overview of HA duties in the UK
Source: Based on MMO (2010)

Apart from the duties outlined in table 3.5 above, ports also have a number of duties under local legislation including ports being open for all users subject to the payment of fees and rates under the section 33 of the Harbours, Docks and Piers Clauses Act 1847; powers to dredge; and conservancy duties under common law which will be reviewed in the next chapter.

Because not every HA can provide, or is required to have pilotage, it was omitted in table 3.5. However, it is relevant to many CAD ports. Pilotage is governed by the Pilotage Act 1987, it is applicable to a *competent HA* defined as "statutory powers in relation to the regulation of shipping movements and the safety of navigation within its harbour" (Section 1(a)). In deciding whether or not pilotage services are to be made mandatory or voluntary, a competent HA must consider the following:

"(a) whether any and, if so, what pilotage services need to be provided to secure the safety of ships navigating in or in the approaches to its harbour;" (Section 2-1(a)) and

"(b) whether in the interests of safety pilotage should be compulsory for ships navigating in any part of that harbour or its approaches and, if so, for which ships and in which circumstances and what pilotage services need to be provided for those ships" (Section 2-1(b)).

The description of HA duties and functions offers a legislative standpoint. The complexity of legislative frameworks that underpin various aspects of port operations and the vagueness of some of them such as environmental duties in table 3.5 is problematic. When the duties in table 3.5 are combined with specific legislative requirements for particular ports including their individual environmental designations and local conservation efforts, compliance can become a very resource intensive burden. Another conclusion is the number of dimensions of port management that underpin port sustainability, since non-compliance can result in financial or other penalties being imposed on that HA.

3.3 The role of governance in ports

One challenge for European ports is to form a "trans-European network", since currently 50% of goods handled in EU ports are received or intended for a different Member State from the one where the port which handled the goods is located (EC295, 2013). With such a huge pressure on ports for meeting future targets i.e. the volume of shipped cargo is predicted increase by 50% by 2030 from 3.7 billion tonnes in 2011 (ibid); port governance models can play a key role in contributing to ports efficiency, development and mode of operations. Having briefly mentioned in the previous chapter the EC's position on the EU port governance structures which was to keep diversity intact, this section will detail various governance models in European ports along with any restrictions.

A distinction was made between governing the port and the port authority, with the former, i.e. port governance, relating to stakeholder management or "cluster governance", and the latter, i.e. port authority governance, being about the internal level of the firm of the port authority (Verhoeven, 2010:251). Port authority was identified as a "body with statutory responsibilities that manages port's water and land-side domains", and as an entity that contains elements of public and private law, dealing with administration and criminal issues whilst competing with other similar institutions (ibid:251). Such wide remit of operation is proof to the diversity of seaport functions as both "public utilities and private enterprises" (ibid: 251). Appendix B contains a detailed analysis of UK and European port governance models.

3.3.1 Discussion

When analysed and compared against EU port governance models, Trust and Municipal ports represent community manager ports which combine economic and social dimension and settling arguments between stakeholders as its prime function; however the regulator's role of ship safety represents a first priority for all CAD ports. Not all ports own their land and similarly to seabed, land can be rented; however all ports manage their existing infrastructure and develop strategies related to port development. A number of CAD ports also provide pilotage, towage and mooring; have dedicated waste handling facilities, transfer services for passengers and even commercial cargo, giving CAD ports also an operator function.

If one was to combine the elements found in CAD ports and equate them to the EU ports, a new governance model of Operating Community Landlord Regulator would emerge, since it combines elements of all four EU port governance models and enhances the argument for complexity and diversity of CAD ports. Having so many responsibilities and revenue streams, EM models developed for EU ports might not be applicable to the UK ports simply because of the governance differences and operational remits that come attached. Having used several examples of CAD ports earlier in this chapter to substantiate an argument for operational diversity, the next section will briefly introduce the South West region and then focus on the ports found there. These ports do not conform to any single EU governance model, are located in environmentally sensitive areas, have vast conservation efforts taking place, help retain money in the economy by attracting holiday makers, provide local jobs and bolster their local economies.

3.4 Introducing Cornwall and Devon – funding for the research and problems of Cornish ports

The SW of England consists of six counties; of which CAD has the biggest coastline (Visit SW, 2013). The coast is essential for the economy and serves as a very attractive proposition for visitors, which is enhanced by the vast heritage legacy of a wide spectrum of activities including farming, fishing, shipbuilding and defence (Howard and Pinder, 2003). In order to preserve CAD's appeal and safeguard the coastline, a number of conservation activities are taking place which includes conservation of terrestrial and marine habitats, landscapes and species. Table 3.6 summarises the conservation initiatives in CAD and compares with the total number of such activities found. In the SW, MCZ programme worked through Finding Sanctuary initiative, which worked with a range of sea users and interest groups to identify and recommend additional MCZs (Finding Sanctuary, 2013).

Designation/Reference zone	Total number in CAD	Total number in UK/England	% of total number
AONB	8	34 – England	24%
HC	16	32 – England	50%
MCZ- Finding Sanctuary	23 inshore + 6 recommended 13 offshore+ 3 recommended	Approx. 101 + 20 recommended – UK	35%
SAC	34	625 - UK	5.4%
SSSI	379	4127 – England	9.2%
Potential Special Protection Areas (pSPA)	1 pSPA (Falmouth to St Austell – internationally important populations of overwintering divers and grebes) (UKGOV, 2014)	1 pSPA	n/A
SPA	4	270 - UK	1.5%

Table 3.6: Summary of environmental designations in CAD

The figures provided in table 3.6 illustrate the vast scale of conservation activities taking place in CAD, but at the same time place a considerable number of restrictions on port operations and infrastructure development projects. Despite the fact that CAD ports and communities are highly dependent on their environment to attract tourists, conservation activities present a “double-edged sword” in the form of restrictions, additional compliance and local opposition (ThisIsCornwall, 2013). With the main intent of the conservation projects to minimise disruption to particular marine and terrestrial habitats in order to protect and enhance the natural beauty of coast, activities characterised as “commercial” taking place in CAD ports significantly vary in their scale, scope and size from the commercial port functions found elsewhere.

Figure 3.1 is a map of port locations listed in Table 3.1, and it combines a total of 24 ports and harbours which is approximately half of all CAD ports. From the sample provided it is evident that trust and municipal ownership types of ports dominate in the CAD region. Despite multiple cases of the same governance types, no two ports in CAD operate in the same way. The next section will analyse the importance of ports at county level and then present a number of port profiles to illustrate their differences and operational restrictions.

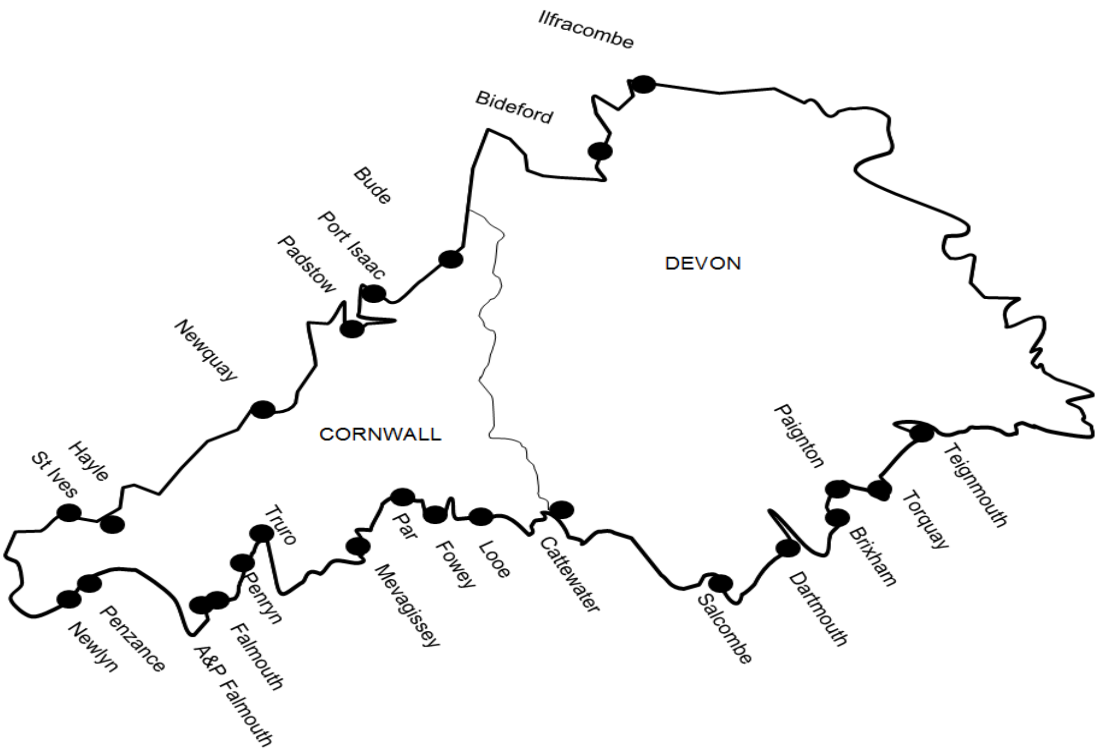


Figure 3.1: Map of CAD port locations

Source: Author

3.4.1 Research setting – smaller ports in Cornwall and Devon

Cornwall and EU convergence funding

Cornwall is the most South Western county of England which has 697 km of coastline, over 500 000 residents and its economy in 2012 was valued at £7.5 billion (Cornwall Council, 2013). In 2010, the average full-time salary in Cornwall was £21,258, compared with £24,236 in the South West and £26,079 across Great Britain (Cornwall Council, 2012:3). Such figures indicate the need for investment into the region, considering that in 2004, average annual salary in Cornwall was just £17,335 and has been steadily increasing since then (ibid).

The convergence funding initiative over the period of 2007-2013 has awarded Cornwall and the Isles of Scilly area £415 million (ibid). The programme has 4 priorities as described by Cornwall Council:

1. Innovation Research and Development
2. Enterprise and Innovation – restructuring the economy
3. Transformational infrastructure- developing a platform for economic performance
4. Unlocking the Economic Potential of Growth – developing in a sustainable manner to accommodate new investment critical to the development of a knowledge base and higher value added economy

Devon County

Devon is located east of Cornwall, and has two coastlines, 145 km on the north, and 185km on the south coasts of the county (Devon County Council, 2013). Devon has nationally renowned landscapes, cliffs, sandy bays, wooden estuaries and historic harbours located within (ibid). Over the course of the last decade, unemployment figures across the county have been fluctuating, from the lowest point of 9600 people in 2005, to the highest of 20608 unemployed in 2012(ibid). Compared with the national unemployment statistics for the people ages 16+, the fluctuating figures in Devon between 2005 and 2012 saw a 215% increase in unemployment, compared with 191% nationally when 1.4m was the lowest unemployment in Sept 2004, and 2.68m the highest figure in Oct 2011 (BBC, 2014).

3.4.2 Proposing a port sustainability management system in smaller ports in Cornwall and Devon

In April 2009, CC became a unitary authority which represents a single authority to manage Cornwall, rather than a two-tier system in which each district is responsible for its own territory and the CC oversees the provision of certain services for the whole county. Since assuming the role of a HA for municipal ports, CC appointed a Maritime Manager with extensive previous experience as a harbour master to manage ten municipal ports in Cornwall. These ports are: Bude, Portreath, Newquay, St Ives, Penzance, Truro, Penryn, Prince of Wales Pier in Falmouth, Portscatho and Portwrinkle (interview with Maritime Manager, 2012). Aside from municipal ports, Cornwall is home to a number of trust ports e.g. Falmouth, Fowey, Padstow, etc.; and private ports e.g. St Mawes, A&P Falmouth, etc. Unlike Cornwall, Devon County consists of local authorities (see fig 5.1) and a County Council authority. A number of municipal and trust ports are also located in Devon; however, unlike Cornwall, municipal ports in Devon are managed by the respective district authorities. Devon does not have a maritime manager that would oversee all municipal ports located within the county.

Cornwall and Devon have many environmental designations and statuses attached to the coast, which makes managing ports and harbours a much more expensive and difficult task than in some parts of UK, where fewer environmental designations have been assigned to port locations (e.g. DEFRA Map, 2013). Some harbours have developed their own in-house

EMS, while others rely on statutory legislation and good practice to address their environmental needs.

3.4.3 CAD ports at county level

On the county level, structure plans set out a framework for strategic planning regarding the use and development of land for the areas specified (DCC, 2004). Devised for the period of 15 years until 2016, Devon structure plans include five ports in four locations which have strategic importance for the county and are summarised in table 3.7.

Port/Authority	Port Use	Reasons for Strategic Importance
Bideford	Commercial	Main commercial port on the North Coast of Devon. Alternative to land transport for goods intended for that region.
Brixham	Fishing	Associated commercial activities e.g. fish markets and quays. Important centre for European Fisheries.
Plymouth (Millbay Docks)	Commercial and fishing port linked to Trans European Network	One of principal ports serving SW with considerable naval and commercial activity. Operates passenger ferry to Spain and France and commercial freight.
Plymouth (Sutton Harbour)	Fishing	Associated commercial activities e.g. fish markets and quays. Important centre for European Fisheries.
Teignmouth	Commercial	Considerable quantities of clay for export from the Bovey Basin. Freight import.

Table 3.7: Ports with strategic importance for Devon County
Source: DCC (2004)

To avoid overcrowding the map, the locations of Millbay Docks and Sutton Harbour were not separately identified as they are located within an immediate proximity of Cattewater Harbour Commissioners (CHC), all of which are located in the city of Plymouth. Combined these three separate statutory harbours operate within the Ministry of Defence Dockyard Port in Plymouth (CHC, 2014). The location of CHC has been marked in figure 3.1.

Across the border, Cornwall Council is less specific as to the exact strategic importance of ports in Cornwall in its structure plans and mentions ports in the general context of their surrounding areas (CC, 2004). The County's transport policy suggests improvements to be made at the port of Par by 2006 and by 2011 at Falmouth, Truro and Penzance ports (ibid). In relation to Falmouth-Penryn, the former being one of the biggest ports in the SW, Cornwall Council (CC) emphasises supporting the prosperity of the maritime, tourist and industrial economy "while protecting important aspects of marine environment" (ibid:48). As an important fishing port for Cornwall, Newlyn and the neighbouring port of Penzance are mentioned by CC in the context of "… provision of fishing industry will be supported", and where development must support "environmental qualities that provide a special setting for the town"(ibid:51). Lastly, the largest city and the biggest municipal port in Cornwall – Truro has a transport policy for the city's importance for the county as a "retail and commercial centre" and not a separate port policy (ibid:53).

3.4.4 Port profiles

From the sample of ports in Table 3.1, nine CAD ports have a commercial element, however as previously illustrated in section 3.0 using the example of Padstow Harbour, commercial activities can mean many different things in CAD ports. Fowey Harbour, located on the south coast of Cornwall is also a trust port and similarly to Padstow has commercial activities in its description.

Unlike Padstow, Fowey is a deep water harbour and is an important exporting port for the SW, and according to port's information they are "the largest in tonnage terms" in the region (Fowey Harbour, 2013). Aside from cargo tonnage, Fowey Harbour also has cruise liners, commercial ship repair and commercial towage services available on request (ibid). Despite the differences, there are also several common trades by type taking place in CAD ports, namely fishing and leisure services. This section will review port profiles of those ports that are strategically important for Devon and those mentioned by Cornwall councils to illustrate their differences, restrictions and scale of operations.

Devon

Bideford

Historically, Bideford was engaged in shipbuilding, timber import, production and export of cloth and tobacco import (Ports.Org, 2013). Today, Bideford is a tidal port which imports and exports clay to Finland, Spain and Holland; logs to German Baltic, and imports Rock salt (SWRPA, 2013). The port is in municipal ownership and is run by Torridge District Council. The port operates a ferry service to the isle of Lundy. In 2012 the port has exported 24,000 tonnes of logs (Torridge Council, 2013), and cargo handling was averaging 5,000 tonnes per month (SWRPA, 2013). Bideford coast is designated as a Northam Burrows SSSI and is part of AONB (DEFRA Map, 2013). The Bideford bay which serves as an approach to the river Torridge on which Bideford port is located is also home to another SSSI, and Braunton Borrows' SAC which is located several miles north (ibid).

Brixham

Brixham is a municipal port, part of Torbay HA which was established as a fishing port in the Middle Ages and by 1850 was the biggest fishing port in England (Ports.Org, 2013). Brixham is still the biggest fishing port in England by the value of catch landed, i.e. £26 million worth of fish in 2011 (MMO, 2011). Currently, there are over 100 fishing boats that land and sell fish in the local fish market, and the port currently has one of the largest fishing fleets in the UK (Brixham Harbour, 2013). Brixham has over 500 moorings to accommodate fishing boats, leisure craft and visiting vessels (SWRPA, 2013). The whole of Torbay marine area is designated as a SAC and the coast has multiple SSSI's (DEFRA Map, 2013).

Plymouth (Millbay Docks)

Commercial operations of the port of Plymouth are located in Millbay Docks which is run by ABP (ABP, 2013). The port operates daily passenger cruise services to France and weekly service to northern Spain for passengers and cargo (ibid). The port handles approximately 170,000 tonnes of cargo each year. The estuary of the River Tamar where Millbay Docks is located is designated as a SAC, with several SSSI's present on the estuary coast (DEFRA Map, 2013).

Plymouth (Sutton Harbour)

Sutton Harbour in Plymouth is privately owned and is part of Sutton Harbour Company (SHC) which is a statutory HA that operates Plymouth Fish market, Sutton Harbour Marina and other properties (SHC, 2013). Harbour activities include commercial fishing, and a marina for 500 berths (SWRPA, 2013).

Similarly to Millbay Docks, on the approach to Sutton Harbour, there is a marine SAC and coastal SSSI's present (DEFRA Map, 2013).

Teignmouth

Teignmouth is a trust port which works in close collaboration with ABP that import and export cargo through the commercial part of the port (SWRPA, 2013). Teignmouth's roots can be traced to 13-th century when it was a thriving port that traded in fish and salt (Ports.Org, 2013). Teignmouth is also a leisure port, with 120 deep water and 700 drying moorings which are currently managed by the Harbour Commission (SWRPA, 2013). Unlike ports mentioned previously, there are no environmental designations, terrestrial or marine present in or around the aegis of Teignmouth Harbour (DEFRA Map, 2013) making this port more suited for heavier commercial traffic.

Cornwall

Although CC did not specify the exact strategic importance of its ports and every port is important for the local community, several ports have strategic importance for the county.

Falmouth

Falmouth is a trust port and the third deepest natural harbour in the world (Ports.Org, 2013). Similarly to Teignmouth, Falmouth works closely together with a different private port – A&P which operate the shipyard, dry docks and the commercial cargo handling facilities (SWRPA, 2013). Most important business element of Falmouth stems from its location – bordering 5°West Sulphur Emission Control Area (SECA). This harbour accommodates bunkering operations that are operated by a private company and offering all grades of fuels and lubricants, as well as gas oil and fresh water (Dinwoodie et al, 2012). The leisure business of FHC operates 588 moorings for residents that are deep-water, and some are in private ownership; and further 19 for visiting vessels (FHC, 2013).

Unlike Teignmouth, the Fal estuary has been designated as a SAC (DEFRA Map, 2013), and there are also SSSI, AONB and HC present in the harbour which were not shown on the DEFRA map (FHC, 2013). Falmouth to St Austell has the only potential SPA in the UK. Operating a commercial port in an environmentally sensitive area poses numerous challenges for the HA i.e. to continue operating commercially and bringing benefit for the local community without endangering the local marine ecosystem and conservation efforts as a result of those operations.

<u>Truro</u>

Situated up river from Falmouth, Truro is a municipal port which is run by CC (SWRPA, 2013). Truro is run as a commercial and leisure port, handling general bulk cargo and providing approximately 1000 moorings around the upper half of the Fal estuary (ibid). Being located on the same estuary as Falmouth, Truro aegis is designated as a SAC, SSSI and AONB (Natural England, 2013; DEFRA, 2013).

<u>Fowey</u>

Fowey is a deep-water harbour in a trust ownership that is operated as a commercial and leisure port. The port is very important for the South West economy as it is the largest in tonnage terms in the region (Ports, Org. 2013).

The main activity of Fowey is export of China Clay mined in Cornwall (ibid). This is in collaboration with Imerys Minerals Ltd, a company which operates the private port of Fowey Docks (ibid). On the leisure side, Fowey Harbour Commissioners own approximately 900 moorings which are rented under annual contract (Fowey Harbour, 2013). Fowey is located within AONB, and has a Bathing Beach as the Marine Conservation Society recommended beach (ibid). The Upper Fowey estuary and Pont Pill which is a branching estuary flowing into Fowey were recommended as a MCZ (WildlifeTrusts.ORG, 2013). Salmon and Sea Trout spawn upstream the Fowey estuary having travelled the length of it (Fowey Harbour, 2013). Fowey estuary is also home to bass nursery area and has designated shellfish waters in Pill point (ibid), which were proposed to be designated as MCZ.

<u>Newlyn</u>

Operating a trust port, Newlyn Harbour Commissioners are in charge of the second largest fishing port in England by the value of catch, where in 2011, £22 million worth of fish was landed (MMO, 2011). There are over 100 fishing vessels operating from Newlyn, and throughout the year in the region of 800 vessels visit Newlyn Harbour (SWRPA, 2013). It is unclear if Newlyn has been designated environmentally since no credible sources for that information have been found.

3.5 Discussion

Since fishing takes place mostly outside harbour limits, and harbours are used to land the fish and moor vessels, not enough credible secondary data is available to describe fishing activities in sufficient depth for all harbours. In the chapters to follow, comprehensive profiles of those ports used during data collection will be compiled and analysed in detail. Fishing scale and types of fish will form parts of those profiles along with more details on commercial operations and revenue streams.

Having so many designated coastal and marine areas, operating without a sustainability management system only with an EMS which is aimed at mitigating environmental impacts might not be a solution for sustainable port management because if the habitat conservation efforts are put at risk, then greater restrictions can be imposed as a result. For CAD ports, proactive measures looking not just at environmental impacts but other factors that are interrelated is the way for a sustainable future and a PSMS is required to help achieve that. A single accident on a sufficient scale can result in higher levels of environmental protection being imposed through statutory designations as a consequence of harming conservation efforts (DEFRA, 2013). These extra measures would impact the levels of harbour operations and activities even further, and can result in monetary fines being imposed by regulatory agencies in accordance with the 2008 Regulatory Enforcement and Sanctions Act (OECD, 2009). Although environment forms only one part of sustainability management, operating in environmentally sensitive areas and tourist based economies makes environmental issues very prominent for

CAD ports and unsurprisingly a great deal of effort is being put to mitigate the operational impacts on the local environment. For that reason ports must look at their operations from a sustainability standpoint which addresses the whole remit of port operations, and not only ecological impacts of what it takes to run a port.

Operating predominantly for stakeholder benefit, few trust and municipal ports have significant commercial activities that could potentially cause an environmental calamity and make ports unsustainable and even bankrupt as a result. Many ports in CAD are making little surplus and due to the nature of their governance models i.e. being run for the community or stakeholder benefits are unable to diversify into commercial cargo sector due to fierce opposition from the stakeholders, unsuitability of infrastructure and environmental designations. Creating and maintaining a sophisticated EMS or even a bespoke PSMS can be a very expensive proposition for some smaller ports and for others might seem as unnecessary since they might only be dealing with leisure vessels. Having previously illustrated how environmentally sensitive CAD port areas are, conservation efforts and habitats can still be damaged even by leisure activities in the port that has an EMS e.g. when users empty their sanitary tanks, disturb the sediment and create turbidity or have minor oil spills in the estuary. Such impacts would need to be proactively mitigated which forms the essence of PSMS that this project aims to build, and not reacted to as most EMS's have been designed to and significantly reduce the level of available resources as a result.

It is not possible to create a generic comprehensive management system for ports as a whole, because no two ports are the same and a considerable amount of adaptation for that system would be required. As illustrated earlier in the chapter, CAD ports do not conform to a single EU port governance model and require a completely new approach towards sustainability management. However, if a common element between all ports is identified, then creating a generic approach to managing those common elements can be one of the ways forward. Most importantly for smaller ports is to create a process to help safeguard their business, community and local environment for the future generations, a process that would not be considered a cost burden by those with smaller scale of operations and would be inclusive of all smaller ports in CAD despite their size, ownership type and location. Most importantly, a process that would address all key aspects that underpin sustainability in ports and not just be focused on selected aspects that have gained momentum in recent years will allow HMs to proactively address port sustainability as a whole, instead of continuing to react to most pressing issues any given time.

The next chapter will discuss traditional port managing methods, provide more detail on FHC KTP and the use of business process approach within an applied context, as well as present the first part of new research conducted which was to identify the terms of reference for a new discourse in CAD ports. These terms of reference will then underpin the fundamental principles established in, and covered by PSMS and will be explained in later chapters.

CHAPTER 4: THE RESPONSIBILITIES OF HARBOUR AUTHORITIES AND MARITIME OPERATIONS

4.0 Introduction

Sustainability represents a key concept for port stakeholders and governments, however current EMS methodologies used to tackle sustainability issues in ports do not consider business processes and typically focus on environmental impacts rather than causes. EMSs can become very resource intensive, time consuming and unaffordable particularly for smaller ports, as discussed in section 2.4.4. An approach which incorporates examination of the wider implications of EM of MOs as a business process is required to encourage sustainable development and unlock the potential of smaller ports (Dinwoodie, et al., 2012). For PSMS to be designed as a business process and not to be cost intensive for smaller ports (i.e. ISO, SDM and PERS have cost elements attached); commercial streams of ports need to be identified and safeguarded through the use of PSMS, ultimately leading to more sustainable port management and development.

This chapter presents the first stage of a new approach to sustainability and assists in identifying and safeguarding of current commercial activities in ports to help facilitate new development. In order to do so, responsibilities of HAs and traditional management methods employed by them are reviewed along with the recent case study of using a business process approach as a vehicle for sustainability and EM. Collated existing literature was analysed using Ethnographic Content Analysis (ECA) to update the prior definition of MOs, which in the later chapters is used as the basis for the scope of PSMS.

4.1 Falmouth Harbour Commissioners knowledge transfer partnership

The PSMS introduced in this research is underpinned by business process thinking, developed and tested using a case study research design. Within this approach each operation is categorised into functions and processes in an attempt to maximise efficiency and eliminate waste. Falmouth Harbour Commissioners (FHC) have adapted a Total Quality Management (TQM) approach to organisational management and developed an internal integrated management system (IMS), whereby issues were viewed from their customers' perspectives and a holistic approach to all parts of their organisation was adopted (Slack et al., 2010). Indifferent relationships with environmental stakeholders and concerns about the port's current and future operations provided a catalyst for change, which led to establishing close working relationships with regulatory bodies and various stakeholders through a Knowledge Transfer Partnership (KTP) with Plymouth University (KTP, 2012). A proactive approach to identifying environmental concerns at an early stage, assessing the evidence of environmental damage and responding to that evidence with relevant action was the basis for KTP (Tuck at al., 2011). Due to the unpredictable nature of port revenues and a successful KTP project, FHC recorded increased annual profits and was empowered to develop the knowledge and expertise required to identify and understand potential environmental and socio-economic impacts on the harbour, their business and the region (ibid). Prior to the KTP project, FHC had no formal EMS, and whilst seeking improvements, identified the importance of stakeholder management and engagement which was later “incorporated into a broader sustainability management system” (Dinwoodie et al., 2012:112). By taking internal responsibility for implementing environmental assessment, FHC was able to increase its stakeholder engagement, generate new contacts and benefit from offers of information and resource sharing (ibid:112). Monitoring systems now benefit from the input of environmental interest groups, who also respond to development proposals and legislative requirements.

4.1.1 Taking PSMS beyond the FHC KTP

To research the scope for implementing PSMS beyond FHC, a theory extension type of case study was deployed (Dinwoodie and Xu, 2008). Having a prior theoretical underpinning, this research represents a theory extension, appropriate to a case study design “capable of tackling how and why type questions” (ibid:400). Dinwoodie and Xu (2008: 401) suggested that theory extension study may seek to “identify the criteria” to ensure successful implementation and may be used to “extend the domain of existing theory”. To build on existing work which was specific to anchoring and bunkering operations within the context of a particular port (Dinwoodie et al., 2012), a PSMS needs to be extended to a wider range of maritime operations and contexts. To achieve this, multiple criteria relating to the local community, harbour masters’ attitudes, barriers for implementation, and port requirements need to be identified and analysed before the PSMS can be developed systematically.

4.2 Traditional management approaches

The processes of compliance that HAs have to follow extend beyond legislation that underpins the powers and duties of ports. Examples of how statutory and best practice processes are used to assist HAs with EM, safety and sustainability have been discovered during the collaboration with industry practitioners. This section briefly introduces MMO compliance and the PMSC to reveal differences between practical approaches and theoretical views of EM and sustainability in ports. The exact processes that smaller ports in CAD employ for managing sustainability are explained in chapter 8.

When placing objects on the seabed or installing infrastructure (e.g. pontoons), consent from the MMO is required; this is often followed by an environmental assessment (MMO, 2014). This process forms the basis for the EM aspect from the statutory side that every port has to comply with. Several other applied approaches have been discovered during data analysis, one of which is a concept of “piggybacking” whereby ports and harbours use their safety management system (SMS) as a foundation for affixing without charge an environmental policy statement or even parts of an EMS. From a business point of view, safety management represents a cost which ports have to cover from other sources. Being used for risk mitigation and arguably forming part of an EMS, SMSs are important vehicles for safety of commercial and leisure users. Within such systems, EM is a form of by-product which occurs due to a reduced risk of collision and therefore reduced risk of an oil spill within a HA’s aegis. Using SMS as a vehicle for EM can be considered to be a practical approach; however it is still reactive by nature and is not comprehensive enough to cover all aspects of port sustainability. Appendix C contains analysis of port conservancy duties as defined in the Guide to Good Practice on Port Marine Operations (GGGPPMO, 2013).

4.3 Using business process principles for environmental management

A view of EM in the context of organisational change reveals that many current job functions, work flows and organisational structures might have been inherited rather than designed (Hammer, 1990). Business process re-engineering (BPR) involves identifying and rejecting some of the existing processes and then finding creative new ways to accomplish work, an “all or nothing proposition with an uncertain result” (ibid:105). In their study of engineering to order companies, Cameron and Braiden (2004) suggested that implementation of BPR can be challenging due to organisations having both “micro” and “macro” processes. In this example, macro engineering due to complex product and “intercompany networks” required for realisation made BPR very difficult, however micro BPR and successful “reconfiguration of several internal processes” was achieved (ibid:270). As a management philosophy, TQM emphasizes the importance of customer satisfaction from the perspectives of availability, delivery, maintenance, reliability and cost (Al-Mashari and Zairi, 2000). According to Gunasekaran et al., (1998:948) “…total quality will create a positive spiral in the company. Happy employees will do a better job, i.e. better products and services which will satisfy more customers”.

Before adapting the TQM type approach towards organisational management, an Input-output model developed in conjunction with FHC sought to understand the business processes which were required to meet their environmental obligations (Dinwoodie et al, 2012). Three levels of decision making are presented in Table 4.1. At a strategic level decisions (S1-S7) "incorporate the overall determination of the system objectives." At tactical level, decisions (T1-T7) are required to "achieve the overall objectives." Finally operational decisions (O1-O6) are required "to keep the system within constraint limits and in accord with objectives" (ibid:115).

Strategic level	Tactical level	Operational level
Input	**Service Processes**	**Output**
S1 Mission Statement	**T1** Local familiarisation	**O1** Internal monitoring, reporting, archiving
S2 Physical Conditions	**T2** Operational conventions	**O2** External communication, dissemination
S3 Governance Issues	**T3** Networking	**O3** Recommendations
S4 Stakeholders	**T4** Consultation	**O4** Mitigations
S5 Local Data	**T5** Reviewing, monitoring	**O5** Sustainability
S6 Management system	**T6** Hire expertise	**O6** Awareness
S7 Resource assessment	**T7** Reporting	

Table 4.1: Input-Output Model
Source: Dinwoodie et al. (2012)

Understanding environmental obligations through the acquisition of relevant knowledge relating to each of the criteria in table 4.1 along with the implementation of internal environmental assessment has assisted FHC in increased stakeholder engagement, generation of new contracts and offers of information sharing (Dinwoodie et al, 2012). The acquisition of knowledge has also helped FHC to better understand the direction that they needed to take the organisation forward i.e. releasing HM's time from attending routine meetings and to "contribute vigorously to policy debates and technical issues" (ibid: 123). The key transferable principle that underpinned the success of FHC KTP was the generation of relevant and reliable knowledge surrounding the issues of EM and port sustainability that was used to establish collaborations with the port's stakeholder groups, helped to create positive media coverage for the port, and an "improved public profile has attracted new requests from universities and harbour authorities to engage and visit" (ibid:123).

The next section will present results of the first stage of establishing new knowledge that underpins the essence of trade in CAD ports and their local communities, specifically to define maritime operations. Safeguarding commercial streams of revenue for ports in CAD is imperative to assist ports in becoming sustainable.

4.4 ECA and maritime operations: updating the definition

Content analysis (CA) is an intellectual process of categorising qualitative data into conceptual categories or clusters in order to identify consistent patterns and relationships between variables or themes (Julien, 2008:121). The "intellectual" part is subject to interpretation but "consistent" patterns imply that regardless of sample size, only consistencies will be taken into account. Holsti (1969:14) defined CA as any technique for making inferences by objectively and systematically identifying specified characteristics of messages. When using CA in a qualitative research framework, text is open to personal interpretation, reflects various meanings, and is context dependent (Given, 2008:121). Bryman and Bell's (2011:291) definition and explanation of CA was adopted as the method on which to base this analysis, where CA is an approach that seeks to "quantify content in terms of predetermined categories and in a systematic and replicable manner". In the context of this research, predetermined categories have been inductively established from Dinwoodie et al.'s (2012) definition of MO based within the context of a specific port. ECA was employed to enable categories to emerge from the data, whilst recognising the importance of understanding the meaning in the context which the analysed item is based on (Bryman and Bell, 2011:291).

Altheide (1996) suggested combining CA with several aspects of ethnographic research into ECA. He defined it as the "reflexive analysis of documents" (ibid). In his earlier work, Altheide (1987) noted that aside from documenting and understanding the meaning of communications to verify theoretical relationships, ECA has to be systematic, analytical but not rigid. This is crucial in that by conceptually coding the data certain items may be relevant for several purposes (ibid). Reflecting on Altheide's work, Krippendorf (2004:21) noted that ECA is ill-defined with proponents antithetical to the rigidity of traditional CA, preferring flexibility regarding new concepts that emerge during their "involvement with texts". Being systematic, analytical but not a rigid approach, during initial stages of ECA the research is steered by variables and categories. Later, other entries including an "orientation towards constant discovery and constant comparison" of relevant situations and meanings are not only permitted, but are expected to emerge (Altheide, 1996:16). Referring to the constant comparison element, which has been central to Glazer and Straus's GT method since 1967, Altheide (1996) articulated clear differences including systematic coding of field notes and theory development as fundamental elements of GT and concept development, description and verification as central to ECA. In this work, the quality, meaning and purpose of text extracts vary, making understanding of the communication of meaning critical (Altheide, 1996). In this context, ECA is apposite for emphasising the discovery and explanation of contexts, their fundamental meanings, and patterns and processes linking variables (Altheide, 2008:287). A systematic approach which is replicable is required to search relevant databases.

When going beyond the traditional management methods explained in section 4.2, due to the lack of sustainability management systems available, some ports adapt an EMS in an attempt to enable a more proactive EM. Whether outsourced or created in-house, most EMSs deployed by ports are resource intensive, require specialist expertise to implement and may not be fit for purpose in smaller ports due to their emphasis on impact mitigation as opposed to targeting port sustainability as a whole. Another element that is missing from the existing EMSs is the capacity for new knowledge acquisition that requires a different philosophy and approach.

A less resource intensive, more focused approach towards understanding the essence of port sustainability would assist all ports to examine the process of not only managing the environmental but also sustainability impacts of operations, and by ensuring compliance with relevant legislation could unlock the potential commercial rewards offered through maintaining existing operations and developing new ones sustainably. As previously stated, non-compliance with environmental legislation can result in regulatory bodies imposing monetary fines on the ports and HAs (OECD, 2009); which, as a result of increased environmental protection can lead to a considerably reduced operational capacity. Subsequently, where smaller ports are unable to demonstrate such compliance in order to accommodate required commercial activity, supply chains can bypass them, depriving them and their hinterlands of much-needed investment and development. In order to safeguard existing commerce and trade, smaller ports urgently require implementation of a business process approach to understand and document the sustainability requirements of MOs.

Prior work with FHC identified the critical weakness which is that MOs should be managed from a business point of view instead of port operations. One way to create a PSMS for different ports is to focus on some common characteristic. Vessels of all types and sizes use ports for activities such as commercial shipping, fishing, leisure and others. Despite the size and numbers of ships, the basic functions that they must perform differ only in scale and port specific approach to that function. Although port operations are often unique MOs are more ubiquitous which facilitates the development of a generic management system to frame their sustainability requirements, appropriate for dissemination across smaller ports. In order to develop this system, a comprehensive search of existing literature has been undertaken and following ethnographic content analysis, an emergent taxonomy to facilitate implementation is reported.

4.4.1 Using ECA: secondary literature search

A comprehensive search of existing literature on MOs spanned all relevant journals and databases such as EBSCO, Metalib, Emerald, Elseiver. After analysing shortlisted sources for patterns using ECA, a tentative taxonomy with major categories has been created. Varying units of analysis have been applied (Dinwoodie and Xu, 2008). Specifically within content analysis, multiple dimensions of thought lead to a taxonomy of concepts, which reflects the position of notions within the network (Krippendorff, 2004:296). Cargo handling is an example of the concept representing an action, but other authors attached no verb, implying an object which belongs to a different category. Such small differences still require two different concepts, which articulate Krippendorff's point about multi dimensions and the need for a taxonomy. Whereas external validity is imperative to ensure generalizability of results, internal validity refers to clear outline of cause and effect whilst tackling exploratory questions (Dinwoodie and Xu, 2008). Akin to cargo handling, bunkering operations have been mentioned by different authors as both marine and maritime, giving more justification for applying ECA as a technique of choice to assign multiple categories to the same concept whilst searching for the complete meaning of each concept.

Despite the efforts of academics, there is still no agreement on the "best" index for measuring intercoder reliability (Lombard et al., 2002:593). To test reliability between coders, Cohen's kappa (κ) has been used to test variance between coders. Krippendorff (2004:419) reported that κ does not recognise that unequal use of categories between two coders could be a reliability problem. This methodology has attracted a wide range response from academics, some had concerns that even with perfect agreement, the maximum value of κ is <1.00 (Lombard et al.,2002). A test has been conducted and categories with perfect agreement came out with an index of 1.000. Krippendorff's alpha (α) is an attractive index which allows for an unlimited number of coders and accounts for chance agreement but is less attractive because calculations are complex (Lombard, et al., 2002:592). Lombard et al. (2002) collated results of coded articles and reported findings of intercoder reliability using Scotts' pi, κ, and α. Statistical difference between the indices was minimal, with robust α producing almost the same results as widely debated κ when analysing textual mediums such as newspapers and magazines; and media sources such as advertisements, news and entertainment (Lombard, et al., 2002:597). The largest disagreements occurred during the analysis of radio, film and data from respondents. Reports of fluctuating levels of reliability concluded that only 49% of four major content analysed journals of news media between 1988 and 1993 reported reliability, whereas 72% of articles in journalism and communication journals achieved reliability in 1997.

Categories with nominal data have been used for coding, which made reliability testing more challenging. Not being able to rank nominal data eliminated a number of indices immediately. Categories have been aligned in SPSS in ascending order from A1 to F5. Numerical values of 1 were assigned when a category was used and 0 otherwise for a particular case. Two columns, one for each coder, have been assigned to each of the analysed case studies. After inputting data, crosstabs analysis between coder A and B was performed using κ to test intercoder reliability, discussed below.

Altheide (1996)	ECA characteristics	This project
(a) Research Goal	Discovery, Verification	Verification of Definition
(b) Reflexive research design	Always	Yes
(c) Emphasis	Validity	Validity, Verification
(d) Progression from data collection, analysis, interpretation	Reflection, circular	Continuous – Circular, constantly updating data
(e) Primary researcher involvement	Purposive and theoretical	Theoretical
(f) Prestructured categories	Some	6 pre-structured categories; 44 emergent categories
(g) Training required to collect data	Substantial	Existing literature search from academic databases
(h) Type of data	Narrative; Numbers	Narrative and Numbers
(i) Data entry points	Multiple	Multiple
(j) Narrative description and Comments	Always	Yes
(k) Concepts emerge during research	Always	206 Concepts emerged.
(l) Data analysis	Textual; Statistical	Textual, and Cohen's Kappa
(m) Data presentation	Tables and text	3 tables: search results; taxonomy; data analysis

Table 4.2: Ethnographic Content Analysis

Source: Adapted from Altheide (1996)

Table 4.2 compares the characteristics of ECA with elements of this project. The project aim so far has been to verify through discovery a definition of MO, which started from an academic theory perspective (e) with 6 pre-structured categories and assisted 44 new ones to emerge (f) through multiple entry points and continuous emergence of concepts (k). Being steered reflexively (b) through acquisition of new data and development of new concepts, much attention is being given to validate and verify (e) multiple streams of information acquired through primary and secondary data sources (i). Statistical techniques were used to validate textual information (l) obtained from a comprehensive search of academic literature sources (g) and analysed by two people to ensure intercoder reliability. Verification of narrative descriptions and comments though the addition of numerical data to validate findings (h;j) were applied throughout. Continuous updating of the tentative taxonomy with new categories, codes and concepts (d) made findings possible. The methods of undertaking ECA are presented in tables 4.4, 4.5, and 4.6 (m).

Table 4.3 summaries shortlisted text extracts. Each source has been searched using keywords “maritime operations”, “port operations” and “marine operations”. “Port operations” and “marine operations” keywords were included due to their constant overlap with MO and general misuse of the terminology. For the new system to be effective, a clear distinction is required between all types of operations that take place in and around ports. Multiple searches were conducted using each source, and keywords varied between search fields. “Title” field was used to conduct an initial search using a new source with all three keywords used in turn. If the search yield was low, keywords were then put into “abstract field” to allow more results to emerge. The next step to tackle the lack of search results was the “all text” field, which sometimes generated unrelated data. Additional keywords such as “anchoring”, “bunkering”, “ballast water”, “ship” and “port” were used to narrow down results to a manageable number. Having done a general search of all relevant sources by discipline for the entire Elsevier database, few results emerged. Because a detailed search within each potentially relevant journal yielded many more results, Table 4.3 lists Science Direct and its constituent journals separately. Once shortlisted, each search result was analysed using the keyword “operation”. Singular form was used to generate more results without restrictions on publication dates. Some date back to the mid-1990s, and many older sources show double spacing between words. Similar searches were performed using publications of local, international and supranational governing bodies and the ports industry to look for relevant official documents. An additional three sources were discovered which yielded four new extracts of relevant literature. Finally, a physical search of library books and journals for relevant keywords generated two additional sources.

After shortlisting all sources, Dinwoodie et al.’s (2012) definition of port-specific MO was analysed allowing concepts to emerge inductively. Six categories identified spanned frequency, action, object, timing, where and purpose. Those categories were then used to deductively extract specific information from other sources to underpin a structured taxonomy. The length of a single coding unit varied between one word (e.g. ship, port, cargo) and a whole phrase (e.g. to safeguard the environment). This approach symbolises the fundamental idea of ECA of discovering meaning and patterns (Altheide in Given, 2008).

Table 4.4 lists all major categories (A-F) and all sub-categories extracted from the literature. Each sub-category (A1- F5) represents a code that was used to tag and group concepts appropriately. A [number] next to each code shows the frequency of use in full text. A total of 206 concepts have been assigned to subcategories (A1-F5), indicating the size and complexity of the taxonomy.

After assigning concepts to text, intercoder reliability was estimated in SPSS using *κ*. Results ranged from 0.828 to 1.000. Using nominal data, SPSS computes Phi (*φ)* and Cramer's V coefficients, which were calculated to verify reliability due to academic disagreement relating to *κ*. Having discovered only a minute discrepancy between the three statistical indices, it was concluded that *κ* is a reliable coefficient to test intercoder reliability in this work. Lombard et al., (2002: 593) reviewed existing literature on acceptable levels of reliability and concluded that a coefficient of 0.90 or greater would be acceptable to all, and 0.80 or greater in most situations

Electronic academic sources	**Dates**	**Total hits**	**Shortlisted**
EBSCO (All resources)	28.12.2011 – 05.01.2012	523	3
Metalib (Marine)	03.01.2012 – 05.01.2012	260	3
Emerald (Books and Journals)	04.01.2012	31	0
Science Direct (all sources)	11.01.2012	3	0
Marine Policy Journal	11.01.2012 – 14.01.2012	113	0
Marine Pollution Bulletin	14.01.2012 – 16.01.2012	69	1
Maritime Policy and Management	16.01.2012 – 17.01.2012	110	2
Maritime Economics and Logistics	17.01.2012 – 20.01.2012	495	2
Journal of Environmental Management	21.01.2012 – 23.01.2012	571	0
Transportation and Research A	25.01.2012 – 28.01.2012	1035	4
Transportation and Research D	29.01.2012	177	1
Transportation and Research E	01.02.2012	373	1
IJOL: Research and Application	14.01.2012	150	0
Total		**3910**	**17**

Other Sources	**Type**	**Publication year**	**Shortlisted**
Department For Transport	Government Report	2009	2 Extracts
Shipping and Logistics Management	Academic Book	2010	1 Extract
United Nations Conference on Trade and Development	Official Report	1995	1 Extract
VTT Manufacturing technology	Academic Article	1996	1 Extract
European Sea Ports Organisation	Industry Report	2004	1 Extract
		Total shortlisted results	23

Table 4.3: Summary of shortlisted text extracts

Source: Author

Major Category	Sub Category/Code (frequency with which each code was used in total).
A. Frequency	**A1**) Routine[3]; **A2**) Exceptions(non-routine) [2]; a2a) Special conditions[1] **A3**) On-going[1];
B. Action	**B1**) Port Operations[12], b1a) Container Port Operations[3], b1b) Port Operation System[1]; **B2**) Maritime Operations[7]; **B3**) Marine Operations[3]; **B4)** Conservancy[12]; **B5)** Value Adding[2]; **B6)** Services To Cargo[10], b6a) on shore[4], b6b) on ship[1]; **B7)** Environmental Management[2]; **B8)** Construction[2]; **B9)** Shipping Operations[2]; **B10)** Port Activity[3]; **B11)** Impact[1].
C. Object	**C1**) Marine Craft[1], c1a) ships/vessels[9], c1b) other marine craft[1]; **C2**) Information Flow[2]; **C3)** Environment[1]; **C4)** Cargo[6]; **C5)** Finance[4]; **C6)** Business Environment[7]; **C7)** Inland Port Objects[5].
D. Timing	**D1**) While/During[3]; **D2**) Normalised[1]; **D3**) In The Near Future[1].
E. Where	**E1**) Port[14]; **E2**) Coastal and Marine environment[4]; **E3**) Sea Voyage[3]; **E4)** Inland[4]; **E5)** Ship/Shore Interface[1].
F. Purpose	**F1**) Commercial [10]; **F2**) Educational[0]; **F3**) Environmental[6]; **F4)** Safety[3]; **F5)** Organising and Operating[5].

Table 4.4: A segment of the full taxonomy

Source: Author

4.4.2 Defining maritime operations

After establishing reliability, pattern analysis was undertaken to compare the extracts of literature. No maximum number of codes was imposed per source, enabling all concepts to emerge. Next, pattern analysis was undertaken because of differences in the quality of sources. Relatively few contained useful definitions with the rest including extracts of all types, ranging from a few sentences to tables. Table 4.5 presents the results, where "patterns of concepts" refers to the number of times the same concepts have been used by different authors. "Used in total" represents the total number of times each concept was coded. This analysis facilitated comparisons of concepts that have been assigned to the full taxonomy and a search for underlying meaning and its significance, as required by the ECA technique (Altheide in Given, 2008).

Pattern 1 (P1) indicates that in all three instances of finalised codes, “routine frequency code” was present in the same text extract as “MO” and “port location”. P2 indicates that all instances of “during” (timing) code (i.e. 3 out of 3) accompanied “MO” and “port location”. P3 indicates that on all three occasions when “MO” and “port location” was mentioned “environmental purpose” was also present. P4 matches “routine frequency” and “during” (timing) of MO in “port location”. In P5 “MO”s overlap with “port operations”, introducing a ship object into patterns with the port location. P6 is as P5 but excludes a ship, and four times, “MO” overlaps with port operations in port location. P7 identifies “conservancy operations” which industry perceives as safety focused, overlapping with MO in port location. P8 introduces a commercial purpose, with MO taking place in the port location, relating to a ship object and overlapping with port operations. This pattern consists of five elements which repeat twice. In P9, MO appears to take place in port locations 6/7 times. Finally, P10 links MO with a ship object in the same definition.

NO	Patterns of Concepts	Used in total
1	MO(**B2**)+ Port(Location **E1**)+Routine(Frequency **A1**) = **3**	7+14+3
2	MO(**B2**)+ Port(Location **E1**)+During(when **D1**) = **3**	7+14+3
3	MO(**B2**)+ Port(Location **E1**)+Purpose(Environmental **F3**)= **3**	7+14+6
4	MO(**B2**)+ Port(Location **E1**)+Routine(Frequency **A1**)+ During(When **D1**) = **2**	7+14+3+3
5	MO(**B2**) +Port Operations(**B1**) + Port(Location **E1**)+ Ship(Object **c1a**)= **3**	7+12+14+9
6	MO(**B2**)+ Port Operations(**B1**) + Port(Location **E1**)= **4**	7+12+14
7	MO(**B2**)+ Conservancy(Operations **B4**)+Port(Location **E1**)= **2**	7+12+14
8	MO(**B2**)+ Port Operations(**B1**) + Ship(object **c1a**)+Port(Location **E1**)+ Purpose(Commercial **F1**) =**2**	7+12+9+14+10
9	MO (**B2**)+ Port(Location **E1**) = **6**	7+14
10	MO (**B2**)+ Ship(Object **c1a**) = **4**	7+9

Table 4.5: Pattern analysis
Source**:** Author

This pattern analysis of the available academic literature facilitated a preliminary comprehensive definition of MO, rather than one based merely on port-specific operations namely: *"maritime operations comprise all routine procedures which ships and vessels undertake whilst in port for commercial and environmental purposes"* (authors). The precise extent of operations which are "routine" with a "commercial" and "environmental" purpose could only be determined after conducting interviews with relevant industry professionals and aligning them with the views of the existing literature.

4.4.3 Updating the definition based on primary and secondary data

Following interviews with experienced HMs and their senior staff more MO have been identified. Participants have asked to remain anonymous and therefore will be referred to as: HM1; HM2; HM3; HM4; Ops. Manager; Deputy HM (DHM); Environmental Officer (EO). Due to the generic nature of MO, many similarities were discovered during the interviews. New operations identified depended on the factors such as: port size; physical location; physical conditions (whether a port has areas that are safeguarded by environmental legislation); main revenue streams; governance model; relations with the community and the stakeholders. Being in charge of a smaller port than HM1, HM4 has a very limited revenue stream and using the port's location which is a sheltered anchorage started doing in-water surveys, hull surveys and hull scrubbing of vessels whilst at anchor. These operations are normally conducted in a dry dock, however dry docks are very expensive and have long booking queues (HM1, HM4, DHM). HM2 runs a tidal port which has deep water anchorage and lays up ships in difficult economic times when vessels are awaiting orders. Ship lay-up was mentioned by every participant but with different emphasis and importance to their profitability and sustainability. HM2 also introduced the concept of a water taxi service which takes sailors to and from the shore as part of their lay-up operation, and another taxi service which takes people across the water thereby taking cars off the road as an environmental benefit to the community. Having a sheltered anchorage, HM4 mentioned coast hopping. This happens when a heavy piece of equipment such as a jack-up rig needs to be delivered to a port and the weather prohibits consistent movement (HM4). To avoid the risk of collision a concept of coast hopping represents waiting for a new weather window within sheltered anchorages, thereby paying water dues to the HA making this operation commercial in nature. Winter stowage was not mentioned in academic literature, but all participants were taking unused craft during the winter period out of the water by the request of their owners and are charging for that process because it requires specialist equipment (HM1, HM2, HM3, HM4). Pilotage is mandatory for some harbours depending on the sea depth and the difficulty of navigation (DHM). Pilotage is both a safety and commercial operation (HM1, Ops Manager), which is statutory for some harbours. So ensuring how pilotage is provided and that there are no infringements with the Pilotage act, regular crew training and vessels are suitable to be operated as such falls under the remit of the operations manager interviewed, who identified management of pilotage contracts as a MO. Key principles of MO have been identified by HM1 saying it was the “essence of trade” and that it was “all the stuff that makes commerce work” (HM1). Having tested this with other interview participants, HM2 said that MO in his view were “commercial, for example loading and offloading". HM3 further substantiated the commercial concept saying that MO were "everything to do with providing facilities and running harbours, and everything involved in that".

4.4.4 Maritime operations defined

Table 4.6 provides a comprehensive definition of MOs based on academic literature and primary data. Operations have been divided into logical categories to assist comprehension of the table. Since not every port deals with cargo, cargo related services have been divided into general (cargo related), as well as operations specific to on-shore and on-ship related activities. The "people involved" category relates not only to the cargo services, but to MO as a whole (c4, Table 4.6). Category c4 encompasses everybody in the port who makes commerce possible. Based only on smaller ports and academic literature, the list of MO presented in Table 4.6 might not be complete, therefore the key rationale behind MO have been summarised under "drivers" in Table 4.6. Using that principle more operations can be identified by major commercial ports and added to their own taxonomy if required.

MARITIME OPERATIONS
In Port
a) Anchoring; **b)** Bunkering; **c)** Ballast Water exchange; **d)** Naval refuelling; **e)** Amphibious landing; **f)** Operation with autonomous underwater vehicles; **g)** Fuel supply**; h)** Movement from ship to ship**; i)** All human activities related to the sea; **J)**Commerce of the port; **k)** Efficient management of throughout of goods; **l)** From the inland connection to the port; **m)** Ship lay-up; **n)** Shipping related (tugs, tows, barges); **o)** In-water surveys; **p)** Hull surveys; **q)**Hull scrubbing at anchor; **r)** Coast hopping (for weather windows); **s)** Winter stowage; **t)** Shipping related services (water taxi); **u)** Management of pilotage contracts; **v)** Everything to do with providing facilities and running harbours, and everything involved in that
Cargo Related
a1) Handling; **b1)** Processing; **c1)** Security; **d1)** Loading; **e1)** Unloading;

f1) Discharging; **g1)** Consolidation; **h1)** Distribution; **i1)** Break bulk
Cargo Related (On shore)
a2) Stevedoring; **b2)** Storage; **c2)** Reception; **d2)** Crane operations; **e2)** Getting cargo on the road; **f2)** Getting the right road connection**.**
Cargo Related (On Ship)
a3) Delivery**; b3**) Receipt**;**
PEOPLE INVOLVED
a4) Stevedores**; b4**) Cargo Supervisors**; c4**) People who work for commercial aspects**;**
DRIVERS
a5) The way you discharge your ship; **b5**) Commercial objectives; **c5**) All that makes commerce work; **d5**) Essence of trade; **e5**) Environmental benefit by taking cars off the road

Table 4.6: Maritime Operations defined
Source: Author

4.5 Significance of findings

Prior literature focused on the aspect of mitigating environmental impacts without being able to identify the exact causes in some cases. One of the reasons that could be attributed to that was the lack of knowledge of the operations that keep ports operational and open for business. The categorisation of these operations allows determining the remit of operations that need safeguarding to assist ports become more sustainable. Generally, assessment of environmental impacts can be very resource intensive and failure to do so in some cases may hinder commercial development and carry legislative consequences. However, looking at the overall aspects that underpin port sustainability which include, but is not specific to EM, could help to safeguard commercial activities of ports and sustain their commercial viability as businesses for the future, which generate on-going socio-economic benefits for the local region. In their current form, many port EMSs have been created by environmentalists as standalone systems under pressure from stakeholders to address issues relating to environmental impacts of port operation, rather than creating a system for managing sustainability which contains a vehicle for EM within. A methodology based on examining the components that underpin port profitability i.e. MOs and how they affect sustainable development offers a clear overview of port aspects that need to be safeguarded to sustain the port and the local community despite economic uncertainty and mounting legislative pressures.

Using the data in table 4.6 this project aimed to create a generic PSMS for ports in CAD to assist HMs in proactively addressing issues that could threaten port sustainability, including environmental impacts of operations. The list of MOs illustrates the diversity of ports and with that, the diversity of aspects that underpin port sustainability. Instead of reacting to issues and having to deal with consequences and bad press as a result, the idea behind PSMS is to use knowledge as a mechanism for sustainability and EM. Table 4.6 forms the first part of that knowledge by identifying the terms of references that small ports and local port communities need to safeguard. The later chapters will present the evolution of port sustainability knowledge that was combined into PSMS and has undergone industry testing to verify the findings.

A potential criticism of the approach presented in section 4.4 might relate to the small sample of sources used. Small ports are a neglected area of research, as most academic efforts focus on larger entities which constantly strive for increased commercial and environmental efficiency. Having searched 4000 sources, a sample of only 23 relevant sources testifies to the neglect of maritime operations as a concept. However, despite the limited availability of secondary data, a significant amount of rich primary data has been collected from a sample of HMs and their colleagues.

This chapter presents a systematic exploratory study which focuses on discovering the maximum number of new generalisations based on direct understanding of ports and their operations (Stebbins, 2008:327). An important facet of exploratory research pertains to a requirement to understand what to look for, which demands a methodical and systematic search for it (ibid). Flexibility is required to accommodate various extracts of literature, coupled with open-mindedness regarding their quality and relevance to the task in hand. Deductive thinking and application of inductively based categories have provided structure and laid down the foundation for future pattern analysis to take place, which later incorporated the views of industry, academics and governing bodies. High agreement between coders, as tested using statistical indices, implies a comprehensive and clear taxonomy that incorporates various aspects related to port, marine and MO, which was combined together with the industry views to define maritime operations. MO identified in this chapter will underpin the creation of PSMS to assist proactive management of sustainability issues and development within smaller ports.

4.6 Conclusion

This chapter illustrated the use of ECA to conceptualise existing views of literature towards MO. The technique proved to be effective for the purpose at hand, and high reliability coefficients between coders underpins the rigorous and systematic structure of the taxonomy. The definition offered presents a basis for building a system for sustainable port management and development, engaging many communities and businesses whose livelihood depends on the sustainability of local ports, commercial development of communities, and hinterland investments of international supply chains. The taxonomy of MO as created from primary and secondary data has helped to underline the vast differences between ports and their operations; and will be used to create new discourse on sustainability inclusive of port's size, scope of operations and income levels. Longer term, the taxonomy is likely to assist ports in different jurisdictions to focus on commercial activities and to benefit from integrating EM with other port management and logistical functions into an overall sustainability management system.

The next chapter will present the evolution of thinking and understanding of what constitutes port sustainability. TFs will be used to illustrate different stages of research, where issues that underpin sustainability have evolved from the grouping of operations at the start of the project, to separation of sustainability themes and challenges under a single model as the final TF.

CHAPTER 5: THEORETICAL FRAMEWORK

5.1 Introduction

This chapter presents an evolution of thinking about the nature of the research problem which is presented in the form of theoretical frameworks (TF). The rationale behind choosing TF over a conceptual model is explained in order to conceptualise the nature of the research problem. Next, additional differences between smaller ports in CAD are outlined ahead of a detailed explanation of six TFs that have been created. Some TFs outlined in this chapter were only ideas that were left as such; however each figure has contributed towards the creation of the final TF that was used as the foundation for PSMS that has undergone industry testing.

5.2 Defining conceptual model and theoretical frameworks

Kitchin and Tate (2000:33) described a conceptual model as a “diagrammatic version of a theory which demonstrates processes, concepts and relationships”. A conceptual model was referred to as a theoretical framework (TF) by Sekaran (2003:29) saying that it combines “all factors contributing to the problem”, which depicts how one imagines or makes sense of the interactions between several factors important to the research problem. Semantics aside, both sources identified a way of seeing all pertinent factors in one place using a visual representation. Miles and Huberman (1994:18) added that frameworks can be “rudimentary or elaborate, theory driven or commonsensical, descriptive or casual”. Anfara (2008:869) described a TF as “any empirical process…, at a variety of levels that can be applied to the understanding of the phenomena". Between these four academic opinions, subtle differences emerged between a conceptual model and a TF, namely the demonstration of relationships versus making sense of interactions and understanding the phenomena. It is not always possible to demonstrate relationships between certain factors to a high degree of accuracy, since some relationships can occur as an aftermath and might not affect all ports which are in a similar situation. For instance, an oil spill in an environmentally sensitive estuary-based port would have a different cause and effect than a similar size oil spill in a busy commercial port on an engineered coastline. If an oil spill is taken as an effect, the causality of this impact can have multiple origins and depending on the port governance type, income streams, level of stakeholder activity, etc., any one of these and other factors can influence the flow of processes and relationships. Therefore, a descriptive representation of the contributing factors with the aim of understanding the phenomena during different stages in the research process would be a more appropriate way of abstracting the research problem using a TF instead of a conceptual model.

5.2.1 Concept and conceptualisation

Whether illustrating relationships, summarising vast amounts of data on several pages or graphically depicting multiple levels of interactions, conceptualisation is essential to move from theory to abstraction. The process of conceptualisation was identified as "coming to an agreement about what the terms mean" within a particular research, whereby unclear notions i.e. concepts are made more precise (Babbie, 2008:136). By summarising groups of apparently linked observations and experiences, one begins to formulate a conception (ibid). Once formulated, a concept then represents a "construct which is derived by mutual agreement from our conception" (ibid:135).

Three types of concepts have been noted by Babbie (2009) whilst reflecting on the work of Kaplan (1964) which identified different dimensions measured by social scientists. *Direct observables* relate to things that can be observed directly, e.g. physical characteristics of something or someone (Babbie, 2009). *Indirect observables* require "relatively more subtle, complex, or indirect observations" (Kaplan, 1964:55). Dimensions and characteristics of someone or something as being indicated on a questionnaire or conveyed without directly observing the phenomena in person are examples in this category. *Constructs* are "theoretical creations that are based on observations, but cannot be observed directly or indirectly" (Babbie, 2009:129). Concepts were defined as a "family of conceptions" by Kaplan (1964:49) and as something we create i.e. a construct.

5.2.2 Moving towards conceptualisation

The chosen methodology for data analysis, specifically GT method by Charmaz (2006) which will be explained later follows a certain set of principles which influence the latter TFs of the research scope and problem. Charmaz (2006:169) argues that the quantitative methods which "invoke an established theory and deduce hypothesis from it before conducting their studies" already have theory in place for their TFs. In contrast to quantitative methods, those using a qualitative approach and GT have their TFs and supporting arguments emerge from their analysis (ibid). Since it is possible to see the same data analysis and extract different messages from it, the TF within the GT method “locates the specific argument that you make” (ibid:169).

5.3 Research paradigm and data analysis technique

Within a social constructivist paradigm, reality is based on the perceptions and interpretations of social actors. All data are considered to be data, even if it is missing, or does not conform to the standard answer expected. To avoid forcing a pre-conceived view of prior literature on the interviews and seeing the data through a lens of earlier research, it has been advocated by classic grounded theorists i.e. Glaser and Strauss (1967), Glaser (1978) to delay reviewing literature until after finalising your analysis (Charmaz, 2006). Looking from a positivist’s perspective, the rationale of prior literature influencing the utter truth that positivists seek in their research approach can be justified; hence the stance of not reviewing prior work until completing your analysis was advocated by the creators of GT. Despite Glaser and Strauss having a radical stance on preconceptions formed by existing literature in *The Discovery of Grounded Theory* (1967); Strauss and Corbin (1990:48) explain their stance by saying “we all bring to the inquiry a considerable background in professional and disciplinary literature”. Glaser (1992, 1998) continues to infer that to avoid contaminating their views, grounded theorists should stay away from existing ideas. However, in *Theoretical Sensitivity* (1978:72) he writes “it is necessary for the grounded theorists to know many theoretical codes in order to be sensitive to rendering explicitly the subtleties of the relationship in his data". An important argument was raised by Charmaz (2006) regarding this last quote by questioning the origins of those "many codes" if they haven't become part of our collection of ideas and knowledge. Between his works in 1967, 1978, 1992, 1998, Glaser starts off saying that scholars should avoid seeing the problem through a lens of earlier ideas, and then he says that to be sensitive the grounded theorist must know many codes, which is then followed by an argument that grounded theorists should keep themselves uncontaminated by previous ideas. It is unsurprising that many authors have disagreed with the view of Glaser regarding reviewing prior literature, because he disagrees with himself on the subject matter. To conclude this argument, Charmaz (2006:165) argued that not only novice researchers can become fascinated by prior work and have their ideas influenced and that established scholars may "become enamoured with their own". By delaying review of existing literature, some grounded theorists ended up writing a careless, or an insufficient coverage of the subject area (ibid). Requirements for writing research proposals or applying for research grants would probably lead a researcher to explore their chosen field in detail before commencing the study. Charmaz (2006) stressed that reviewing literature can help set the stage for what a researcher is going to address in the chapters to follow; to analyse the most significant works concerning the issues now developed within your GT.

By constructing the meaning of reality following a constructivist research paradigm, prior literature was used to set the scene, to define the terms of reference, and to identify the scope. TFs were created to compare views of both, literature and practitioners to use a combined view which would underpin the development of PSMS. The creation of TFs took place at specific intervals during the research project, namely at the very beginning, after a literature review, prior to data collection, during and after data collection and analysis. A total of six frameworks illustrate the evolution of thinking and understanding of the research problem and each one has contributed towards the creation of the final version of PSMS in chapter 9.

5.4 Difference between smaller ports in Cornwall and Devon

Before presenting the evolution of thinking, it is important to briefly illustrate the diversity of ports in CAD from the governance perspective on the local and county levels. Being predominantly dominated by municipal and trust ports, the ports sector differs between Cornwall and Devon, let alone if compared to ports at national or EU levels. As discovered during data collection, municipal ports in Cornwall are run by a unitary governance authority which includes ports as one of its public sectors and is run centrally by a maritime manager. Some ports under the centralised Cornwall Council management structure, namely Truro, Penryn and Newquay have been accredited with the ISO14001 system, and considering that Newquay was added to the ISO 14001 system of ports of Truro and Penryn, the trend is to gradually include other municipal ports under the centrally managed EMS. The location of Cornwall municipal ports was illustrated on the map of CAD ports in section 3.1 in chapter 3.

Within Devon county, municipal ports are divided between local and unitary authorities. Figure 5.1 below illustrates the location of ports and local and unitary authority boundaries within Devon County. Torridge, North Devon, South Hams, Exeter City and East Devon local authorities have responsibilities for ports within their areas. Within the local authority areas, public infrastructure such as roads, schools and healthcare is managed by the Devon County Council (Interview with DCC, 2012). Two statutory authorities independent of Devon County Council that have only geographical association with Devon are Plymouth and Torbay. There are no municipal ports in Plymouth, but Torbay is home to three ports, one of which, namely Brixham, is the most important fishing port in England and Wales.

Figure 5.1: Map of municipal ports in Devon County

Source: Author

Coupled with operational, locational and environmental differences that have been discovered between smaller ports, this section demonstrates another level of influencing factors i.e. governance. Whilst all municipal ports in

Cornwall County work as one group and are managed by a maritime manager, each municipal port in Devon County operates very differently and belongs to an owning authority, each with an individual view and agenda and can result in varying levels of infrastructure quality, unavailability of funds due to joint accounts and a lack of development strategy as a result. Variance in the way the same port governance models were governed on the local level indicated that PSMS had to be inclusive of every type of IT infrastructure, be easy to use and affordable for ports operating on minimal profit margins.

The remainder of this chapter will present TFs that will explore the evolution of the research scope and problem understanding during a particular time. Although most concepts are based on indirect observables, e.g. impact of governance on profitability, impact of policy, etc.; a number of direct observables such as port traffic, air and water cleanliness, port size and infrastructure, and others have been combined into forming constructs that underpinned the creation of the final version of PSMS and the scope of the research problem.

5.5 Theoretical evolution of port sustainability

5.5.1 Initial stage

In order to fulfil the aim and objectives and create a generic system for smaller ports that would assist them with sustainability management and unlock commercial benefits, identifying the terms of reference that were common in all the ports was an essential starting point. Chapter four detailed the specifics of how exactly this development took place, however it does not show the full scope of thinking at that time.

TF1 below is a graphical representation of interlinked elements within the scope of maritime and port operations. This TF was date stamped the 26th of October 2011, three weeks after the start of the project. The task then was to verify and to update the definition of MO using academic and industry literature, and specifically the definition provided by Dinwoodie et al. (2012:111), that “maritime operations span all routine procedures which a ship must undergo whilst in port to operate efficiently, including anchoring, marine fuel bunkering and ballast water exchange”. TF1 illustrates initial thinking that was driven by identifying other MO and finding connections with port operations. Taking Piloting for example, it is listed under both port and maritime operations. On the port operations side the logic was that Piloting might be required depending on the size of vessel to coming in to allow for safe anchoring and berthing. Working off the definition provided by Dinwoodie et al, the routine element would not be present if not every vessel requires pilotage to come into port, therefore making it a non-routine operation. In contrast to that, bringing in cruise ships and super yachts into small ports would most likely require pilotage because of their size and draught requirements, making pilotage in this case both, a routine and a maritime operation.

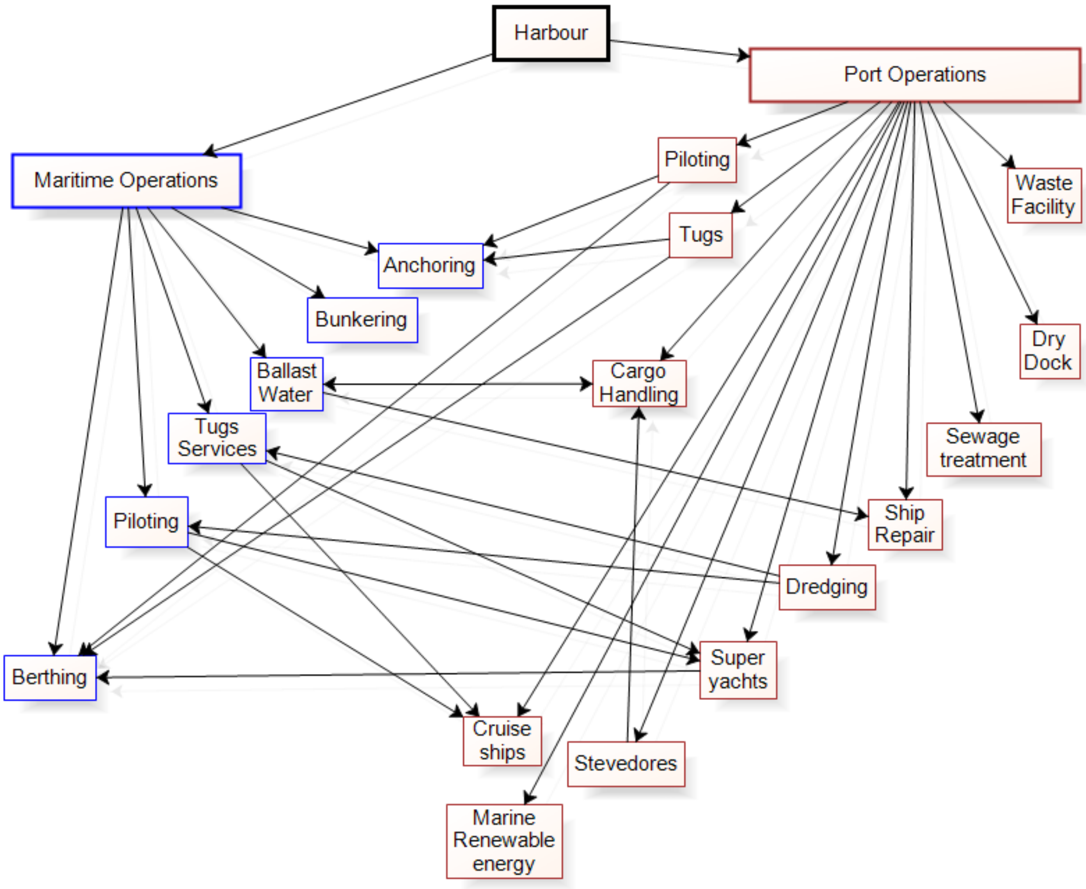


Figure 5.2: TF1: Defining maritime operations
Source: Author

The concept of some operations being both, maritime and port, as demonstrated above using the example of pilotage has been the catalyst for further research to establish the exact scope of MOs based on the available literature.

5.5.2 Scoping stage

After providing a preliminary definition of MO based on academic literature which was explained in chapter 4, the next stage of research was to conduct scoping interviews to get a better understanding of how small ports are run.

As a business partner of the project, FHC invited the author to spend 5 days working from the port and during that time to interview a number of employees. The main goal of the scoping study was to compare the views of academic literature and practitioners regarding certain sustainability needs of ports. TF2 represents a conceptualisation of components that form FHC Integrated Management System (IMS) that was developed as a result of the KTP. This TF consists of several levels, namely influencing factors on the top, components of the IMS on the middle, and relevance of these components to a particular operation. The top row of TF2, i.e. political, stakeholder and legislation are drivers that feed into the IMS using a top down approach and provide the drivers for the system to work. An example of bunkering was demonstrated and how all four elements, specifically PMSC, quality (QMS), health and safety (H&S) and EMS were relevant to any given operations. In the case of bunkering, the H&S system monitors the safety of FHC employees that are taking part in this operation (responsibility for other workers lies with their own employer), EMS related to environmental controls in place for the safe delivery of operations. On the marine safety side, i.e. PMSC, a regular assessment of ships and their operations is carried out. Lastly the repeatability and the way marine safety is assessed falls under a quality standard (QMS) within the organisation. Interestingly, not all of these components (QMS, PMSC, EMS, H&S) have an equal weighting for every operation, however all activities fall under this system.

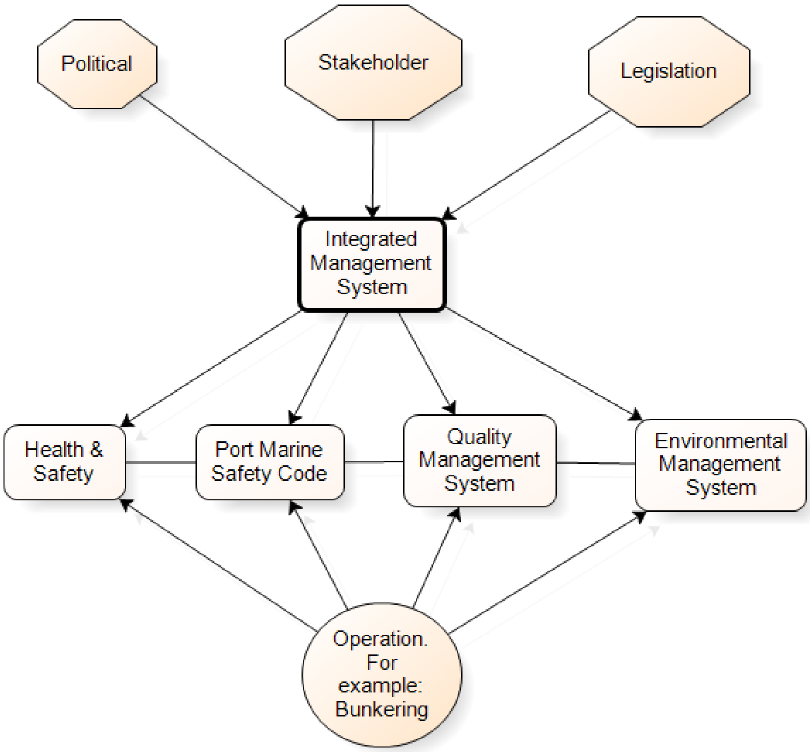


Figure 5.3: TF2: Components of an integrated management system
Source: Author; FHC

TF2 has added additional dimensions to the author's view of port sustainability which extended beyond maritime operations. Key themes that contributed to shaping a deeper understanding of port issues were the influencing forces that affected ports and their operations which became catalysts for environmental and sustainable initiatives. Although a very comprehensive approach, the concept of IMS is not transferable to other ports in a generic format, and for successful implementation has to be created in-house and tailored to a particular organisation as demonstrated by FHC.

A new concept was discovered during a scoping study, specifically managing environmental impacts through safety. Looking at TF2, the four components on the middle level all represent equal importance to the organisation as a whole, but as previously mentioned have different weighting when looking at a particular operation. For example, having a potential for a greater environmental impact and, as a result more severe consequences for port sustainability; PMSC and EMS have higher importance than QMS and H&S systems when it comes to managing maritime and marine operations within the port aegis (see TF2).

5.5.3 Managing environmental impacts through safety

This next TF was based on the view stemming from the previous section about managing environmental impacts through effective safety management system. MOs were identified by DfT as “moving, berthing and unberthing of ships and other marine craft within the limits and approaches of a harbour authority” (DfT, 2012:4). Following the scoping study, marine functions were identified as safety orientated by the practitioners. Following the example demonstrated in TF1 about one operation fitting into more than one group of operations; the same principle was applied to TF3 to see how many operations can have both, safety and commercial functions.

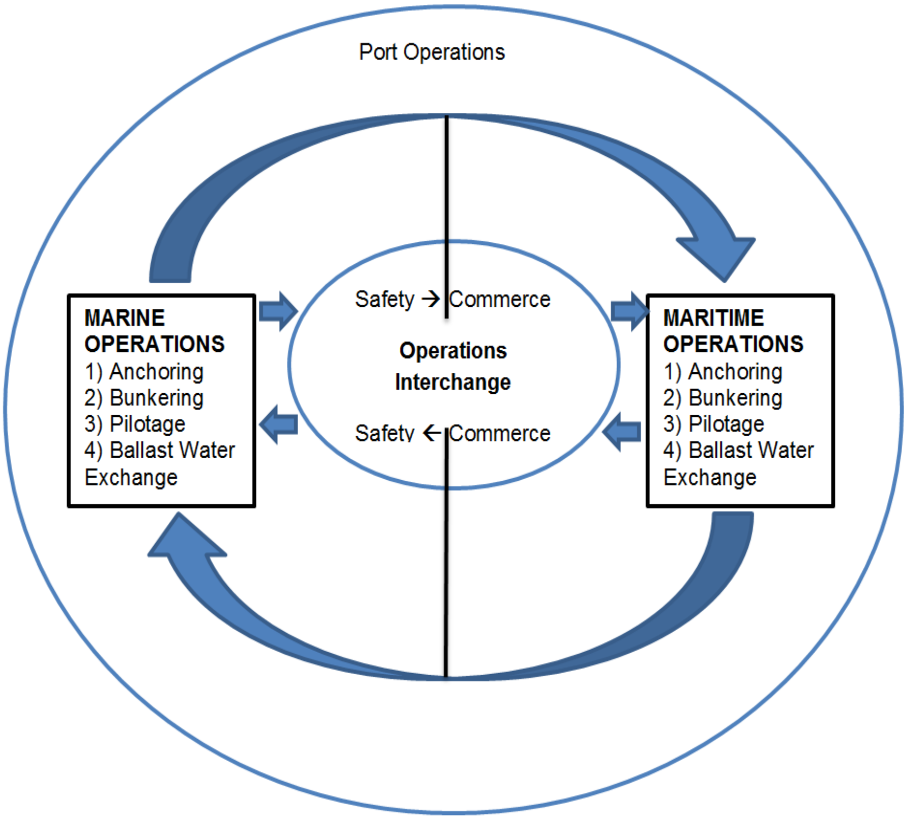


Figure 5.4: TF3: Operations interchange
Source: Author

Marine Function	No	Operation	Maritime Function
Safety for vessels and HA, environmental control	1	Anchoring	Revenue to the HA
Vessels need fuel to sail → a vessel without fuel is a hazard	2	Bunkering	Revenue to the HA
Safe navigation in the Harbour	3	Pilotage	Revenue to the HA
Ship stability → increases vessel safety and reduces risk of pollution	4	Ballast water exchange	Less ballast water → lighter ships → faster speed → cheaper

Table 5.1: Operational Functions based on TF

Source: Author

The idea behind TF3 is that if a port was able to establish an exact location of the operation in a safety/commercial cycle represented in the TF3 graph, namely whether it is still *a safety* function, e.g. a vessel which is on its way to arrive at the anchoring zone, has moved into the *operations interchange* area, e.g. the vessel has safely arrived in to the anchoring zone; or the *commercial function* where the vessel has anchored and the HA started to charge that vessel anchoring fee; the port would then be able to have a better understanding of the cost of a mistake, and potentially how much resources does an operation require at which point in the cycle for maximum efficiency. This idea did not mature further due to complex calculations required and extensive testing of such theory, which would have extended beyond the scope of this project. TF3 has provided a view that identifying with an utmost certainty which operations are marine, maritime and port can be difficult due to multiple functions and dimension that some operations possess and that a higher level conceptualisation of the research problem was required for successful creation of PSMS.

5.5.4 Maritime operation – essence of trade

The concept of operations having multiple dimensions in TF3 has been an influencing factor to start thinking about external influences and expectations, and to focus on commercial operations. Multiple views regarding sustainability and EM have emerged during data collection, several of which suggested they perceived MOs to be commercial by nature, and wanting to undertake environmental initiatives, but being worried about the cost of it and the impact on port sustainability. With that view in mind, TF4 below illustrates four pressures relating to port sustainability that have to be addressed by the HM. Several new operations such as winter stowage, where leisure vessels are lifted out for the winter; vessel services where ports provide service to clean vessel hulls have been identified; and moorings which are fixed locations for leisure craft to tie up to whilst stationary have been added to the list of previously identified commercial sources of revenue. Working off the model of triple bottom line which the ports industry uses and adding up the element of safety, TF4 combines interview observations with several industry practitioners together with an evolving view of port sustainability.

Influence of previous TFs can be traced to TF4, specifically TF3 identifies safety as an imperative dimension of all operations taking place within port aegis which was promoted to a sustainability pressure in TF4. The rationale here was that if the harbour is not safe or an incident occurs due to the lack of safety measures in place, the cost of making things right can bankrupt an organisation, making it arguably the “foundation” of port sustainability. TF2 provided a view of external pressures and varied levels of importance of different types of systems for each individual operation. No individual relationships and levels of pressure from the four sustainability factors established so far were illustrated in TF4 to avoid imposing authors views based on a number of interviews compared to decades of experience that the interview participants possessed. Overlap and complexity and interdependence of operations were outlined in TF1 which influenced the structure of TF4, specifically not grouping operations into port and maritime, but into those that bring income to the HA and pressures that need to be addressed to safeguard these revenue streams and remain operational.

The idea behind TF4 was to summarise the main sources of revenue that ports in CAD had, to establish a better visual representation of those operations that need safeguarding. Not every harbour would engage with all nine categories of operations outlined in TF4. Dredging, although represents a big cost for the HA, is essential to allow safe navigation of vessels that would ultimately result in relevant fees and dues for the HA. The reason dredging was included as a commercial operation is because it follows the fundamental business principle of investing to get a higher return.

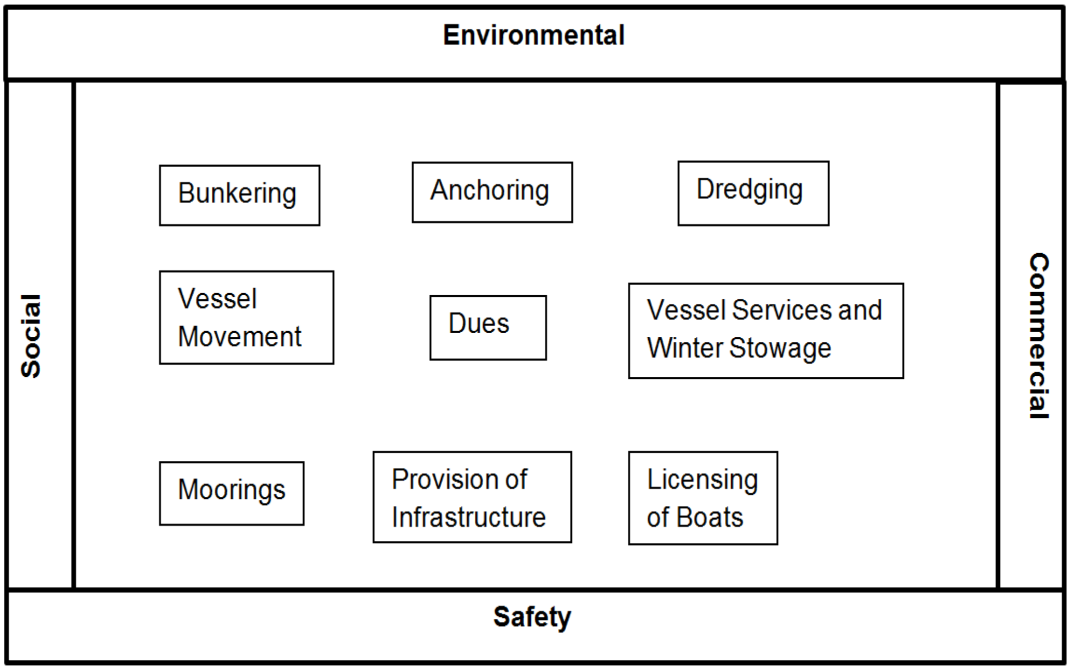


Figure 5.5: TF4: Commercial maritime operations
Source: Author

5.5.5 Sustainability themes from preliminary interview coding

The biggest shift in thinking took place between TF4, which was based predominantly on the results from the scoping studies and first several interviews of the main data collection stage; and TF5 that was created at the end of main data collection phase. Chapter 7 will outline coding stages in depth and the reasons behind each of them. Two additional dimensions of sustainability are incorporated into TF5 which were identified from the interviews conducted. Arrows in TF5 represent only some of the relationships identified from data collection; however two of the most important links in TF5 are those between *sustainability* and *governance* and *achieving change.*

As old institutions, many of smaller ports in CAD have existed for centuries and have strong community traditions that have been passed down for generations. One such tradition was not to see major development and big scale changes taking place. Without being able to develop their businesses further, i.e. develop infrastructure, facilitate investments, and diversify product streams; smaller ports in CAD can find profitability to be a challenge.

Being run predominantly for the benefit of stakeholders and local communities, CAD consists mostly of trust and municipal ports, with only several private ports present in these two counties. Trust ports' management boards consist of local people who represent community's interest in the port, and if that interest is the status quo, then that would most likely be their decision for the strategy of that port. Municipal ports are run by a board consisting of council employees, who also would not go against the wishes of their respected communities and might also oppose change.

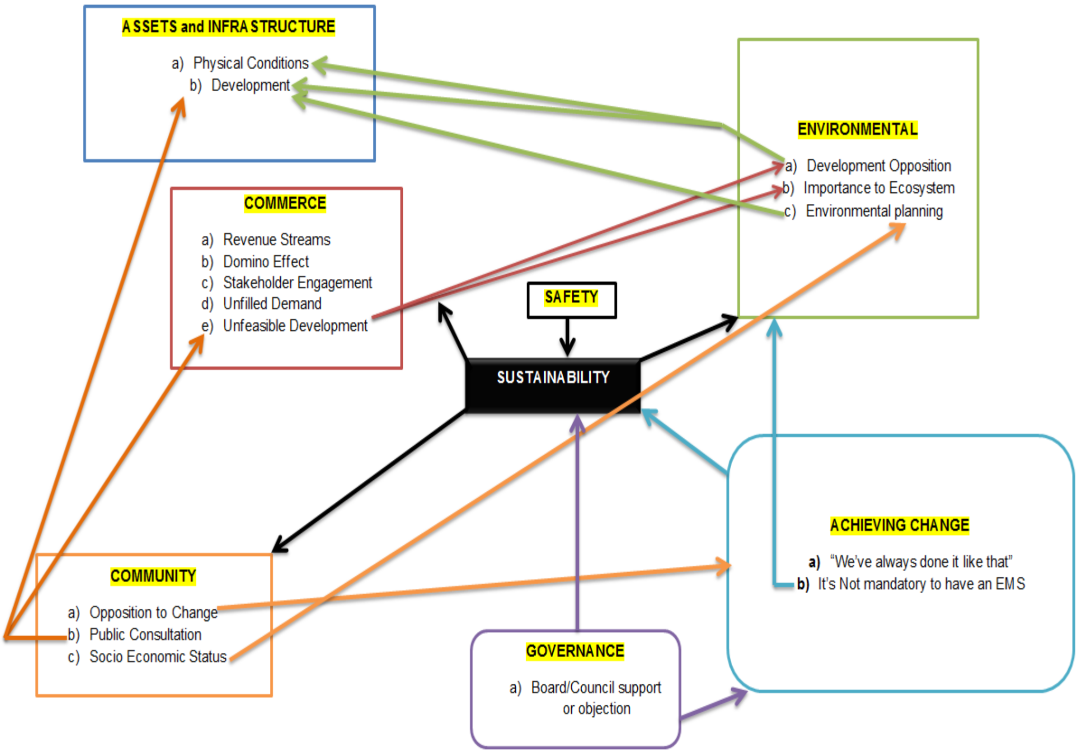


Figure 5.6: TF5: Preliminary sustainability components
Source: Author

5.5.6 Eleven components of port sustainability

TF6 is the final conceptualisation of the research project after completing data analysis and several testing stages of preliminary output models. Two year collaboration with local HMs has illustrated the differences between MOs, which makes them not suitable for a practical PSMS because of the differences discovered e.g. bunkering processes vary between ports. Bunkering can be on a small leisure scale or large commercial scale; however the processes involved in refuelling vessels differs considerably. Bunkering for leisure craft can be from a floating barge, from a fuel tank hidden from sight inside port structures, from a special vessel or might not be provided at all. Depending on environmental designations of the port area and types of fuel supplied, different emergency response protocols, levels of risk and infrastructure would be required for these operations which fall under the umbrella of bunkering. A number of other MO also exhibit noticeable differences when compared between ports.

Because of so much variance within MOs, basing PSMS on them would have been impractical and would have required immediate local adaptation. Instead, during data analysis a number of themes have started to emerge which explained various port issues related to sustainability, rather than delving into the specifics of particular operations. Having started with MOs as being the terms of reference, the next phase of evolution in thinking was to switch from looking at operations to themes that underpinned them i.e. a higher level of abstraction. Chapter 7 will explain the evolution of these themes in detail, however a brief overview will be provided for the purposes of this chapter.

When using grounded theory to code qualitative data, *initial coding* is the first step, whereby a researcher aims to explore any theoretical possibilities by remaining open and using processes to code the data; and *focused coding* where researcher uses “the most significant and/or frequent codes to silt through the large amounts of data” (Charmaz, 2006:57). The process of exploring data with initial coding, and finding the most significant concepts with focused coding has made it possible to capture and summarise issues outlined during various phases of data collection relating to port sustainability.

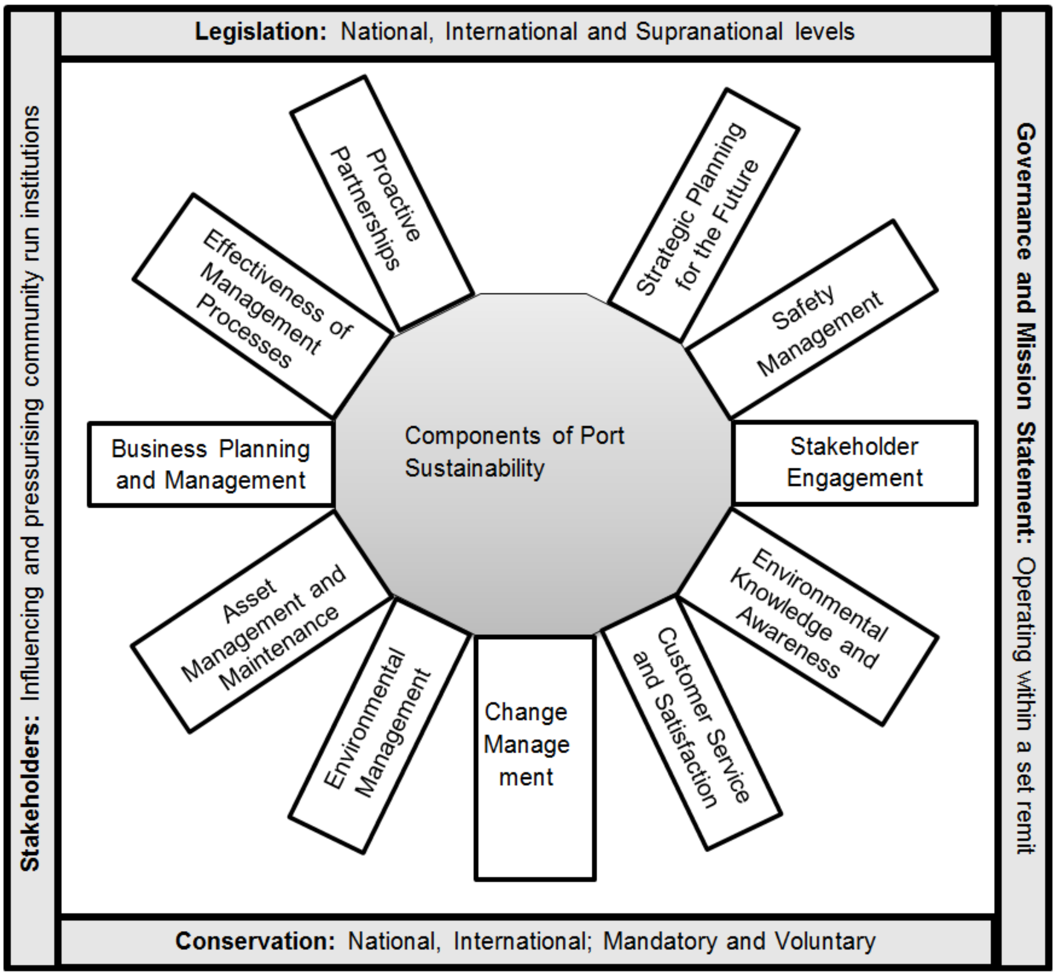


Figure 5.7: TF6: 11 Components of port sustainability
Source: Author

TF6 builds on the idea behind TF5 which was to identify additional components of port sustainability and combines 11 themes of sustainability which are equally important for ports to be sustainable, and can be individually applied to most port, marine and maritime operations taking place within the port aegis. The final version of PSMS incorporates the 11 themes presented in TF6 and the evolution of PSMS is explained in chapter 9. Four pressures and influences have also been identified, namely governance, conservation, stakeholders and legislation which affect various elements of port management and require ports to strive towards sustainability. These four pressures are often the causes why some ports have adopted a reactive approach to sustainability as a result of addressing the most prominent issue at the time rather than proactively planning ahead. The smaller ports industry follows the view of sustainability using the TBL approach, which is a very generic overview and lacks industry specifics to answer research objectives 1,2,3 and 4, i.e. to categorise requirements for environmental planning, asses sustainable development needs, synthesise how ports manage environmental sustainability, and assess attitudes of HMs to PSMS. TF6 provides a comprehensive overview of the research problem which was used to develop and test the final version of PSMS for small ports in CAD.

5.6 Conclusion

This chapter is intended to design a theoretical framework of smaller port sustainability in CAD. It follows an evolutionary process of the project whereby using a constructivist approach more components of port sustainability have been discovered which was illustrated in the TFs presented above. The original idea to use MOs as terms of reference for a practical PSMS would have taken the generic element away and made it specific. Instead the research design continued on the idea of sustainability themes and influencing factors that underpinned MOs, and when combined, provided a comprehensive overview of sustainability aspects of smaller ports. The next chapter provides a detailed overview of the research methodology used, including more background on ECA which was explained in chapter 4. The exact process of conducting GT analysis was excluded from the methodology chapter, and is contained in a separate chapter that is dedicated to the use of GT i.e. chapter 7.

CHAPTER 6: RESEARCH METHODOLOGY

This chapter details the selected research methodology and provides justification for its use and relevance. It begins by identifying research paradigms, approaches and methods used in this research and establishing a link between epistemological stances and methods of qualitative research. The second half of the chapter discusses issues relating to ethical considerations, stages of data collection and theoretical grounding for conducting applied research and criteria for proposing a PSMS.

6.1. Research paradigms

A research paradigm has been defined as a "way of examining social phenomena from which particular understandings of these phenomena can be gained and explanations attempted" (Saunders et al., 2012:140-141). Paradigms determine "how members of the research community view both the phenomena their particular community studies and the research method that should be employed to study those phenomena" (Donmoyer, 2008:591).

Both the concept and the word pragmatism can be traced back to the 19th century (McCaslin, 2008). The fundamental idea of this paradigm is the nature of truth and that the truth "is relative to the current situation" (ibid:672). Pragmatists identify that there is no single point that is capable of representing the entire picture and that there are multiple ways of exploring and interpreting multiple realities of the world (Saunders et al., 2012). Emile Durkheim (1983) put forward two statements that capture well the essence of this paradigm: 1) “Truth changes over time because reality changes”, and 2) “Truth changes through space because people have different ideas” (cited in McCaslin, 2008).

Positivists prefer dealing with an “observable reality” where they can look for inconsistencies and “causal relationships” in the data in order to formulate almost scientific overviews (Saunders et al., 2012: 134). Paley (2008:650) suggested that there is “no single thesis that counts as positivism and no single criteria that defines it”. In his view, some claims of positivism can be related to other paradigms while others cannot (ibid).

Constructivism or interpretivism highlights the need to understand the variance between “humans in our role as social actors” (Saunders et al., 2012:137). The term “social actor” refers to the interpretation of the meaning of the daily activities that people undertake (ibid). The main shift of focus in this paradigm is from explaining to understanding a phenomenon (Costantino, 2008). In this case the researcher “co-constructs” his or her understanding “with that of the participant through their mutual interaction” within the research setting (ibid:119).

This research combined elements of pragmatism and interpretivism. The ontological assumption or the nature of reality - was closer to an interpretivist paradigm by being subjective and socially constructed (Saunders et al., 2012). Small ports in CAD are dependent on many variables such as governance type, environmental status of the area, available draught, road networks, varying levels of pressure from stakeholder groups and others, so the only way to understand the reality was to see it as being based on experiences and interpretations of individual HMs, rather than try to seek out the truth. Following that ontological assumption, getting different answers to the same questions yields rich data, rather than incorrect data (Saunders et al., 2012). Epistemologically, focusing on “practical applied research” and on the “reality behind the details” were the views that constituted acceptable knowledge in this project and capture elements of both, pragmatism and interpretivism (ibid: 140).

6.2 Research methods

6.2.1 Origins of grounded theory

GT is a set of flexible and systematic guidelines for collecting and analysing qualitative data in order to be able to construct theories which are “grounded” in the data (Charmaz, 2006:2). Having been developed in the 1960s by Glaser and Strauss, over the last three decades, GT has been divided into Glaserian and Straussian schools, with researchers choosing sides (LaRossa, 2005). With an addition of Juliet Corbin just over two decades after the first publication by Glaser and Straus in 1967, between the three of them, seven methodologies have been produced, which were very much alike in terms of data gathering, coding, categorising and comparison; theoretical sampling and development of a core category along with theory generation; however the differences are found in ways these processes are performed (Walker and Myrick, 2006). Another methodology was developed in 2006 by Kathy Charmaz, who learned GT from Glaser’s graduate seminars and collaborated with Strauss as her dissertation chair, bringing the total number of methodologies to eight (Charmaz, 2006).

Differences

At its outset, GT had combined the epistemological views of the schools of its creators – Columbia school of positivism, Chicago school of pragmatism; and field research (Charmaz, 2006). Glaser's intent to organise qualitative research, the logic of GT, systematic approach and epistemological assumptions of GT stem back from his quantitative training at Columbia University (Charmaz 2006). Glaser's background and training has instilled GT with "dispassionate empiricism, rigorous codified methods, emphasis on emergent discoveries, and its somewhat ambiguous specialized language" which resembles quantitative methods (ibid:7). Strauss's schools tradition has also influenced his views (ibid). He perceived people to be "active agents in their lives and in their worlds rather than as passive recipients of a larger social force" (ibid:7). To Strauss, social and subjective meanings have "emerged through action" and were dependant on the use of language (ibid:7). The contribution of Strauss's pragmatist epistemological views to GT were the notions of "human agency, emergent processes, social and subjective meanings, problem-solving practices, and the open-ended study of action" (ibid:7).

Despite branching out from the same method which was *The Discovery of Grounded Theory (1967)* by Glaser and Strauss, over the decades numerous modifications have been made by the original authors to their pioneering discovery and more methods of GT have emerged since. Attitudes to preconceptions based on prior literature indicate another evolution of the method, when initially Glaser (1978:3) wrote that "the first step of gaining theoretical sensitivity is to enter the research setting with as few predetermined ideas as possible". He also added that "when the theory (generated) seems sufficiently grounded and developed, then we review the literature in the field" (ibid:31). This view of literature has evolved in the later versions of GT (i.e. Glaser,1992; Strauss,1987; Strauss and Corbin 1998) which have recognised the value of studying prior literature, "but also contend that the literature significantly influences coding", potentially without the awareness of the researcher doing it (LaRossa, 2005:850).

Several years after publishing the first edition of the *Basics of Qualitative Research (1990)*, Strauss and Corbin were criticized by Glaser saying that by applying the concepts of axial coding and coding paradigms, the "researcher would force categories on the data instead of allowing the categories to emerge" despite the fact that GT was initially developed as an inductive method of inquiry (Kelle, 2007:202). Walker and Myrick (2006) have investigated the main differences between Glasserian and Straussian methods of GT. According to them, the main difference between Glaser and Strauss is the way that the "processes are carried out", rather than the essence of the meaning of the general processes of GT (ibid:550). Glaser's approach was divided into two main procedures, the first about making comparisons to generate categories and the second required the researcher to use neutral questions for data examination, which along with memos that "document analyst's ideas and coding proceeds, and theoretical sorting, which organises the data and the memos, are the essence of Glaser's method" (ibid:551). Strauss and Corbin also considered asking questions to make comparisons, however they stated that the approach to asking questions and making comparisons "changes with each type of coding" (Strauss and Corbin 1990:62). Strauss and Corbin also suggested that there is more to analysis than just asking questions and making comparisons. "These processes are not labelled as we go along. You have to watch closely to see how we use them" (ibid:63). Whilst Glaser puts constant comparison "central within his analytic coding", Corbin and Strauss have "elevated their use of tools, paradigms and metrics to place above the constant comparative method" (Walker and Myrick, 2006:551).

By working with the data in a sensitive and theoretical way at the same time, a researcher can then achieve theoretical sensitivity (Glaser, 1978). Glaser explained that theoretical sensitivity "refers to the attribute of having insight, the ability to give meaning to data, the capacity to understand and capability to separate the pertinent from what isn't" (ibid:42). In *The Discovery of Grounded Theory*, Glaser and Strauss (1976:46) wrote that theoretical sensitivity is lost when a researcher "commits himself exclusively to one specific preconceived theory for then he becomes doctrinaire [and] can no longer "see around" either his pet theory or any other". Having initially agreed on the importance of theoretical sensitivity, their views have later differed regarding the ways of achieving that goal. To Glaser (1992:50), "what the subjects themselves are saying" ought to open up the data; and that theoretical sensitivity can be reached through "immersion in the data, line by line, comparison by comparison, memo by memo and code by code" (Walker and Myrick, 2006:552). Strauss and Corbin (1990 and 1998) argued that theoretical sensitivity can be achieved by using specific analytical tools, which they have referred to in the 3rd ed. of *The Basics of Qualitative*

Research as "…own strategies for probing data", and that "these are "tried and true" strategies that Straus has used over the years"(Strauss and Corbin, 2008:68). Theoretical sensitivity was then replaced by the term sensitivity in Strauss and Corbin (2008:19) and defined as "the ability to pick up on subtle nuances and cues in the data that infer or point to meaning". Looking back at the evolution of theoretical sensitivity, if a researcher was to give meaning to data and separate what was relevant and what was not, would he/she use only the data that was in front of him/her and continue line by line, code by code, memo by memo comparison until the meaning was eventually revealed from the extant data, or would the same researcher use one or all of 13 analytical tools which Strauss and Corbin (2008) have developed based on Straus's extensive experience of GT? A potential argument for emerging, versus forcing data is reaffirmed again. Strauss (1987:12) said that GT was an "inductive theory" but also that to avoid excluding personal experience and prior studies "from provisional formulation of hypothesis", GT methods include elements of induction, deduction, and verification (cited in Walker and Myrick, 2006:853). This is one of the bigger differences between the processes of carrying out analysis, where on one hand, Glaser is saying that it is all about immersing yourself in data, and on the other end Strauss, and later Strauss and Corbin offer analytical tools and a coding paradigm to make the process more understandable for researchers, which ended up being perceived, and perhaps used by some deductively and data being forced. It is unsurprising that by trying to create a "user-friendly" version of Straus's method of GT and publishing the first edition of the *Basics of Qualitative Research in 1990*, Glaser (1992) has critiqued what has been presented in that book which has eventually lead to formulation of the Straussian and Glaserian schools of thought (Walker and Myrick, 2006: 549).

Coding is a very important practical aspect of doing GT, and the term coding was defined by Glaser(1992:38) as "conceptualizing data by constant comparison of incident with incident, and incident with concept"; as "the process of analysing data" by Strauss and Corbin (1990:61); as "deriving and developing concepts from data" (Strauss and Corbin 2008:65), and as "categorising segments of data with a short name that simultaneously summarizes and accounts for each piece of data; your codes show how you select, separate, and sort data to begin an analytic accounting of them" (Charmaz, 2006:43). Arguably, as a student of both Glaser and Strauss, Charmaz had the benefit of having an overarching view of the whole evolution of GT and to contribute something that was previously missing – a detailed manual of how to use GT. Charmaz (2006:6) wrote "Authors [Glazer and Strauss 1967] told their readers little about how to tackle analysing the piles of collected data". Having read a number of methods of GT, including Glaser and Strauss (1967), Strauss and Corbin (1998 and 2008), clarity of use was missing. For instance, in Strauss and Corbin (2008), description of axial coding takes up roughly 0.5% of space of the whole book, and the rest of that chapter was devoted to memos and methodological notes. Axial coding was defined as "relating concepts/categories to each other" (ibid:198), which is arguably the most difficult point of GT analysis, where you have a "jigsaw puzzle" of codes. For instance, this research project generated approximately 1000 open codes, and with so little explanation of how to proceed with axial coding, Strauss and Corbin's method is unclear for inexperienced GT researchers. Although *The Discovery of Grounded Theory* (1967) was designed for both, novice and experienced researchers, and *The Basics of Qualitative Research* (Strauss and Corbin 1990, 1998, 2008) was supposed to be a user–friendly manual; however, based on the experience of the author in this research project, the validity of that statement of inclusivity can be challenged. The author recommends that those methods be used by intermediate to advanced level researchers.

Listed above are just some examples of changing viewpoints from the creators of GT since its development, which has “turned into a cottage industry” where individuals are pledging allegiance to a particular side (LaRossa, 2005:839). A number of changes have also been identified, some having a more profound impact on the process of analysis than others and thereby confusing the process of doing GT analysis according to Glaser, Strauss, and Strauss and Corbin. The process of using GT will be detailed in chapter 7.

6.3 Research approach

As a highly practical research project which was based around the actual issues of smaller ports and was mainly dependent upon primary data; a number of data collection staged have taken place to obtain missing information and to test prototypes of PSMS. The remainder of this chapter is dedicated to various stages of data collection, systems testing and other issues associated with that.

Whether to use existing theory and a deductive approach to “shape the approach that you adopt to the qualitative research process and to aspects of data analysis", or seek to build up theory that is "adequately grounded in your data" lies the distinction between the two approaches according to Saunders et al (2012:548). For centuries deduction was considered to be a single valid mode of enquiry, and has roots that can be traced back to Aristotle (Shank, 2008). Greek philosophers used deductive reasoning as a method of inquiry which derived implications from the notions that were considered to be true (ibid). With the development of modern science, researchers started to derive implications from premises that were only "empirically (and therefore probably) true" (ibid:208). A deductive approach entails a theory driven project which tests "a clear theoretical position through the collection of data" (Saunders et al, 2012:48). Deduction is not appropriate for this research, because much was unknown about the state of sustainable practices in smaller ports in CAD to generate and test prior theory. During the KTP between FHC and Plymouth University, a systematic approach to managing anchoring and bunkering operations in FHC Harbour Area has been developed which led to the idea of a possible generic sustainability management system which can be applied across the region.

Table 6.1 below outlines the research approach from reviewing literature as phase one to completing testing of PSMS v5 as phase nine. Instead of testing existing theory, new theoretical assumptions have been developed using an inductive approach and tested during initial and second rounds of data collection respectively i.e. phases 3 and 4 in table 6.1 (Saunders et al., 2012). Contrary to deduction, in social science research inductive reasoning can be used to "extend existing theory to a new setting" or "develop an understanding where none currently exist" and qualitative approach works particularly well when applied with inductive reasoning (Fox, 2008:429). Making sense of socially constructed and subjective meanings within a natural setting for research participants to establish trust and gain a deep understanding of the matter at hand represents the essence of a qualitative research philosophy (Saunders et al., 2012).

Phase No.	Details	Dates
1	Literature review	Oct 2011 – Jun 2012
2	ECA + Maritime Operations	Dec 2011 – May 2012
3	Scoping Interviews	Mar 2012 – Apr 2012
4	Main Data collection stage	Aug 2012 – Feb 2013
5	Data analysis using GT	Aug 2012 – May 2013
6	PSMS v 1-4 creation	May 2013 – Jul 2013
7	PSMS v 1-4 testing interviews	Jun 2013 – Jul 2013
8	PSMS v5 creation	Jul 2013 – Aug 2013
9	PSMS v5 industry testing	Oct 2013 – Jan 2014

Table 6.1 Processes and Timing of research

Saunders et al. (2012:164) discussed mixed methods research design as something that may be used to “test a theoretical proposition, followed by further research to develop richer theoretical perspective”. The authors described such research as complex with multiple phases (ibid). After reviewing relevant literature, phase two of this project was to test and update the definition of MO using ECA where mixed methods have been adapted, and concept development and verification were the reason for using this method.

During the later phases of research i.e. phase 4-9; quantitative methods were not used due to the necessity of constructing the reality based on the experiences of expert practitioners through the use of interviews. Doing so using statistical and numerical data would not have been possible to obtain a similar depth and richness of data as was collected using a qualitative approach. Another important factor that prompted to use a qualitative approach during the main data collection was the lack of prior literature and the need for induction to successfully answer research objectives. After PSMS v5 testing has concluded, the results have been presented using graphs to better illustrate the findings. These results will be discussed in chapter 9 and presented in Appendix S.

6.4 Methods of data collection

To analyse how smaller port authorities in CAD manage sustainability aspects, empirical data were gathered through semi-structured interviews with ports and local authority officials to identify the processes of sustainability management that were currently deployed. Additional questions sought to glean what sustainable port development opportunities were available, practitioner attitudes towards PSMS, and any issues pertinent to successful implementation (Table 6.4). The remainder of this section describes how ports were sampled, and the theory building process which was deployed to analyse interviews. The analysis offers a synthesis which highlights the variety of processes which smaller port authorities in CAD currently deploy to manage sustainability. Charmaz (2006:102) defined the logic of theoretical sampling as “constructing tentative ideas about the data, then examining ideas through further empirical inquiry”. A snowball sampling strategy assisted in gaining access to data and in building strong working relationships, starting with a small group of HMs and then using their knowledge, expertise and suggestions of whom to approach next (Saunders et al., 2012). Following initial discussions with one HM the use of snowball sampling generated a twentyfold increase in the number of contacts.

6.4.1 Collecting qualitative data

Since no two ports are the same, creating a very rigid set of questions and trying to standardise the interview process to obtain similar answer was not relevant for this study. Semi-structured interviews were chosen to be able to cover a list of key themes and some key questions, but also to have enough freedom in each interview to pursue particular concepts in more depth (Saunders et al, 2012). The use of semi-structured questions in a situation with lots of unanswered questions was indicated by Easterby-Smith et al., (2008) as the most advantageous method. Note keeping along with recording were suggested by Saunders et al., (2012) to have a number of advantages when used together. Devising probing questions whilst maintaining concentration and having a backup copy if the recording does not work are all benefits of note taking according to Saunders et al., (2012).

Every interview has been recorded to ensure maximum accuracy of information collected during the meetings with HMs. A high quality recorder was used to maximise the chances of isolating correct words when background noise such as telephones, conversations, road traffic, etc. was present. Interviewing HMs at their offices when they were on duty and had to respond to urgent phone calls, a certain amount of contingency planning and flexibility has been incorporated into the preparation process, for instance making a hand written note of precisely what has been said if there was a distinct background noise present that would have been hard to pick up on the recording. Ethical issues are reviewed in detail in section 6.6.

6.4.2 Scoping stage

The initial stage of data collection took place in the form of an exploratory study, the purpose of which was to gain a much better understanding of how small ports are run, and what small ports are. Saunders et al., (2012) refer to such a study as being very useful to help clarify understanding of the problem.

Working in partnership with FHC, the names and location of possible interview participants have been suggested by the HM of Falmouth during the initial meetings before commencing data collection. Time was spent in company to see first-hand how a small port is run. An opportunity was presented to interview employees of FHC in order to gain a much deeper understanding of how each job role was designed to obtain multiple perspectives on how their job contributed towards the sustainability of the harbour. Table 6.2 below represents a summary of scoping stage interview participants between 26-30th of March 2012.

Job Title	Port
Harbour Master	FHC
Deputy Harbour Master	FHC
Assistant Harbour Master: Conservancy	FHC
Assistant Harbour Master: Operations	FHC
Environment Manager	FHC
Leisure Services Manager	FHC
Finance Manager	FHC
Environmental Manager	A&P Falmouth
Harbour Master	Port of Truro

Table 6.2: List of exploratory study participants

A&P Falmouth is a private company that owns Falmouth Docks and Engineering Company (FDEC) and is located at Falmouth Harbour. FDEC is a private port in its own right and is located within the waters of FHC which is a trust port.

Table 6.3 below highlights some of the questions asked during the scoping study to all interview participants. The nature of scoping interviews and of theoretical sampling is to explore concepts in depth and during every interview various concepts were explored which lead to some questions being answered before being asked or being irrelevant.

• **What are you responsible for as a (insert job title)?**
• **As a port, what new business would you like to develop?** o *What are the commercial needs of that new business?* o *What are the environmental requirements of it?*
• **Would you like to handle any other/new commodities?** o What is stopping you from doing it?
• **What is your perception of having a PSMS?** o *What would the PSMS need to do in order to be useful for your port?* o *In what form would a new port system be beneficial to achieving aims? Something to help manage the environment, or the general day to day running of the Port?* o *What is your current position on CSR and Ethics?*
• **Who are your key stakeholders?**
• **Have you got an EMS** o *How do you manage your sustainability system?* o *What are your environmental responsibilities? Who manages them?* o *What commercial opportunities are being underdeveloped?*

Table 6.3: Exploratory study prompt sheet

6.4.3 Main data collection phase

The main data collection phase commenced in late August 2012 after having gained significant understanding of port operations, daily issues and attitudes towards PSMS.

Semi-structured interviews with all participants commenced as shown on the prompt sheet (Table 6.4), but depending on the answers received, the ordering of questions was varied to allow each conversation to take its course and flow naturally to allow more data to emerge.

Interview prompt sheet for HM
1) Which port authority / administration are you working for or responsible for? a. What is your role in the port/ administration?
2) What do you understand by the term maritime operations in the context of your port authority? a. Please give me a few examples of the main operations in your port(s)?
3) What are the potential environmental impacts of maritime operations in your port? a. What are the requirements for environmental planning in your port(s)? b. What are your main current port development plans? c. What are the potential environmental impacts of these developments plans (in your port)?
4) Describe the process you currently employ for managing the environmental impacts of maritime operations in your authority
5) Describe the process you currently employ for managing the environmental impacts of port development plans in your authority a. Do you currently have an EMS? b. When was the system formulated; why was it formulated; describe the process of formulating and implementing (e.g. internally created (by whom), or have consultants been involved (whom, how long did it take, cost) c. Technical - What is the format of the system? (Excel, Access, software…?) d. When was it implemented? Does it represent a cost, or do you see a return on the investment? What was the set up cost / maintenance fee…? e. Who does what in terms of managing safe navigation and environmental impacts? f. What is your budget for environmental and safety management?
6) Is your current EMS fit for purpose? a. In what ways does it perform beyond expectations? b. What are the main limitations? c. What are your main current EMS requirements which are not being met ?
7) What are your port's main current sustainability needs?

a. How do you manage these? b. What would be required (e.g. systems, resources, training) to manage sustainability more effectively in your port? c. What would be the main benefits of such a system for your port? d. What would be the requirements for, and costs of setting up a sustainability system for your port? e. What would be the main barriers to implementing a PSMS?
8) Would you be interested in receiving details of the PSMS developed for use locally
a. Where is your current balance of focus as an authority? Around profitability? Stakeholder issues? b. Do you see yourself as being close to commercial customers and prioritise the needs? c. Which initiatives seem to be working well within your community?

Table 6.4: Interview prompt sheet for Harbour Masters

Table 6.5 summarises the ports interviewed during the main data collection stage lasting 10 months. Time was allowed between interviews to initiate GT analysis and to have enough time to come back to the field and gather more specific data in order to "refine theoretical framework" (Charmaz, 2006:23). The selection of interview participants spans a range of trust and municipal ports in CAD. Additionally to A&P Falmouth, a discussion was initiated with Fowey Docks, which is owned and operated by Imerys Minerals Ltd. The situation here is similar to Falmouth Harbour and A&P Falmouth, where private ports are located within the waters of Trust ports and are working in close collaboration. Both A&P Falmouth and Fowey Docks have their own accredited ISO14001; however unlike A&P, Fowey Docks were not interested in further discussions regarding PSMS. Having interviewed a Maritime Manager who is in charge of Cornwall's municipal ports, a decision was made to establish the exact role that Devon County Council has regarding responsibility for Devon's ports. Not having a dedicated person responsible for ports, a Coastal Officer was the closest the two-tier governance structure had with regards to ports. It turned out that aside from having four ports written into Devon County's structure plans and indicating strategic importance for the county, the CC had no further involvement in day-to-day operations of ports, and therefore that interview was not analysed.

Interviewee Position	Duration	Port/Harbour Authority	Location	Date	Governance Type
Maritime Manager	105 min	Cornwall Council	Cornwall	03.08.2012	Municipal
Devon County Coastal Officer	92 min	Devon County Council	Devon	22.10.2012	County Council
Executive Head & Harbour Master	106 min	Torquay/ Torbay	Torbay (Devon)	26.10.2012	Municipal
Harbour Master	84 min	Padstow	Cornwall	17.01.2013	Trust
Harbour Master	73 min	Teignmouth	Devon	29.01.2013	Trust
Harbour Master	77 min	Fowey	Cornwall	05.02.2013	Trust
Harbour Master	157 min	Salcombe	Devon	18.02.2013	Municipal
Harbour Master Environment Manager	190 min (collective)	Falmouth	Cornwall	15.05.2013	Trust

Table 6.5: Interview subjects of the main data collection stage

6.4.4 Draft PSMS stage

The final stage of data collection addressed objective 5 which was about proposing and evaluating a model to disseminate PSMS in CAD. Table 6.5 indicates people interviewed and topics discussed during the first part of the final interview stage. Having been developed prior to completing a full GT analysis, PSMS version 1 represented a test of ideas of system design and usability, rather than a practical system with academic footing. As is visible from the table 6.6, a different agenda was set for these 3 interviews to allow the maximum amount of new data to emerge.

Interviewee	Port Authority	Date	Topic
Harbour Master and Environment Manager	Falmouth	15.05.2013	PSMS version 1 – usability and practicality
Harbour Master	Salcombe	28.05.2013	PSMS version 1 – contribution to day to day operations
Harbour Master	Truro and Penryn	25.06.2013	PSMS version 1 – complementing in-house ISO 14001

Table 6.6: Follow up interviews to test PSMS version 1

After conducting a GT analysis, version 2 of PSMS was designed, which consisted of 15 sub-categories of GT and 33 themes which they encapsulated. These themes summarised the range of issues in smaller ports, which were then used as a foundation for designing PSMS version 2. These themes will be explained in significant detail in chapter 7. Table 6.7 summarises the interviews conducted to edit PSMS version 2 and create version 3.

Interviewee	Port	Date	Topic
Harbour Master	Falmouth	01.08.2013	PSMS version 2 – concepts and PSMS dissemination
Environment Manager	Falmouth	01.08.2013 02.08.2013	PSMS version 2 – accuracy of statements and wording. Ability of non-academics to use PSMS. Simplicity and functionality.

Table 6.7: Interviews to develop PSMS version 2

6.5 Pilot test of PSMS

Chapter 9 outlines a detailed evolution of PSMS along with the industry testing conducted; however it is important to explain the way testing was conducted and processes involved.

Multiple tests have been conducted, specifically to evaluate the quality of conducted applied research using six criteria outlined Ackoff (1962) which are explained in chapters 8 and 9; and a pilot test of PSMS during the preliminary and final stages of system design. Unlike versions 1 and 2 of PSMS which have undergone some testing, the final version of PSMS i.e. v5 has undergone rigorous industry testing over the course of three months. There are approximately 35 ports and harbours located in CAD that are part of South West Regional Ports Association (SWRPA) including those based in Plymouth and Torbay which are statutory authorities and have only geographical links to Devon County. All three governance models present in the UK i.e. trust, municipal and private are present in CAD ports, and combined with a vast diversity of income streams and resources makes these two counties a good basis to conduct the PSMS pilot test.

Having interviewed a number of HMs in CAD as part of data collection, the pilot tests were designed to obtain feedback from the interview participants in the first instance, and then expand to a wider audience of HMs. The reason behind conducting the pilot test was to test the applicability of PSMS, its functionality, assess benefits, problems and to get a much better view of the general reaction to this system.

6.5.1 Communication strategy

To avoid receiving answers which were not thought through and were chosen at random, a communication strategy outlined in Table 6.8 used a three stage process of contacting HMs which was sent to a secretary of SWRPA. Not all ports in the South West are members of SWRPA and according to Ports.Org there are other smaller ports and ferry terminals across CAD which have not been present during the meetings or were on the mailing list for the members of SWRPA. A number of reasons could be attributed to that, including outdated public information and operational status; however the most likely reason would be very small size of those harbours and the lack of resources and interest for memberships as a result.

	Date	Contact type	Interview Participants	Everybody Else
START OF THE PILOT TEST	03.10.13	Personalised email detailing the system, potential benefits, instructions and questionnaire.	7 requests with high priority	
	17.10.13	SWRPA Secretary mass email with comprehensive instructions and description.	Everybody on the list (65 email addresses)	
FIRST REMINDER	19.11.13	Personalised follow up email to schedule 30 min telephone interview/visit	All remaining interview participants.	**Possibly** some other HM's who I have working relationship with
	19.11.13	Mass email with a first reminder **(excluding interview participants)**. Stress the importance of getting feedback to help ports with their issues of sustainability		CAD ports that **did not** participate in the interview stage
FINAL REMINDER	16.12.13	Personalised follow up reminder stressing the importance of getting feedback **(excluding interview participants)**. Setting a cut-off date **on the 17th of January**	All remaining interview participants	**Possibly** some HM's who I have working relationship with
	16.12.13	Mass email with the last reminder to other CAD ports. Establishing a cut-off date **on the 17th of January**. Stressing once again the importance of feedback.		All remaining CAD ports that did not participate in the interview stage.

Table 6.8: Initial Communication strategy

Source: Author

Since the start of the project, a working relationship with SWRPA members has been established and was being developed continuously. This resulted in two different approaches being outlined in Table 6.8 for those ports who were part of the data collection, and other members of SWRPA including those with an established working relationship that were not initially interviewed.

After the three reminders were sent and the deadline of 17th of January 2014 approached, only 6 responses had been received by that time. Following a courtesy call to enquire whether the respondents encountered any difficulties whilst conducting the pilot test, the general reply was that they did not manage to find time to do it on their own and a suggestion was put forward to contact HMs and arrange meetings. Having contacted a number of HMs over the telephone, it was revealed that the vast majority would have preferred to conduct the pilot test in person and suggested a convenient time for a meeting. Such an approach was not anticipated as per original communication strategy, however additional communication with HMs did not affect the quality of data received, as they were happy to meet in person and discuss the system. An 80% positive response (12 out of 15) rate to PSMS indicates that the communication strategy applied was effective and helped to yield good quality testing data.

Port Name/ Respondent	Governance type	Location
A&P Falmouth	Private	Cornwall
Cattewater	Trust	Plymouth
Cornwall Council Maritime Manager	Municipal	Cornwall
Dartmouth	Trust	Devon
Falmouth	Trust	Cornwall
Ilfracombe	Municipal	Devon
Looe	Trust	Cornwall
Newlyn	Trust	Cornwall
Padstow	Trust	Cornwall
Penzance	Municipal	Cornwall
Salcombe	Municipal	Devon
St Mawes	Private	Cornwall
Teignmouth	Trust	Devon
Torbay	Municipal	Torbay
Truro	Municipal	Cornwall

Table 6.9: PSMS pilot test responders in alphabetical order

Table 6.9 summarises the list of participants of the PSMS v5 pilot test which have been listed in alphabetical order in order to protect the confidentiality of port sustainability scores provided by the respondents. Because the original scoring results have been organised chronologically based on the date the response were received and that data can be made available to HMs upon request, the alphabetisation of participants maintains confidentiality. Another important aspect to point out from table 6.9 is the spread of ports by county and governance type resulting in high quality testing data. The process of conducting pilot test is explained in detail in chapter 9.

6.6 Ethical issues

At the start of the project ethical clearance to conduct qualitative research for the duration of three years was obtained from the ethical committee of Plymouth University. Saunders et al., (2012:52) described the importance of ethical clearance particularly when research is dealing with “young or vulnerable participants”. Expanding on this suggestion, the concept of vulnerability could be expanded upon in the sense that HMs could be classed as being commercially vulnerable since there are roughly 40 ports and harbours in CAD, and many of them compete against each other (Ports.org.uk, 2013).

Since the start of using theoretical sampling, by working together with FHC, a few HMs were slightly suspicious of this research; however everyone perceived questions asked to them as important information that was missing. During the interviews, commercially sensitive information has been revealed to illustrate a particular point and to answer the question truthfully. A reassurance was given at the start of each interview that before any data would be analysed, validity would be established with the interviewee, which Saunders et al., (2012:68) identified as “the extent to which data collection methods accurately measure what they were intended to measure”.

Confidentiality of information and using validated data for research purposes only has been agreed upon at the start of each meeting; hence all interviews have been transcribed by the author. A transcript of the meeting was sent over to the participant, with potentially sensitive areas highlighted in red colour, asking them not to delete information if possible, and keep it for background knowledge and make more sensitive areas red instead of removing text. This way, despite rewording some areas of transcripts and in case something got lost in paraphrasing, original meaning was left for the author to be read only as background information in order to relate concepts with their intended meaning.

6.7 Processing of the data

Each recorded interview was transcribed in the order it was recorded and analysis began immediately after validity was established. Since scoping interviews did not follow a particular pattern and their purpose was to gain an understanding of the subject area, and explore some main issues, they were not used in the main data collection phase; however ideas from those interviews were developed into questions for semi-structured interviews.

During the main data collection stage, several participants spoke in a very formal language and had barely any colloquialisms in their sentences. Some others have used plenty of conversational expressions and such interviews could have been perceived as informal conversations. The presence of audio recording could be a possible explanation of a very formal language from some and an informal from others as it could have inhibited some participants' responses and have made them less reliable (Saunders, et al 2012). Another approach used by the author to ensure the quality of answers provided was to ask some of these questions in different wording to the same people during a regional meeting of HMs. Having received the same answers back, it can be argued that the original answers provided were accurate despite the use of language on the day of the interview. Despite the variance in the language used by HMs that did not affect the quality of GT analysis conducted.

Chapter 7 details the specifics of how GT analysis was conducted and outlines an evolution of GT analysis from the first codes selected to choosing the highest levels of codes that underpinned the foundation of PSMS.

6.8 Setting up criteria for a Knowledge Management system

Once the data were processed, an extensive search of literature commenced to settle on theoretical criteria that would underpin the creation of the PSMS. Having identified areas of missing knowledge during data collection, a decision was made that PSMS should follow the logic and functionality of a knowledge management (KM) system.

Chan and Chao (2008:87) suggested a systematic deployment and balance of “external and internal thrusts” for a KM system to be effective. Authors used Gold et al’s., (2001) measurement items of what constitutes an effective KM, specifically in order for a KM to withstand organisational competitiveness, two types of capabilities for KM have to be deployed and harnessed, which are infrastructure and process capabilities(cited in Chan and Chao, 2008). They conducted a survey of 68 small and medium companies and based on the measurements from Gold et al., (2001) have reflected on applicability of those factors and areas for improvement of KM practices. Using a European Commission’s definition of SMEs, most ports in the SW could be considered as micro – having fewer than 10 staff and annual turnover less than €2million, and small –sized companies with fewer than 50 staff and less than annual €50 million turnover (EU Commission, 2013).

Some of the more relevant findings to this research from Chan and Chao's (2008) survey are:

- More than 50% of respondents stated that their existing KM systems are "not useful to the end users" because useful information is difficult to search for from "volumes of documents and poor interfaces" (ibid:84)
- 61.8% stressed their organisations preferred "a simple structure that promotes collective rather than individual behaviour" (ibid:85)
- Continuing on the previous point about simplicity, 75% criticized information overload or "non-systematically sorted" influx of new information (ibid:86)
- A majority of 80.5% had perceived KM as a positive way of gaining an advantage in the area of organisational performance and competitiveness, in particular if "knowledge can be used within their working groups, teams or departments" (ibid: 5). An important finding was communicated by the authors that such visions have not been effectively communicated throughout the entire establishment (ibid).
- More than 50% responded saying they do not have a "clear process for replacing outdated knowledge or incorporating knowledge from business partners" (ibid:86). Additionally, those respondents indicated being "sceptical to new knowledge before they integrate it into daily work" (ibid:86).

The findings above illustrate a clear connection between smaller ports in CAD and the survey of SMEs in Hong Kong by Chan and Chao in 2008. Both parties find it difficult to deal with information overload; prefer simplicity and effective communication of management tools, and are cautions about integrating new methods into the operational level of organisation. Having identified a number of similarities and established the relevance of the Chan and Chao's (2008) study, their criteria was used as theoretical foundation for creating a PSMS version 1.

6.8.1 Knowledge management criteria explained

Figure 6.1 below combines three criteria for infrastructure capability (technology, structure, culture) with four criteria for process capability (acquisition, conversion, application and protection) which in the view of Chan and Chao (2008:76) "should be more balanced and deployed systematically". The authors explained infrastructure capabilities as being external, and process capabilities as internal thrusts of organisations (ibid).

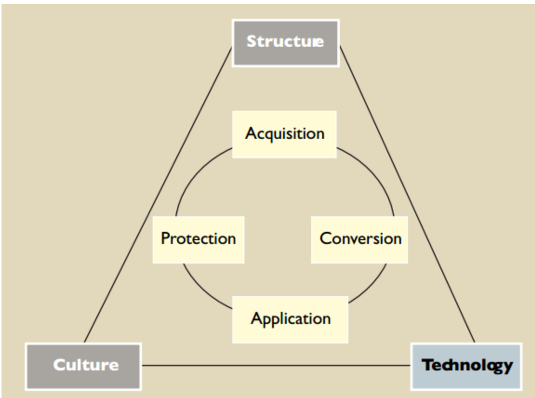


Figure 6.1: Unity of Knowledge Management Capability

Source: Chan and Chao (2008:88)

Infrastructure Capability criteria defined

Technology – underinvestment into technology is not uncommon among SMEs. A simple set of KM systems was suggested as a starting point. Role of the people regarding the KM system and designing new technology with the "sense of acceptance" together with communication and "continuous evaluation" has been defined as the main points in technology (Chan and Chao, 2008:87).

Structure – Delegating, self-learning and improvement are at the centre of this principle. Suitable "incentive schemes and reward systems to encourage more knowledge sharing" among the employees, and assigning clear responsibilities to those who are involved in KM to "enable effective evaluation" (ibid:87).

Culture – Having management to lead by example and demonstrating to employees the relevance and applicability of KM practice, and that KM is "a course of action to identify and share everyone's skills and experience" in order to make organisation more competitive (ibid:87).

Process Capability criteria defined

Acquisition – ensuring "systematic capture, screening, categorisation and storage of useful knowledge or relevant information" from a range of sources including suppliers, business partners and internal networks (Ibid:87-88). Initiating and sustaining a "common discourse and unanimous understanding" of knowledge can easily spread KM to everyone within the organisation (ibid:88).

Conversion – Converting own knowledge into something colleagues can learn, or even might need to know (ibid). Clearly communicating a message to employees that knowledge is not “confined to a certain group of people” (ibid:88).

Application – Utilising and experimenting with knowledge is the essence of this measure (ibid). Chan and Chao (2008) also suggested encouraging employees by either recognition within the organisation, or celebratory events to incentivise personnel to apply their new or existing knowledge. As for the management, the general suggestion is to try and implement new ideas in existing operational processes in order to “support more knowledge experimentation from conceptual ideas to practical actions” (ibid:88).

Protection – This category emphasises the importance of a well-established plan to prevent the knowledge being lost because of staff leaving the organisation (ibid). Incentivising and rewarding personnel was suggested as a counter-measure for staff departure therefore increasing organisational loyalty and assisting with knowledge retention

The application of the KM criteria to PSMS version 1 will be explained in detail in chapter 8 along with the development and evolution of PSMS.

6.9 Conclusion

Combining elements of two research paradigms, this research uses a mixed methods approach with an inductive approach to use academic theory and apply it to a practical problem. Situated between pragmatist and interpretivist paradigms with the aim to inductively generate new theory, a justification for the use of GT in order to answer this research's objectives has been provided, specifically Charmaz's (2006) method has been used, and the process of using GT will be thoroughly explained in the next chapter. Aside from GT, justification for the use of ECA and KM have also been provided, the former being vital to establish the terms of reference for the new theory to be generated, and the latter being a set of principles for proposing knowledge based PSMS for smaller ports in CAD.

CHAPTER 7: USING GROUNDED THEORY

7.1 Introduction

This chapter presents details of the GT methodology used to analyse the semi structured interviews conducted with HMs in CAD during the main data collection stage. A detailed evolution of codes and memos with examples is explained throughout this chapter along with the processes of coding and memoing to illustrate chains of thought and demonstrate how closely the author's interpretation of using GT matches the method of Kathy Charmaz (2006).

7.2 Using grounded theory

The process of constructing GT as used in this project is based on the assumption that both "the research process and the studied world are socially constructed through actions" (Clarke and Friese, 2007:376). GT represents a systematic method of "analysing and collecting data" which begins with inductive enquiry but does not necessarily end in the same way (Charmaz, 2012:2). As a method for studying processes, GT can also be described as a "method in process" which emphasises data analysis which also informs data collection strategies at an early stage (ibid:2). Arguably, most qualitative researchers have used some GT strategies such as coding, memo writing as well as concurrent phases of data collection and analysis. What makes those methods differ from GT is using them in "a more general way than grounded theorists do", and as a result not realising the power of

GT (Charmaz, 2012:3). A number of distinctive features of GT have been highlighted in table 7.1 below.

Distinct Features of Grounded Theory
Provides explicit tools for studying processes
Promotes an opening to all possible theoretical understandings
Fosters developing tentative interpretations about the data through coding and categorising
Builds systematic checks and refinements of the researcher's major theoretical categories

Table 7.1: Distinct Features of GT
Source: based on Charmaz (2012:3-4)

The process of GT begins with data, as researchers use observations, interactions and materials about the subject area to construct data (Charmaz, 2006). Studying early data through the use of qualitative coding allows the researcher to "separate, sort and synthesise data" by adding labels to particular segments of data which represent the meaning of each segment (ibid:3). Using coding from the early stage of data collection allows the researcher to start making comparisons with other extracts by filtering and categorising data (ibid). The next step in using GT is to write "preliminary analytic notes called memos" regarding the codes, data comparisons and other relevant ideas that occur in the process (ibid:3). By following this process, namely analysing data, comparing segments and memo-writing, which is the process of writing analytical memos; researchers begin to define better suited ideas and construe certain extracts of data as preliminary analytical categories (ibid). These analytical categories eventually merge after further analysis and end up becoming more theoretical (ibid). Analytical categories stem from data analysis, links are established between them and theories derived about a given concept by reaching "down to fundamentals up to abstraction, and probe into experience" thus providing a "conceptual handle" on the studied phenomena (ibid:135;3).

7.3 Coding processes

A first step is the process of identifying the meaning of the data, i.e. qualitative coding (Charmaz, 206). The process of coding entails naming a particular segment of data with a label that "simultaneously categorises, summarises, and accounts for each piece of data" (ibid:43). GT coding creates the "bones of your analysis", which will be assembled into a "working skeleton" using theoretical integration, meaning that coding in GT is more than just a process and represents an essential building block for the analytical foundation, which will then be used to add additional levels and stages to the analysis (ibid:45). A key point that needs to be mentioned about GT coding is the emphasis that is put on the studying of processes and actions, rather than simply looking at the generic meaning of data (ibid). GT coding comprises of at least two main stages, the first involves "naming each word, line or segment of data" i.e. the initial phase, proceeded by the second stage i.e. focused, selective phase when researcher is able to "sort, synthesise, integrate and organise" large volumes of data through the use of most important or significant initial codes (ibid:45). The essence of the initial phase of coding is to remain open to multiple theoretical possibilities and directions discovered through "close reading of the data", and as the coding progresses those categories that stand out in the data should be identified and developed further using focused coding (ibid:45). Having selected focused level coding, the final coding phase is to "specify possible relationships between categories developed" during focused coding (ibid:63).

7.3.1 Initial coding

Having provided a brief overview of coding processes above, the following sections will illustrate how particular principles of each of the coding stages have been applied during this project.

	“A code for coding”
a	Remain Open
b	Stay close to the data
c	Keep your codes simple and precise
d	Construct short codes
e	Preserve actions
f	Compare data with data
g	Move quickly thorough the data

Table 7.2: Principles of Initial Coding
Source: Charmaz (2006:49)

Table 7.2 above summarises seven principles of initial coding as outlined by Charmaz (2006:49), saying that researcher should “make your codes fit the data” instead of “forcing the data to fit them [codes]”. Point (e) from table 7.2 refers to using gerunds to obtain a “strong sense of actions and sequence” whilst coding your data (ibid:49). Line-by-line (LBL) i.e. “naming each line of your written data” coding was advocated by Charmaz (2006:50) to be an “enormously useful tool” which works especially very well with “detailed data” concerning problems and processes captured in the form of interviews, documents or observations.

Table 7.3 below represents an example of coding from the first interview, where codes were still rather long and as author was just learning about initial coding and the power of coding for processes using gerunds. The original coding was done on an A3 page format in landscape mode using Microsoft Word, where initial codes were assigned to as many lines as possible, provided there was sufficient meaning to assign a code. Table 7.3 consists of one long answer to a question which was broken down into subsections to better illustrate the relationships between codes assigned and the original text. The guidelines for initial coding provided in table 7.2 are clearly visible in the initial codes assigned in table 7.3. Codes remained close to the data (point (a), table 7.2) by using phrases consisting of between four and eight words which aimed at demonstrating actions (e). Barely anything was disregarded (a) and codes were assigned to capture the meaning (b) by using as fewer words as possible to make codes shorter (d), but at the same time to keep them precise (c). Charmaz (2006:52) in her own example of initial LBL coding uses codes consisting of between two and nine words, which put the length of codes used in this project under the short codes category (d).

Initial code	Q: What are your main current port development plans
Developing through rebuilding.	**A:** We have a port Masterplan and in it one of our biggest projects is the rebuilding of Lighterage Quay.
Having an important role in the local society. Rebuilding existing infrastructure.	This quay (350 m in length) was built in 1961 by the MOD and built because Truro was considered to be strategic port. Laid up moorings further downriver were to be used to assemble convoys in case of war.
Having an important role in the local society. Safeguarding local community.	Convoy of ships would come up the river to these secure berths and would be serviced by smaller lighters using Lighterage Quay. The existing flood barrier was completed by the Environment Agency, and they can close this and stop tidal flooding affecting Truro.
Considering alternative safety measures. Strengthening flood defences.	In addition a 1 metre high wall was built along the length of Lighterage Quay, otherwise the flood waters would go around the flood defence systems.
Monitoring for safety.	About 5-6 years ago it was apparent that accelerated levels of corrosion had been noticed on the flood defence system and the quay.
Thinking about the future. Contributing together towards a common cause.	The port required a new quay and it was agreed that provided the port paid for the ‘extra over costs’ then we could go for the more expensive option but yet which was a ‘win-win’ situation for both parties. The port contributed £750k from Harbour Fund reserves and the EA built a new quay which will have a lifespan for a further 100 years together with a flood defence system for Truro.

Table 7.3: Example of using Initial Coding
Source: Author

Comparisons of data (f) were undertaken at various stages, e.g. when receiving similar answer to different questions and when comparing with the same section in another interview(s). The initial coding stage has been coded quickly (g) and all ideas developed during this process were described, explained and later developed in memos which will be explained later in this chapter.

7.3.2 Focused coding

A second major phase of GT is the transition between initial and focused coding (Charmaz, 2006). These codes are used to "synthesise and explain larger segments of data" after establishing "strong analytical directions" using initial LBL coding (ibid:57). The general idea is to use either the most frequent or significant initial codes; however during focused coding an important decision is required regarding which of the initial codes "make the most analytic sense" to help categorise data "inclusively and completely" (ibid:58).

Focused codes	**Initial code**
Rebuilding existing infrastructure	Developing through rebuilding
	Having an important role in the local society Rebuilding existing infrastructure
Safeguarding local community	Having an important role in the local society Safeguarding local community
	Considering alternative safety measures Strengthening flood defences
Contributing together towards a common cause	Monitoring for safety
	Thinking about the future Contributing together towards a common cause

Table 7.4: From initial to focused coding
Source: Author

Table 7.4 adds a layer of focused codes to the initial codes example demonstrated in table 7.3. Using focused coding has helped to "condense the data and provided a handle on it" (Charmaz, 2006:59). Although a number of initial codes were repeating throughout the interview, predominantly significant codes rather than most frequent ones have been promoted to the focused level. Looking at initial codes in table 7.4, *having an important role in the local society* is the only code that repeats in that example; however the code of *safeguarding local community* also encompasses aspects of protecting the local community, and the important role that ports play by strengthening flood defences and increasing safety measures resulting in the process of safeguarding. This short example is a good illustration of logical progression from initial to focused levels of coding.

Similar logic and principles of identifying the most suitable focused codes were applied to the rest of the interviews which resulted in a large amount of data. Approximately 300 pages of typed transcripts were analysed resulting in 996 different initial codes, and 309 focused codes developed as a result. Having so many focused codes might seem like a data overload, however after a quick calculation of the example demonstrated by Charmaz (2006), from 22 initial codes, she ended up having 5 focused codes on the same excerpt of data which is more than a four-fold reduction in data. Since no interview is the same and even when asking the same questions to different people, data received can vary substantially. Over a three-fold reduction in data was achieved in this project, which is not very dissimilar from the principle demonstrated by Kathy Charmaz (2006). The original codes have not been modified since they were first identified and numbers of codes developed and subsequent data reduction figures were not calculated until pilot testing of the final system has commenced, which was six months after completing data analysis using GT.

7.3.3 Theoretical coding

Theoretical coding is the last stage of GT data analysis that aims to "clarify and sharpen" the analysis, however they must be developed carefully to avoid “imposing framework on it [analysis] with them [theoretical codes]” (Charmaz, 2006:66). Imposing views and existing preconceptions on data analysis has been a very big debate, with Glaser taking a strong stance against reviewing academic literature prior to data analysis, with a view of taking every precaution against forcing data and letting it emerge completely inductively. Formulating theoretical codes has to be done with a great deal of caution so that theoretical codes “may lend an aura of objectivity” to already conducted analysis, rather than stand on its own as “as some objective criteria about which scholars would agree”, which related back to the previous argument about the natural flow of data (ibid:66).

From the outset of this project there was no view of what results the data analysis was expected to deliver, instead there was a curiosity factor of what would the output be. Table 7.5 below illustrates the third phases of data analysis, specifically combination of focused into theoretical codes. Those focused codes used as examples in table 7.4 have been highlighted in bold in table 7.5. As evident from table 7.5, no specific numbers of focused codes have been developed into a theoretical code; however every effort was made to avoid forcing and excluding data in order to follow some sort of pattern. Many focused codes conveyed very important concepts so a number of theoretical codes have combined the essence of those focused codes and brought higher level of data conceptualisation, whilst reducing the total amount of data and making data a lot more manageable. Out of 309 focused codes developed during the second phase of coding, 35 theoretical codes were developed in the first instance, 33 of which were then combined into 13 Sub-categories and one core theme.

Theoretical Codes	Focused Codes
Charging environmental levy to prevent major infrastructure failure (T1)	**Rebuilding existing infrastructure**
	Not wanting to have major infrastructure failures
	Charging additional levy into infrastructure fund
	Making incremental improvement out of income rather than savings
	Suggesting to pay a percentage of their income and put it into reserve for infrastructure
Safeguarding, educating and giving back to the community (T18)	**Safeguarding local community**
	Duty to support port and community sides of life
	Benefiting port and community
	Lack of community understanding
	Giving back to the community
	Being lazy (users) to care for the environment
	Having always done that – not seeing it as a problem (community related environmental impacts)
	Holiday makers not being marine focused
	Educating users about buying phosphate free washing up liquid
	Educating users is the most difficult aspect
	Providing a foundation for a tourist based economy
	Bringing in new people rather than having steady income
Working together with stakeholders and governing bodies to engage in strategic planning and introduce measures for reducing environmental impact (T21)	**Contributing together towards a common cause**
	Having managed to engineer better relationships with some organisations
	Collaborating with stakeholder groups
	Having all harbour meetings public
	Having to accommodate the needs of everyone
	Working together
	Engaging in collective action
	Providing alternative sources of power
	Farm run off impacting quality testing
	Improving credibility of HA through environmental record keeping
	Incentivising stakeholders to install drainage
	Bringing Environmental Agency expertise through a commissioner
	Collaborating with environmental governing bodies
	Working with farmers to introduce catchment farming
	Shaping strategy based on feedback

Table 7.5: From focused to theoretical coding
Source: Author

Table 7.6 below represents the list of those original 35 focused codes as identified following the third phase of GT coding. Three of the 35 focused codes in table 7.6 have been used as an example to demonstrate the evolution of theoretical coding in table 7.5, and have a corresponding code number attached.

Code No.	Theoretical Codes
T1	Charging environmental levy to prevent major infrastructure failure
T2	Evolving, developing, and rebuilding harbour infrastructure
T3	Balancing the provision of new infrastructure with navigation requirements
T4	Unutilised, uncared for and unmaintained infrastructure
T5	Maintaining harbour and beach safety, and managing liability
T6	Damaging the environment to maintain and improve safety
T7	Managing the environment through controlling the safety and risk of vessel's movement
T8	Evolving knowledge, awareness and expertise of using all aspects of TBL in decision making
T9	Relying on own experience and common practice for managing environmental impact (regarding BWE and its ENV management)
T10	Ensuring profitability and resilience to safeguard HA's ability to remain operational short and long term
T11	Relying on others for environmental warnings, and statutory requirements for environmental protection
T12	Doing an EIA on every marine/maritime operation at one point within its lifecycle
T13	Reducing visible/significant environmental impact/pollution through practical/visible measures
T14	Responsible boating - proactively looking after the harbour authority's waters
T15	Using research as a mechanism for EM
T16	Managing environment is about local perceptions as well as organisms
T17	Not having pressures relating to the environment from the community and governing bodies
T18	Safeguarding, educating and giving back to the community
T19	Community not wanting those things that make employment possible and businesses work
T20	Separating personal and professional to conduct business properly
T21	Working together with stakeholders and governing bodies to engage in strategic planning and introduce measures for reducing environmental impact.
T22	Collaborating and conflicting with governing bodies regarding conservation and designation
T23	Evolving requirement to have management tools (EMS, IMS, PSMS) practical and relevant to those people who use them
T24	Having too many operations in EMS – would result in planning for oil

	spill instead of movement
T25	Not seeing evidence to suggest unsustainability of habitats
T26	Sharing best practice
T27	Evolving requirements, duties and expectations of Harbour Authority's functions from society and governing bodies
T28	Naturally evolving with time, knowledge, and experience– having to adapt to changing circumstances
T29	Making your inefficiencies as efficient as possible
T30	Taking proactive actions to safeguard sustainability of the harbour for future generations
T31	Understanding customer requirements to deliver pleasant and safe experience
T32	Needing to change/adapt unsustainable policies/aspects for the future
T33	Being affected (favourably or negatively) by port location and/or environmental designations that come with it.
T34	Needing the industry to generate conservation funds
T35	Commercially efficient, environmentally friendlier, and socially acceptable

Table 7.6: List of original theoretical codes
Source: Author

Although there is an overlap between theoretical codes in table 7.6, trying to make each code unique without any overlap would have resulted in imposing a particular structure on the data, rather than a structure showing through a systematic process of coding. Section 7.5 will discuss further the final concepts that have been developed using a combination of memo-writing, which is discussed next, and a process of bringing theoretical codes to a higher level of conceptualisation. Those final concepts were then used to create PSMS which was tested and disseminated to local HMs.

7.4 Memo-writing

Since a number of GT elements are used by other qualitative methods, memo-writing is what differentiates a GT data analysis from other qualitative methods. This process is described as an essential midway step between collecting data and "writing draft papers" (Charmaz, 2006:72). One might misinterpret the reasons for moving quickly through during initial coding which Charmaz (2006) suggested to be one of the seven steps to initial coding as illustrated in table 7.2. Memo-writing complements the lack of emphasis on analytical thinking during initial coding by introducing a process where you can “stop and analyse your ideas about the codes in any-and every-way that occurs to you during the moment”(ibid:72). So rather than spending time analysing each code and in doing so potentially forcing the data or excluding some data to allow highly analytical codes to emerge, GT emphasises writing down a note to yourself detailing your thinking, ideas, and at later stages discussing some, if not all codes or categories in depth. During the first stages of coding, memos can be very simple and could potentially seem like a waste of time, but through “conversing with yourself while memo-writing, new ideas and insights arise during the act of writing” (ibid:72).

Having read significant amounts of literature on memo writing prior to commencing data analysis, the author struggled to understand the reasons behind talking to yourself and discussing ideas further, but having coded the first half of the first interview and followed Charmaz’s (2006) method as close as possible, quick initial codes have prompted analytical insights which would have been missed otherwise. Table 7.4 illustrated evolutions of focused codes, and the third focused code i.e. *contributing together towards a common cause* was written as a memo on the first day of using initial coding. The memo reads as follows:

“***Code: Contributing together to a common cause***
It happens sometimes when governing bodies that normally don’t contribute to port management but only follow their agenda – which is in a nutshell ban as much activity as possible to conserve the environment, however sometimes the two entities come together, combine resources agendas and expertise to a common cause. Lighteredge quay in Truro is a perfect example of such thing – tackling flood defence for the city and a quay for the harbour in 1 project, “two for the price of one” in retail terms. Surely this is not isolated incident and more projects of similar nature are possible elsewhere in CAD?”

Memo 1: Source: Author

Having written the memo, the initial code was then renamed into *towards a common cause*, rather than *to a common cause* as illustrated above. Notice how the quality of written English in the memo above is of considerably lower standard and was left unchanged for the purposes of demonstrating the speed with which thoughts can occur when coding and the importance of catching the depth of each idea to the maximum. The fact that there are grammatical and syntax errors tells the reader that those were genuine ideas, rather than a well written statement which was made into a memo sometime after the coding was finished.

Table 7.5 illustrated how the focused code of “working together towards a common cause” was combined with additional 14 focused codes to make “working together with stakeholders and governing bodies to engage in strategic planning and introduce measures for reducing environmental impact (T21)” theoretical code. Towards finishing theoretical coding process, the following memo was created which describes the code numbered T21 in depth:

> **“T21 - Working together with stakeholders and governing bodies to engage in strategic planning and introduce measures for reducing environmental impact**
>
> Some concepts are important, others are interesting. This concept captures the essence of environmental management and indeed the essence of sustainability for smaller ports.
>
> Some say keep your friends close but enemies closer – some harbours with environmental status might consider governing bodies as enemies and probably had heated discussions in the past. But what was the result of that? What did either party gain aside from agitation and disproval of one another? Same goes for community and constantly battling with the most vocal members? I’m certain that harbours are trying to work together, but perhaps the lack of knowledge about environmental issues, lack of evidence prompts both parties to push their own agenda instead of compromising.
>
> It starts by knowing your stakeholder groups, knowing their interests and leaders. Some stakeholders would have a higher impact on the harbour than others, for example farmers and fishermen. Working together by using evidence to justify the chosen course of action and to be flexible to accommodate any necessary changes”.

Memo2: Source: Author

This memo 2 extract captures the essence of theoretical code T21 and most importantly why the aspect of *working together* is so important for small ports. Similarly to memo 1, language was left unchanged to demonstrate exact thinking at the time when memo 2 was created and to preserve intonation, as paraphrasing can result in some ideas getting lost in rewording.

Looking back at the process of using GT to analyse qualitative data, in particular memo writing, reaching theoretical saturation would not have been possible without the use of memos. To conclude this section, Charmaz (2006:73) wrote to “use memos to help you think about the data and to discover your ideas about them”. The Word document containing memos was made up of 20 pages without spacing and contained 11,000 words of thoughts, ideas and discussions i.e. memos, which played a pivotal role in helping to develop focused and theoretical codes.

7.5 Theoretical sampling

"Theoretical sampling (TS) involves starting with data, constructing tentative ideas about the data, and then examining these ideas through further empirical study" (Charmaz, 2006:1002). This process entails further development of your "emerging theory" by pursuing additional relevant data, until no additional properties and dimensions to your categories can emerge (ibid:97). It can also be used as a tool against getting stuck during data analysis which works by saturating existing categories, which have had their dimensions and properties explored to the fullest, then sorting them to "integrate your emerging theory" (ibid:97). As a process, TS can be described as "strategic, specific, and systematic" since the researcher aims to use it for the purposes of elaborating and enhancing research categories, as engaging with TS encourages the researcher to "predict" how and using which data, especially from whom can the gaps in the current state of data become saturated (Charmaz, 2006:103).

When applying TS, a researcher would start by exploring any hunches or intuitions about the emerging data with further targeted data collection (Charmaz, 2006). TS can be used in early or late stages of research depending on whether the categories at which to direct TS have emerged thus far (ibid). If they have, benefits of TS during early stages include helping "to fill out the properties of a category" to enable the creation of an "analytic definition"; whereas during the late stages TS is beneficial for "demonstrating links among categories" (ibid:107).

In order to answer set objectives that were approved by the funding body for this project to create a generic PSMS, semi-structured interviews were planned to ask a number of ports the same main questions targeting objectives 1-4 which in most cases took up approximately half of the allocated interview time e.g. 45 out of 90 minutes. The remaining allocated time, to which few stuck and majority allowed exhausting questions fully whilst going over the allocated time was designated for theoretical sampling, i.e. following up on "intriguing codes"(ibid:90), adding properties to emerging categories and demonstrating links. Half way through coding the first interview, a very important idea emerged, which only seemed as a "hunch" at the time, but resulted in giving property to the core category of GT. This "hunch" was memoed as follows:

> **"Evolution"**
> The idea of "evolution" has been mentioned frequently over the past months. FHC HM said that their IMS was an evolution from a standalone system, and it took some trial and error to achieve it. Now in the interviews I can see evolution of job roles and descriptions, the evolution of environmentally friendly infrastructure. Is **Evolution** going to be part of the core concept? Just thinking about it makes sense that every company has to go through a phase of testing, to start small see how those initiatives going to be used before committing more resources into a project. I will have to keep an eye on this concept.

Memo 3: Source: Author

The properties of this concept, being a very early stage of data analysis, were explored using TS further in the following interviews. What prompted this chain of questioning were the examples demonstrated during the first interview when he was demonstrating examples of how environmental practices have moved on from where they were 20 years ago, e.g. when pouring oil down the drain was considered to be normal practice, etc. Combined with data gathered from a scoping stage of interviews where FHC HM spoke about evolution in various contexts, including how his organisation, FHC, changed, created new roles and hired new people, more dimensions to the concept of *evolution* have been discovered.

During the following interviews the idea of evolution in various contexts has been investigated further. The thinking was that if ports and many of their aspects such as speed of information flow, access to knowledge, environmental practices and others have changed with time, i.e. evolved, why didn't port infrastructure follow the same trend? From the author's point of view at the time, investing into newer and more suitable infrastructure seemed like a suitable way forward for ports as businesses. The answer received was completely unexpected, but helped to provide the concept of *evolution* with additional dimensions and properties. The memo written after one of the earlier interviews reads as follows:

> "**Wanting to keep the harbour traditional"**
> "A very interesting point I did not pay attention to previously. Padstow HM said that because the harbour has been in Padstow for hundreds of year's people don't want any development and want to keep it traditional. So is the reason for not developing to maintain the tradition? But what is tradition? It's the way people do certain things at a given point in time. Hundreds of years ago traditions were different from what they are now because societies have evolved, and yet having smartphones, hybrid vehicles, fibre optic broadband and other luxuries of our time, people still want to preserve the "traditional" aspect of the harbour. Was this meant to be "historic" rather than "traditional"? The Hydraulic gates at the Padstow's inner

harbour have definitely not been there for hundreds of years, and yet they are there now. So the historic element has been evolved to better fit the requirements of our time, and yet development is objected?"

Memo 4: Source: Author

Memo 4 has captured two very important dimensions for the concept of *evolution*, i.e. the opposition to change to remain traditional and at the same time having modern technologies i.e. hydraulic gates for enhanced benefit, resulting in a blurred line between what local communities say they want, and what "modern" features ports have, therefore contradicting their own statements. After exploring this trend further, all remaining participants have noted their experience of dealing with severe opposition to change from their local communities, which in some cases even resulted in a HM being physically attacked.

After further investigation, four theoretical codes have been created, which were based directly on the idea of port evolution. A number of other categories have benefited from this chain of questioning, resulting in properties and dimensions being added to the concepts of *safeguarding, safety*, *working together*, *usability of management tools, environmental knowledge and management* and others. Memos 5-7 conclude the example of using TS provided in this section:

"T2 - Evolving, developing, and rebuilding harbour infrastructure

This category reflects the evolution of society which harbour infrastructure has to try and accommodate. Users are expecting harbours to be safe, with lots of preventative measures in place, in most cases even to have refuelling facilities. Examples were shown that previously some harbours did not have space to receive visitors, and now they have hundreds of metres of pontoon to accommodate visiting yachts. Some have

infrastructure that evolved enough to serve its intended purpose. Others have higher demand for infrastructure and very likely much higher depreciation, which needs to be addressed by rebuilding existing structures and making them fit better for intended purpose (e.g. better concrete, stronger foundation, more resilience against erosion).
The key point here is the evolution aspect which has been seen in most categories and concepts. It seems to be very simple and natural thing for infrastructure to evolve with harbour requirements as a concept, but in reality it is much more difficult than that. Rebuilding structures might constitute as development – which is a hated word in the port communities in South West. Development means dirt, noise and pollution. Factors such as safety of life, safeguarding of commercial revenue and sustainability of the harbour should be weighed against the wishes of community to come up with joint plan of action"

Memo 5: Source: Author

Continuing on the idea of development being a "hated" word in memo 5, memo 6 below conceptualises this idea in sufficiently more detail:

"T19 - Community not wanting those things that make employment possible and businesses work

Severe opposition to change is the general message for most small harbours and their communities. People like things the way they are (good or bad) and want development. Their accommodation and mooring is perfectly adequate for them and don't want more people coming in and disturbing them.
I think a valuable point was mentioned when one HM divided community into Locals and Residents, the former being those who want development and jobs for their children and who don't have high levels of education, resources and experience to strongly voice their concerns. The latter being people who finished their working lives and came here to retire – those people are the ones who are strongly against smaller harbours and their respective towns having any development, any noise or form of industry. They bought their little "corner of England" and it's perfect for them. Because of such attitude – HM's are being constantly subject to scrutiny and have to tread very carefully. The word development is a no-no.

Another argument for wanting to keep the harbour traditional has been presented in several harbours, and perhaps that was used as an excuse to restrict development. But what is traditional? Could that be a synonym to obsolete? Not everyone in the community sells fish, others rely on visitors and holiday makers. If the whole town was to stay traditional, without development, then houses would not be fit for purpose in the 21-st century. Diversity gives the appeal to a small town, so why wouldn't this give the same appeal to the harbour?"

Memo 6: Source: Author

Memo 6 adds a final layer to the concept of opposition, which was the division into locals and residents, with the latter being people with sufficient knowledge, experience and resource to voice their concerns and oppose development. One HM even mentioned that he has been dealing with solicitors hired by those residents regarding a proposed development project. Combined with ideas from memo 6 and the main idea of the PSMS which is the aspect of *sustainability*, memo 7 extract looks at the future sustainability of the harbour with the view that opposition to change contributes to unsustainability:

T32- Needing to change/adapt unsustainable policies/aspects for the future

"… how do you achieve it [change]? How do you change from the way things have been done for decades and implement a new approach?

How much time port managers spend thinking and planning for the future as opposed to looking at financial statistics and tearing out their hair thinking where to get extra money from? If these and other issues are not properly addressed, there might not be a harbour in the future".

Memo 7 extract: Source: Author

Theoretical sampling was used in relation to refining key categories and asking specific questions to add layers and properties to emerging concepts a lot more often than targeting specific individuals. This subsection presented a number of examples to illustrate the chain of thinking, the use of TS and reasons for investigating emerging concepts in further depth. Memo 6 has concluded the thought process of why port infrastructure does not evolve with time as efficiently as other aspects of port operations. Following additional data collection, memo 7 presented a potential outcome of this opposition that small ports in the SW could face with regards to infrastructure development projects, if no measures are taken.

7.5.1 Variation

Variation was described by Charmaz (2006:109) as focusing on "certain actions, experiences, events, or issues to understand how, when and why your theoretical categories vary". By conversing with, or observing certain individuals a researcher is likely to obtain more "knowledge about those experiences, events or issues "he seeks to treat theoretically" (ibid:109).

An example of variation discovered during early stages of data analysis was the general negative attitude from communities towards port infrastructure development; however HMs had different opinions regarding opposition they were facing from their local communities regarding development. Following a constructivist approach and interpreting society as being socially constructed, these different views of people towards the same problem constituted as variation and were perceived as extra dimensions and properties of data. The element of theoretical variation was based on "how they act and feel about it", i.e. how HMs perceived this hostility towards their efforts, despite being the person tasked with being a CEO of a port/HA (Charmaz, 2006:109). By applying TS, additional properties of emerging categories were discovered which helped to saturate data, namely *community stability, varying levels of opposition, level of discourse with stakeholders, level of transparency and others.*

7.5.2 Theoretical saturation

Knowing when to stop collecting data before a researcher starts to get overwhelmed with data that is not producing any new insights i.e. saturate is a very important part of the GT process. Categories become saturated when further data collection does not "spark new theoretical insights, or reveals new properties of these core theoretical categories" (Charmaz, 2006:113). When using GT a researcher can wrongly "assume that their categories are saturated" and seeking answers to specific questions could help in assessing whether the categories are really saturated(ibid:113).

Questions to help establish saturation
1) Which comparisons do you make between data within and between categories?
2) What sense do you make of these comparisons?
3) Where do they lead you?
4) How do your comparisons illuminate your theoretical categories?
5) In what direction, if any, do they take you?
6) What new conceptual relationships, if any, might you see?

Table 7.7: Assessing Saturation
Source: Charmaz (2006:113-114)

Table 7.7 equips a GT researcher with a set of questions designed to spark further analytic insights in order to establish whether partial or full theoretical saturation has been achieved. In practice achieving saturation is a delicate process and in addition to the use of questions from table 7.7 can be expedited using processes such as theoretical sorting, diagramming, integrating, and of course, memo writing (ibid).

Using theoretical sorting the GT researcher can benefit by "working on theoretical integration of your categories"; therefore enabling comparison of "categories at an abstract level", and refinement of theoretical links (ibid:115). This technique proved to be very effective for the current project, as 35 preliminary theoretical codes from table 7.6 with the use of analytical memos and data comparisons were sorted into 10 categories and 3 core goals for ports to strive towards (see fig 8.3). Using theoretical sorting, focused codes have been combined into port sustainability themes, each covering a big range of issues, but as per project requirement remained generic.

Sustainability Theme	Theoretical Codes
Working together	**T21 Working together** with stakeholders and governing bodies to engage in strategic planning and introduce measures for reducing environmental impact
	T22 Collaborating and conflicting with governing bodies regarding conservation and designation
	T26 Sharing best practice
Relevance of Management Tools	**T23** Evolving requirement to have **management tools** (EMS, IMS, PSMS) practical and relevant to those people who use them
	T24 Having too many operations in EMS – would result in planning for oil spill instead of ship movement
Safety of Life	**T5** Maintaining harbour and beach **safety**, and managing **liability**
	T6 Damaging the environment to maintain and improve **safety**

Table 7.8: Example of theoretical sorting
Source: Author

Table 7.8 lists examples of sustainability themes which were developed after theoretical sorting and comparison of theoretical codes.

> **“Working together”**
> “I think I will see this code further up the ladder and possibly become a core category. The idea of community strength and objection was alien to me when I started, but having been involved in this project for 1,5 years I am beginning to see the conflicts.
>
> But what about working together in terms of conservation groups? How far do we push conservation? What if there will be few very vocal opponents that would become “leaders of the pack” and others would not “see the wood for the trees”? Although trust ports have to hold public meetings how much of “working together” are they exploring there?”

Memo 8: Source: Author

Memo 8 represented an extract from the memo in which a focused code of *contributing together towards a common cause* conceptualised an idea of taking the strong community spirit towards objecting development, and instead of conflicting, redirecting it towards joint conservation initiatives. After applying theoretical sorting as indicated in table 7.8, a theme of *working together* emerged with memo 9 conceptualising its importance and conceptual depth:

> “This category works on the principle that sustainability is a joint initiative, no single person or organisation can do it themselves and need participation and help from stakeholders/partners/etc. At the end of the day, if everyone put their pride and agenda aside, every stakeholder of the harbour wants the same thing – clean, prosperous and flourishing harbour authority that would be there for decades to come.”

Memo 9: Reaching conceptual depth
Source: Author

The example provided above illustrates a journey from an idea of *collaboration*, to further inquiry and theoretical code of *contributing together*, to theoretical sorting. This process resulted in bringing a theoretical concept to an abstract level through the use of data comparison and conceptualisation. As a result a dimension of sustainability being a joint initiative i.e. in the last sentence of memo 9, has exhausted the theoretical insights of this category making theme of *working together* saturated and suitable to be used as a subcategory of GT output.

7.6 Conclusion

This chapter has presented the processes used and output obtained from applying GT method as created by Charmaz (2006). The examples presented in this chapter of coding, memoing and the evolution of codes indicate the relevance of the selected methodology and epistemological stance of constructivism for this research project. Charmaz's (2006) method of GT was created as a detailed manual that explained many nuances of using GT. Having so much detail about every aspect of GT allowed the author to follow it as closely as possible resulting in formulation of new theory that was successfully applied to building PSMS. Several references have been made to the core theme/category in this chapter which will be explained in detail in the next chapter.

Along with the core theme, chapter 8 presents answers to objectives 1-3 and an explanation of the emerging theory based on the GT analysis. Objectives 4 and 5 will be answered in chapter 9.

CHAPTER 8: PRESENTING CORNWALL AND DEVON PORTS

8.1 Introduction

This chapter presents answers to objectives 1-3 that have been formulated as a result of primary data analysis and extensive collaboration with industry practitioners. These objectives are: O1 – Categorise the requirements for environmental planning in CAD ports; O2 – Analyse the sustainable development needs of CAD ports; O3 – Synthesise how smaller ports manage environmental sustainability. This chapter presents findings that have been outlined as part of the output of conducting applied research, and have been instrumental in the evolution of PSMS (see chapter 9). Before answers to objectives 1-3 are outlined, the next section introduces the notion of applied research in greater depth, and then presents the summary of commercial operations found in CAD to set the scene. The latter part of this chapter presents the new emerging theory developed as a result of GT analysis and answering objectives 1-3 which are based on stages 3-5 as outlined in table 6.1.

8.2 Conducting applied research

The notion of applied research entails having an "immediate relevance" for the industry and "addressing issues they see as important" which then have to be presented in a way that practitioners can understand and act upon (Saunders et al., 2012:12). Brodsky and Welsh (2008) stated that the essence of applied research was the element of application of knowledge relevant either to a particular organisation or to society as a whole. The use of applied research extends beyond working with organisations on the application of relevant knowledge to areas of “interdisciplinary research and human services to a wide range of persistent social problems and theoretical questions” (ibid: 19). Brodsky and Welsh (2008) cited six applied research criteria from a classic text by Ackoff (1962) specifically: (1) formulating the problem; (2) constructing the model; (3) testing the model; (4) deriving a solution from the model; (5) testing and controlling the solution; (6) implementing the solution.

These criteria have been applied throughout this project to create and test a working version of PSMS. Problem formulation phase (1) consisted of several stages. The first emanated from the FHC KTP with Plymouth University and the benefits that optimisation of management processes through the use of business process thinking has brought (KTP, 2012). Increasing legislative pressure on ports regarding environmental protection and the importance of safeguarding sources of revenue in smaller ports have set the scene for the current collaboration to create a generic method to help address port sustainability. Additional problem formulation took place during the scoping interview stage and throughout data collection whilst using GT to investigate various ideas and concepts in depth. The following sections present answers to objectives 1-3, and through constructing visual models (Ackoff (1962) criteria no. 2) have helped to shape author’s understanding of the nature of the research problem as well as the creation of TF6 in chapter 5. The second part to Ackoff’s 2nd criteria, i.e. constructing the model of PSMS along with criteria 3-5 will be addressed in chapter 9.

8.3 Commercial operations of CAD ports

Table 8.1 summarises commercial operations found in ports and local authorities interviewed in CAD and is based on several rounds of primary data collection and follow up discussions. A prominent feature of table 8.1 is the vast diversity of smaller ports in CAD which served as a precedent for creating a generic PSMS aimed at strategic management of aspects underpinning PSMS, rather than focusing on any particular operation.

	Summary of commercial operations				
Trades / **Port**	**Wet Bulk**	**Dry Bulk**	**Fishing**	**Marina & Leisure** (M&L)	**Other**
FHC	• Fuel (heavy and low sulphur) • Marine Gas oil • Lubricants, oils		• Crab (S) • Oyster (S)	• 588 Moorings	• Water lease for renewable energy testing • Casualty reception
A&P Falmouth	• Fuel (heavy and Low sulphur) • Marine Gas Oil	• Animal feed • Fertiliser • Coal • Stone products			• 40 000 cruise passengers per year • Ship Repair
Truro	• Petrol and Diesel (Mylor Yacht Harbour)	• Sand • Cement • Scrap Metal • Building Materials • Grain	• Oyster (M) • Prawn (S)	• 1200 moorings • Pontoons	• 8 Lay ups • Commercial moorings • Land and infrastructure lease
Torquay	• Petrol for Leisure users		• Small in-shore fleet	• 500 Marina berths	• Ship services at anchor • Land and Infrastructure lease

Padstow	• Lubricants, oils • Fishing fleet • Leisure	• Sand removal	• Lobster(S) • Netters (M-L)	• 187 moorings	• Ferry service • Land and infrastructure lease
Torbay	• Diesel for commercial bunkering		• 60 species of fish	• 1000 marina berths (500 at Torquay + 500 at Brixham) • 350 Moorings	• Land and infrastructure lease (LIL) • Casualty reception
Fowey		• China Clay • Aggregate	• Grow shellfish • Kingfisheries • 4-5 trawlers	• 1600 moorings	• Shipyard –vessel conversion • Leisure vessel sewage pump • LIL
Salcombe	• Petrol and diesel barge – privately owned on a leased a mooring		• 24 fishing boats • Exported £13m worth of Crab • Shellfish	• 2500 moorings • Visitor pontoon	• Winter stowage • Scrubbing Grid
Teign-mouth		• Ball clay (ABP) • Animal Feed • Agribulks • Stone Chippings • Salt • Forest products	• Small scale • One regular fishing boat	• 650 Moorings • Several visitor pontoons	

Table 8.1: Commercial operations by port
Source: Author

Identifying MOs and synthesising how smaller ports maintained profitability was a first step in a new discourse for sustainability. An earlier view of safeguarding commercial operations through the creation of PSMS has been updated with the introduction of port sustainability themes as a result of GT analysis. Table 8.1 provides additional contribution to knowledge which is a summary of commercial sources of revenue that sampled CAD ports have, which need to be safeguarded to ensure port sustainability for the future. ‘Other’ in table 8.1 includes water lease for renewable energy testing, casualty reception, vessel services and land and infrastructure lease (LIL).

8.4 O1 – Requirements for environmental planning in CAD ports

The amount of environmental planning small ports in CAD have to do is affected by *physical condition* of the harbour and *resource availability*. When asked directly, few participants were able to provide a comprehensive answer outside of statutory port requirements which was predominantly based on their own experience of dealing with environmental planning within their ports. Based on a number of follow up questions and discussions with various port practitioners regarding the requirements for environmental planning (REP), figure 8.1 conceptualised those responses along with the main data analysis into a theoretical framework. Two of the four pressures from TF6 in chapter 5 (i.e. legislation and conservation) can be seen in figure 8.1 in the form of *port location,* which can significantly impact *resource availability.* The idea of having influencing factors which can be out of control of HMs has contributed to the creation of four pressures in TF6. Having less available resources in turn can affect the overall state of port sustainability.

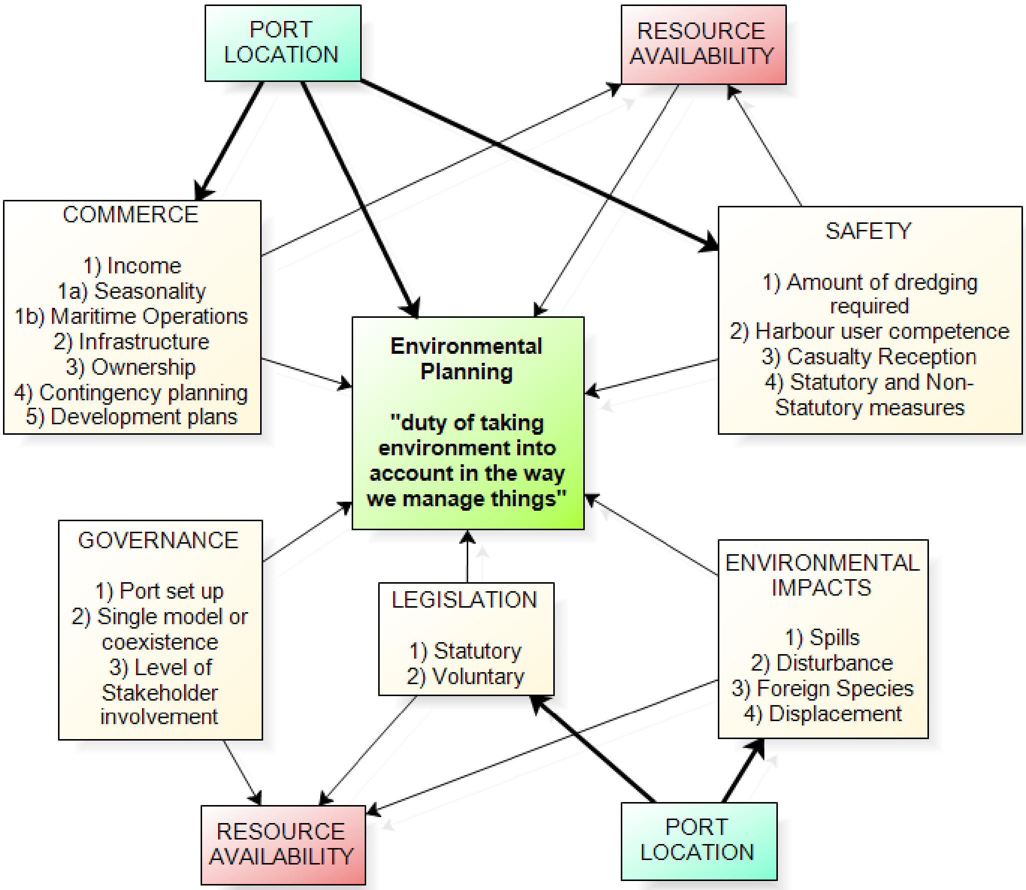


Figure 8.1: Influencing factors of environmental planning
Source: Author

It is expected for legislation and governance issues to evolve and change with time and as a result influence different aspects of ports; hence figure 8.1 is a conceptual representation of how things were at the time of conducting this research. Based on the assigned colour scheme used for an easier visual representation, *port location* and *resource availability* play a special role in relation to the REP, specifically the arrows from *port location* have been highlighted in bold and have an inward influence, i.e. something that is out of the control of HMs. Beige boxes represent REP found in CAD ports. Port location can have either a significant or minor or no impact on environmental planning, which is illustrated in sample causality chains below:

The following causality chain illustrates an example where *port location* has little or no impact on operations

Port located in a *non-sensitive* environmental area → less legislation to comply with → lesser cost of dealing with EM and impacts → lesser impact on commerce (i.e. no movement restrictions, easier to dredge) = **less REP** → **more** resource available (i.e. financial, staff time)

When *port location* has a considerable or a severe impact on operations, then

Port located in an *environmentally sensitive area* → more legislation to comply with → much higher cost of dealing with EM and mitigation of impacts → greater impact on commerce (i.e. higher environmental costs, fewer resources available for development) = **more REP** → less resources available.

In order to answer research objective 1 in detail, a specific port must be used as an example, due to a number of variable factors between ports. On a generic level, REP in small ports would depend on the following issues:

a) **Port location**, if a port

1. Is in an environmentally sensitive area or not
2. Port has shallow waters and needs regular dredging which could pose environmental threats depending on (a1).
3. Is a casualty reception point (if receiving vessel in distress, much higher level environmental planning would be required)
4. Has a very strong community opposition
5. Has to comply with additional levels of environmental legislation

b) **Governance**, whether port has been set out to be run for the benefits of stakeholders (i.e. trust, municipal). If so, heavy involvement of stakeholder groups could result in higher REP.

c) **Environmental impacts**, depending on point (a1), the severity would vary from *manageable* to *jeopardising conservation efforts* and possibly *killing off certain habitats*.

d) **Harbour Safety**, would depend on (a2) and (a1) which would determine the cost of maintaining safety measures.

d) **Resource availability** would depend on the port location (a); on how much commercial focus is permitted over stakeholder benefit under as per port governance model (b); whether there have been any significant environmental impacts (c); and the cost of safety measures which ultimately depend on whether the port is located in an environmentally sensitive area (a1) and if the port has shallow waters and requires regular dredging that could pose environmental threats depending on the location (a2).

8.5 O2 – Sustainable development needs of CAD ports

Similarly to the previous objective, in order to detail all sustainable development needs (SDNs) a specific port would have to be used as a case study. SDNs differ on a daily basis depending on the most prominent issue at the time. Among the certain obvious elements that are vital for port sustainability, namely the condition of physical infrastructure, safety and environmental track records, commerce, and stakeholder management; a number of new elements have been discovered during data collection which, if not addressed, could put future port sustainability at risk.

Without going into specifics for a particular port, figure 8.2 conceptualises *SDNs* for CAD ports, shown in beige, and outlines the *challenges* that most ports are faced with daily, shown in green. A pattern of challenges and sustainability categories is clearly visible in figure 8.2 which informed the creation of TF6 in chapter 5, i.e. the idea of port sustainability having multiple categories, all of which in turn can be affected by external variables i.e. pressures. Since figure 8.2 was created based on a whole plethora of issues in a number of regional ports, it is unlikely that any single port would be faced with all of the challenges from figure 8.2. New concepts such as *domino effect, need for change, efficiency and planning process* were discovered and signify an importance to the long-term sustainability of CAD ports.

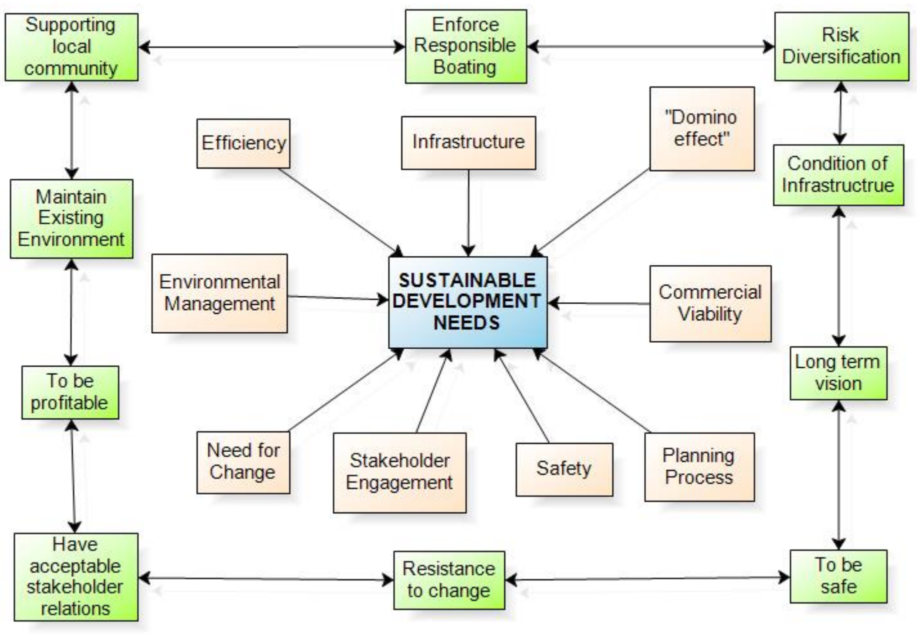


Figure 8.2: Components and influences of port sustainability
Source: Author

Selected SDNs explained:

Need for change: A number of examples highlighted “we’ve always done it like that” attitude regarding some aspects of port operations. For instance, community favouritism can have economic impact because some port employees can become completely integrated into the local community, which can stand in the way of proper business conduct, for example giving someone a priority, a discount or waving the charge completely based on a personal relationship. Maintaining foreshore moorings which dry out and require people physically digging the mud to either change the chain or disconnect the mooring for the winter period to reduce chain wear and tear is one example of unsustainable process for the future, as finding people willing to do that might pose a challenge (Interview with HM10, 2013). A need for change concept is based on these and other examples which indicate that addressing change poses a significant challenge to HAs and that these issues are widespread. This makes a *need for change* into a SDN in order to ensure greater commercial efficiency and future sustainability of ports.

Domino effect: Many, if not all port functions, are interrelated and require joint action and collaboration to ensure sustainability. Multiple examples provided during interviews stipulate to that point, namely the importance of dredging to allow safe vessel navigation, and the impact on the local community of vessels not being able to call at port. A number of HMs who run leisure ports with no commercial cargo have used this example specifying that without dredging even leisure vessels will be unable to come to port. If ports were unable to dredge, then the *domino effect* would be the impact on the local jobs directly and indirectly, community identity, and also contribution to the government in taxation. This SDN requires collaborative actions with communities and governing bodies to minimise environmental impacts within a port's aegis so that ports are able to dredge cheaper and dispose of sediment at sea. If the sediment is to be found contaminated, land based disposal could bankrupt many ports.

Planning process: Making longer-term plans, which would incorporate aspects such as budgeting for infrastructure repairs and renewal; rather than only looking at profit and loss accounts and hoping that infrastructure doesn't fail. One way of doing so would be to engage in a masterplanning process, whereby a port examines its future and starts to identify and prioritise issues that need to be addressed for the port to remain functional. This process would also serve as a tool for stakeholder engagement and help facilitate collaboration with various stakeholder groups. A Port Master Plan is one way of planning for the future and might not be suitable for those CAD ports with very small scale operations and little revenue, as it can be an expensive process.

Commercial viability: Relates to whether the current revenue streams of the port are sustainable, therefore whether the port in its current condition is commercially viable. Viable in this case refers to making enough profit to cover expenditure incurred from maintenance and reactive safety and environmental measures, rather than having to take money out of reserves on such occasions.

Selected challenges explained:

Enforcing Responsible boating is about *p*roactively looking after the environmental quality of a port's aegis instead of waiting for environmental impact to accumulate and pose significant threats. For instance, since most ports need to dredge, effluent and discharges from vessels can seriously contaminate the water column resulting in unaffordable dredging prices, because dredged spoil can no longer be dumped at sea. If dredging is not carried out, it could cause unsustainability of port operations. Implementing measures to control waste, providing and encouraging harbour users to use sewage pump-out systems; introducing measures to safely scrub boat's hull without contaminating the water column, etc. would enable a proactive mitigation of environmental impacts therefore significantly reducing and possibly eliminating the element of unaffordable dredging and reducing the risk of unsustainability.

Resistance to change: Similarly to the "need for change" SDN, this challenge encompasses the "we've always done it like that" attitude in the context of port structures to restrict development. This challenge also extends to educating harbour users about environmental impacts they are creating and how it can lead to unsustainability, for instance throwing dead fish/crab overboard, or why the *responsible boating* should be implemented collaboratively, and why harbour users should not clean their boat hulls on a low tide. In order for ports to be sustainable, this resistance needs to be managed, and educating users and stakeholders can be a good starting point.

Supporting local community: Some smaller communities solely depend on their ports, and a certain trade that ports engage with can be classed as a "backbone of the community". Being run for the benefit of the community, trust and municipal ports should identify the importance of each of their operations on the wider community and ensure viability and sustainability of that activity. For instance, fishing was identified as a "backbone of the community" in one Cornish port, and if dredging was to stop there, fishing trawlers would be unable to safely come in, resulting in a detrimental impact on the community which relies of that industry. That port has been taking extra measures to ensure sustainability of the fishing industry from the port side of operations.

Have acceptable stakeholder relations: Community run ports have to accord with the wishes of stakeholders and their actions have to match community expectations. For instance, if certain development projects which would have faced severe opposition from stakeholder groups and despite that would have still gone ahead, the level of collaboration between opposition would dramatically increase and only grow, resulting in very costly reactive measures. Antagonising the community over a project or a new type of operation despite potential profitability is unsustainable for ports in CAD and establishing acceptable working relations is important for longer term sustainability.

Risk Diversification: This pressure refers to having multiple revenue streams in order to avoid relying solely on one or several main incomes. Since ports are providing a service and rely on many external factors such as weather, the state of global and national economies, demand for their service; income figures would vary year on year, which could make consistent profitability a challenge. Although not every port can fully spread their commercial risks and most are still reliant upon on one or several main income streams, even starting with smaller scale diversification could positively contribute to port profitability.

8.6 O3 – Ways of managing sustainability by CAD ports

Table 8.2 was compiled to summarise who conducts environmental assessment within the eight ports and two local authorities interviewed. Four ways of conducting environmental assessment have been identified based on primary data collection: outsourcing, best practice, internal and centralised. In most cases, multiple methods of assessment have been established. *The Harbour Master* and *Trade Liaison* are the main sources of information for Trust and Municipal Ports in Table 8.2, which form a majority of ports and harbours in the UK (Ports.Org, 2013). A private port A&P has different governance and management structures, and has a dedicated *environmental manager*, who is responsible for environmental issues (A&P Interview, 2012). *Trade liaison* represents a bimonthly regional meeting with harbour masters from several counties working together and discussing issues, proposing solutions and sharing experiences. The *"Other"* category refers to the active participation of local community in port operations. In Torbay (Torquay is part of Torbay) and Padstow stakeholders communicate their findings and voice concerns with regards to potential environmental issues to the harbour authority. *Centralised* County model refers to CC's system which comprises ten municipal ports with a centrally run line management. Salcombe shares its Environmental Officer with 4 other estuaries in the region.

	Is there a problem? Environmental Assessment Through					
	Outsourcing		**Best practice**	**Internal**		**Centralised**
	Consultant	Other	Trade Liaison	Environmental Officer	Harbour Master	County Model
FHC	✔		✔	✔	✔	
A&P			✔	✔		
Truro	✔		✔	✔	✔	✔
Torquay		✔	✔		✔	
PHC		✔	✔		✔	
Torbay		✔	✔		✔	
Teignmouth			✔		✔	
Fowey		✔	✔	✔	✔	
Salcombe			✔	✔	✔	
Cornwall Municipal Ports			✔		✔	✔

Table 8.2: Who conducts environmental assessment?

Source: Author

Table 8.3 summarises current EMS deployed within the ports interviewed. Statutory systems represent a combination of safety management, Marine Management Organisation environmental impact assessment and legislation that prohibits unauthorised development without written consent and a valid licence. Integrated Management System (IMS) aimed at enhancing quality and using a TQM type approach is a system specific to FHC which encompasses sustainability, stakeholder, safety, prosperity and organisation into one vision (FHC, 2011). Previous collaboration between FHC and Plymouth University yielded a PSMS type system for sustainable management of two important maritime operations, as opposed to internally developed IMS/TQM for overall management of the port. Truro and A&P are two from a very small number of ports in the Southwest which have developed their own accredited ISO 14001 system. Torbay consists of three harbours, where all employ only statutory vehicles for EM. Fowey harbour has been previously accredited with EcoPorts PERS system; however the port's board did not see enough benefit in that process to continue subscription. Salcombe had an Environmental Management Plan (EMP) for Salcombe-Kingsbridge estuary from 2005 – 2010 which detailed a framework for conservation planning. A revision of that plan is currently in progress.

	Systems Deployed to Manage Environmental Impacts				
	Statutory	**Bespoke EMS as part of**			**Other**
		IMS/ TQM	PSMS	ISO14001	
FHC	✔	✔	✔		
A&P	✔			✔	
PHC	✔				
Truro	✔			✔	
Torquay	✔				
Torbay	✔				
Teignmouth	✔				
Fowey	✔				
Salcombe	✔				✔

Table 8.3: Systems deployed
Source: Author

Table 8.4 summarises who manages environmental issues after environmental assessment has been conducted. Three new concepts emerged which are consultant, information sharing and grouped procurement. FHC has been using a quality systems *consultant* on an ad hoc basis to help build a knowledge base of current environmental legislation and synthesise how to manage it. *Grouped procurement* refers to leisure management software which was purchased by a number of harbours, some of which are included in the sample of ports interviewed. Being developed by a very small team of people, this software company is family-run and required investments up-front to be produced. During a later regional meeting, one of the ports that purchased it said the updated grouped procurement software has been very beneficial. *Information sharing* represents various meetings between harbour officials with government agencies, stakeholders, and other ports to discuss pressing issues and plan ahead. This concept differs from trade liaison by being very specific in nature and focusing on issues local to the harbour.

	How is it managed?						
	Outsourcing	**Best practice**			**Internal**		**Centralised**
	Consultant	Trade Liaison	Grouped Procurement	Information Sharing	Environmental Officer	Harbour Master	County Model
FHC	✔	✔	✔	✔	✔	✔	
A&P		✔		✔	✔		
Truro		✔		✔		✔	✔
Torquay		✔		✔		✔	
PHC		✔	✔	✔		✔	
Torbay		✔		✔		✔	
Teignmouth		✔		✔		✔	
Fowey		✔		✔	✔	✔	
Salcombe		✔	✔	✔	✔	✔	
Cornwall Municipal Ports		✔		✔		✔	✔

Table 8.4: Who manages environmental issues?
Source: Author

8.7 Emerging theory: evolving sustainable practices of smaller ports

The final phase of GT was the theory generation from the categories that have emerged from data analysis. A definition of what constitutes theory needs to be established. In GT there has been a longstanding debate about the meaning of theory because of “ideological clashes… without necessarily realising their epistemological underpinnings” (Charmaz, 2006:125). Columbia and Chicago school’s positivist and pragmatist views have influenced Glaser’s and Strauss’s backgrounds, resulting in different interpretations of theory being presented and used by grounded theorists. Under a positivist view, theory seeks “causes, favours deterministic explanations, and emphasises generality and universality” (ibid:126), which in essence is about establishing cause and effect, establishing and verifying theoretical relationships. Establishing the cause and effect of environmental impacts would not be possible, as many causes are still unknown. Interpretive theory assumes “emergent, multiple realities; indeterminacy, facts and values as linked; truth as provisional; and social life and processual” (ibid:126). The reasons for interpretivism being unsuitable in this research are based on the ideas of indeterminacy, imagination and the notion of truth. Unlike positivism, interpretivism “allows for indeterminacy rather than seek causality” by prioritising “showing patterns and connections, rather than linear reasoning” (ibid:126). In contrast, a constructivist view of theory prioritises the “phenomena of study and sees both data and analysis as created from shared experiences and relationships with participants” (ibid:126). The emerging theory also depends on the view of the GT researcher and “does not and cannot stand outside of it” (ibid:126). With experience, the view of researchers move more towards abstraction due to enhanced understanding of the subject area and increased knowledge. By adopting a reflexive stance towards GT research, constructivists consider how “their theories evolve” which relates to an earlier point about the GT researcher “interpreting meanings and actions” along with the participant (ibid:126).

Because of so much diversity found in smaller CAD ports and as indicated by objectives 1-3, the research view has been updated to stand away from particular operations and look at sustainability themes that underpin them. Ten themes of port sustainability emerged on a final level of abstraction, initial reaction to which was:

> “…the vast research you have done will pay back in the sense that you have an authoritative idea of what keeps HMs awake at night” (HM in Cornwall, 2013)

This statement from a very experienced HM stipulates to the validity of the conducted research and the applicability of emerging theory onto the daily port management practice. Kitchin and Tate (2000:34) defined conceptual validity as relating to the “correct marriage of theory and methodology, so that research becomes philosophically sound and adopts appropriate methodologies for data generation and analysis”. Following the initial theory formulation, one HM in Cornwall gave a following response during a formal discussion:

> “What you did was you engaged with the industry and said that you were looking to try and come up with a tool to support them in their work. To that extent I think that mission has been accomplished extremely well” (HM in Cornwall, 2013).

The emerging taxonomy of sustainability themes have grouped focused codes based on their properties. During this process, three focused codes have been promoted to goals that harbours have to aim all their activities at in order to be sustainable which is summarised in Appendix E and can be seen on figure 8.3. The emerging taxonomy was then conceptualised to illustrate the final data collection and analysis output, and the initial idea behind pillars of sustainability and harbour goals.

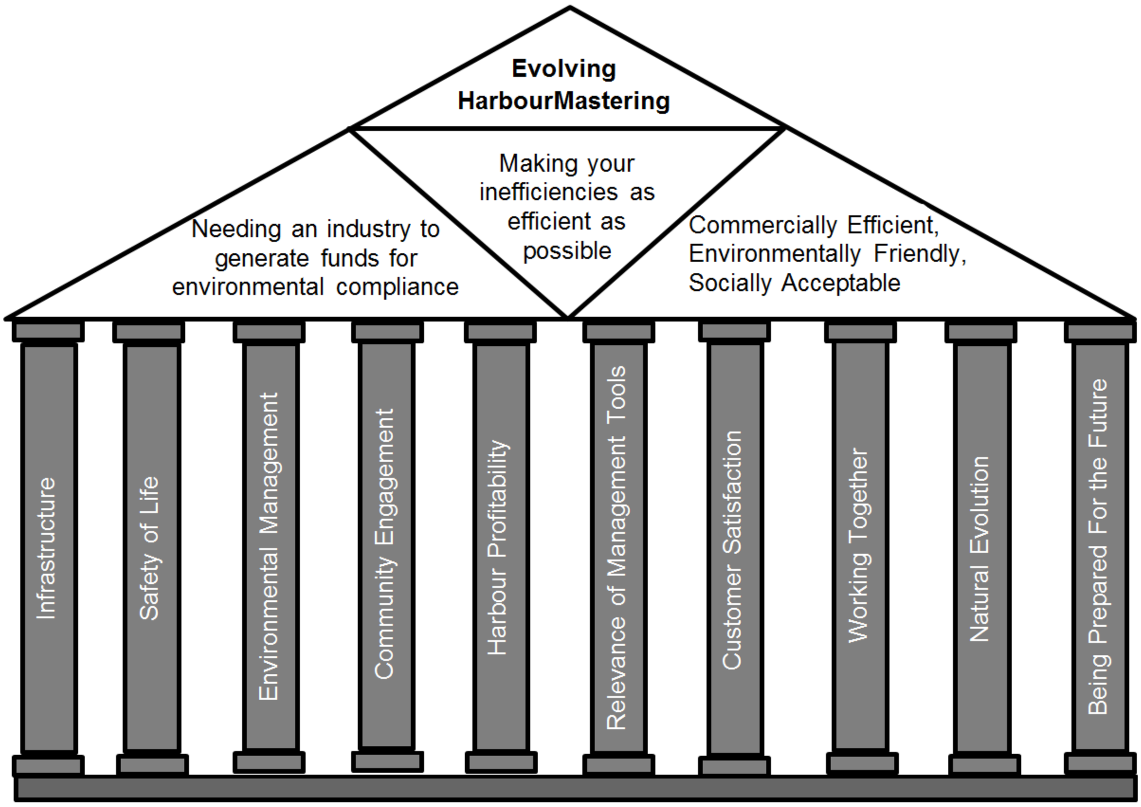


Figure 8.3: Evolving HarbourMastering
Source: Author

Figure 8.3 presents a view of port sustainability and is based on concepts that emerged as a result of GT analysis. Every column, i.e. *pillar* plays an equally important role combined with the three goals of harbour authorities, specifically *needing the industry to generate conservation funds; commercially efficient, environmentally friendlier, socially acceptable;* and *making your inefficiencies as efficient as possible*. Over the course of PSMS evolution, the "pillars" from figure 8.3 have been further developed into practical categories of port sustainability (see section 9.5.1), and those final categories can be seen in TF6 as "petals". Having gone through the interview transcripts to ensure the initial meaning was kept intact, one of the harbour goals, specifically *needing an industry to generate conservation funds* has been reworded to incorporate the whole aspect of environmental compliance, of which conservation is only a part. The original concept was mentioned by a HM who had environmental designation and was referring to conservation as a combination of all EM activities, statutory and voluntary. Appendix E has been left unmodified to be able to trace the evolution of concepts presented in figure 8.3.

Above the three harbour goals in figure 8.3 is a core theme of *Evolving HarbourMastering* which refers to the changing nature of port management and encapsulates *pillars* and *goals* of port sustainability. The concept of Evolving HarbourMastering in this case has a second meaning, of mastering a harbour through addressing foundational elements of sustainability, creating goals by understanding the level of interconnectedness and diversity of port operations. The schematic in figure 8.3 does not illustrate exactly what was intended by the emerging theory, because if someone was to take a pillar out of the middle of the figure 8.3, the “roof” would not collapse; whereas in practice every pillar carries equal importance, and not addressing one could be detrimental for the long term sustainability of the port. Reaching the top level is possible by constructing and implementing a strategy that would encompass sustainability *pillars and goals*, which would then make possible for ports to evolve in a sustainable way.

Within a constructivist approach theory emergence is possible after data collection and analysis, and the evolution of a theoretical framework that underlines this is evident in chapter 5, specifically how different experiences and views of reality contributed to forming a final theoretical framework of the research scope and design, leading to the theory of evolving sustainable practices in smaller ports. A preliminary quote from a HM in Cornwall illustrated earlier in this chapter stipulated that a plausible reality with relevant layers was constructed using sustainability themes that have emerged as a result of coding for processes. The core category of Evolving HarbourMastering was left purposefully as two words instead of three, making it grammatically incorrect; however, it better highlights the process of movement, and the importance of continual growth, development and change for the long-term port sustainability.

8.8 Conclusion

This chapter has presented the findings and answered objectives 1-3 based on the results of primary data collection. It is important to note that the "pillars of sustainability" outlined in figure 8.3 represent a conceptualisation of the final output of GT and not the final criteria for building PSMS. The evolution of the concepts in figure 8.3 into the criteria than underpinned PSMS will be explained in the next chapter along with the rationale for doing so.

The next chapter presents findings to answer research objectives 4 and 5. The journey of PSMS creation will be explained and each step evidenced to provide a comprehensive overview of how and why 5 versions of PSMS were needed to create a final output. The results of industry testing are also contained in the next chapter along with the arguments for authenticity and trustworthiness of research findings.

CHAPTER 9: CREATION AND EVOLUTION OF PSMS

9.1 Introduction

Having identified new theoretical constructs that emerged from GT analysis, this chapter describes how those concepts were turned into a workable system and the journey that process took to agree on a final version. Objective 5 aimed to propose and evaluate a model to disseminate PSMS in CAD. As a result of successful engagement and collaboration with port practitioners a practical system has been created and tested and the output has exceeded expectations.

This chapter aims to address research objectives 4 and 5, namely to *assess the attitudes of CAD port authorities towards PSMS,* and to *propose and evaluate a model to disseminate PSMS in CAD ports*. In order to address objective 4, an evolution of PSMS as developed in this research will be explained along with the rationale for its theoretical underpinning. Before proceeding with an explanation of the final model, attitudes of CAD port authorities will be assessed based on the initial versions of PSMS and summarised. To achieve objective 5, rather than merely to propose and evaluate a *model,* an actual system has been created and piloted. Concluding thoughts on both objectives 4 and 5 are deferred to the next chapter.

9.1.1 Addressing Ackoff's (1962) applied research criteria 2, 3, 4 and 5

Section 8.2 presented the notion of applied research and introduced six criteria by Ackoff (1962), the first one, and the first part of the second criteria were addressed in section 8.2. The following section addresses the remaining Ackoff's criteria, as outlined in section 8.2

Following the primary data analysis, early prototypes of PSMS v1 and v2 were created (2), where v2 was based predominantly on academic theory reformulated for practical application, and v1 was wholly practical. Through the use of further interviews and additional academic inquiry, both v1 and v2 were tested with several HMs (3) to determine their practical application and whether changes were required. Testing revealed that both PSMS v1 and v2 were impractical and had flaws that would have restricted their usage in the industry. PSMS v3 represented an easier visual representation of concepts and theoretical foundation of PSMS v2; however despite the changes it remained impractical. After further enquiry a solution was derived (4) in the form of PSMS v 4.1, which was reworked into v4.2 for ease of use. A number of adjustments were undertaken with a local HM and his environment manager to PSMS v4.2 and then into v5 to create a practical system for HMs across CAD to use daily (5). One HM who participated undertook several attempts at self-scoring (5). After this, the system was ready for wider implementation and testing at other ports (6). Dissemination to a wider audience of generic management tool in this project included further testing because it was not possible to develop PSMS with input from all HMs during each stage. Although it violates Ackoff's (1962) 6th criteria, his model related more to implementation than testing and this point is not problematic. The results in section 9.8 will outline that not much adjustment was required for PSMS to be a practical system based on the comments of pilot test participants who saw benefits in using it. Many participants did not see any faults in the current design of PSMS v5 and were happy to use it without any further changes.

9.2 Creation of first prototype of PSMS

Once the data were analysed, a decision was made to create a knowledge based system, rather than a prescriptive management tool in order to help address port sustainability on a generic level. Using the criteria suggested by Chan and Chao (2008 see chapter 6), the creation of the initial version of PSMS took place. For KM to be effective, the authors suggested a balancing of internal and external forces, which, combined with systematic deployment and SME understanding of time and effort required, was considered to result in effective KM (ibid).

From the outset, the input-output model by Dinwoodie et al (2012) which was developed as a result of the KTP between FHC and Plymouth University represented one of the possible ways generic level PSMS dissemination could take place, potentially even by updating that model (see Figure 4.1 chapter 4). Attempts have been made to use primary data and update the existing input output-model so that it could be applicable to other smaller ports. However, after having identified themes of sustainability from the GT analysis, a decision was made to ascertain how those could be used in creating a new system to assist ports with sustainability management rather than trying to update a system that was made using a specific port case study. For the first prototype of PSMS, the instinctive reaction was to integrate sustainability themes into the operational context of ports by focusing on MOs as per the initial view of PSMS and to test the reaction of HMs to such a system.

9.2.1 PSMS v1

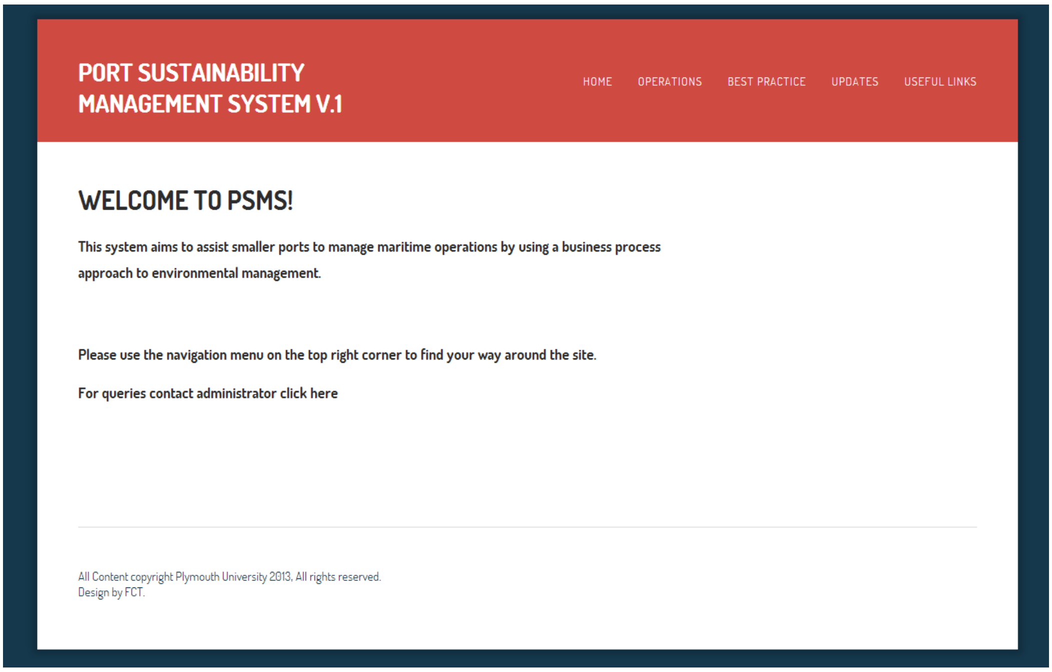


Figure 9.1: PSMS V1 - Homepage

Figure 9.1 shows a homepage of the PSMS v1 system which was created as a website to address issues of infrastructure and process capability after Chan and Chao (2008) and to make it into a practical knowledge based system. Figure 9.2 below indicates eight categories of MOs found in smaller ports in CAD excluding dues, which are an underlying factor of port commerce, rather than a separate operation. The idea was that by combining all accumulated knowledge from data collection and analysis and sorting it according to operation type, a useful knowledge bank could be created for ports to use daily.

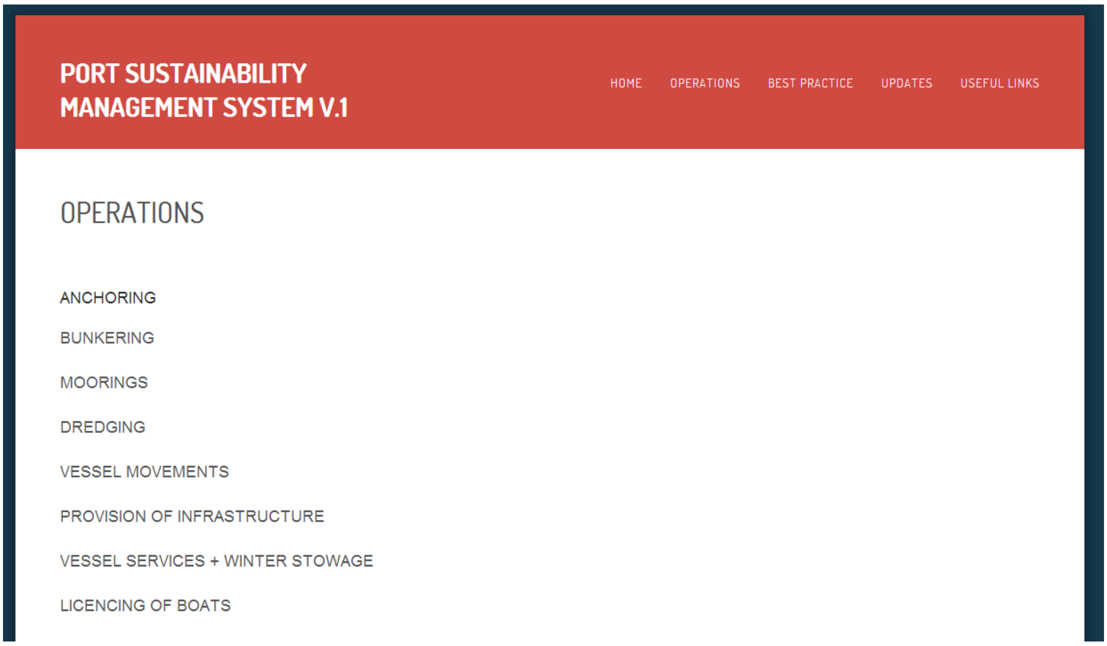
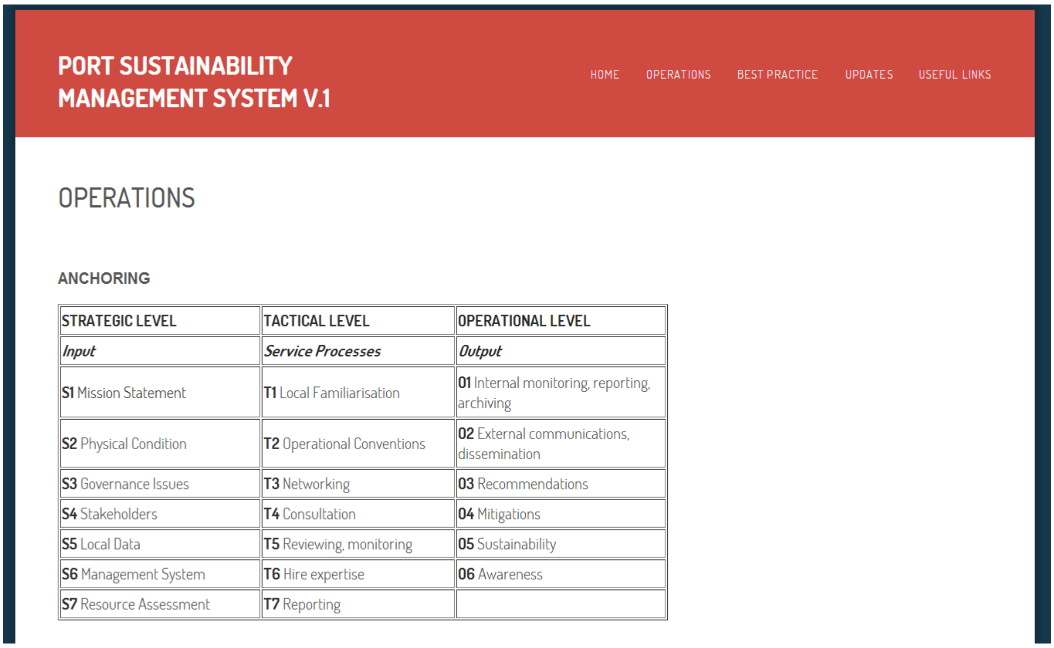


Figure 9.2: PSMS v1 - Operations

Figure 9.3 illustrates how each of the MOs was indented to be structured using the principle of, and the input output model from, Dinwoodie et al., (2012). The themes of sustainability outlined in figure 8.3 would have been incorporated throughout the concepts on strategic, tactical and operational levels.


PORT SUSTAINABILITY MANAGEMENT SYSTEM V.1

HOME OPERATIONS BEST PRACTICE UPDATES USEFUL LINKS

OPERATIONS

ANCHORING

STRATEGIC LEVEL	TACTICAL LEVEL	OPERATIONAL LEVEL
Input	*Service Processes*	*Output*
S1 Mission Statement	**T1** Local Familiarisation	**01** Internal monitoring, reporting, archiving
S2 Physical Condition	**T2** Operational Conventions	**02** External communications, dissemination
S3 Governance Issues	**T3** Networking	**03** Recommendations
S4 Stakeholders	**T4** Consultation	**04** Mitigations
S5 Local Data	**T5** Reviewing, monitoring	**05** Sustainability
S6 Management System	**T6** Hire expertise	**06** Awareness
S7 Resource Assessment	**T7** Reporting	

Figure 9.3: PSMS v1 - Detail of operational factors

9.2.2 Relevance of KM criteria

Based on the criteria for KM used to create PSMS v1, Table 9.1 below illustrates how the criteria suggested by Chan and Chao (2008) were addressed.

Key Infrastructure Capability Criteria Chan and Chao (2008)		**Application to PSMS v1**
Technology	**a)** Simple set of KM systems **b)** Sense of acceptance from people **c)** Continuous evaluation	**a)** Able to access on any device – non discriminative of older IT infrastructure **b)** The idea of joint action from the whole team – available for use by all port employees **c)** Incorporating knowledge from PSMS into daily operations and tracking progress
Structure	**d)** Self-learning and improving **e)** Encouraging more knowledge sharing **f)** Assigning clear responsibilities	**d)** Having quick access to relevant knowledge for daily enquiries about port sustainability **e)** Aimed not only at top level management, but at everyone who is either interested or needs to quickly locate and access certain information **f)** Delegation of responsibilities as a possible way of incorporating sustainability management into daily practice.

Culture	**g)** Management leading by example **h)** KM is not only jargon, but a course of action **i)**Sharing everyone's skills and knowledge	**g)** Open access to the PSMS for management to use for target and goal setting, and for staff to learn to incorporate new knowledge into their daily activities **h)** A practical system which contains relevant knowledge of port's commercial sources and which need to be safeguarded for long term sustainability. **i)** Sustainability is possible only through collective action. Using PSMS as a knowledge bank is a good starting point for collective action.
Key Process Capability Criteria Chan and Chao (2008)		**Application to PSMS v1**
Acquisition	**j)** Systematic capture, screening, categorisation and storage of useful knowledge **k)** Common discourse and unanimous understanding	**j)** By giving it to a port association, the idea was to have a dedicated person updating the website on behalf of a number of ports with relevant up to date knowledge to ensure maximum usability **k)** Demonstrating your rationale and communicating with the board and stakeholders using the knowledge based PSMS
Conversion	**l)** Converting own knowledge into something others can learn **m)** Promote creative ideas and innovative thinking	**l)** Incorporating mechanism of updating knowledge and using PSMS v1 as a starting point for each port to develop their own knowledge bank relevant to their operational specifics **m)** Converting and recording knowledge sparks creative ideas which can then be shared or stored in the knowledge bank(s)
Application	**n)** Employee rewards, e.g. incentives and recognition **m)** Knowledge experimentation from conceptual idea to practical action	**n)** PSMS v1 was intended as a framework for knowledge creation, recording and usage. Knowing exact level of contribution from a particular person is a starting point for rewards. **m)** The idea of trial and error – it can't be enforced, however having a knowledge bank from where ideas can be drawn, then results and experiences can be recorded.

Protection	**o)** Plans for preventing knowledge loss	**o)** Most ports have their own dedicated IT systems which are regularly backed up. Adding another digital source of knowledge to an overall backup system should not make much difference to usual operational procedures.
	p) Counter-measure for staff departure, e.g. rewarding, increasing loyalty	**p)** Staff departure can result in knowledge loss. Creating a more interactive and rewarding working environment by contributing together towards the capturing of, using, experimenting and improving existing knowledge can be a good starting point to increase staff loyalty and enhance knowledge retention.

Table 9.1: Application of Chan and Chao (2008) KM criteria to PSMS v1

Source: Author

After conducting interviews to test the applicability of PSMS v1, issues regarding the ownership of knowledge, cost associated with security and storage and availability of technical specific knowledge relevant to a particular harbour emerged. The principle of a website based system gave rise to some reflection on the issues from one HM when interviewed and this subsequently contributed not only to the evolution of PSMS, but also to a wider research impact.

> "The design you have done there, although I wouldn't take those headings necessarily, that has given me some food for thought in terms of how we are going to progress some of those ideas" (HM in Cornwall, 2013).

In the same discussion of what the HM in Cornwall thought PSMS should look like, the following response was given:

> "I think everyone envisaged this to be some sort of environmental device platform. I don't see that as something that we would necessarily see it as and that really we would see the environmental advice coming out of our own management system type approach. It's actually the overall sustainability agenda is driven by the management processes and the culture of the organisation that you got, which is a difficult one to address. It isn't addressed at a HM level; it is addressed much at board and cultural level" (HM in Cornwall, 2013).

The point about organisational culture was then explored further by discussing the practicality of such a system. A very important answer followed which has helped to understand why there has been no similar system developed, considering the vast amounts of knowledge HMs possess:

> "…it's how you encourage people to contribute, and that has been a big problem in other best practice example" (HM in Cornwall, 2013).

When other HMs were interviewed about the PSMS v1, their comments were related mostly to what needs to be changed for a particular HM to use it, instead of the longer term usability by smaller ports in the region. The quote below is an illustration of what HMs perceived to be a useful system for them:

> "If you take dredging for example, if you have a designation you need to consult Natural England… So you could have the latest version of the form in there and it's there in the system so you draw it down, fill it in and send it off. And alongside it is some methodologies, where I can do removal, I got a new method now where provided the tide is coming in, we can use the fire hose and suspend the solids and move it from operational area somewhere else- another quirky methodology and it's not involved disposal or we are going to go for this environmental permit which is above mean high water and we can have a free 1000 tonne disposal for beneficial construction use. So here is the permit, that's the name of the permit, you need to speak to your local office, do this and that" (HM in Cornwall, 2012).

Dredging differs in methods, costs, scales, physical constraints, and on a number of other factors, so if a specific dredging protocol was to be put on the website it would probably be directly relevant to few ports, and others would have to make adjustments to it, which would defeat the purpose of a knowledge bank that PSMS v1 was intended to be.

9.3 Evolution of PSMS

Following on from the knowledge based system, i.e. PSMS v1, the next version aimed at addressing the strategic aspects of ports with the view that every port is different and capturing all process variations in one knowledge bank would not be possible. Based on what was said during the first round of testing about some HMs being a “one man band”, and about difficulties encouraging others to contribute and share best practice, the direction of PSMS took a radical change, from a knowledge based system to a strategic guide based on the elements of knowledge. This led to the evolution of further versions, which are explained next.

9.3.2 PSMS v2

The figure in Appendix F is based on the principle of Ishikawa Diagrams which is aimed at identifying possible causes by conceptualising them using a fishbone type structure (IMS international, 2013). Although designed to test industry’s reaction to theoretical management systems, this method has helped to visually map out the complexities associated with effective Business Process Management (BPM). Having ascertained that causality was not possible to be established for many port operations, this principle was applied to illustrate potential relationships and influencing factors due to enhanced visual representation. The theoretical aspect underpinning the context of PSMS v2 in Appendix F was the business process approach from Michael Hammer (2010:5) aimed at attempting to define “end to end processes” which he stated that many organisations lacked. The sections below will outline a short background regarding the suitability of BPM and

BPR as chosen methodologies and the credibility of Michael Hammer's views on the subject area in order to justify basing of PSMS v2 and v3 on BPM principles.

Following the disappointing results of BPR ventures from the mid-1990s, BPM attracted extensive corporate attention with some heralding it as the successor of BPR (Ko, 2009; Ko et al,. 2009; Yen, 2009; Hammer, 2010 cited in Choong, 2012). Choong (2012) conducted an in-depth literature review surrounding the topic of performance measurement systems and discovered confusion between measurement tools which include BPM, BPR, and business processes. Although the exact roots of BPM are debateable the aim of this methodology is clear. Reflecting on 18 academic works, Choong (2012:541) summarised BPM as a "holistic management philosophy that uses a systematic approach and IT to improve processes that focus on aligning all aspects of an organisation with the wants and needs of the customers". After revisiting sources suggested by Choong (2012), 17 out of 18 articles were accessed, with 8 using at least one reference to Hammer's individual or co-authored work to substantiate an argument. Seventeen citations of Hammer's works from 1990-2010 were found. As a vocal advocate of BPR in the 1990s, Hammer (1990) had questioned organisational structures and suggested reasons for major inefficiencies.

Ung et all., (2007:638) used Six Sigma approach as a statistical measure of analysis aiming to improve the efficiency of port operations and concluded that compared with the manufacturing industry where Six Sigma was originally developed, its implementation into the ports sector "may not be as easy". Improving efficiency was subject to increased level of customer satisfaction and awareness of the improved quality of port security measures (ibid). The notions of efficiency and strategy have been the driving factors behind PSMS v2 which outlined to the HMs the requirements of satisfied customers, components of effective processes and a strategy for measuring results (see Appendix F). The evolution of PSMS v2 is explained next.

Figure 9.4 illustrates the essential process management cycle as demonstrated by Hammer (2010) where the process begins at the bottom of the figure with creation of a formal process. The reason behind choosing this particular methodology was the emphasis that Hammer (2010) placed on the importance of end-to-end processes within a BPM framework which creates customer value across an organisation, which coincides with the definition provided by Choong (2012:541) of a "holistic management philosophy" that focuses on putting customer first and thereby aligning all organisational needs with those of their customers.

After setting up a process, the next stage is to manage it with regards to customer needs and requirements for the company (ibid). If the set targets were not met, the next step would be to establish the reason for it, whether there was an error in the design or in execution. If the process design was at fault, does it get updated or restructured (ibid)? When execution is at fault, a cause of it needs to be established to allow for corrective measures take place so that results can be measured and cycle could start again(ibid).

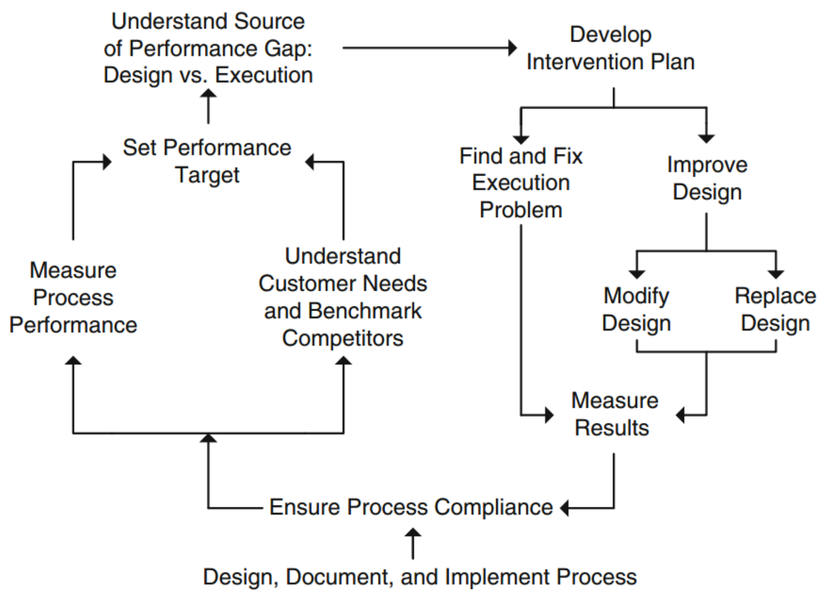


Figure 9.4: Process Management Cycle

Source: Hammer (2010)

This process is based on the Deming's (1986) PDCA cycle (chapter 2) with the addition of the "attention to process design" (Hammer, 2010:6). The value of this cycle lies in the idea that performance of an organisation and customer value is created through the management of "end-to-end processes" and not by "trial and error, pushing people harder and not through financial manipulation"(ibid:6).

The main principle of PSMS v2 conceptualised in Appendix F is underpinned by the "iron triangle" consisting of customers, results and processes, which Hammer (2010:6) referred to as elements which an organisation has to be equally serious about, rather than focusing on one or two. Such a rationale was explained by saying that customers "care about one thing only: results", which are not a consequence of "managerial genius; they are the outputs of business process, of sequences of activities working together" (ibid:6). The quote from Hammer yet again highlights the role of collective action, and how much results depend on effective managerial collaboration. The top end of the triangle in Appendix F is based on the wishes of local communities identified during the data collection stage, which are essentially based on keeping the status quo, and wanting to be consulted on every minor project which was related to port development. According to Hammer (2010) customers care only about results, and based on that the bottom left corner in Appendix F conceptualised process management cycle illustrated in Figure 9.4. The causality type approach using Ishikawa Diagrams was implemented simply to illustrate relationships and influencing factors, and not the actual cause and effect. The cycle in Appendix F was broken down into elements and each assigned a specific number from 1 to 6, and the circle with numbers from 2 to 6 symbolises a process of continual action, once the step (1) of *designing, documenting and implementing the process* was addressed. For the processes to be successful, they have to be properly designed, and the "managerial genius" that Hammer (2010) referred to is a result of that. Hammer (2007:3) identified "five critical enablers for a high-performance process", which are essential for process to operate sustainably, superficially process design, metrics, performers, infrastructure and owners. Key concepts from each of the five process enables have been conceptualised in Appendix F, along with influencing factors for several of those. Having explained the components of PSMS v2, the next section will outline the responses received during industry testing.

PSMS v2 has strong theoretical foundations of a business process approach and was intended to serve as a strategic guide for senior management to use the principle and apply it to the operations within their ports. A key element emphasised by Hammer was the idea of collective action, and for that reason the principle of PSMS v1 i.e. the knowledge bank was thought to be a possible addition to PSMS v2, i.e. for both systems to work in unison, however not on shared, but on an individual basis. Having a strategic map for processes would require quick access to knowledge for those processes to be successful, which differs between ports based on a number of variables. Starting with a strategic tool for improving organisational processes, an organisation would as part of (1) *designing, documenting and implementing the process* as per Appendix F, document their processes and create a relevant knowledge bank as it goes through the cycle of process management.

The general view conveyed by the experienced practitioners this version of PSMS during testing was very well summarised by one HM:

> "I think it is an academic level summary; it doesn't take into the account the way the operators see their particular role. I don't think there is something wrong with it, it's a question whether that is a useful output in terms of distribution as far as this project" (HM in Cornwall, 2013).

At this stage both PSMS v1 and v2 had issues with practicality, in the case of the website the difficulty was encouraging others to participate, and the triangle i.e. PSMS v2 was deemed to be overly academic. To make PSMS v2 less academic, its layout was changed into a loop, conceptualised as PSMS v3 (see Appendix G).

9.3.3 PSMS v3

PSMS v3 added links between the sides of the "iron triangle" which were not specified in v2. One idea for improving PSMS v2 was to provide more explanation of academic theory and to test its usefulness for practical application.

> "That's the sort of business training model and actually there aren't that many HM who would instantly see how to apply that within their organisations and their operations I don't think. I don't think they would relate well to that" (HM in Cornwall, 2013)

The quote above illustrates well the traditional port structures (chapter 3) related to safety and risk management, and not business process planning. However, after further inquiry, one HM in Devon said that he used a similar loop principle for safety:

> "I do something very similar with my safety management system, it's a loop. You look at the end result, you measure if you are achieving it and you come back and see how you are going to tweak it, and it's a constant loop going around" (HM in Devon, 2013).

What the transition from PSMS v 2 to v3 has indicated is that there is scope for academic theory to inform operations within the ports sector; however it needs to be practical. The popular beliefs that academia and industry do not mix have been challenged by several of the statements above, and indicating that the core principles of some academic theories can be traced back to the industry, i.e. using principles of loops in safety management and using results to improve process functionality and performance as indicated in the quote below:

> "I tend to try and work from my end – the result I want to achieve and try and work back from there" (HM in Devon, 2013).

The experiment of using the sustainability themes which emerged from data analysis and collection as areas of organisation that needed to be looked at using a theoretical based strategy was not successful. Several quotes illustrated above and most importantly the full discussions regarding PSMS v2 and v3 with experienced practitioners have helped the author's view of ports to evolve and move on to a higher level of abstraction. Having discovered that there was scope for academic theory in the daily operations of smaller ports, the next version of PSMS used widely accepted academic theory also used by the ports industry as a foundation for a self-assessment strategy, which is discussed in section 9.5.

9.4 O4 – Attitudes of CAD port authorities towards PSMS

During the data collection stage, based on the understanding at the time of what PSMS might look like, preliminary views of CAD port authorities were assessed and analysed. In order to understand the attitudes of CAD port authorities towards PSMS, it is important to understand the views of CAD port authorities towards issues which either relate to, or can affect the use of, PSMS. The category of *barriers to implementation* (see Appendix H) refers to the earlier views of PSMS i.e. a tool that would help unlock resources using EM as a business process and enable more sustainable port management. The attitudes of CAD port authorities towards PSMS will be discussed in section 9.7 following industry testing of PSMS v5.

The attitudes expressed in Appendix H refer to ports having to use another mechanism for EM to supplement current statutory and voluntary compliance systems. Nine categories of attitudes were identified from primary data (see Appendix H), all of which could influence the HA's decision to engage with voluntary environmental mechanisms in order to contribute to longer term sustainability of the harbour. The categories are: commercial decisions, change, governance, community, barriers to implementation, sustainability management system, sustainable development, port sustainability, and EM. Despite several ports in CAD in relatively close proximity, the attitudes of HMs who run them and their communities are very dissimilar. Two adjacent ports expressing their opinion towards change included one saying that it did not want to change and the other that it could not continue the way their grandfathers did and signifying the importance of change for port sustainability (see category *change* in Appendix H).

To better illustrate a sample spectrum was constructed. Figure 9.5 is a graphical representation of one category of HM's attitudes from Appendix H. Similar graphs have been created for attitudes towards sustainable development, sustainability management system, change, and port sustainability. However no clear patterns were apparent. The numbers in Figure 9.5 refer to the concepts under the same number outlined in Appendix H, which have been divided into three boxes with an associative connection between them indicating that each of the three boxes are of equal weight and value and do not influence one another.

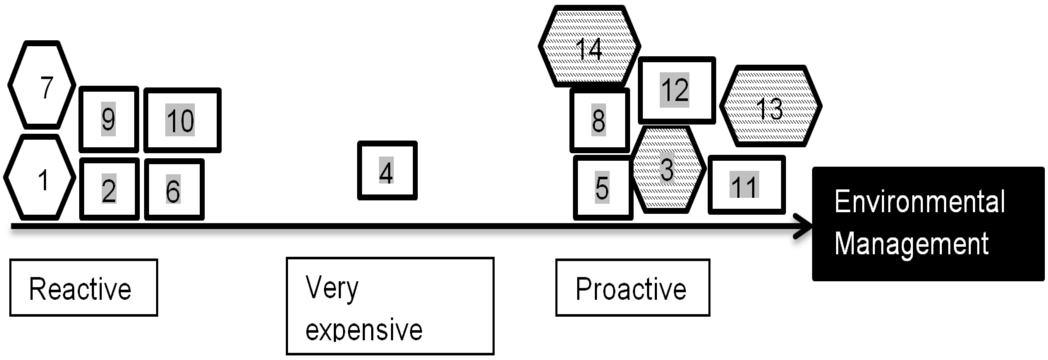


Figure 9.5: Attitudes of HMs towards EM

Source: Author

Figure 9.6 below represents a legend to understanding the meaning of shapes and shading in Figure 9.5. An interesting pattern can be seen in Figure 9.5 which is that all smaller ports which have commercial cargo based activities in their harbours (i.e. dashed downward diagonal pattern) are being proactive about EM in their thinking, approach and implementation. That is not to say that all ports without commercial traffic pay less attention to the environment, but rather that they have mixed views about EM. For instance, concepts 5, 8, 11, 12 are municipal ports with leisure services (black thick frame) and fishing (grey highlight) as their main sources of revenue have adopted a proactive stance towards EM, whereas concepts 2, 9, 6, 10 which fall under the same categories of municipal ports with leisure and fishing industries are currently reactive towards environmental issues. Similar division of opinions and views is present with all other categories of attitudes.

Figure 9.6: Legend to Figure 9.5

Source: Author

As established in previous theoretical frameworks throughout this thesis, influencing factors can significantly impact port operations, can be out of the control of the port authorities, but must still be complied with. This could be one of the explanations for the difference in the views of municipal ports with leisure and fishing industries towards EM, as demonstrated in the example above. The considerable differences in views reflect how different ports are, and the reason why attitudes to PSMS were difficult to measure until a functional system was created with an intent to test its functionality and applicability to the ports industry.

This section has demonstrated HMs views towards various influencing aspects of port sustainability. Appendix H provides a contribution in the form of an anonymised taxonomy of HMs opinions that was not altered to suit any political agendas. These opinions reflect the current state of the smaller ports industry and highlight a number of strengths and weaknesses, some of which could threaten future sustainability of smaller ports in CAD.

9.5 Evolution of the final version of PSMS

Having taken into account the attitudes of HMs towards PSMS, EM and sustainable development, the creation of the final model of PSMS began by addressing very important aspects to ports - practicality. Using the notion of applied research which is to apply relevant knowledge as specified earlier in the chapter, an attempt was made to combine principles of TBL which ports are very familiar with and assign various levels of significance to each of the TBL dimensions by creating a chart.

Figure 9.7 represents a significant shift in thinking from trying to apply a theoretical model i.e. Appendix F and Appendix G; to creating a practical model based on theory. Figure 9.7 outlines functions that HAs have to undertake in order to evolve in a sustainable way, namely to be an environmental body, a business and an integral part of the community. The idea of concentric circles was used for easier representation along with the green, blue and red colour schemes for environmental, social and economic aspects of TBL respectively. Having presented PSMS v4.1 to the collaborative partners during its very early stages, a suggestion proposed combining the sustainability themes with the mechanism of self-scoring into a new system without the TBL principles. The intended aim for PSMS v4.1 was to act as a strategic mapping tool to assign goals and priorities based on the level of importance. For instance complying with statutory legislation takes priority over desirable compliance from the HA's point of view. The idea was to assign different criteria for each of the cells in figure 9.7 for port managers to score themselves on, however as previously explained, PSMS v4.1 was never finished, and exactly how and which sustainability themes would have been integrated into this process was yet to be determined. Despite that, the visual representation of PSMS v4.1 was used to create what would be the final version of PSMS.

Figure 9.7: PSMS v 4.1

Source: Author

9.5.1 Final version based on theory

PSMS v4.2 (see Appendix J) combined suggestions offered towards the unfinished v4.1 as listed above together with the element of practicality. A series of significant changes to v4.2 included a colour scheme resembling a “bull’s-eye target” with the aim of getting as close to the middle. Sustainability themes from Appendix E have been added to this version of PSMS, some of which were divided into two concepts to avoid excluding data and imposing bias.

The principles of Greek philosopher Hierocles regarding concentric circles stated that we should not “see ourselves as devoid of local affiliations, but as surrounded by a series of concentric circles” (Nussbaum, 1997:9). “The first is drawn around the self; the next takes in one's immediate family; then follows the extended family; then, in order, one's neighbours or local group, one's fellow city-dwellers, one's fellow countrymen" (ibid:9). The principle of care and attention relates back to PSMS scoring, e.g. one would place more care and attention to self and immediate family, compared to city-dwellers. So the closer to the centre of the "bull's-eye target" one wants to score a particular sustainability theme, the amount of effort required to do that would increase.

The scoring process of PSMS v4.2 would have commenced in Appendix K where the detailed criteria are listed for each of the sustainability themes identified. It is important to note that these criteria emerged directly from the primary data analysis, and only the titles of themes were created based on the most common elements that combined a number of criteria together.

Having selected an appropriate score for a particular theme, the goal was then to place the acronym for a given sustainability theme (see Appendix J) onto the "bull's-eye target" model based on the score given. An example has been demonstrated in figure 9 in Appendix J with the first four criteria of how that would have looked like.

Another important part of PSMS v4.2 was the Table in Appendix J which combined a number of columns, all of which were designed with a particular purpose in mind. If used regularly, for instance quarterly, to avoid interrogating archives and looking for previously assigned scores to compare a port's performance, HMs would be able to write figures on one sheet of paper, offering an element of practicality. It was also important to explain the purpose of the columns *goal* and *grade* which referred back to the idea that each of the harbour functions should try to achieve one of the three harbour goals identified at the end of Appendix K along with the grade achieved. This idea has not been accepted as practical by the collaborative partners and was included into this section only to demonstrate the full evolution of PSMS.

The issue of inclusivity was also addressed by creating an electronic version of PSMS using Microsoft Excel spreadsheet aimed at ports moving away from paper record keeping and going digital. An extract of the electronic version is of PSMS has been illustrated in Appendix L. The spreadsheet was zoomed out in order to include all columns and to demonstrate that no extra modifications have been made and that both systems were almost identical. Because the transition stage between versions 4.2 and the final version was fairly quick, digitally generated charts i.e. spidergram and bar chart were not created for this version, but were planned to be included in the final system to allow for an easier representation of the scores assigned during self-scoring.

Comments received noted that a number of specific cases that have been incorporated into the creation of PSMS v4.2, for instance the collapse of quay wall under INSC score 1 (see Appendix K). A suggestion was put forward to reword certain criteria with the view of being applicable to all harbours, rather than being based on specific examples of the few.

> “The moment you start putting clear definitions and clear distinctions based on individual cases it becomes much more

difficult to use and people think why should I bother?"(HM in Cornwall, summer 2013).

The positive comment relating to the overall structure of PSMS v4.2 so far reads as follows:

> "You are really on to something here; I think in terms of coming up with a tool it's very good. There needs to be more work done in actually defining those questions, so that they can genuinely fit to all those people who might be trying to undertake this questionnaire. Certainly the way you have broken down the sustainability themes is right" (HM in Cornwall, summer 2013).

9.6. PSMS for smaller ports in CAD

A number of modifications were made to PSMS v4.2 based on theory, to make it into a practical tool that HMs could use Appendix M illustrates PSMS v5, the final version. Noticeable differences in v5 compared to v4.2 include colour scheme, reworded terminology of sustainability themes and criteria.

The rationale for changing the colour schemes was to discourage somebody scoring 2 instead of 1 to avoid being "in the red" on one of the themes. A more neutral colour scheme follows the principle of evolution from a "grey area" in the outer circle, to a bright green symbolising sustainability as the inner circle of PSMS v5. The core concept in the middle of the "bull's-eye target" model was reworded from Evolving HarbourMastering (Chapter 7) which makes perfect sense from a theoretical standpoint, to Evolving Sustainable Practices in Smaller Ports. The main reason was to avoid confusion and to have a clear statement which would identify the rationale.

A second important change was to reword the headings of sustainability themes suggested in PSMS v4.2, as some of them were conflicting with terminology used for marine safety, and some were not easily understandable. Safety of Life was reworded into Safety Management (see Appendix J and 10) to avoid confusion with SOLAS (Safety of Life at Sea) which is an international safety convention (IMO, 2014). All other concepts from Appendix J have been reworded to allow for easier understanding by everyone, e.g. *Infrastructure: Structure and Conditions,* and *Infrastructure: Efficiency* were combined into *Asset Management and Maintenance*. Similarly, Community Engagement: Harbour User and Community and Community Engagement: Governing Bodies were combined into Stakeholder Engagement. From an overall number of 13 themes present in PSMS v4.2, the final version of PSMS v5 combined 11 themes which have been presented in TF6 in chapter 5 (see Appendix E and Appendix K).

The most significant changes came in the form of adjusted criteria for each of the sustainability themes (Appendix N). Comments regarding the specificity of concepts in PSMS v4.2 (Appendix K) were addressed by retaining some criteria in more generic form i.e. as examples for selected categories in PSMS v5. Compared to PSMS v4.2, where specific examples served as the foundation for some scoring criteria, the modified examples have now been incorporated into PSMS v5 in the form of action plans (see Appendix N). Whilst having a generic enough statement that would describe a very similar situation in fewer words, having the presence of examples and actions plans in the nearby column allows for a better correlation between the criteria provided in PSMS v5 and the situation in port(s). Combined with reworded statements for each of the sustainability themes, PSMS v5 was more inclusive.

9.6.1 Conducting the PSMS self-appraisal

Being predominantly aimed at HMs and their EMs, PSMS v5 was designed as an internal strategic tool to help appraise sustainability practices in the harbour they were responsible for. Its aim is to allow HM's and/or EMs to define where they are within the parameters of their operations in order to set targets and make plans for progress. It combines eleven themes of harbour operations which, if taken together, make up harbour sustainability. This system is based on the real issues identified from thirty hours of interviews and continuous collaboration over a period of two years. Since it was very difficult to find targets that would fit more than one particular port, conducting a self-appraisal and creating and incorporating your own targets into your port management plan was seen as one way forward. This tool was intended to support HMs in their work and not to put additional pressure by judging ports and their performance based on the scores assigned.

The scoring process of self-appraisal commences by reading through the list of criteria for each of the 11 sustainability themes (see Appendix N) and selecting the score which most appropriately represents the current situation in the harbour. After all scores have been assigned, the cover sheet (Appendix M) provides the user with the facility to input all scores into one table. The next step is to input scores assigned to the "bull's-eye target" chart (Appendix M) and to connect the dots. The finished result should look similar to the example illustrated below in Figure 9.8, however the example below is based on random figures generated solely to illustrate. When used by practitioners scores on the other 10 categories can vary considerably, aside from scoring reasonably high on Safety Management (SM) because it forms the foundation of port management.

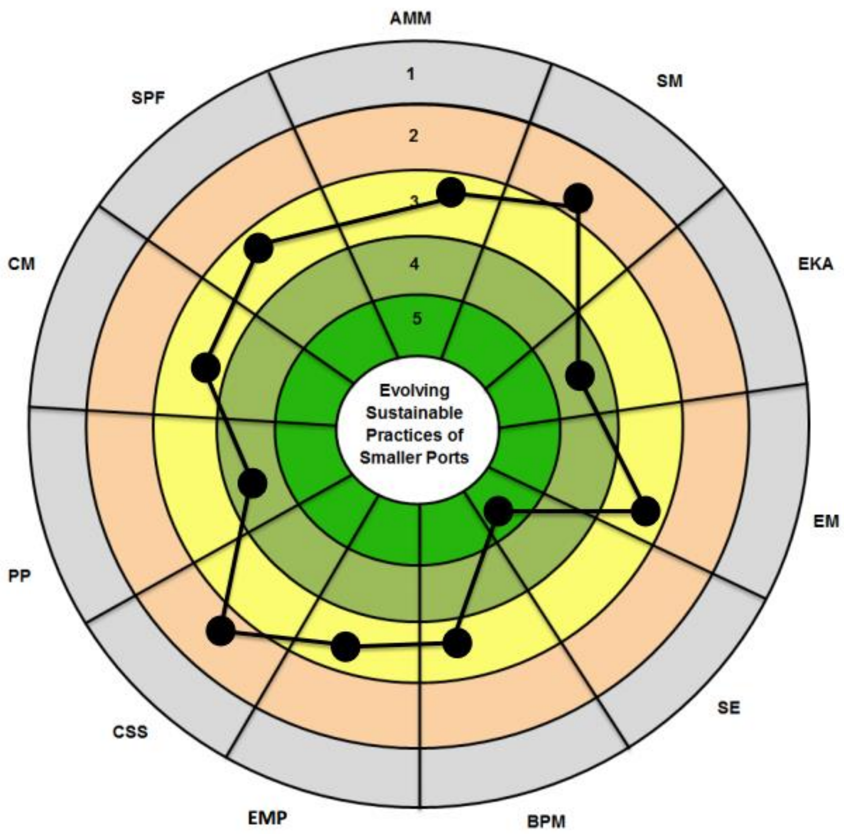


Figure 9.8: Example of PSMS v5 scoring

Source: Author

After completing self-scoring, the next step is to assess whether one or several categories require immediate attention and should therefore be included into short-term action plans. During the creation process, the main benefits of using PSMS v5 were estimated to be generation of knowledge and awareness, the ability to assess a port's performance in a very short space of time, and if used over time, to be able to compare a port's performance with the same time in the previous year or a different selected period.

If the score assigned was lower than expected or a HM wanted to improve the element of sustainability for a particular port area, the scoring criteria in Appendix N could also serve as a bank of knowledge for HMs and their colleagues to know which direction to strive towards to score higher and be more sustainable.

9.7 Conducting a pilot test

Table 9.9 outlines the questions that were asked of all participants. These criteria were established in mid-October 2013 at the start of the pilot test and remained throughout. Participants had a choice of either using the electronic version in MS Excel, or the hardcopy version in PDF that required printing and sending back by post.

During the first phase of testing, i.e. the mass communication to members of SWRPA (see Table 6.8), only 6 responses were received indicating various uses for the system from all governance types of ports with only one respondent not seeing any benefits in using PSMS. Such a positive initial reaction served as a catalyst for further inquiry to get a bigger and more representative sample size. Interestingly everyone who did PSMS scoring in the first phase opted for the electronic version in MS Excel rather than the hardcopy version in PDF. One of the main reasons for a small response size, as discovered later, was the necessity to read the instruction sheet attached with PSMS testing files in order to get a better understanding of what PSMS was about and to be able to conduct the self-scoring accurately (see Appendices O - R).

During the second phase of testing, i.e. visits to a number of small regional ports which took place during the last week of January 2014, a quick fact find and an explanation of the system was provided by the author followed by a request for the HMs to score their port practices as they currently stood. All HMs were asked to score as accurately as possible and were reassured that information received would be used strictly for research purposes regardless of the scores provided.

1) Which version of PSMS have you used? (electronic/hardcopy/both)
1a) Which version of PSMS are you likely to use in the future? (electronic/hardcopy/both)
2) What were you hoping to achieve from using PSMS?
3) Please describe your experience of completing a PSMS self-appraisal regarding for example
3a) Its relevance,
3b) Its ease of use,
3c) Its comprehensiveness,
3d) Did it help you to think about issues?
3e) Did it raise new issues?
3f) Did it offer new insights?
3g) Any other issues?
4) What benefits do you see in using PSMS in your port?
5) What problems did you find with the current design of PSMS that need to be immediately addressed?
6) What is your reaction to PSMS as a strategic self-appraisal tool of harbour sustainability practices?
7) Would you use this system regularly? (E.g. scoring your port annually?) If so, for what purposes?
8) Under what circumstances might you share your average index with other HMs?
9) Would you require further assistance in using PSMS?
10) Would you be interested in attending a dedicated workshop to discuss the potential use of PSMS, and issues related to its efficiency, usability, and feedback?
11) Are there any additional comments you would like to add?

Table 9.2: PSMS testing questions Source: Author

Some questions were asked during testing, specifically related to the exact application of several concepts to sustainable port practices in order to provide the most accurate scores. The immediate feedback from those HMs who were part of the second phase of testing was a surprised positive reaction, for example:

> "I'm hugely impressed with the fact that you have 11 headings that none of them I'm looking that is not relevant – they are all relevant. I think that's captured the issues about running a sustainable harbour really well" (HM in South West, 2014)

Similarly, one HM in Cornwall gave the following comments after completing the pilot test during a second phase visit to his harbour:

> "I think you've done a phenomenal job of getting it all together. It's a difficult thing to do, because as you say all ports and harbours are different. Very difficult to try and find common criteria that people can mark on" (HM in Cornwall, 2014)

Having received 9 more responses from the second phase of testing, the final sample was set at 15 ports in Cornwall, Devon and SW. A total of 7 trust ports, 6 municipal and 2 private ports made up the respondents sample of PSMS testing. Out of the 7 trust ports, 4 were based in Cornwall, 2 in Devon, and 1 close to Devon. Out of 6 municipal ports, 3 were located in Cornwall, 2 in Devon and 1 close to Devon. The 2 private ports which responded were both based in Cornwall.

Appendix S summarises the results of testing against the questions asked to the HMs. A total number of 11 questions with some sub questions resulted in 18 different questions and parameters of PSMS being assessed during testing. Predominantly descriptive or nominal data was generated as a result of PSMS testing as that data is "impossible to define the category numerically or to rank it" (Saunders, et al., 2012:475). The essential criteria for nominal data are to be "unambiguous and discrete" i.e. addressing "one particular feature" at a time (ibid). Such clarity and simplicity i.e. only being aimed at one issue at a time serves another purpose which is to avoid questions being asked regarding "which category an individual case belongs to" (ibid:475). The second type of data generated as a result of pilot test was ordinal, or ranked data, specifically for questions 3a, 3b, 3c and 3d which asked participants to give their view regarding a specific criterion (see Table 9.2). The idea of ordinal data is the ability to place data sets in rank order (Saunders, et al., 2012). This ability to rank more than 2 sets of data is what differentiates nominal and ordinal data (ibid). The more common use of ordinal data would be to ask participants how strongly they agreed or disagreed with a given statement and then to rank the answers received (ibid). In order to allow for richer data to be gathered, a variety of different types of question e.g. open ended, specific, and closed questions were asked to maximise the use of testing data received. For that purpose participants were not asked to agree or disagree with a statement, and provide their views on a particular issue, which generated interesting discussions, and much richer data emerged.

Measuring nominal data is only possible by offering "names or labels for characteristics" (Babbie, 2009:143), and by counting the "number of occurrences" for every category or variable (Saunders, et al., 2012:475). Appendix S illustrates the conceptualisation of pilot test answers as graphical representations, which combined the same or very similar answers under an umbrella that was assigned a particular tag. Four questions structured in the way of ordinal data have also been graphically represented, since ranking only of those answers would not contribute towards new knowledge.

9.8 Pilot test results

For inference purposes, three governance types private, trust and municipal have been illustrated on each graph to show the differences in priorities, opinions and attitudes for each of the port governance type interviewed. After collating answers according to groups and computing frequencies 20 charts in Appendix S summarise responses to the 18 questions. The additional two charts summarise benefits and purposes for questions 4 and 7 respectively. Figure 9.9 summarise responses to question 1 which asked participants which version of PSMS they have used during testing. The results have been plotted according to port governance type and the chart legend acts as a map that helps the reader to navigate around various colour schemes which range from two to five per single chart. The colour scheme consistencies were maintained throughout the charts, with *blue* and *yellow* colours representing the first and the second variable colours and are present on every chart in Appendix S.

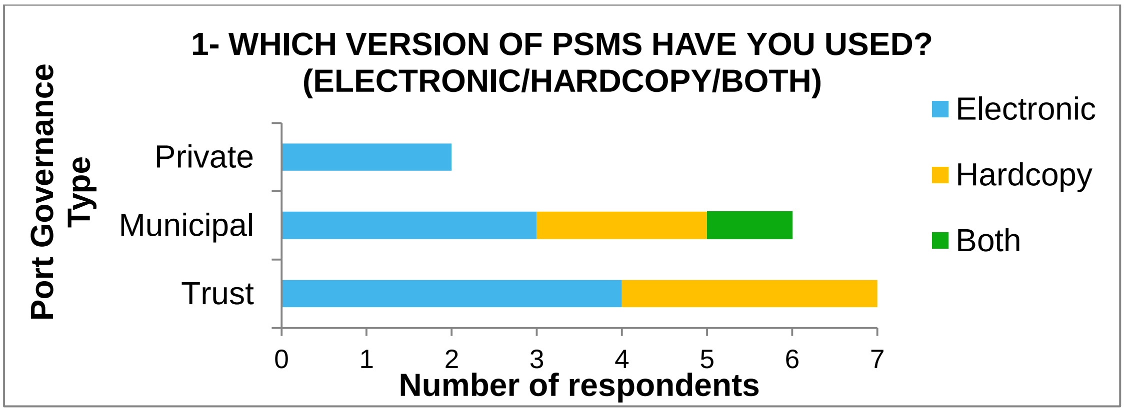


Figure 9.9: Example of PSMS Pilot test analysis

Source: Author

The maximum number of respondents was 15, i.e. 7 trust, 6 municipal and 2 private ports; but the maximum “number of port respondents” as indicated on all charts in Appendix S is only 7 the maximum number of respondents per port governance type.

The next section presents findings and inferences that have been made from the charts in Appendix S.

9.9.1 Findings from testing questions

It is not unexpected for questions to have different levels of significance to the pilot test, as some merely establish the functionality and usability aspects of the system, whereas others aim to identify benefits and conceptualise opinions of users. The following section discusses answers to all questions of the pilot test, and since the level of significance varies among questions, so will the emphasis and depth of analysis for each of the category of answers received. For all charts please see Appendix S.

Question 1: Which version of PSMS have you used? (electronic/hardcopy/both)

- 4 out 7 trust ports; 3 out of 6 municipal ports; and 2 out of 2 private ports opted to use an electronic version.
- 3 out of 7 trust ports (43%), 2 out of 6 municipal (33%) and no private ports used the hardcopy version.
- 1 out of 6 municipals (17%) opted for both, electronic and hardcopy during testing.

The significance of these findings indicate that the issue of inclusivity has been successfully addressed by creating PSMS in different formats to allow HMs to decide which they are more comfortable using. Unlike many management systems this offers sufficient flexibility to allow choice for the user. The spread of answers indicates that despite the digitalisation of information for easier access, “greener” credentials, and longevity of storage, some still preferred a paper version.

Q1a: Which version of PSMS are you likely to use in the future? (electronic/hardcopy/both)

- 5 out of 7 trust (71%), 4 out of 6 municipal (67%), and 2 out of 2 private ports (100%) indicated that they will use electronic version of PSMS in the future.
- only 1 out of 6 municipal ports (17%) indicated further usage of a hardcopy PSMS system
- 2 out of 7 trust (29%) and 1 out of 6 municipal (17%) indicated they will use both versions for future self-scoring using PSMS.

Unlike the scoring process, where overall 5 participants used hardcopy version, only 1 has opted to use the paper system in the future. Various reasons can be attributed to that, including familiarity with the process of PSMS self- scoring, still going through the process of digitalisation and preferring hardcopies of management tools to the virtual ones, etc. This question indicates that even those HMs who preferred to use paper are going through the evolution of change and have accepted that in the near future using electronic formats would be the best way forward.

Q2: What were you hoping to achieve from using PSMS?

Out of the five criteria depicted on chart no.3 in Appendix S, three indicate a potential benefit; one shows the open mindedness of HM towards a new management tool; and the 5^{th} indicates that no answer was provided.

- 4 out of 7 trust (57%) and 2 out of 6 municipal ports (29%) stated they were hoping to get an overview of the current harbour performance to have a better understanding of their strengths and weaknesses.
- 2 out of 7 trust (29%), 3 out of 6 municipal (50%) and 1 out of 2 private ports (50%) were hoping PSMS would contribute towards improvement of port management functions
- 1 out of 6 municipal ports (17%) was looking for utility, i.e. exploring possible uses of PSMS

An almost equal number of ports in percentage terms combined (86% for trust, and 83% for municipal) identified benefits relating to either improvement or harbour performance. A possible conclusion is that more trust ports (4 trust or 57%, compared to 2 municipal ports or 33%) are confident in their level of improvement and are interested in viewing their port's performance to know which areas to improve, rather than finding new methods of doing so. When looking at improvement as a process, 3 municipal ports or 50% compared to 2 trust or 29% were hoping for new insights from PSMS. This second inference complements the conclusion about more trust ports looking for ways to assess port performance and identify weak and strong areas which is a performance breakdown, compared with more municipal ports being interested in making improvements to their overall management of the port. As for private ports, one was also interested in improvement, and the other wanted to visualise outside opinion which could have been related to any of the other categories e.g. outside opinion on how smaller ports perform, outside opinion of what is required for smaller ports to improve; however it was left as a standalone answer to highlight the diversity of answers.

This observation for further enquiry (OFQ) can be formulated as follows:

OFQ1 – Trust ports are more advanced than municipal ports with regards to process improvement and more trust ports seek new ways of measuring their current performance, rather than identifying new ways of improving it.

Q3: PLEASE DESCRIBE YOUR EXPERIENCE OF COMPLETING A PSMS SELF-APPRAISAL REGARDING FOR EXAMPLE

Q3a: Relevance

- 6 out of 6 municipal (100%), 3 out of 7 trust (43%), and 1 out of 2 private ports (50%) said that the system was relevant
- 2 out of 7 trust (33%), and 1 private (50%) ports said they were unsure of the benefits, but did not respond negatively about the relevance of PSMS
- 2 out of 7 trust ports (33%) did not answer this question.

Why do all municipal ports think PSMS is relevant when only 43% of trust ports think the same? Could the two trust ports that answered *unsure* be ahead of their colleagues in terms of management systems and have higher levels of sustainability across their ports? Coupled with two trust ports that did not answer this question, this system could potentially be somewhat basic for some trust ports if looking purely at the data received. Other factors for such difference in answers could be the sizes of trust ports interviewed for the pilot test, and those that did not answer question 3a thought their port was probably too small to have a strategic system that was looking at the pillars of port sustainability. A second OFQ can be concluded based on the governance models of ports, specifically:

OFQ2 – Municipal ports are under higher pressure from stakeholders and governing bodies to establish transparent sustainable practices in their ports, and to be able to demonstrate improvement to their management boards using management tools e.g. PSMS.

Q3b: Its ease of use:

- 13 out of 15 respondents, or 1 private (50%), 6 municipal (100%), and 6 trust ports (86%) agreed the system was easy to use
- 1 trust port (14%) did not answer the question; 1 private port (50%) thought PSMS was "slightly misleading for input scores".

Continuing on the idea of inclusivity, all HMs have different backgrounds and have been accustomed to using different types of systems and software. One of the criticisms of currently available management systems came from one very senior HM saying that "after question 4 I'm losing the will to live"(HM in Devon, 2012). The same HM was very impressed with the functionality of PSMS saying during the PSMS testing that "… this is all meaningful to me" (HM in Devon, 2014). A number of other HMs pointed out significant time constraints associated with some systems. Since PSMS was intended for all small ports, its ease of use was one of the key reasons for why only version 5 of PSMS went into the pilot testing phase, as all previous versions did not adhere to that criterion. Overall, 86.7% of respondents (or 13 out of 15 ports) agreed it was easy to use.

Q3c: Its comprehensiveness

- 10 out 15 respondents agreed the system was comprehensive, specifically 1 private (50%), 6 municipal (100%) and 3 trust ports (43%).
- 2 trust (29%) and 1 private port (50%) thought some criteria were slightly misleading and unclear.
- 2 trust ports (29%) did not answer the question

OFQ1 formulated after Q2 postulated that trust ports are more advanced in the way of management processes than their municipal counterparts, and answers to question 3c could further substantiate that hypothesis. All municipal ports agreed that PSMS is comprehensive, but only 43% of trust ports think the same. Being a first version that was tested, it is not unexpected for PSMS to lack comprehensiveness in certain aspects when being tested with a variety of ports that have fewer things in common compared with those that are different. Similarly to the previous questions, private ports' views are divided between system being comprehensive and being unsure about it.

So an OFQ3 can be formulated as follows:

OFQ3: Without being tailored to specific port practices, PSMS v5 in its draft state is being viewed by the majority of trust ports as not comprehensive enough for their *modus operandi* and possibly regarded as an entry level system; whilst all municipal port respondents see PSMS as comprehensive for their current state of port operations and management.

Q3d: Did it help you to think about issues?

- 11 respondents agreed that doing PSMS self-scoring helped them to think about issues, specifically 5 out of 7 trust (71%), 5 out of 6 municipal (83%) and 1 out of 2 private ports (50%).
- Similarly to questions 3a, 3b, and 3c, the two private ports were divided between 1 (50%) saying it helped to think about new issues, and the other 1 (50%) stated that PSMS had possibly some things to consider for them.
- 1 municipal (17%) and 2 trust ports (29%) said that PSMS either did not help them to think about issues or did not answer this question altogether.

In percentage terms, 11 out of 15 respondents (or 73%) have agree that conducting PSMS self-appraisal has helped them to think about issues, and potentially if the second trust port is going to see benefits after using the system again that would bring the total number of positive responses to this question to 12 or 80%. Looking at the positives, out of 15 pilot test respondents only 6 were part of the original data collection, and considering that 11 respondents found that PSMS has helped them to think about issues, including those 5 who were not part of the original data collection, it can be concluded that a generic system to help ports manage their sustainability practices is not only plausible, but workable.

Q3e: Did it raise new issues?

- 2 out of 2 private (100%), 4 out of 6 municipal (67%), and 1 out of 7 trust ports (14%) agreed that PSMS has raised new issues for them after conducting the self-appraisal
- 2 out of 6 municipal (29%) and 6 out of 7 trust ports (86%) said that no new issues have been raised for them.

Several patterns emerge from this data, specifically the agreement of both private ports and the sharp contrast with what the trust ports have responded to the previous question. Q3d asked if PSMS helped ports to think about issues and 71% of trust ports agreed that it did compared with only 14% of trust ports saying that it raised new issues for them. Based on this it is possible to conclude that PSMS helped the vast majority of trust ports to think about their existing issues and possibly serve as a reminder of what has not been given enough attention lately.

In contrast to that, 83% of municipal ports in Q3d said that PSMS has helped them to think about issues and 67% of municipal ports have stated in this question (Q3e) that PSMS has raised new issues for them. Although the numbers are not exact, the difference between 67% and 83% in the case of municipal ports is 4 and 5 respondents respectively out of the maximum of 6. So a new OFQ can be formulated from this data, specifically:

OFQ4: PSMS self- scoring has helped the majority of municipal ports to think about new issues that they have not previously considered compared with the trust ports that benefited from PSMS as a reminder to pay more attention to particular areas of port management rather than discovering new areas they have not previously looked into.

Q3f: Did it offer new insights?

- 3 out of 7 trust (43%), 5 out of 6 municipal (83%) and 1 out of 2 private ports (50%) said that PSMS has offered new insights.
- 4 out of 7 trust (57%), 1 out of 6 municipal (50%), and 1 out of 2 private ports (50%) either said the system did not offer new insights or did not answer this question.

If combined, the total number of 9 out of 15 respondents said the system offered new insights which equates to 60% of ports participating in the pilot test. Having gone through the data, only 4 out of the 9 respondents took part in the original data collection; hence the other 5 ports have discovered something new for them regarding port sustainability from a generic system undergoing its first pilot test.

Q3g: Any other issues?

- 13 out of 15 respondents indicated they either had nothing further to add, or did not answer this question
- 1 municipal port (17%) suggested adding more questions about the numbers of accidents involving members of staff and the public, the rate of growth, port’s turnover, etc.
- 1 municipal port (17%) suggested that given their current governance structure currently, this does not always allow them to go above minimal

requirements on all aspects of port sustainability and hence operate more on the “need to do” rather than “nice to do” basis.

Governance has been determined to be a key factor in how ports operate and answers to this question substantiate that further. Both municipal ports that have offered further comments were part of the data collection and having established strong working relationships with them these HMs offered important thoughts on which other sustainability issues they considered to be important. For commercial reasons these ports will remain unidentified. A fifth OFQ can be summarised as follows:

OFQ5: Operating under local authority influence, municipal ports which are considered to be a public benefit are less able to focus on matters outside of port safety than their trust counterparts, making port sustainability a greater challenge for them.

Q4: What benefits do you see in using PSMS in your port?

- 12 out of 15 respondents or 80% have identified at least one benefit per port with the following breakdown: 2 out of 2 private (100%), 6 out of 6 municipal (100%), 4 out of 7 trust ports (57%).
- 1 trust port (14%) was unsure whether there were any benefits to their operations
- 2 trust ports (29%) either did not answer the question or have not identified any benefits.

Having had the benefits identified by 80% of respondents, this confirmed that a generic system for managing sustainability for small ports that are different is not only possible, but can deliver benefits even in its draft phase. A sixth OFQ can be formulated which concerns private ports:

OFQ6: Not being subject to the same stakeholder pressures and governance type based rules; private ports have less sophisticated port management mechanisms in place, which might not address the full spectrum of sustainability issues. PSMS pilot test has raised new issues for all private ports participated, who in turn saw benefit in this approach to port sustainability.

The benefits identified that have been were collated under 4 main headings have been taken directly from the answers provided, specifically:

- **Improvement**, i.e. "… I can see where we can improve"; "…reminder to strive for improvement" (HMs in South West, 2014).
- **Progress/Performance/Strengths and Weaknesses**, i.e. "simple way of identifying areas of weakness"; "…measure of progress in key areas"; "… calendar check on progress"; "…good measure of progress" (HMs in South West, 2014).
- **Enhanced communication/Reporting,** i.e. "… coordinated report to take to my Harbour Board"; "Brevity of communication…"; "We would use it in annual report…" (HMs in South West, 2014)
- **Reminder/ prompt to stimulate thought process,** i.e. "It's a good prompt… it prompts you to think about something…"; "it would stimulate my thought process…"; "it helps you to achieve a high standard and best practice…" (HMs in South West, 2014).

The quotes above have been copied directly from the pilot test interviews to demonstrate the actual expressions used to highlight benefits of PSMS; however for commercial reasons none of the quotes have been referenced fully to maintain anonymity of respondents. Several interesting patterns can be seen in the benefits breakdown data that relate to the similarities in thinking and port interests, in particular:

- Only private (2 out of 2, or 100%) and trust ports (2 out of 7, or 29%) have identified the benefits of Progress/ Performance/ Strengths and Weaknesses, while only municipal ports (2 out of 6, or 33%) saw the benefit of PSMS being improvement related.
- Twice more municipal than trust ports saw benefits in enhanced communication/ reporting (2 municipals compared with 1 trust), and in using PSMS as a prompt to stimulate thought process (2 municipals compared with 1 trust).

What is interesting about this data is during the PSMS v5 creation stage only several benefits have been identified such as indication of port's performance, and a possible way for easier communication with board and stakeholders. Having 4 categories of benefits identified, it is plausible to conclude that with relevant changes to system every small port should see at least one benefit from using PSMS as part of their management strategy. This conclusion can be formulated into the 7th OFQ:

OFQ7: By combining various utility into one system, different organisations that seek different benefits can benefit from a single generic system.

Addressing sustainability involves a combination of different benefits which different organisations might require at different times.

Q5: What problems did you find with the current design of PSMS that need to be immediately addressed?

- 7 out of 15 respondents or 46%, specifically 3 out of 6 municipal (50%) and 4 out of 7 trust ports (57%) said that they did not find any issues with the current design of PSMS.
- 5 out of 15 respondents or 33%, specifically 2 out of 2 private (100%), 2 out of 6 municipal (33%) and 1 out of 7 trust ports (14%) said that some wording needs revisiting or that the scoring criteria was a little confusing.
- 2 respondents, 1 municipal (17%) and 1 trust port(14%) suggested adding a 12-th category that would include marine skills, staffing and succession planning which are essential to port sustainability practices
- 1 trust port (14%) suggested tailoring PSMS to reflect the way in which many models of ports operate

The suggestion for the 12-th sustainability criteria has been put forward by two ports located in different counties, operating under different governance models and having different commercial streams. However despite their differences, their views on criteria for port sustainability have coincided which strengthens the argument for a generic sustainability management system being practical, rather than hypothetical.

Q6: What is your reaction to PSMS as a strategic self-appraisal tool of harbour sustainability practices?

- 12 out of 15 respondents or 80%, namely 2 private (100%), 6 municipal (100%) and 4 trust ports (57%) had a positive reaction to PSMS and said that it was a helpful and a useful tool.
- 1 trust port (17%) said that PSMS formalised something they already did, 1 trust port (17%) stated that the system was too analytical for the remit of their operations, and 1 trust port (17%) that the system was not quite there for them to use it.

Positive reactions came from ports with all modes of governance which implies that sustainability is not underpinned by governance models, but by industry requirements. Based on their level of operations, environmental status and level of community relations, trust ports can have varying levels of pressure being exerted on them by stakeholder groups, and going back to OFQ7, potentially in the near future those 3 trust ports that had mixed reactions to PSMS would see it differently due to changing circumstances in their *modus operandi*. Findings from this question make it possible to summarise an additional OFQ:

OFQ8: Sustainability requirements are not affected by governance types of ports, but by factors such as physical location, revenues streams and level of community involvement, and the combination of these factors can either add or reduce the pressure from the HA to increase or decrease spending into the sustainability related initiatives.

Q7: Would you use this system regularly? (E.g. scoring your port annually?) If so, for what purpose?

- 10 out of 15 respondents or 66.7%, specifically 1 private (50%), 5 municipal (83%) and 4 trust ports (57%) said they would use the system in the future
- 2 ports, namely 1 private (50%) and 1 municipal (17%) said that they would once the system is refined
- 3 out of 7 trust ports or (43%) either did not answer the questions or said they would not use PSMS.

The combined number of respondents who said they would use the system once refined is 12 (or 80%), out of which 7 (or 47%) did not specify an exact purpose for which they are going to use this system. These findings reinforce OFQ7 formulated earlier which suggested that different ports would require different sustainability benefits at different times. By being a versatile system and offering 4 types of benefit categories, the pilot test proved that PSMS can be used as a tool to assists a variety of ports governance, and commercial models with improvement, tracking progress and identifying areas of weaknesses, enhancing communication streams and stimulating thought processes to strive for sustainable port practices.

Q8: Under what circumstances might you share your average index with other HMs?

- 9 out of 15 participants (or 60%), specifically 2 private (100%), 4 municipal (67%) and 3 trust (43%) said they were happy to share their average index for benchmarking purposes amongst colleagues or if asked

- 6 out of 15 participants (or 40%), namely 2 municipal (33%) and 4 trust ports (57%) said that sharing average index was either not relevant to them, did not want to share or did not answer this question

Interestingly, municipal and trust ports were divided whether they wanted to share their average index, whereas both private ports were unanimous in being happy to share their average indices. The idea behind sharing the average index was to introduce a comparison tool which would not reveal any specific details of port practices, but would have allowed HMs to use the combined average of all their scores either for the purposes of reporting or sharing among regional colleagues. Various comments were received regarding this suggestion, including that it was not practical to base performance figures on how each category was scored. As a suggestion that was not a core part of PSMS v5, the average index can be left for those HMs who see value in using it.

Q9: Would you require further assistance in using PSMS?

- 12 out of 15 respondents (or 80%) said that they did not require any further assistance
- 1 municipal port (17%) suggested some areas for improvement, specifically a next “logical piece of advice” (HM in Devon, 2014).
- 1 municipal port (17%) suggested doing scoring with the author present to ensure they understood every criteria correctly
- 1 trust port (14%) did not answer this question

Simplicity and clarity were at the forefront when creating PSMS v5, and as indicated by the responses, it was successfully achieved. A suggestion was put forward to create a continuation process for when HMs have conducted the self-scoring and are looking at their scores on the spidergram in Excel or on the “bull’s-eye” on paper. The “what do you do now” as said by one HM could be a potential extension of PSMS which would be very relevant for those ports who have not taken part in PSMS creation process, and would be using it after reading the instructions document.

Q10: Would you be interested in attending a dedicated workshop to discuss the potential use of PSMS, and issues related to its efficiency, usability, and feedback?

- 10 out of 15 respondents (or 67%), specifically 1 private (50%), 5 municipal (83%) and 4 trust ports (67%) said they either would attend themselves or send a colleague
- 1 private (50%), 1 municipal (17%) and 3 trust ports (43%) either said they would not attend or did not answer this question

The PSMS workshop was originally intended to gather HMs together and for everyone to conduct self-scoring at the same time. Aside from SWRPA meetings it would have been difficult to gather HMs from across the two counties in one place for the purposes of testing, so this question explored more their attitudes towards doing a workshop, rather than trying to slot into the calendars of 10-20 very busy people a single date and time, with a venue that is appropriate for everyone.

Opinions have been divided amongst governance types of ports, with no single group having a unanimous agreement or disagreement. However a positive response of 67% stipulates to the willingness of smaller port’s HMs to put in the effort to help address sustainability concerns of their ports and harbours.

Q11: Are there any additional comments you would like to add?

- 5 out of 15 participants (or 33%), specifically 3 municipal (50%) and 2 trust ports (29%) were positively surprised with the functionality, relevance and practical applications of PSMS
- 9 out of 15 participants (60%) either did not have any further comments, and 1 private port out of those 9 outlined their staffing numbers saying they have a very small harbour and a very small team of staff
- 1 municipal port (17%) suggested constrictive comments for improving functionality of PSMS

Section 9.6.2 outlined several quotes from HMs that were positively surprised by PSMS v5. One of the HMs suggested his opinion on the difference of smaller ports:

> "I have an asset base; I think all HMs have the safety management, environmental and stakeholder issues. Some HMs don't get involved in BPM because it's all done for them at a higher level. Likewise, some don't get overly involved in PP or indeed CM... I can lead change, I can institute change, I'm a business manager, I have responsibility for the strategic planning side of it" (HM in South West, 2014).

Even though if some ports do not have to deal with particular areas of sustainability as it is being dealt with by their managing authority i.e. a council, owning authority; some criteria might not be applicable to them at this moment. This reinforces the rationale of H7 that emphasised that different ports would have different sustainability priorities at different times, and if there would be an institutional change of some port owning authorities, an increasing amount of responsibilities could be assigned to those HMs that did not have to deal with it previously.

9.9 Authenticity and trustworthiness of the findings

Guba and Lincoln (in Denzin and Lincoln, 2000:158) have outlined that those researchers who adopted a constructivist stance were orientated at producing "reconstructed understandings of social world". Such an approach has had new criteria of trustworthiness and authenticity to replace the positivist's criteria of internal and external validity (ibid). In 1989, Guba and Lincoln have suggested five "potential outcomes of a social constructionist enquiry", each of which was "rooted in the axioms and assumptions of the constructivist paradigm" (Denzin and Lincoln, 2000:180). The authenticity criteria were believed to be "hallmarks of authentic, trustworthy, rigorous, or "valid" constructivist inquiry" (ibid:180).

Authenticity has been divided into the following five categories, specifically: fairness, ontological and educative authenticity, catalytic and tactical authenticity (ibid). In establishing authenticity, researchers seek reassurance of both the "conduct and evaluation of research" being genuine and credible from the points of view of participant's experiences and "wider political and social implication" of that research (James, 2008:44). Table 9.6 below outlines the individual criteria of authenticity and trustworthiness and the correspondence of those criteria to this research.

Guba and Lincoln (1989) criteria	Research Application of Authenticity
Fairness refers to the quality of balance that is representative of various stakeholder concerns, views and claims, and that exclusion of participant views can constitute as bias (Denzin and Lincoln, 2000). Through developing stronger working relationships with research participants, they become part of the research enquiry and responsible for its "cultural reproduction" (James, 2008:44).	A full year of collaboration has passed before the official data collection phase commenced. Two weeks into the project was the first meeting with regional HMs where the author has presented the research aim, objectives and goals. A completely inductive approach has been undertaken, whereby information not relevant to answering research objectives has not been discarded and was used to build a richer picture of port sustainability which resulted in the creation of PSMS with multiple dimensions. All research participants have been asked semi structured questions to initiate discussions that would provide rich qualitative data. An ongoing relationship was kept with all participants and a number of other HMs throughout the project through regional collaboration and ad-hoc visits to ensure all of their views have been correctly understood, appropriately recorded and conceptualised.
Ontological authenticity refers to helping the research participants gain a greater understanding of the "social context being studied" (James, 2008:44)	The social context being studied was port sustainability. From the outset sustainability was viewed using the industry accepted view of it i.e. TBL. During every regional meeting, the author had 5-10 minutes to give an update on the status of the research, tell HMs about new developments and new issues uncovered. During data collections, an in-depth summary of the research context has been provided to each individual HM with follow up questions from the participants to ensure full understanding.
Educative authenticity involves the researcher aiding the participant in expanding their perspectives by having a better understanding and appreciation of other stakeholder's points of view (James, 2008)	Having been attending various industry meetings where different port stakeholders were expressing their views and concerns, these points of view were included into the discussion with the HMs during data the collection phase. Throughout the 2.5 year period, a number of conversations with governing bodies such as EA, MMO, DEFRA, NE and IFCA took place during stakeholder meetings and these were conveyed back to the HMs to ensure they were aware of the latest developments, points of views and stakeholder perceptions of the ports industry.

Catalytic authenticity – talks about some form of action taken by the research participant as a result of a stimulated thought process. (James, 2008). Enabling the participants to expand their awareness levels through engaging in research with intention of positively affecting their current circumstances is the approach that should be adapted to catalytic and tactical authenticities described next (ibid).	The audio recording of SWRPA meetings dates back to the start of this project when the author first met the HMs and with the permission of Chairman recorded the meeting for better record keeping. This practice has been taken up by the current secretary to enable much more efficient information sharing. Various discussion regarding data security and port sustainability have resulted in some HMs becoming more proactive with digitalisation of data and invested more resources into conducting scientific enquiries about environmental status of their port's aegis. Following an interview with one HM and a regional meeting that the author has organised, a 2 year KTP has been signed with Plymouth University creating a new job of a Sustainable Business Manager at that port. From the outset, all research participants were interested in improving their port sustainability practices, to have a better understanding of management systems and make a positive impact on their port, stakeholders and their local communities.
Tactical authenticity- is the "degree to which participants are empowered to act – to engage in action not only as individuals, but also as members of their community" (James, 2008:44)	HMs can institute change, cooperate with various stakeholder groups, governing bodies and academia to expand their awareness of the latest issues and being empowered to act in the best interests of their respective communities. Vast majority of ports in CAD are run for the benefit of the community, and the HMs act in the best interests of their stakeholders making them ideal candidates from the tactical authenticity standpoint

Table 9.3: Research Authenticity
Source: Based on Guba and Lincoln (1989)

Table 9.3 clearly illustrates that this research is authentic in the way that it addressed concerns of research participants and through the balance of stakeholder views (i.e. fairness), involvement of HMs to help increase their understanding of the researched social context and other stakeholder views (i.e. ontological and educative) has stimulated new thought processes and actions being taken as a result (i.e. catalytic) by those empowered to act on behalf of their chosen communities (i.e. tactical).

Authenticity also serves as a “component of establishing trustworthiness” when doing qualitative research in order to benefit for the society (James, 2008:44). Trustworthiness allows researchers “to describe the virtues of qualitative terms” outside of those parameters that have been normally applied to a quantitative enquiry (ibid:895).

Trustworthiness criteria from James (2008:895 - 896)	Research Application of Trustworthiness
Transferability – outlines the importance of being aware of and the ability to describe the “scope of one’s qualitative study” in order to make it applicable to different contexts of enquiry. A study which is not applicable to other contexts is not considered “unworthy”, however by using a proper trail others can establish “to which alternative contexts the findings might be applied”.	The scope of this study was the expansion of the working model of sustainability from TBL, which was the working practice of smaller ports industry prior to this project, to focusing on industry specific areas. This process has allowed getting a much better overarching view of the crucial domains of port management which needed to be addressed for ports to remain sustainable. The exact path of data analysis and system creation has been very well documented in this thesis using a step by step evolutionary process, from scoping interviews and data collection to creating a system and finally conducting a pilot test.
Credibility – accurate representation of data and rich description of the “phenomenon in question” are the essence of credibility criteria.	Testing results discussed in section 9.7 underpin the relevance and the importance of this enquiry. The phenomenon in question was the creation of a sustainability management system for ports, which at early stages seemed to be unfeasible due to vast differences between ports. After finding a common criteria for all ports i.e. sustainability, issues and concerns of HMs were then accurately combined, analysed and represented in a system which has been positively accepted by the HM community during PSMS testing phase.
Dependability – suggests that a similar explanation	Evolution of author’s thinking along with its influencing factors since the start of the

for a phenomenon should be discovered under similar conditions by following the research procedures, instruments and data collection methods as described by the author.	project has been well documented. Chapter 5 outlines the theoretical framework of the research problem and explains the rationale for continuing an inquiry and developing new TFs. This chapter presents the evolution of PSMS, from having preliminary interview results to conceptualising the first prototype, to adapting that prototype for applied research purposes. Dependability and ability to replicate have been at the forefront of author's thinking since the start of the project and, and every important step has been well documented.
Confirmability – refers to the need for ensuring that the "Interpretations and findings match the data", so that unsupported by data claims cannot be made.	The intention of the pilot test was to evaluate the practicality and applicability of PSMS v5 to smaller ports in CAD. Using sustainability criteria as the basis of PSMS was not the original idea and was discovered only after analysing primary data. Since not every HM took part in data collection, it was important to test whether those criteria were applicable to all smaller ports, if any changes were needed and whether it addressed what was intended. Findings in section 9.7 support the data.

Table 9.4: Research Trustworthiness

Source: James (2008) based on Lincoln and Guba (1985)

Table 9.4 clearly illustrates how using general principles that can be transferred to different industries and applications (i.e. transferability) and accurate representation of rich data has resulted in the creation of a generic system for managing sustainability practices in a number of different smaller ports (credibility). Through industry testing and ongoing collaboration with port's professionals, findings have been tested to ensure accurate representation of collected data (confirmability) and using a rigorous filing and documentation system since the start of the project, minor and major evolutionary steps in the author's thinking along with the development and the creation of PSMS have been recorded (dependability) in order to be replicable by others.

9.10 Conclusion

This chapter has demonstrated the evolution of PSMS that was required to theorise, create and test a practical PSMS v5 that has been received with enthusiasm by the industry. The previous section outlined how each of the authenticity and trustworthiness criteria have been addressed, in particular the criteria of dependability which suggests that findings should be replicable by other researchers if very similar conditions are maintained throughout their enquiry. The analysis of the PSMS pilot test data has given rise to, and substantiated a number of observations for further enquiry which also provide a contribution as they offer some potential explanations for why do smaller ports operate so differently.

CHAPTER 10: DISCUSSION

10.1 Introduction

This chapter presents a general discussion of the research including the individual and combined contribution to knowledge from answering all research objectives. The chosen research strategy and the quality of research conducted are also evaluated. Research implications for theory, industry and policy are analysed and presented together with research benefits to CAD.

10.2 Research overview

The findings presented in the previous chapter indicated that a generic sustainability management system for smaller ports has been well accepted by HMs in CAD, and despite considerable differences between all ports the criteria identified were appropriate to the vast majority. Being a significantly under researched industry, smaller ports can be classified as SMEs, which make up the foundation of all economies. Understanding better how smaller ports operate, what sustainability challenges they are faced with daily, how to safeguard the revenue streams and local communities are some of the contributions to knowledge of this research.

In order to formulate PSMS in objective 5, four objectives were set to categorise, analyse, synthesise and assess essential areas of port management, both internal and external, in order to map out the nature of influencing factors and pressures that could have direct and indirect effect on port sustainability practices. As a result, each of the individual contributions to knowledge has contributed towards the creation of PSMS v5, initially in terms of thinking and later on in shaping themes of port sustainability.

10.2.1 Taxonomy of maritime operations

As one of the elements small ports have in common, MOs were found to be commercial streams of revenue that took place within the port's aegis. The first definition provided by the author was based on prior academic and industry literature and was only able to define MO as being *routine* and having a *commercial and environmental purpose*. Only by defining the principle that underpins the nature of MOs from analysing nearly 4000 academic and industry sources using ECA (chapter 4), was the author then able to use that principle and significantly expand on the number of MOs defined. Seven categories of MOs have been identified from the literature specifically, anchoring/mooring, bunkering, Ballast Water Exchange (BWE), cargo handling, ship to shore transfers, dredging and pilotage. By using the principle of MOs and interviewing HMs, Table 4.6 was expanded from 8 to 39 MOs divided into 4 categories and additional categories of *people involved* and the *drivers* behind MO were added to the taxonomy.

The final taxonomy provides a comprehensive breakdown of commercial aspects that bring revenue to smaller ports, make their local communities viable and contribute to the local national economies. Initially MOs were intended to be used for a generic level system for smaller ports in CAD, however due to the specific nature of each operation, e.g. bunkering procedures differ from port to port; during the latter stages of research instead of using MOs directly as the terms of reference for PSMS, the themes that underpinned sustainability aspects of those MOs were used to create PSMS. Having the knowledge of the variety of potential sources of revenue in smaller ports, academics and consultants can collaborate with HMs on a wider scale and create templates for management systems that would be specifically aimed at managing commercial sources of revenue. Being a very specialised industry it can be argued that without spending sufficient amount of time researching the intricacies of smaller port management with the help of professionals, it can be difficult for outsiders to understand the role of smaller ports in the community, local supply chains and therefore ways of safeguarding their revenue streams and helping them to become more sustainable. With 700-800 smaller ports in the UK, each of which plays a pivotal role for their surrounding community, the taxonomy of MO offers a very useful tool to provide knowledge of those commercial operations that can affect sustainable development and would therefore need safeguarding.

With regards to PSMS v5, identifying commercial streams of revenue that make the businesses of smaller ports viable has contributed towards the creation of the *business planning and management (BPM)* category, which emphasised the issues of economic resilience, continual innovation and commercial efficiency. By looking at commercial revenue sources of smaller ports, i.e. MOs from a higher level of abstraction, it was then possible to identify key factors that must be taken under consideration for revenue sources to continue being profitable and serve as the driving engine for smaller port sustainability. Objective 2 has contributed towards the conceptualisation of BPM category and will be explained later.

10.2.2 Overview of the requirements for environmental planning in CAD ports

By categorising the requirements for environmental planning (REP) in CAD ports, *port location* was discovered to be an influencing factor that was out of control of the HMs. Chapter 8 detailed some examples where port location could have a positive or negative impact on the availability of a port's resources as an output. If a port was situated in an environmentally sensitive area, port location as an influencing factor would have a direct impact on the amount of environmental legislation and regulations a port authority would have to comply with and therefore significantly increasing the level of environmental planning for many aspects of port management. The scale of commercial operations and revenue streams would also affect the REP, because safety measures would have to be adapted to maintain risk, and environmental impacts associated with the increase in movement are likely to increase.

Smaller ports is a very specialised industry, and having varying levels of environmental planning and EM, figure 8.1 in chapter 8 has mapped out some of the relationships and influencing factors that could affect the REP of smaller ports. Being referred to as "the duty of taking environment into account in the way we manage things", the mapping of O1 informs port stakeholders that environmental planning is resource intensive, elements of it can be out of a port authority's control and that it is crucial that ports understand the importance of REP and the consequences of not doing it. Having two categories in PSMS v5 dedicated to environmental issues i.e. *environmental knowledge and awareness (EKA)* and *environmental* *management (EM)*; O1 contributes to an understanding of issues that need to be considered for ports to have sustainable environment within their aegis to which knowledge and awareness are a first step. Although the model of O1 can be described as being simplistic and touching upon the general concepts without going into specifics, the principle of knowing what the environmental requirements and pressures are before one can devise a way of managing them is crucial. For instance, by having comprehensive knowledge about the port's seabed, water quality and local marine species, an action plan can then be drafted to incorporate the management of those sensitive habitats, if there are any present. Having a conceptualisation that allows for an easier overview of links and relationships is a strong contribution towards knowledge of environmental issues within smaller ports.

10.2.2 Overview of the sustainable development needs of CAD ports

By analysing sustainable development needs (SDNs) of CAD ports (see figure 8.2 in chapter 8), and dividing them into *SDNs* and *challenges;* O2 has contributed towards three sustainability themes in the final model. Having to constantly balance the SDNs along with the challenges of achieving them can detract attention from a particular initiative, and make achieving sustainability a bigger challenge for port authorities. Aside from mapping out the SDNs of smaller ports, the links between the needs and challenges have contributed to the evolution of thought processes and contributed to three categories in PSMS, namely business planning and management (BPM), stakeholder engagement (SE) and proactive partnerships (PP).

The idea of challenges (see green boxes figure 8.2) affecting the needs (beige boxes figure 8.2) is at the centre of why some ports can struggle to achieve particular sustainability needs. BPM category emphasises the management of planning and business aspects, specifically maximising efficiency, building up economic resilience of ports, continuing to innovate and ensuring a consistent surplus is being generated. By having to deal with challenges that put additional pressures on the HAs and HMs specifically, ports have to continually engage in efficient planning to ensure they are contributing to an overall sustainability of their port. A simplistic example below demonstrates the links:

Challenges **increase** the amount of pressure on ports regarding their SDNs (e.g. infrastructure condition can put significant strains on the commercial viability of the port). This in turn will **increase** the amount of management around business and planning that needs to be done by the HAs resulting in a **better** contribution towards overall port sustainability. This example demonstrates the importance of BPM for ports to successfully manage their SDNs.

Being run for the benefit of their communities, municipal and trust ports, which form the vast majority of ports in CAD by governance type, have a variety of stakeholder pressures they have to address. SE category in PSMS v5 expands on the concept of stakeholder engagement and suggests that an aspect of port sustainability depends on the ability of ports to influence stakeholder perceptions, to educate them in marine issues, to proactively engage various stakeholder groups and at the same time to soften conflicting relationships amongst certain groups. Very often due to insufficient understanding of ports, stakeholders are quick to form opinions without having the full facts. By proactively engaging with stakeholders, ports can reduce the amount of pressure they have with regards to SDNs and make some challenges (e.g. the resistance to change, enforcing responsible boating) more feasible to achieve.

One of the challenges that ports have to respond to is associated with EM and the quality of water in the harbour. PP is a second stakeholder related concept in PSMS v5 and is aimed at establishing working partnerships and sharing best practice with interested stakeholders. Higher criteria of PP is aimed at creating partnerships with governing bodies that have vested interests in an area of a harbour, and through collaboration reduce bad press, operational impacts on the harbour and the cost associated with that. The reason for separating SE and PP was the level of engagement that was the key difference between these categories. Where SE emphasises engaging stakeholder groups, influencing their opinions, educating stakeholders and having joint projects, the scale of those projects is of a smaller nature and for example does not entail measures such as the construction of a new quay wall. Instead SE stresses the importance of working together to ensure the harbour is meeting the demands and requirements of the local community and port users. In contrast, PP outlines the need for a better understanding of the nature of stakeholder relationships, the benefit behind sharing best practice and using that as a foundation for building stronger working partnerships with governing bodies that are also port stakeholders and have the ability to influence port operations if environmental issues are not being considered sufficiently. The idea of joint contribution towards the harbour, as demonstrated in the example of Lighterage quay in Truro in previous chapters is the higher level of PP, where a functional working relationship between the port and a governing body resulted in a joint benefit for the community at a reduced cost for the port, which has made a significant contribution towards the sustainability of Truro Harbour.

10.2.3 Taxonomy of how smaller ports manage environmental sustainability

Knowledge and understanding of what constitute the sustainability related issues in smaller ports and how they are managed is the overall contribution of this project. O3 explored in detail the processes of conducting environmental assessment, the systems deployed to manage environmental impacts and who does it within a port.

Findings presented in tables 8.2, 8.3 and 8.4 confirm that diversity of small ports extends beyond their commercial operations and affects their internal management processes. The review of academic literature regarding EM processes in ports covered more widely accepted systems which have been designed for larger commercial ports and focus solely on mitigating impacts despite the costs. As discovered from data collection, availability of resources is a serious issue for smaller ports and often costs associated with the widely accepted EMS methods are not sustainable.

By exploring in detail the current environmental systems and processes that smaller ports have and comparing them to the EMSs that large commercial ports have, the idea of effectiveness of management processes emerged. If a smaller port was to spend money on a system that would be only relevant for one part of their operation and then would need to spend more money on other systems that would put a bigger strain on resource availability.

> "So there is absolutely no point in me having a system that covers the wet bit, and another that cover the dry bit. I said I'll take your system [referring to a recent conversation with a big organisation] but I want to widen it out to include everything that I do…" (HM in Devon, 2012)

The differences discovered in how ports conduct environmental assessment and managing environmental issues indicate that a prescriptive system would not be relevant for many smaller ports and a category of *effectiveness of management processes (EMP)* has emerged as part of PSMS v5. EMP category stresses the importance of evolving the informal thought process and actions that HAs were used to into a formal system for port management. The contribution to knowledge from answering O3 lies in evidence that port differences go beyond their visible operations, and encompass internal management processes and mechanisms for problem diagnosis which have to be effective in order to contribute to port sustainability rather than drain resources. Having a category that makes HMs think about how effective their management processes are, both internal and external, and take the relevant steps to improve their effectiveness and relevance makes a fundamental contribution to addressing port sustainability.

10.2.4 Taxonomy of attitudes of smaller ports towards sustainability related issues

The taxonomy of attitudes presented in chapter 9 has revealed not only the differences in opinions, but also complete contrasts. Opposing views have been highlighted towards aspects such as change, EM, sustainability management system and sustainable development. Having only discovered one pattern specifically that ports with commercial activities have a more proactive stance with regards to environmental issues, it can be argued that smaller ports and their communities have different views towards port sustainability and might not be looking into the future. The pattern example demonstrated in chapter 9 also detailed two very different reactions towards EM from ports of the same governance type and with similar revenue streams. Completely contrasting attitudes towards change can be seen in Appendix H when some think that “we can’t continue the way our fathers did” (HM in Devon, 2012), others are of the opinion that “we are happy here” (HM in Devon, 2012). A potential conclusion can be made based on the differences of HMs’ attitudes that probably not many, but at least some processes, policies or aspects of port management have remained largely unchanged for generations, and with increasing legislation, global economic uncertainty and varying pressures on HM, change and future preparedness are two of the key components that underpin port sustainability.

The analysis of HM attitudes in O4 has contributed towards the creation of two categories, specifically *change management* (CM) and *strategic preparedness for the future (SPF)*. CM emphasised the importance of changing mind-sets by recognising the need for change and the unsustainability of certain ways or procedures taking place in the harbour for the modern society e.g. the importance of environmental protection, minimising risks and continuing to be a profitable business. The higher level criteria under CM incorporated the elements of being proactive with legislative changes that would have to be adapted by the HA and the principles of continual improvement and full process integration, i.e. incorporating sustainable practices into daily management of the harbour, rather than being reactive and responding to posing risks.

While CM addressed the immediate need for change, SPF considered the future sustainability of ports by starting to create and implement relevant strategies. Planning future resources, forecasting future trends, creating business plans and regularly reviewing and updating sustainability practices of the harbour are some of the ideas behind SPF to assist HMs to future-proof their harbours. The highest level criteria at SPF divided sustainability needs into short, medium and long-term so that each of these could have a dedicated management strategy for a greater level of success.

10.2.5 PSMS v5: "11 pillars of port sustainability"

Having emerged from data analysis, the thinking behind the 11 pillars of sustainability has been largely affected by answering objectives 1-4. As explained previously, PSMS v5 combined themes of port sustainability which emerged from data analysis and were reworded to avoid conflicting meanings and to better represent contextual depth. These original themes have been represented as pillars in figure 8.3 to illustrate an equal importance of every one of those pillars for long term port sustainability. Thinking behind TF5 was essential to create figure 8.3, which in turn evolved into 11 pillars as represented in TF6.

This model provides HMs with the ability to conduct an in-house overview of port sustainability practices without the need to involve consultants or to use tools that were not designed with small port sustainability in mind. PSMS v5 helps HMs to better understand the underlying principles of port sustainability, some of which might not be evident on a daily basis such as *effectiveness of management processes* (EMP) or *environmental knowledge and awareness* (EKA). By combining challenges, influencing factors, management strategies, and best practices along with external and internal pressures that ports are faced with, PSMS v5 captured the diversity of port functions, processes and requirements. It became more than a tick sheet exercise, as some might have viewed it at first – but rather into a version of a "how to" sustainability guide for smaller ports. Not all the benefits of this approach have yet been identified. The quote below illustrates that from the point of view of one very experienced HM in Devon:

> "Initially it was that it is just something else to do which would not be used. Now I'm sure, it may be useful in reporting" (HM in Devon, 2013).

The notion of stakeholders not having enough knowledge about port operations and forming their opinions based on an incomplete picture has been captured by a number of HMs and resulted in two separate categories that are essential for smaller port sustainability – stakeholder engagement (SE) and proactive partnerships (PP). Having previously explained the difference between SE and PP in section 10.2.2, for a small organisation to have multiple stakeholder strategies relates back to the external pressures that ports have to adhere to in order to remain as important entities of their respective communities. Although scores during the pilot test on SE varied from (3) to (5), for those ports who scored (3) and wanted to improve, looking at PSMS v5 would be a good starting point. For instance, making action plans to create a communication strategy and undertake a stakeholder educator function as an institution for a score of (4); and taking it further by having the ability to influence stakeholder's perceptions and participating in joint projects that were intended to benefit the community would be an indication of sustainable stakeholder engagement practices taking place in that port community with PSMS score of (5).

The example illustrated above is not an isolated one and only relevant to SE; all other categories are based on the same principles of continual and gradual improvement. The idea of evolution has been incorporated into all 11 themes and has been evident from some interviews:

> Question asked: how did these needs [sustainable development needs] change from what they were 5 years ago and how likely are these to change for the foreseeable future?
>
> Answer: "It's an evolution; it's not a constant change of points. We evolved into an organisation that realised unless we could demonstrate positively that we were doing more to take the environment into account in our operations, then our operations could be adversely affected by environmental campaigning" (HM in Cornwall, 2013) .

This quote clearly indicates how the practice of sustainability takes place in smaller ports – not through obliteration of old processes as one could argue from the theory of BPR - but through an evolution of an organisation that is based on matching the pace of society. PSMS v5 responds to the demands from society by outlining areas of port management that are essential for long term sustainability and providing HMs with criteria for achieving sustainability, and empowers HMs to take control of sustainability as a whole within their ports instead of waiting for stakeholders and legislative pressures to increase to make certain elements mandatory. It also encourages port managers to adapt a proactive stance and a longer term outlook, rather than continue with the traditionally reactive position and a short term view.

> "Sustainability is not 2 years or 5 years, its generations" (HM in Devon, 2012). This quote embodies the essence, the purpose and aspirations of PSMS v5.

As with all theory, PSMS v5 has limitations. Being based on seven semi-structured interviews with the use of theoretical sampling (approx. 15 hours of recording), along with 15 hours of scoping interviews which did not go into the analysis and 2.5 year collaboration with the regional HMs; it could be argued that the sample size was insufficient. However, this can be countered by the example of reaching data saturation i.e. when data does not yield any new ideas, as demonstrated in chapter 7. Coupled with the nature of semi-structured interviews to explore certain concepts in more depth, saturation was reached after seven interviews and more data would not have contributed new knowledge to the same questions.

As indicated in chapter 9, a theme of *marine skills, staffing and succession planning* has been suggested by two HMs during separate testing interviews. The validity of that comment has been confirmed by other HMs and PSMS v6 will encompass 12 pillars of sustainability. Another arguable limitation is the 15 testing respondents, and whether more than one additional sustainability theme could have been suggested during testing as a result. There is no reason to assume systematic bias amongst HMs, in the sense that additional 15 respondents would not have given completely different views towards the same system. The testing phase included ports of all governance types and locations and a good spread between trust and municipal ports in CAD has been achieved, with the addition of two private ports to allow extra comparison.

10.3 Creating a PSMS for smaller ports in CAD

The implicit Research Question (RQ) that was visible throughout this research and objectives can be formulated as follows: *How can a port sustainability management system be developed and disseminated to smaller ports in Cornwall and Devon?* The essence of having a RQ is to "specify the stated purpose of the study, which in turn addresses the stated research problem" (Sandelowski, 2008:786). Saunders et al (2012) stated the importance of having the RQ due to one of key criteria for successful research being a clear set of conclusions drawn from the data collected, and that the clarity of the RQ would determine the extent of those conclusions. A clear set of interview questions has emerged from the five research objectives that encompassed the stated purpose of this work i.e. to create a PSMS for smaller ports in CAD and information that was required in order to do so. Following various stages of data collection, clear conclusions have emerged from the data in the form of theoretical codes at the higher level of abstraction that summarised the essence of port sustainability in CAD which facilitated the creation of PSMS, the final version of which has undergone industry testing.

From the outset, one of the possible outcomes could have been that creating a generic PSMS for dissemination to smaller regional ports was not possible. Such an assumption was based on the almost non-existent prior relevant academic literature to establish a preliminary background to any of the research objectives. The specific criteria formulated within each of the research objectives have been invaluable for defining gaps in research and designing enquiry methods based on that. The extensive industry collaboration has been the key to creating PSMS, where HMs were in favour of creating a generic sustainability management system for all ports. Some were uncertain whether such an approach was possible based on their prior experiences of dealing with management systems that are not tailor-made to fit particular institutions; however prior experience did not affect their ability to provide comprehensive answers to the questions asked. Successful industry collaboration was underpinned by SWRPA. Being able to meet the same people over the course of the whole project to update them on progress and thereby to slowly established confidence in the project also encouraged more proactive participation. All of these factors contributed to making a generic PSMS for smaller ports in CAD possible.

PSMS has undergone substantial adjustment to become a practical rather than theoretical system. Functionality has been at the centre of every version and is the main reason why only version 5 has undergone wide industry testing.

> “That’s the sort of business training model and actually there aren’t that many HM who would instantly see how to apply that within their organisations and their operations I don’t think. I do not think they would relate well to that” (HM in Cornwall, 2013).

The quote above is a reaction of one very experienced HM towards PSMS v2 during testing phase interviews in spring of 2013. As outlined in previous chapter, PSMS v2 was predominantly based on theoretical principles and as a result needed to be redesigned for practical application. A possible argument emerges here that some existing port systems were not designed having only practicality in mind and because of that cannot be effectively applied by smaller ports that have to be very efficient with resources.

Having done one round of testing benefits beyond those identified by HMs remain speculative. Knowledge and awareness are two of the key benefits that make the foundation of PSMS. The knowledge element empowers HMs to adapt a proactive stance towards the overall sustainability of the harbour, to use the awareness that emerged out of using PSMS and ensure that every “pillar” was addressed at least to a certain level to assist with addressing longer term port sustainability.

As a result of extensive industry collaboration, a new KTP was signed between Plymouth University and a regional port in CAD worth approximately 300% of the total scholarship cost of this project with regards to the EU funding. This KTP created a new full-time post for the harbour, and over the next two-year period will further contribute to the knowledge of smaller ports through extensive industry-academia collaboration. As a generic system, PSMS can help HMs to gain or refresh their knowledge about certain aspects of sustainability that would lead to increased awareness; however, strengthening port’s understanding requires a more tailored approach that would include port specifics. A KTP represents one of the steps a port can take to enhance their understanding of certain processes, their causes and possible solutions. The example of FHC KTP has been used throughout this work and illustrates the previous point. Additional benefits to CAD are considered below.

The initial idea of basing PSMS on MOs i.e. commercial streams of revenue in ports, did not materialise into a management system, since every port and their respective community have an individual approach towards managing common operations. Instead, following extensive data collection and a GT approach to data analysis, a set of themes that underpinned MOs emerged that encompassed a plethora of issues, concerns and challenges that smaller ports deal with daily. Those themes were then used as a foundation of PSMS and having developed a range of criteria for each theme with scores ranging from (1) to (5), each of the 11 themes incorporated a clear sustainable evolution and provided some practical examples for achieving particular goals.

The next section will focus on the theoretical side of conducting a GT research; will discuss the chosen research strategy and the quality of the research conducted before summarising implications for theory that emerged.

10.4 Theoretical implications: conducting a grounded theory research

This section evaluates the quality of the research strategy adapted for collecting and analysing data, and any theoretical implications that emerged. As indicated in chapter 6, views on conducting GT have been divided amongst scholars, with some choosing to follow the method by Glaser, others opting for Strauss and Corbin's. A method has been proposed in 2006 by Charmaz as an alternative for the existing GT views, specifically to construct GT in the form of a practical guide, rather than a set of guidelines that GT books were written as previously. This research has followed the constructivist approach of Charmaz's GT from the outset, and this section will evaluate the quality of GT research conducted through the use of quality criteria to ascertain how closely it adheres to it.

10.4.1 Research strategy

Strauss and Corbin (2008) identified a general consensus for the necessity of research evaluation among scholars, but a lack of consensus about the components of such inquiry and hence a variety of different criteria for evaluation of GT have been suggested. The classic criteria suggested by Glaser and Strauss (1967; Glaser 1978) of fit, work, relevance and modifiability suggests that:

> "Theory must fit the empirical world it purports to analyse, provide a workable understanding and explanation of this world, address problems and processes in it, and allow for variation and change that make the core theory useful over time. The criterion of modifiability allows for refinements of the theory that simultaneously make it more precise and enduring" (Charmaz, 2005:527).

Charmaz's analysis of Glaser and Strauss's criteria of *fit* entails a theoretical fit to the observed world, and from the pilot test analysis it was evident that not all participants saw benefits in using PSMS v5 at this time, or whether they were likely to in future. To say that PSMS v5 fits an empirical world would not be incorrect; however it does not fit every participant because the numbers of small ports are counted in hundreds, not in tens. The *workability* criterion *refers* to an explanation "of this world" where the researcher's output is going to provide that explanation and a workable understanding of the phenomena. Under a constructivist stance, viewing reality as socially constructed and understanding the role of humans in the society cannot provide a definitive explanation, but rather a constructed view, which was based on opinions, experiences and contributions of industry professionals. The intention of this discussion is not to discredit the original GT criteria, but to illustrate that "different disciplines adhere to different standards for the conduct of research and for acceptability of evidence" (Charmaz, 2006:182). Even in the same field, expectations from the output of GT may vary (ibid); hence the criteria for evaluating research quality should also vary and be more suited to the epistemological stances adopted, the nature of the studied world and the studied research problem.

Charmaz (2006:182-183) suggested a set of criteria for constructivist research, namely (1) credibility, (2) originality, (3) resonance, and (4) usefulness. She stated that a "strong combination of originality and credibility increases resonance, usefulness, and the subsequent value of the contribution" (ibid:183). Through addressing the "implicit actions and meanings in the studied phenomenon", these criteria would help the researcher to analyse how it was constructed, and account for the "empirical study and development of the theory" (ibid:183).

Appendix D outlines contextual meaning of each of the four quality criteria as outlined by Charmaz (2006:182-183) along with their relevance and applicability to this research.

This section has demonstrated how each of the GT criteria set out by Charmaz (2006) has been achieved upholding the quality of the research conducted and the validity of the output produced.

10.4.2 Implications for theory

Prior theory did not propose a systematic methodology aimed at helping smaller ports to assess and manage their environmental impacts. Existing approaches towards EM in ports have been reviewed in chapter 2 and concluded that the successful application of methods such as EcoPorts and ISO occurs amongst larger commercial ports with sufficient resources to accommodate extra costs incurred as a result. What those methodologies do not address is the overall sustainability of the port and its operations. Diversity of such organisations and specificity of individual needs can be one of the attributing factors for the lack of a sustainability management system and as a result focusing on mitigating environmental impacts at potentially high commercial cost has been the accepted industry practice.

What this research has shown was that despite procedural differences amongst ports, governing models and varying levels of legislative compliance, there is a common criterion for all smaller ports in CAD and arguably across the UK and elsewhere. This criterion is sustainability, specifically particular aspects of ports that might not even fall under the widely used principle of TBL that is often mistaken for the essence of sustainability; but that are imperative for the long term survival and prosperity of smaller ports. One change to prior theory is the importance for industries to identify their respective sustainability criteria for more practical application. TBL does not correspond closely with practical application because a vast range of variables can be attributed to economic, social and environmental criteria, making TBL more theoretical than an applied principle. One of the theoretical contributions of this research is a potentially new explanation of the applied sustainability concept, namely that it *encompasses all aspects of an organisation that can have direct or indirect impacts on its commercial resilience, therefore directly reducing an organisation's capability to comply with legislative and societal pressures, safeguard jobs, respond to changing patterns and trends of the society, accrue knowledge and ensure environmental considerations have been taken into account.* Many indirect aspects can affect the level of resilience of the business side of an organisation, hence it is important for business managers to identify those relationships and ensure the sustainability of each of those to avoid any adverse effects in the form of a "domino effect". For example, asset infrastructure and maintenance (AMM) received the lowest overall average scores amongst the pilot test participants and for ports to have infrastructure in a good condition is a prerequisite that enables them to trade and provide services for their customers. Maintaining and managing infrastructure is part of the commercial aspect of an organisation and should arguably come out of the application of the TBL principle; however low scores and lack of awareness of this being a priority for some compared with other areas of their business upheld an earlier argument i.e. that TBL does not correspond closely with practical application, especially when ports are managed by very small teams of people that are responsible for everything.

Further implications for theory have emerged from pilot test analysis where eight observations for further enquiry (OFQ) were formulated. Some of these posed questions which could contribute to the understanding of ports by questioning the differences in views that emerged as a result of PSMS testing. Based on the data received, governance was seen as a crucial factor for why some ports have completely different views towards the usefulness, comprehensiveness, benefits, purpose and implications for them using PSMS v5. Based on the results of what smaller ports were hoping to achieve from using PSMS, OFQ1 summarised that more trust port respondents were seeking ways of measuring performance, whereas more municipal port respondents were hoping for new ways of improving their current processes. With regards to comprehensiveness, OFQ3 outlined that all municipal ports saw PSMS v5 as comprehensive, whereas only a minority of trust port respondents saw it as such. While PSMS v5 has helped a majority of municipal ports to think about new issues they have not previously considered, trust ports have benefited from PSMS as a reminder to pay more attention to certain areas of their operations, rather than discovering new areas they have not yet looked into as indicated in OFQ4. These three examples clearly illustrate why governance can be a major influencing factor when looking at port sustainability practices as they currently stand. The quote below provided by one of the HMs during data collection could provide a possible explanation to this emerging implication for theory i.e. that port governance can obstruct sustainable practices taking place:

> “All the stuff that is of no interest to me I still have to do. I might have the PMSC and H&S, but then have to attend H&S management meeting as part of council, go to an events management meeting as part of the council. One of the things I have found by being a part of this council, is the amount of meetings you are expected to go to has gone from 5% of my time to 50% of my time, including meetings which have nothing to do with ports” (HM in South West, 2012).

The quote above can be further substantiated by OFQ5 which referred to the local authority influence being the cause of some municipal ports not being able to focus on matters outside of safety which is the underlying factor of all ports. One of the four pressures identified in TF6, namely governance can be clearly seen as having a negative impact on port sustainability. In this case the availability of resources, specifically staffing numbers and time spent on arguably unrelated activities can be seen as one of the causes for why municipal ports can be seen as less proactive on matters outside of port safety. Additionally, a number of municipal port accounts are not ring-fenced from those of their owning authority i.e. district or county council; which can result in having substantially less resources as a result of their port governance structure.

OQF7 which has been reinforced by findings from three questions of the pilot test (see chapter 9) stated that addressing sustainability involved a combination of different benefits which different organisations might require at different times, and by combining various utility into one system i.e. PSMS v5; different organisations seeking different benefits can benefit from a single system because of that. Repetitive use of the word *different* was left unchanged and the decision was made not to use synonyms to avoid detracting from the meaning from that very important message that can carry significant implications for theory, industry and policy. Sustainability means different things for every organisation at any given point in time, and one of the reasons that a generic system for managing port sustainability has not been created until now was due to the lack of flexibility that existing systems exhibited by focusing on one or few aspects of port management at a time, rather than on the processes that keep ports operational and require safeguarding for future generations.

As evident from this section, a number of OFQs postulate that port governance models have a negative impact on port operations and ultimately sustainability, which if proven valid could have significant implications for ports policy in the UK. Understanding the effects that governance can potentially have on ports could provide a significant contribution towards understanding port diversity and based on that, formulation of more accurate theory. A second important implication for theory is the contribution to understanding port sustainability, specifically what makes a successful application of sustainability related management practices and potential causes of why this has not been done previously. Being part of a district or council authority can often restrict the ability of ports to implement change, and to update their internal processes when required, resulting in much slower, or lack of innovation; ineffectiveness of internal processes and heavy bureaucracy inherited from the council. Combined with some ports having un-ring-fenced accounts, as a result some ports are able to meet only the minimum statutory and legislative requirements reactively, instead of adopting a proactive stance sustainability management. From the outset governance was expected to have an impact on sustainability, however potential scale of impact could not have been foreseen.

10.5. Implications for industry

Following on from theoretical implications, the non-close- correspondence of TBL with practical application of sustainability in ports was one of the reasons for creating PSMS to empower HMs with more knowledge and awareness. Knowing what constitutes sustainability in ports and being able to look for strengths and weaknesses in order to apply relevant knowledge and to be able to assess the impact of that knowledge are the main benefits of PSMS for ports. Whilst operating on limited resources, smaller ports cannot justify spending vast amounts of their savings or resources on consultants for them to help improve port sustainability as a whole because they would not know where to begin and addressing everything would be at an unsustainable cost. This is where the contribution of PSMS v5 comes in, specifically to demonstrate to HMs which areas of port management need extra knowledge and additional effort, and which can be used as an example of processes for other issues. Being able to specify exactly how many areas of sustainability there are in ports i.e. 11 pillars have been identified with 1 possible to be added in the future; as part of *Proactive Partnerships* criteria and *Stakeholder Engagement*, HMs can then outsource required knowledge from a wider range of academic and consultative institutions and generate awareness in the process. The use of TBL would not have revealed the need for proactive partnerships to be one of the criteria for sustainability, which then would not have been used as a catalyst for targeted knowledge acquisition resulting in better sustainability performance of the port. By breaking down port sustainability into relevant components, HMs can undertake knowledge acquisition through various part government funded KTP partnerships; through collaboration with schools and universities and even EU funded PhD level project similar to this one; however knowing what areas of sustainability to address and which criteria to aim for comes from using PSMS v5 and assessing strengths and weaknesses and making action plans accordingly.

Two main implications for the industry are knowledge and understanding, both of which are essential for ports to be sustainable. What made the initial KTP between FHC and Plymouth University successful was the level of understanding of the potential environmental and socio-economic impacts of the harbour that emerged from the project. The knowledge accrued was then used as a starting point to enable a more effective dialogue between the port and stakeholders to take place. The ability to challenge assertions due to increased credibility as a result of enhanced knowledge and understanding was the next stage of benefits that FHC experienced. By continuing to engage with a number of academic institutions and continuing to accrue high quality knowledge, this enhanced their understanding of their port's aegis and what lay on the seabed. Being able to speak the language of environmental bodies was one of the starting points for FHC KTP, and as a result of that process FHC came to understand more than specialist bodies about certain species. This short example is a demonstration of the power of knowledge and understanding of environmental, and indeed sustainability, issues that can be used to challenge preconceptions, facilitate dialogues and enable ports to provide much bigger contributions to their respective communities.

Being able to assess the state of a port's sustainability without the need to engage external consultants can result in significant time and cost savings which can be invested in other areas of port operations. Since no formal way of assessing environmental impacts of smaller ports has been found, the same would apply to assessing the state of port sustainability. PSMS v5 empowers HMs to assess, strategize and create tailor made plans to improve those areas of the port that require urgent attention. The knowledge and understanding received as a result of undergoing through the process can then serve as a strong footing, similarly to FHC, which would enable ports to better speak and understand not only the language of EM and impacts, but sustainability as a whole. Awareness is another benefit to the HMs from using PSMS v5 which arguably originates from knowledge and understanding in the evolutionary sense for those harbours who are much less impacted by environmental legislation and have smaller scope of operations within their area limits. A building stands because the weight of its roof and floors is being equally distributed on the supporting pillars and if one of those was to be removed or damaged, the structural integrity of the whole structure would be compromised. PSMS v5 tells HMs what “pillars” ports stand on, and using simple visual representations in the forms of a spidergram/“bull’s-eye target” encourages them to take measures and improve those “pillars” that are in need of care, and provides knowledge and examples of what needs to be done in order to achieve improvement. By demonstrating knowledge, awareness and understanding of how to safeguard port communities, to protect jobs and to minimise the waste of resources; HMs can facilitate stronger stakeholder partnerships and much more effective discourses to greatly benefit sustainability of their ports and communities.

One of the limitations is that PSMS v5 doesn’t go into sufficient enough detail into environmental impacts in order to be used as an EM system for managing them. Instead it creates knowledge and awareness about the importance of environmental knowledge which is included in PSMS v5 as one of the pillars of port sustainability. The newly acquired knowledge will then gradually evolve into awareness and can facilitate the creation of port management tools based on the specificity of each institution.

One of the limitations of conducting applied research is the immediate relevance of knowledge to the industry, and because of that compromises had to be made for PSMS v5 to be practical and easy to use for all, rather than for a number of specific ports. Figure 8.3 conceptualised three goals that harbours should strive towards, namely *making your inefficiencies as efficient as possible; needing an industry to generate funds for environmental compliance; commercially efficient, environmentally friendly,* *socially acceptable.* Because goals are individual to each harbour and the three goals in figure 8.3 listed the underlining principles of business process approach i.e. delivering what the customer wants; these goals have been left out of PSMS v5 at this stage to avoid making the system more prescriptive and relevant for fewer harbours as a result. Instead, these three goals could be applicable in the "next step" system that some HMs have suggested during the pilot test which would complement the existing PSMS v5 very well; however the creation of such a system depends on the development of PSMS v5 by addressing comments from first round of testing and further testing to ensure that PSMS v6 would be applicable to a larger number of ports. Only then can a manual for using PSMS v6, or even a later version, be created to assist HMs with the "next step", by detailing a significant number of examples for most, if not all criteria listed; and proposing examples of how improvement to sustainability themes can take place and possible starting points to consider. Due to time and resource constrains associated with this project, such enquiry will have to be undertaken in the future and involve ports from more than two counties to allow for richer data to be gathered, analysed and used to expand on the foundation of existing version of PSMS.

Despite its limitations and time constraints, 80% of respondents discovered at least one, if not a number of benefits for them from using PSMS v5 in its draft form. The reason why the core category of Evolving HarbourMastering was renamed into Evolving Practices of Smaller Ports was because sustainability can be viewed as an organisational evolution which considers past shortcomings and addresses them for greater efficiency and lesser impact. Another reason is that sustainability is collective action as stated on multiple occasions in previous chapters, and HarbourMastering would refer to the HM being responsible for the successes and failures of HA to become sustainable, when in fact it is the whole community that needs to partake, and using knowledge, awareness and understanding jointly contribute to a more resilient, safeguarded and sustainable future. Knowing what port sustainability is and how to address it is the main implication for the industry from this research.

10.5.1 Benefits to CAD ports

Previous section referred to the cost savings of not engaging consultants associated with the creation of PSMS. Table 10.1 outlines estimated benefits to CAD ports from using PSMS v5.

Benefit category (number) / Criteria of benefits	**Cost per day (£)**	**Days saved**	**Cost per year or Total Cost (£)**	**Number of Years**	Benefit per port per year (£)	**Benefits per port over 5 years (£)**	**Benefits for 12 ports per year (£)**	Benefits for 12 ports over 5 years (£)
(1) Creation	500	230	115000	1		7667		**92004**
(2) Annual membership fee of existing systems			500	5	**500**	2500	6000	**30000**
(3) Saving of HM's time on assessment	500	5	2500	5	**2500**	12500	30000	**150000**
(4) Saving HM time spent travelling	500	10	5000	5	**5000**	25000	60000	**300000**
(5) PR budget savings			5000	5	**5000**	25000	60000	**300000**
(6) Consultancy services for publicity and stakeholder engagement	500	5	2500	5	**2500**	12500	30000	**150000**
(7) Less complaints to process by HMs	500	5	2500	5	**2500**	12500	30000	**150000**
(8) Safeguarding ports business and operations				5	**16000**	80000	192000	**960000**
(9) Safeguarding jobs				5	**16000**	80000	192000	**960000**
TOTALS					**50000**	257667	600000	**3092004**

Table 10.1 Benefits to Cornwall and Devon

Source: Author

Nine categories of benefits are estimated by days, costs per day, days saved, etc. The categories are:

(1) Creation – it has been estimated during a conversation with a HM in Cornwall who used consultancy services previously that carrying out work of similar depth of analysis would at least require 12 months full-time as a paid consultant. Using the rate of £500 per day which is indicative of a medium level consultant with a similar level of education to the author and taking into account public holidays and paid leave, a total of 230 working days multiplied by £500 per day = **£115000**. The full cost was not assigned to a particular port because PSMS v5 is generic and would have been undertaken by a collective of ports to gain a regional benefit associated with proactive view towards sustainability: £115000 divided by 15 ports that participated in the pilot test = £7667 cost savings per port.

(2) Approximate annual membership fee of EcoPorts was taken as a benchmark based on the experience of one HM in Cornwall. If PSMS would have a membership fee and would run for the period of 5 years, it would save £500 per port per year (PPPY).

(3) Saving of HMs time as a result of increased awareness (e.g. evaluating different areas of port management against some sort of sustainability benchmark). It is reasonable to estimate that evaluating sustainability of the entire scope of ports operations would take up at least 1 working week for a HM. If HMs salary is taken with the on-cost (office space, electricity, tax, pensions… etc.) it would amount to approximately £500 per day. Multiplied by 5 days saved per year = £2500 PPPY

(4) Saving time spent travelling to meetings to find out more about port sustainability; how to appraise port sustainability and systems that exist for doing so; about sustainability benchmarks; about best practice, etc.. Considering CAD is a remote region and many meetings taking place either in London or places outside of CAD, 2 days travelling for 1 meeting is not unexpected. Attendance at 3 meetings per year results in approximately 10 working days of HMs time that can be saved as PSMS v5 is based on knowledge around port sustainability and can be used to benchmark ports practices. 10 days x £500 per day = £5000 PPPY savings.

(5) Savings to PR budget due to increased awareness, using a tool for enhanced communication and a more proactive approach and less reactive measures needed. A budget of £5000 is not unreasonable to be used by ports to react to posing issues e.g. conduct ad-hoc surveys, gather more data, etc. PSMS v5 can be used as a tool for communication which can potentially reduce the need for a PR budget resulting in a saving of approx. £5000 PPPY.

(6) Second half to the PR budget – engaging services of consultants to help enhance publicity of the port. PSMS v5 can be used to demonstrate progress to stakeholders, to show them the areas that ports are doing very well and those that need improvement. Saving of 5 days' worth of consultant's time can result in a saving of £2500 PPPY.

(7) Having less complaints to process as a result of enhanced communication with stakeholders and better sustainability knowledge and

awareness can generate a savings of 5 days' worth of HM time or £2500 PPPY.

(8) Safeguarding business and ops as a result of enhanced knowledge of port sustainability. One percent of business from the average port turnover based on all accessible. It is difficult to estimate which operations are unsustainable and need safeguarding, however 1% of average turnover gives an indication of the approximate average port turnovers is a reasonable benefit assumption as a result of enhance knowledge, awareness and a tool to assess port's strength and weaknesses. Average turnover based on public accounts was £1.6m x 1%= £16000 PPPY.

(9) Safeguarding jobs - which depend on the port being operational. Similar to the previous category, it is difficult to estimate direct and indirect jobs that rely on ports being operational and sustainable. A figure of 1% of the average turnover is reasonable = £16000 PPPY

Whilst calculating overall benefits, the cost savings as a result of creating (1) PSMS were not added to a yearly benefit for ports as it is expected for the system to be valid for at least 5 years and hence the savings of £7667 was added to the figure of port's benefits over 5 years.

Benefits to Cornwall:

- Benefit of £50000 PPPY represents **76%** of the cost of the 3 year project as funded by the EU. Original proposal suggested creation of 2 jobs per port and the savings of **£50,000 PPPY** is worth 2 entry level jobs with on-costs at each of the 12 ports in CAD.

- If taken over 5 years which is an estimated time for PSMS to be valid a savings of £257667 results in **397%** benefit compared with the EU project funding.
- For 12 ports that positively responded to the pilot test, PSMS would generate £600000 benefits worth per year or **923%** increase on the EU investment.
- Over the course of 5 years for 12 ports using PSMS the estimated benefits to Cornwall and Devon ports are worth **£3,092,004** or **4757%** return on ESF-CUC investment into creating a PSMS for smaller ports in CAD.
- Lastly, based on OFQ7 which stated that different ports have different sustainability requirements at different time, it can be argued that those 3 ports that did not see direct benefits from using PSMS v5 during the pilot test will be able to see benefits from using this approach in the future. If calculated for 15 ports instead of 12, over 5 years PSMS is estimated to generate **£3,865,005** worth of benefits for ports in Cornwall and Devon or **5946%** return on ESF-CUC investment into this project.

10.6 Implications for policy

Often used as a buzzword, sustainability is arguably the most important concept for our society. In July 2010 as part of savings cuts programme, Government announced that it was going to “axe” the sustainability development watchdog (The Guardian, 2010), which was officially closed on the 31st of March 2011 (Sustainable Development Commission, 2011). DEFRA’s sustainable development indicators are based on the principle of

TBL which has been used to demonstrate which of aspects of TBL i.e. environment, society or economy does a policy contribute towards. For the policy to be understandable for the majority, the use of traffic light principle i.e. green – improving, yellow – little or no overall change, red – deteriorating has been adopted throughout the document to indicate the progress of the society as a whole. Despite the irreplaceable and unquestionable importance for the UK economy and accounting for over 90 percent of world trade, shipping and ports have been omitted from the policy; the word “shipping” was not mentioned once throughout the 100 page document. Another document i.e. Ports: National Policy Statement for England and Wales – Appraisal of Sustainability (AoS) published originally in 2009 and updated in 2011 identified key sustainability issues for ports which were also divided into the TBL criteria. This 125 page document outlined policies, plans and programmes (PPP) of sustainability relevant for ports which aside from the TBL criteria of social, economic and environmental, have also included Overarching PPPs i.e. objectives that in general should be met; ports specific PPPs; and transport PPPs (DfT, 2011). A number of generic objectives have been set in port specific PPPs namely achievement of good environmental status of the seas; prevention of pollution from ships; safety; protection of the coast and marine conservation; protect and preserve the marine environment from all sources of pollution; movement of freight, port health, and navigation (ibid:12). Extensive explanation has been provided on environmental issues and economic issues along with some of the environmental impacts that certain port operations such as dredging can have on the state of biodiversity (ibid). An example of an appraisal of sustainability in the case of the marine environment is "identifying and protecting existing marine biodiversity, fisheries, and coastal habitats from the risk of runoffs, spills and leakages of cargoes as well as dredging" (ibid:20). The document then outlines an AoS framework which is based on sustainability objectives and presented using the TBL criteria, where under commercial the following statement was written regarding port infrastructure: "AoS20 To ensure adequate funding arrangements are in place for new or upgraded port and supporting transport infrastructure" (ibid:38). Without having substantial resources to fund infrastructure repairs, the solution for smaller ports is to continuously invest and maintain their infrastructure. DfT policy document does not provide an action plan, or suggest how ports should proceed with particular objectives, but rather lists all policies for all ports. By contrast, PSMS v5 allows for gradual improvement to take place through the use of self-scoring process where over a period of time accumulated scores can be used as indicators of sustainability for a particular area. Having argued previously the resource constraint of smaller ports and being run by very small teams of people who are responsible for everything, having to read in detail and understand 125 page document that does not propose a solution is not a practical use of time for HMs and is unlikely to be undertaken unless mandated. A quote below has been previously used to illustrate reaction from one very experienced HM in Devon towards PSMS v5 and it captures the essence between doing something that is not going to be used and something practical:

> "Initially it was that it is just something else to do which would not be used. Now I'm sure, it may be useful in reporting" (HM in Devon, 2013).

Considering the amount of adjustment PSMS had to undergo to become a useful tool for ports, policy statements need to be better tailored for the practitioners and this is the first implication for policy to have emerged from this work. Having sustainability related policy on a generic level for organisations of different sizes and revenues is not helpful for those SMEs who have only a fraction of resources and revenue streams compared to the market leaders and who also have to adhere to the same rules and targets. The evolution of PSMS in this work clearly indicates the differences between theoretical and practical applications and could be used as an example to illustrate the evolution of thought from conception to practical application.

A third implication for policy is the impact of port governance models on day to day management and whether undergoing restructuring of the ports industry would be beneficial. Not having to worry about council authorities dehypothecating port accounts to fund other initiatives in the regions, trust ports have higher freedom and financial security to think beyond safety issues and invest resources into overall port sustainability. PSMS pilot testing has indicated that whereas all municipal port respondents saw PSMS v5 as comprehensive, only a minority of trust ports saw it as such, which further substantiates the argument for a national ports' restructuring policy. Resource availability and lack of financial security in municipal ports due to the owning authorities being able to dehypothecate port's accounts, and in doing so to divert all port profits into the general council fund could be one of the reasons why trust ports have shown themselves as more evolved with regards to port sustainability aspects. By not being able to save sufficient money for contingencies, for infrastructure repair and maintenance, municipal ports arguably face higher risks of unsustainability as this next quote from a municipal port HM demonstrates: “If the big slipway cracks or breaks, there is no money to repair it” (HM in South West, 2012). The next quote further substantiates that argument: “The reality is now that the council are trying to get hold of any spare cash we have, I’d rather be spending that on environmental officer, but the council won’t allow me to” (HM in South West, 2012). Trying to raise all available resources puts a significant strain on council ports and not having financial security municipal ports can adapt a reactive stance towards sustainability issues and focus on what is more pressing at the time, rather than looking ahead.

Although the 6 municipal ports responded to the pilot test are equally spread across CAD, making conclusions and recommendations about ports policy based on that sample can be considered as a limitation.

10.7 Conclusion

This chapter provided a discussion of the research conducted, discussed individual and combined benefits, implications and benefits. Benefits and limitations were outlined along with the breakdown of financial benefits to CAD ports. Very close adherence to GT research quality criteria assists the credibility and usefulness of research findings and benefits of PSMS v5 as discovered during industry testing.

CHAPTER 11: CONCLUSION

This research has created a PSMS to assist smaller ports in CAD to manage sustainability issues through the use of knowledge based self-scoring criteria which underpinned the system. The reason for conducting this research was the increasing legislative, governance, conservation and stakeholder pressures that smaller ports in CAD face daily due to the rich biodiversity and ecosystems that inhabit the aegis of those ports.

Varying levels of influence that the four pressures presented in TF6 (chapter 5) have on ports were the reason for not including them into PSMS v5. Conservation and part of legislative pressure often coincide when a port is situated in an environmentally sensitive area and is subject to stringent rules in order to avoid disrupting conservation efforts. Other legislative pressures include compliance with new IMO procedures, EU directives, and UK Government's instructions and policies. Similarly, governance, mission and stakeholder pressures often coincide when ports are run for the benefit of local stakeholders and have devised their mission statements to incorporate safeguarding and conservation of local biodiversity (as indicated in chapter 3). Stakeholders can sometimes exhibit strong interest in port operations, and as a result, put pressure on HAs to address certain posing issues, oppose or favour developmental projects or even dictate how the port should run its business. Findings presented in chapter 8 confirm that diversity of smaller ports extends beyond their commercial operations and affect their internal management processes; hence to avoid imposing specific examples, the four pressures from TF6 were excluded from the final version of PSMS.

The work presented has fulfilled all research objectives and has undergone industry testing to test and validate the findings. Having reflected in the previous chapter how this project addressed each objective, this chapter will detail some concluding thoughts and focus predominantly on recommendations and future work.

11.1 Recommendations

PSMS v5 has been created in an applied research context, where views of experienced practitioners, principally HMs have been inductively constructed and analysed using academic techniques to produce 11 themes of sustainability as an outcome. The conceptualisation of these principles required unfettered access to the practitioners and a substantive amount of collaboration undertake over the course of the project. The reasons for that are the interconnectedness of sustainability principles and the interdependence of ports and their respective communities. A very positive response has been received from the HMs contacted during the pilot test towards the system and the sustainability criteria that underpin PSMS and the idea behind it. A general consensus about the practicality of that system indicates the viability of PSMS v5 as a practical tool for smaller ports in CAD. Based on that, the following set of recommendations can be outlined:

By using PSMS and creating goals and targets based on the scores appraised and keeping records of historic data, the user can then compare the evolution of scores across all 11 pillars of sustainability. The first recommendation for practitioners would be to continue using PSMS v5 at regular intervals and record any progress or decline in scores. If the scores are increasing at a steady pace and the overall state of harbour's sustainability is following the same trend, then tailoring PSMS to fit particular needs would be the next step. PSMS v5 is not based on any operational specifics or intricacies of internal or external processes. To be applicable for ports in plural it provides only a limited scale of progress.

Secondly, the principle of using knowledge as a mechanism for EM has been proven effective by a number of ports in CAD. Knowing what constitutes sustainability and being able to look for strengths and weaknesses is only the first step which needs to incorporate the application of relevant knowledge to enable progress. The recommendation for the industry is to increase collaboration with academia at high school, college and university levels to allow students to gain practical experiences and obtain valuable data as a result at a fraction of the consultant's cost. Being able to identify and target relevant areas of port operations that need an input of knowledge for sustainable practices to occur is one of the benefits of PSMS v5 that made possible an overall overview of port sustainability issues. However, without the acquisition of new knowledge and data, making progress on some, if not most of the 11 pillars of sustainability will be challenging. The argument for knowledge generating awareness and better understanding as a result has been highlighted in the previous chapter and it is worth reiterating that knowledge is the essence of PSMS, and it evolves with the society. Ports need to continuously acquire new knowledge relating to those 11 pillars to ensure that port practices are sustainable.

A third and final recommendation is to share best practice amongst the non-competing ports related to scores obtained during the self-assessment process. To be more specific, expanding on the current process of sharing best practice during regional meetings i.e. the general ideas and principles and being more specific by partnering up with a particular port that has a higher score on a particular category in PSMS v5. Through close working, and with collaboration and exchange of information that might be commercially sensitive in a general meeting, both ports can benefit from establishing that discourse and working towards improving sustainability issues. Such mini partnerships can be a very strong management tools for port managers, and working off the same set of sustainability criteria as outlined in PSMS v5, more effective and targeted resolutions can be found and implemented.

11.2 Future work

In chapter 9, a total of eight observations for further enquiry (OFQ) have emerged from the pilot test analysis. Port governance was the emphasis of six of those observations and the remaining two focused on the influencing factors of sustainability criteria for ports. From the outset governance was considered one of the major factors affecting sustainability development needs and of municipal ports restricting their ability to operate commercially. Pilot testing has indicated that the expectations of trust ports regarding the sophistication of management systems and their requirements to look beyond the safety aspects of port management exceed those of municipal ports. Whether governance is the cause of that or whether it could be factors such as port location and level of community involvement is the first proposal for future work. Because port governance differs across the world, the British model is unique in that local authority ports are owned by the council and do not get money from the council; by comparison in France such ports are being supervised by the central government with municipalities playing a “secondary role in governance system” (Debrie, 2010:7). To conduct an enquiry and map out the areas of port management affected by governance model would be an important contribution to knowledge that could be used by policymakers in the future.

The second ambition for future work is to test PSMS v5 with ports in other national contexts, for example France and potentially Finland and Canada to establish whether port sustainability criteria are the same in different countries and what factors, if any affect that. The countries mentioned previously all have smaller ports and very different governance models from the UK ports sector (Debrie, 2010). In order to do that, conducting PSMS pilot test in smaller ports in France with different governance models can be a good start to see whether port governance is one of the factors that can potentially impact port sustainability and as a result require any additional criteria to be added. Findings from that enquiry will make it possible to assess whether PSMS can be used as a European model for port sustainability assessment, and ultimately tested in Canada to substantiate existing findings due to the country’s recent devolution of governance. As a result of that process “65 ports have been divested to other federal departments, 40 to Provincial governments (mainly ferry ports), 123 to local interests, and 238 deproclaimed as public harbours or demolished. Seventy-four still have to be transferred by the end of the 10-year process” (Debrie et al, 2007:459). The application of PSMS to smaller ports under such a variety of ownership types would be an excellent platform to test the applicability of port sustainability criteria across continents, different marine environments and associated stakeholder groups.

It would also be interesting to find out whether the process of constructing views using a constructivist stance and a completely inductive approach by working with the industry and for the industry has contributed to a new dimension of sustainability theory i.e. applied sustainability. The evolution of PSMS outlined in chapter 9 has clearly indicated that there is a huge difference between theory and practice, and the amount of extra effort required to make theory into a practical tool that can be used by practitioners. Theory of sustainability has been mostly centred on the TBL concept, which pilot testing revealed does not correspond well with practical application in the smaller ports industry. By constructing the industry's views into sustainability themes of smaller ports and building PSMS v5, it can be argued that the applied context of this project allowed the applied sustainability theory to emerge, as all theoretical principles had to be considerably modified for practical application. Whether or not this project has stumbled upon a new dimension of sustainability theory would be an interesting future academic enquiry.

Lastly, establishing whether, and if so how many smaller ports should be divested from the council ownership to the local communities for more sustainable management or whether some ports cannot be sustainable and need to be closed is an important question. As stated many times, every small port is different and whereas many can be sustainable, the question to explore further is can all small and medium ports be sustainable?

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Appendix A – Analysis of designations found in CAD ports

MCZ's are aimed at protecting and conserving nationally important habitats and species that are either rare, being threatened or have a representative sample (DEFRA, 2013). DEFRA claim that MCZs will also take into consideration factors of social and economic nature during the identification process of those sites (ibid). Restrictions placed on the designated site will vary depending on the sensitivity of species, habitats and types of activities that are taking place in that area (ibid).Once designated, the public authority must ensure that permission is not given to activities that could harm conservation efforts(ibid).

Having over 600 areas in the UK which cover over 8million hectares (JNCC, 2013); SAC's are designated under EC's Habitats Directive Annexes I and II which aim to conserve 189 habitat types and 788 species that have been identified. It is estimated for 78 habitats from the Annex I to be in the UK, and 43 species from Annex II either are native or reside in the UK (ibid). On the marine side, there are 108 SACs having a marine component to them that cover 7.6% of the UK sea area. Management principles of SAC are not intended to ban human activities from the protected sites, but rather ensure that they do not threaten conservation interests (UKMPA, 2013).

Unlike MCZ and SAC, AONB's are aimed at protecting landscape qualities in order to preserve and even enhance their beauty (Natural England, 2013). This designation covers landform and geology, plants, animals and history of human settlements (ibid). They are protected against development and are legislated under National Parks and Access Countryside Act 1949 (ibid).

HC is aimed at conserving, protecting and enhancing the natural beauty of the coasts, their marine flora and fauna, and their heritage features (Natural England HC, 2013). Unlike the previous three, HC is not associated with a statutory designation process and can only be defined (ibid). Other purposes of HC include enhancing enjoyment and appreciation from the public, maintaining and improving the health of inshore waters through suitable environmental measures (ibid). There are currently 32 designations of Heritage Coast in the UK, 16 of which cover almost the full length of the coastline of Cornwall and Devon in the SW of UK.

Over four thousand SSSI's cover an estimated 8% of the UK's land area, more than 70% of which by area have international importance because of their wildlife and have been designated either as SAC or an alternative environmental status (Natural England SSSI, 2013). The following are included under SSSI: "wetlands teeming with wading birds, winding Chalk Rivers, flower-rich meadows, windswept shingle beaches and remote upland peat bogs" (ibid). NE stated that aspects covered by SSSI are under threat from "development, pollution climate change and unsustainable land management" (ibid). SSSI's are protected under Wildlife and Countryside Act 1981 (as amended) (ibid).

SPAs first were classified in the UK in 1980s and since have been regularly updated. Aimed at protecting birds and migrating species, SPAs are being selected according to the principles outlined in the SPA selection guideline published by the JNCC "on behalf of the statutory conservation agencies" as no formal criteria for selecting SPAs has been outlined by the Birds Directive (DEFRA, 2014).

Appendix B – EU and UK port governance models

European models of Non-UK ports

Four models of port governance have been detailed in the ESPO (2010) report on European Port governance, namely landlord, regulator, operator and community manager. Landlord function was one of the three functions traditionally assumed by port authorities (Verhoeven, 2010). Regardless of whether port authority owns the land it manages or it is being managed on behalf of the government either on local or national scale, there are principles that differentiate landlord ports i.e. its functions (ESPO, 2010). Landlord port can take on a number of roles including manage, develop and maintain port estate, develop and implement strategies that are linked to the port estate, and provide infrastructure and facilities (ibid). Three major changes have taken place with Landlord ports over the past two decades. Firstly, decisions to invest into infrastructure to be able to handle containers was imposed on the sector by the prevailing market forces, often speculative (Verhoeven, 2010). Secondly, landlord ports had to find funding sources independently of governments which reduced financial support in order to continue engaging in "public-private partnerships to finance investment projects" (ibid:253). And lastly, the impacts of port use of land is felt a lot more locally, however the benefits derived from using that land often "extended far beyond the port-city perimeter" (ibid:253).

Regulator port function can be best described as "controlling, surveillance and policing" the port area, whilst ensuring the safety of ship and cargo operations (ESPO, 2010). Regulator ports also take on an enforcing role of legislation and regulation relating to harbour safety and environmental protection (ibid). Using a previously given definition of port authority as a “body with statutory responsibilities that manages port’s water and land-side domains” (Verhoeven, 2010:251), the functions of regulator port coincides well with the definition of port authority. Regulatory role provided by the ports with this governance type is often undertaken by a co-operation with a governing institution in order to either avoid conflict of interests, but also to help cover the costs associated with the regulatory function (ibid).

An operator function combines the physical transfer, transport and technical services, specifically moving cargo and passengers between the marine and terrestrial interfaces; providing pilotage, towage, mooring and a range of supportive services such as handling waste, cold ironing, etc. (Verhoeven, 2010; ESPO, 2010). Cargo handling element within this type of governance model had resulted in private operators taking over the cargo handling business in ports, leaving port authority either to provide “specialised services (e.g. cranes for heavy lifting)” or to acting as a “service provider ‘of the last resort’”(ESPO, 2010:39).

The fourth and final type of governance defined by ESPO (2010) is the community manager which combines the economic and community dimensions within its prime function. Conflicting interests between stakeholder groups form the basis of the social dimension, whilst the “evolution of economic actors” serves as the basis for the economic aspect (ibid: 45). When combined, the community manager port function aims to deal with shared problems within the port area and going deeper into the hinterlands (ibid). To protect “licence to operate”, community manager function strives to resolve conflicts of interest, whilst lobbying the government “on behalf of the port community” (ibid: 45).

With so many overlaps relating to European port governance, it is not unreasonable that the EC does not want to conform EU ports to a particular governance model and encourages diversity. As a direct result, classifying ports precisely is not always possible due to vast overlaps that different governance functions undertake (Verhoeven, 2010). Ports in CAD generally fall under regulator, community manager and an operator function, however elements of landlord ports specifically maintaining and developing port estate are present in most CAD ports. The next section will detail the UK port governance models followed by a comparison and analysis with their EU counterparts.

UK Port Models

UK port governance models differ from those of the EU ports. Three generic port governance types are present in the UK, namely trust, municipal, and private (GGPPMO, 2013). No specific document was found that would analyse the difference between all governance models, however the GGPPMO provides a port assessment checklist which allows selecting one of the three port governance types, specifically trust, municipal or owned by a company (ibid). Furthermore, an online search of Ports.Org which is an internet based directory of UK ports and harbours revealed 86 trust, 385 municipal, and 347 private ports listed with description and coordinates attached (Ports.Org, 2013). Some other ports were found to have a governance type missing from the description, making the numbers provided above approximate. The total of 818 ports in UK that have a description and arguably most of which are operational, compared to 996 ports found without selecting any governance type making 178 ports unaccounted for (ibid). This quick comparison illustrates the scale of the ports industry in the UK and its importance to the country's and local economy, UK society and lifestyle.

Trust ports

The DfT (2013) defines trust ports as "independent statutory bodies, each governed by their own, unique, statutes and controlled by a local independent board". Trust ports are set up by the Act of Parliament and controlled by an independent board formed of local people interested in maximising stakeholder benefit, without having shareholders or owners present (ibid). The management board of these institutions are often known as Harbour Commissions or Conservancy Boards (HCL, 2013). One of the Board's duties is to resolve conflicts between stakeholders with regards to port's objectives, whilst taking into account consideration of commercial and social nature, and planning ahead (DfT, 2009). Similarly to private companies, trust ports should be run as commercial businesses which seek to make profit, however unlike private firms, the surplus generated by trust ports should be invested back into the business or "directed towards the interests of the ports stakeholders" (ibid:4). Another very important function of trust ports is transparency, i.e. to conduct business in the "interest of the whole community and stakeholders openly, accountably and with commercial prudence" (ibid: 4). Having this emphasis on commercial profitability that is aimed at benefiting the local community makes trust ports very important institutions for the local economies, and for British society as a whole.

DfT (2013) reports over 100 trust ports in the UK, while the House of Commons parliamentary briefing on trust ports states that over 20 have an annual turnover of £1M (HCL, 2013). Having found only 85 trust ports in the UK as explained at the start of section 3.3.2, the exact number of these establishments is not known. In 1991 the legislative environment was created with the Ports Act to allow the sale of the Trust ports into private ownership if the trustees believed that to be beneficial (Petit, 2008). Turnover was a key factor in allowing privatisation, and several trust ports with a turnover in excess of £5 have been privatised. An exception to privatisation was the Port of Dover, which despite its size and turnover remained a trust port because of its strategic importance for the “UK cross channel trade” (ibid:722).

Municipal Ports

Similarly to trust ports, the aim of municipal ports is to benefit the stakeholders including the local community, but unlike trust ports they are not governed by an “independent, bespoke, expert and directly accountable body”, but form and important part of the local authority (DfT, 2006:6). Being part of the local council, port accounts are often not separated from those of the council, which could hinder port business planning, maintenance and development as a result of unsystematic provision of resources (ibid). Being part of the local council, municipal ports are treated “the same way as any other service” (ibid: 6).

DfT's (2006:8) review into municipal ports has recommended a number of changes for municipal ports as "the way forward". Firstly, the creation of "assured accounts" and agreeing on the infrastructure rental fee in the memorandum of understanding between the "port managing body and the owning authority" was referred to as beneficial (Ibid:7). Other recommendations made were based on the Modernising Trust Ports report, which according to DfT "sets out the benchmarks in terms of board composition, appointment, performance and accountability" (ibid:9). Out of 61 municipal ports that participated in DfT (2006) review, 96% had leisure facilities, 89% had fishing activities, compared to 14% and 36% dealing with liquid and dry cargo respectively. Although the sample of 61 municipal ports represents approximately 15% of the total number of such ports in the UK (based on the figure in section 3.3.2), this illustration provides a general overview of the municipal ports sector. Leisure and fishing activities both depend on much cleaner environment compared with major commercial ports; hence profit margins and turnover would be considerably less. Out of 61 participating ports in the DfT (2006) report, only 14% (or 8.5 ports) stated that the current governance system was not fit for purpose (ibid).

Private

Private ports were developed under the Act of Parliament which "permitted the building of enclosed docks and the development of dedicated docks" that replaced existing warehouses available river side at that time (Petit, 2008:719). From the Government's perspective, the main goal of private ports in the UK is to increase efficiency; however the decisions concerning port capacity remain in the hands of the markets (Baird, 1999).

The private ports sector manages 15 of the 20 largest ports in the UK by tonnage accounting for nearly 80% of the total UK's traffic (UKTI, 2013). The vast majority of private ports in the UK are part of large port operator companies such as ABP, Hutchinson Port Holdings, Peel Ports and DPWorld. ABP (2013) is "Britain's largest and leading port operator capable of handling every type of cargo" operating 21 ports and has developed its own centrally-led sustainability initiative which is implemented in all member ports (ABP, 2013).

Co-operations are also often found with private ports, when a port operator has to work together with the port owner. Example illustrated in section 3.1 of Port of Southampton, where DPWorld and ABP work in co-operation as terminal operator and port owner respectively.

Appendix C – Port Marine Safety Code and A Guide to Good Practice on Port Marine Operations.

The Port Marine Safety Code (PMSC) was introduced in 2000 following the "Sea Empress" disaster and subsequently reviewed in 2009 and 2012 (ABP, 2013). This document "establishes a measure by which harbour authorities can be held accountable for their legal powers and duties to run harbours in safety" (ibid). This code was developed to enable HAs across the UK to improve safety and manage marine operations to nationally agreed standards (DfT, 2012). When implemented in full, PMSC claims that there should be a reduction in the risk of incidents occurring within the limits of the harbour authority as well as to provide "some protection for the duty holder if an incident does occur" (ibid:9). This is achieved through defining the roles and responsibilities of key people involved in the navigational safety of the port and through a legal requirement to have an SMS "based on formal risk assessment" (ibid: 9). Statutory aspects of the PMSC may be capable of adaptation to elements of sustainability management, and provide a management infrastructure for other initiatives including the environment.

Conservancy

Alongside PMSC, a document titled "A Guide to Good Practice on Port Marine Operations" (GGPPMO) has been created to provide guidance on how to comply with PMSC. GGPPMO identifies conservancy as a HA's duty "to conserve the harbour so that it is fit for use as a port" (DfT, 2013: 62). This section of PMSC instructs HA's to provide users with "enough information about conditions in the harbour, such as depth of water, local notices to mariners, etc", and designates harbour authorities with powers to provide aids to navigation and regarding wrecks (ibid:62). From the user standpoint, this appears to be an obvious requirement that harbours have to comply with to remain safe; however it entails a number of responsibilities for harbours which can take up vast amount of their available resources.

Table below summarises port conservancy duties as outlined in GGPPMO (DfT, 2013)

Hydrograph y	A duty of HA to "find, mark and monitor best navigable channels in the harbour" (ibid: 62). HA's must also have effective arrangements with regards to publishing this information to alert users.
Admiralty charts	Providing regular information to UK Hydrographic Office for publication is a standard procedure.
Prevailing conditions	Establishing procedures to provide users with information about general, meteorological and other conditions which affect harbour usage.
Aids to navigation	Provision and the level of aids to navigation which "should be based on formal risk assessment", availability and characteristics of which should comply with internationally agreed guidelines (ibid: 62).
Anchorages	HA's SMS should take appropriate actions to ensure safe anchorages "in the harbour and its approaches" depending on the vessel type, size and the needs of other users (ibid: 62).
Wrecks	HA have powers to "raise, remove, destroy and mark a wreck" which can become danger to navigation, with the aim to minimise the risk to "as low as practically possible" (ibid: 62).
Reviewing changes	Significant increase in harbour traffic and changes to operations should prompt HA's to undertake surveys.
Works in harbours	HA's SMS should incorporate the effect of harbour works on safe navigation. Special assessment will be required in each case "where new hazards are likely to arise" (ibid:62)

Appendix C: Port Conservancy Duties

Source: Based on DfT (2013)

Despite the PMSC being described as “non-mandated… more flexible than a rigid legislative approach, reflecting new operational best practice…” it is evident from the table above how many safety related responsibilities this document places on the HAs (DfT, 2012:5). Such code can be perceived as all-encompassing due to its origins from best practice and the non-mandatory nature. However, looking at it from the business point of view, aside from the concept of safety that encourages users to use the facilities of the harbour, conservancy duties listed above represent a cost to the HA which has to be covered from additional revenue streams making the use of PMSC as a single management method unsustainable long term. The next section is going to present the novel approach towards EM developed as a result of FHC KTP by viewing it as a business process, rather than a cost. The specific details of that collaboration were left out of section 4.3 and only key points were summarised to illustrate certain important transferable principles.

Appendix D – Criteria for evaluating the quality of GT research

Criteria as outlined by Charmaz (2006)	Relevance to this research
Credibility	
Has your research achieved intimate familiarity with the setting or topic?	Over 30 hours of interviews have been conducted during the 2.5 year collaboration with the industry professionals. Ongoing collaboration with regional HMs during the SWRPA meetings on a bi-monthly basis with the opportunity to present my up to date research and facilitate questions during most meetings. Additionally, close to 30 hours of telephone conference calls with the HM and environment manager of Falmouth port as official business partners of this research. Discussion of research issues during professional meetings such as Devon Maritime Forum, CILT seminars, and academic conferences, including WCTR2013 in Rio de Janeiro, and LRN 2012 in Cranfield, UK.
Are the data sufficient to merit your claims? Consider the range, number, and depth of observations contained in the data.	Pilot testing of PSMS v5 established that 80% of the respondents have found at least one benefit of using PSMS v5 in their ports. PSMS v5 attempted to summarise the areas of port management that need to be addressed for ports to be sustainable. One further category has been suggested by the practitioners, although its content has been implicitly implied in PSMS v5. The depth of observations made during analysis and interviews made possible to summarise internal and external factors i.e. themes, which all form arguably an equal part of port sustainability.
Have you made systematic comparisons between observations and between categories	Observations about emerging themes and ideas have been recorded in the memos and were later used to inform, and compare with categories. The idea of “working together” symbolised the idea of collaborative efforts. It was based on the observation of the rebuilding of Lighterage quay in Truro. That project was important to safeguard community against flooding and to safeguard port’s infrastructure. This idea was later developed into the category of *Proactive Partnerships (PP)* that formed one of the 11 pillars of sustainability in PSMS v5.
Do your categories cover a wider range of empirical observations?	Yes, the categories in PSMS v5 have been formulated from the highest level of abstraction where 996 initial codes, were developed into 309 focused codes and ultimately into 35 theoretical codes which were the foundation of theoretical

	formulation and the development of new theory in PSMS. Since all coding took place using an inductive approach, where no data was disregarded, emerging theory of PSMS does indeed cover a wider range of empirical observations.
Are there strong logical links between the gathered data and your argument and analysis?	The gathered data initially helped to answer objectives 1-3 which then, combined with emerging theoretical codes made new theory formulation possible. The evolution of how gathered data has informed the research problem and contributed to a much better understanding of the research problem are evident throughout. Logical links in data analysis informed the creation of PSMS.
Has your research provided enough evidence for your claims to allow the reader to form an independent assessment and agree with your claims	All important steps taken in the evolution of thinking, conceptualisation and systems development have been methodically recorded so that the process of construction could be replicated. Forming an independent opinion would require a comprehensive enough map that would guide the user along the 2.5 year journey from identifying key variables of all objectives to testing an actual system. The constructivist stance adapted in this project has underpinned the construction of the sustainability related issues, challenges, concerns, best practices and requirements of smaller ports, and using the process of GT identified key theoretical constructs. Results of the pilot test along with the detailed description of project evolution should be sufficient for the reader to agree with the claims made.
Originality	
Are your categories fresh? Do they offer new insights?	Yes, all of the categories have inductively emerged from the GT analysis and offer new insights into the areas of port sustainability.
Does your analysis provide a new conceptual rendering of the data?	Yes, as a result of data analysis vast amount of issues relating to environment, risks, change, commerce, stakeholders, etc. have been categorised to provide an overview of the wide range of issues relevant for smaller ports. The grouping of data into categories has received positively surprised feedback from HMs in CAD and was illustrated throughout.
What is social and theoretical significance of this work?	The theoretical significance of this work is the extension of the widely accepted TBL as a way of viewing sustainability by the industry. TBL can be used as a good starting point for an organisation seeking to be more sustainable but does not correspond closely with practical application. PSMS v5 highlighted all areas of port management that need to be managed for ports to be sustainable.

How does your GT challenge, extend or refine current ideas, concepts, and practices?	There has not been a generic comprehensive system to manage port sustainability due to the vast differences between ports. PSMS v5 addresses that issue and provides HMs with a self-scoring mechanism with an added knowledge element in the form of scoring criteria. Testing has revealed comprehensiveness, practicality and usefulness of PSMS v5 for HMs. The constructivist GT approach has helped to construe the data in such a way that it was possible to take it to the highest level of abstraction where the meaning of 996 concepts (i.e. initial codes) was not lost, but combined into more appropriate categories with deeper meaning. This work is evidence of the power of GT if used correctly.
Resonance	
Do the categories portray the fullness of the studied experience?	The categories have revealed much deeper dimensions of the study that was anticipated. By constructing GT using the principle outlined in chapter 7 i.e. making codes fit the data, instead of forcing the data to fit the codes. The 996 initial codes emerged have all addressed different issues and covered a range of topic relevant to HMs. The comprehensiveness of sustainability themes which emerged as a result of qualitative data analysis was tested with HMs and some views have been recorded in section 8.6.
Have you revealed both liminal and unstable taken-for – granted meanings?	Yes, e.g. the early idea of *contributing together towards a common cause* was scrutinised with the purpose of revealing the links and connections that make it happen. The idea of proactive partnerships emerged after more data interrogation and comparison. Some well-established meanings e.g. safety of life has multiple meanings depending on the background of the person reading it. Although the concept was later reworded into safety management to avoid confusion, the original meaning was remained unmodified and combined with other similar concepts.
Have you drawn links between larger collectives or institutions and individual lives, when the data so indicate?	Having been collaborating with the members of SWRPA since the start of the project and interviewed selected members during various stages of data collection, links have been drawn between the sustainability requirements of a whole county of ports compared to the individual ones. The data indicated to test some emerging theories about the state of ports infrastructure, and an interesting comparison was made regarding long-term underinvestment into infrastructure on a Naval

	base and one of the CAD ports. Another concept about *providing foundation for tourist economy* as recorded in the memos looked at the ports as the being the foundation that makes tourist economy possible, comparisons were made between different Cornish coastal communities and their reliance on having the presence of ports. Eventually this idea was merged into the safety requirement of ports to dredge and maintain a certain level of draught in order to allow vessels to come into the port and for the community to benefit from that.
Does your GT make sense to your participants or people who share their circumstances? Does your analysis offer them deeper insights about their lives and worlds?	Yes, quotes from impressed HMs have been demonstrated throughout this thesis. The following quotes indicate the reaction of some HMs towards PSMS v5: "I'm hugely impressed with the fact that you have 11 headings that none of them I'm looking that is not relevant – they are all relevant" (HM in Devon, 2014) "I think you've done a phenomenal job of getting it all together…" (HM in Cornwall, 2014) "I think it's great, it gives a very clear simple way of seeing where you are at the present time. It gives you the opportunity then to look at it and see what to start making better" (HM in Cornwall, 2014). "Interesting 15 minutes could be used as part of presentation" (HM in Cornwall, 2014) "…it feels worthwhile. It's a worthwhile exercise to take stock and look at yourself, rather than just to continually trudging the same path." (HM in Cornwall, 2014) "Initially it was that it is just something else to do which would not be used. Now I'm sure, it may be useful in reporting" (HM in Devon, 2013). The last quote clearly illustrates the surprise of one very experienced HM in Devon when he took part in PSMS v5 pilot testing. His view is arguably shared by other HMs who might have assumed PSMS to be like every other system they came across i.e. time consuming, not comprehensive enough for an entire area of port management and very prescriptive. PSMS v5 offers guidance on sustainability related issues, whilst not taking away the "freedom" of HMs to start at the back, the front or the middle and work their way up.
Usefulness	
Does your analysis offer interpretations that people can use	Chapter 9 clearly illustrates the evolution of PSMS, in particular how the concepts produced in PSMS v 4.2 were reworded along with the scoring criteria for

in their every-day worlds?	greater suitability for the industrial application. During testing, 80% of respondents said they will use PSMS v5 regularly. A lot of effort was put into rewording the concepts to ensure the meaning was not lost or disregarded due to a clash of terminology as illustrated in chapter 9.6 with the example of *Safety of Life*. Making PSMS into a practical system that can be used daily was one of the key tasks of this project.
Do your analytic categories suggest any generic process?	A possible generic process that can be suggested by the categories is the development of a template which an organisation can follow in order to identify their areas for sustainability along with criteria for achieving it.
If so, have you examined these generic processes for tacit implications?	This process has not yet been examined for implications and whether after following it an organisation in a different industry would be able to create a comprehensive system similar to PSMS v5. Some immediate implications to address would be the amount of industry specific issues and sustainability themes and the process of formulating those from data, and whether that would be transferable to a template.
Can the analysis spark further research in other substantive areas?	Each of the sustainability themes combined a vast variety of issues all of which are intertwined with the overall aspects of port management. Further research is planned with the starting point of updating PSMS v5 based on the comments received during the pilot test and to select several ports and to work closely with them to see and to record the benefits of using PSMS as part of their strategies. Suggestions have been put forward to create a second part to PSMS in the form of the "what's next" guide after HMs completed the self-scoring process and wanted to improve certain areas.
How does your work contribute to knowledge? How does it contribute to making a better world?	This work provides a number of contributions to knowledge, especially since smaller ports have been significantly under researched as an industry. Firstly, the working theory of sustainability in the industry i.e. TBL has been considerably expanded to better fit the purposes of ports and help make sustainability possible using a practical approach. Since port communities depend on their ports for food and for income, helping to ensure future sustainability of smaller ports is a hugely important task. Secondly, the idea that organisations which differ in every operational aspect can be managed using a generic process is a contribution itself.

	Sustainability has been taken as the highest level of abstraction which allowed internal and external processes and dimensions to be grouped together and to form a theoretical framework of the industry. Arguably, many other industries which differ significantly in their approaches to business but are similar in their fundamental infrastructure could come up with a generic process to help address their sustainability issues respectively.

Appendix D: Criteria for evaluating the quality of GT research

Source: Based on Charmaz (2006)

Appendix E – Emergence of sustainability themes

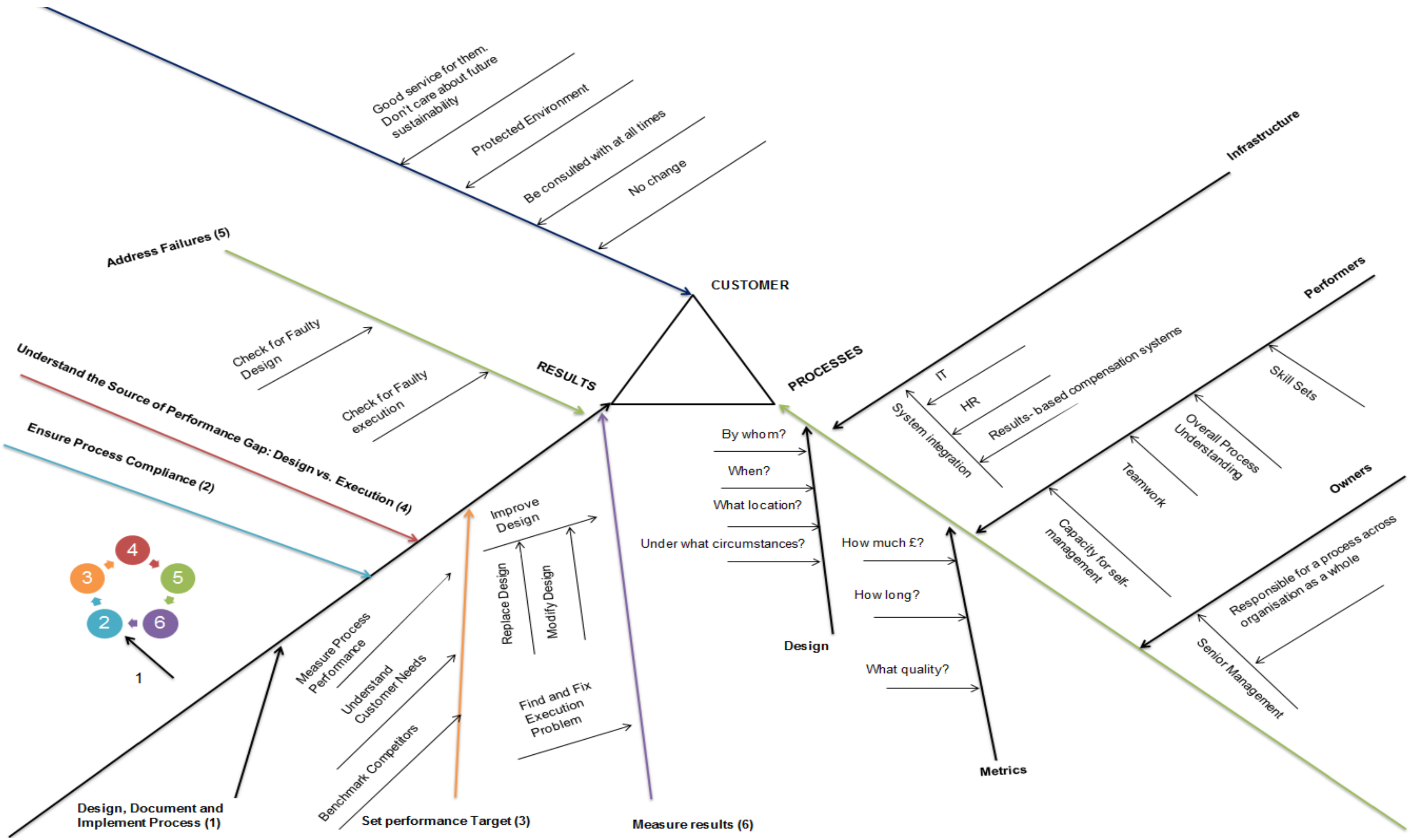
Sustainability Theme	**Codes and Concepts**
Infrastructure	**T1** Charging **environmental levy** to prevent major infrastructure failure
	T2 Evolving, developing, and rebuilding harbour **infrastructure**
	T3 Balancing the provision of new infrastructure with navigation requirements
	T4 Unutilised, uncared for and unmaintained **infrastructure**
Safety of Life	**T5** Maintaining harbour and beach **safety**, and managing **liability**
	T6 Damaging the environment to maintain and improve **safety**
Environmental Management	**T7** Managing the **environment** through controlling the **safety** and risk of vessel's movement
	T14 Responsible boating - **proactively** looking after the harbour authority's waters
	T15 Using **research** as a mechanism for environmental management
	T16 Managing environment is about local **perceptions** as well as **organisms**
	T11 Relying on others for environmental warnings, and statutory requirements for environmental protection
	T9 Relying on own experience and common practice for managing environmental impact (regarding BWE and its ENV man)
	T12 Doing an **EIA** on every marine/maritime operation at one point within its lifecycle
	T13 Reducing **visible/significant** environmental **impact**/pollution through practical/visible measures
Community Engagement	**T17** Not having **pressures** relating to the environment from the community and governing bodies
	T18 Safeguarding, educating and giving back to the **community**
	T19 Community not wanting those things that make **employment possible** and businesses work
Harbour Profitability	**T10** Ensuring profitability and resilience to **safeguard HA**'s ability to remain operational short and long term
	T20 Separating personal and professional to **conduct business properly**

Relevance of Management Tools	**T23** Evolving requirement to have **management tools** (EMS, IMS, PSMS) practical and relevant to those people who use them
	T24 Having too many operations in EMS – would result in planning for oil spill instead of movement
Customer Satisfaction	**T31** Understanding customer requirements to deliver pleasant and safe experience
Working together	**T21 Working together** with stakeholders and governing bodies to engage in strategic planning and introduce measures for reducing environmental impact
	T22 Collaborating and conflicting with governing bodies regarding conservation and designation
	T26 Sharing best practice
Natural Evolution	**T8 Evolving** knowledge, awareness and expertise of using all aspects of **TBL** in decision making
	T27 Evolving requirements, duties and expectations of Harbour Authority from society and governing bodies
	T28 Naturally evolving with time, knowledge, and experience– having to adapt to changing circumstances
	T33 Being affected (favourably or negatively) by port location and/or environmental designations that come with it
Being Prepared for the Future	**T30** Taking proactive actions to safeguard sustainability of the harbour for future generations
	T32 Needing to change/adapt unsustainable policies/aspects for the future
Harbour Authority Goals	**Codes and Concepts**
Harbour's Ultimate Goal	**Sub/Core 2** Commercially Efficient, Environmentally Friendlier, and Socially Acceptable
Harbour's 1-st Goal	**T29** Making your inefficiencies as efficient as possible
Harbour's 2-nd Goal	**Sub/Core 1** Needing the industry to generate conservation funds

Appendix E: Emergency of Sustainability Themes

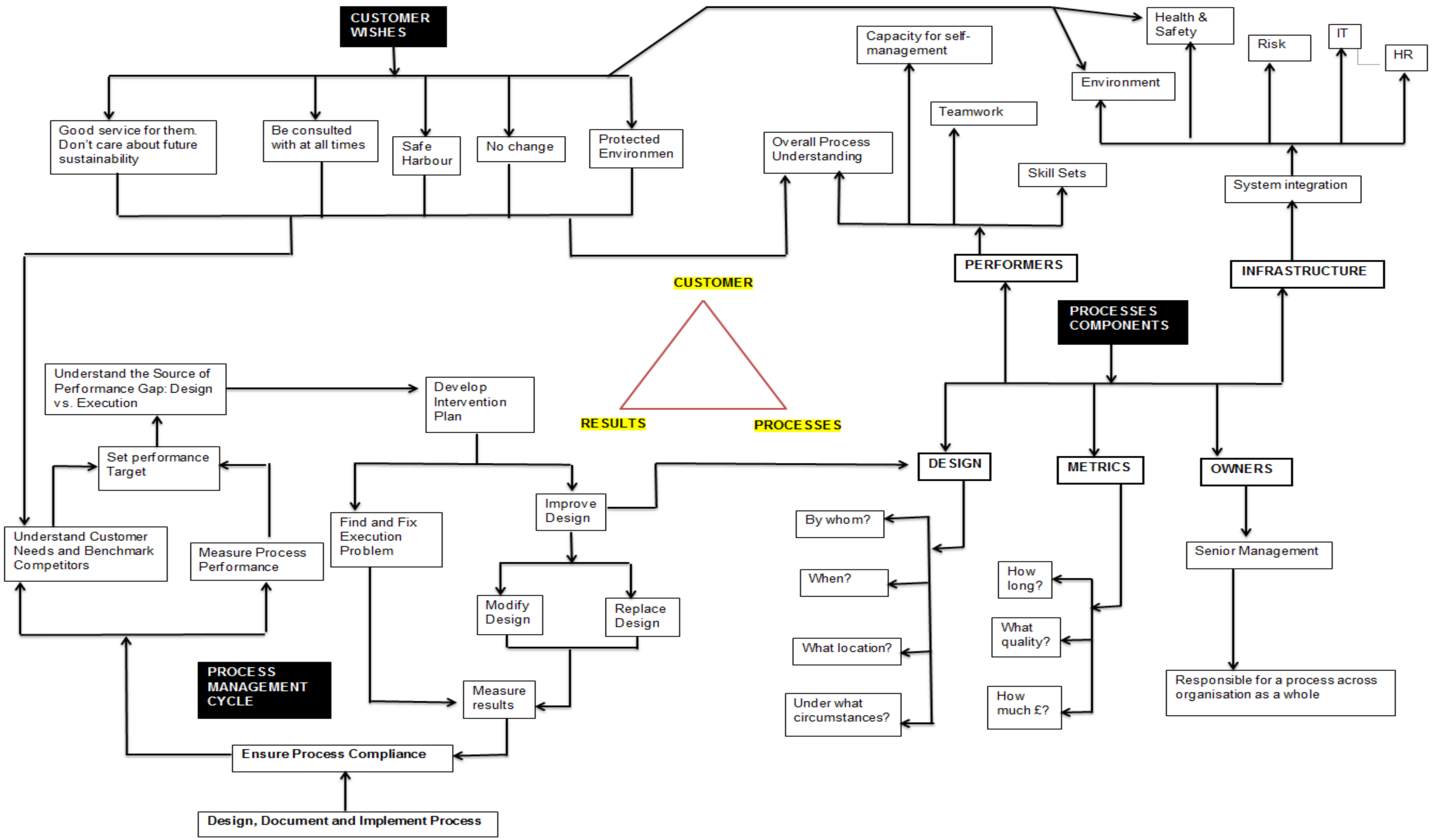
Source: Author

Appendix F – PSMS v2



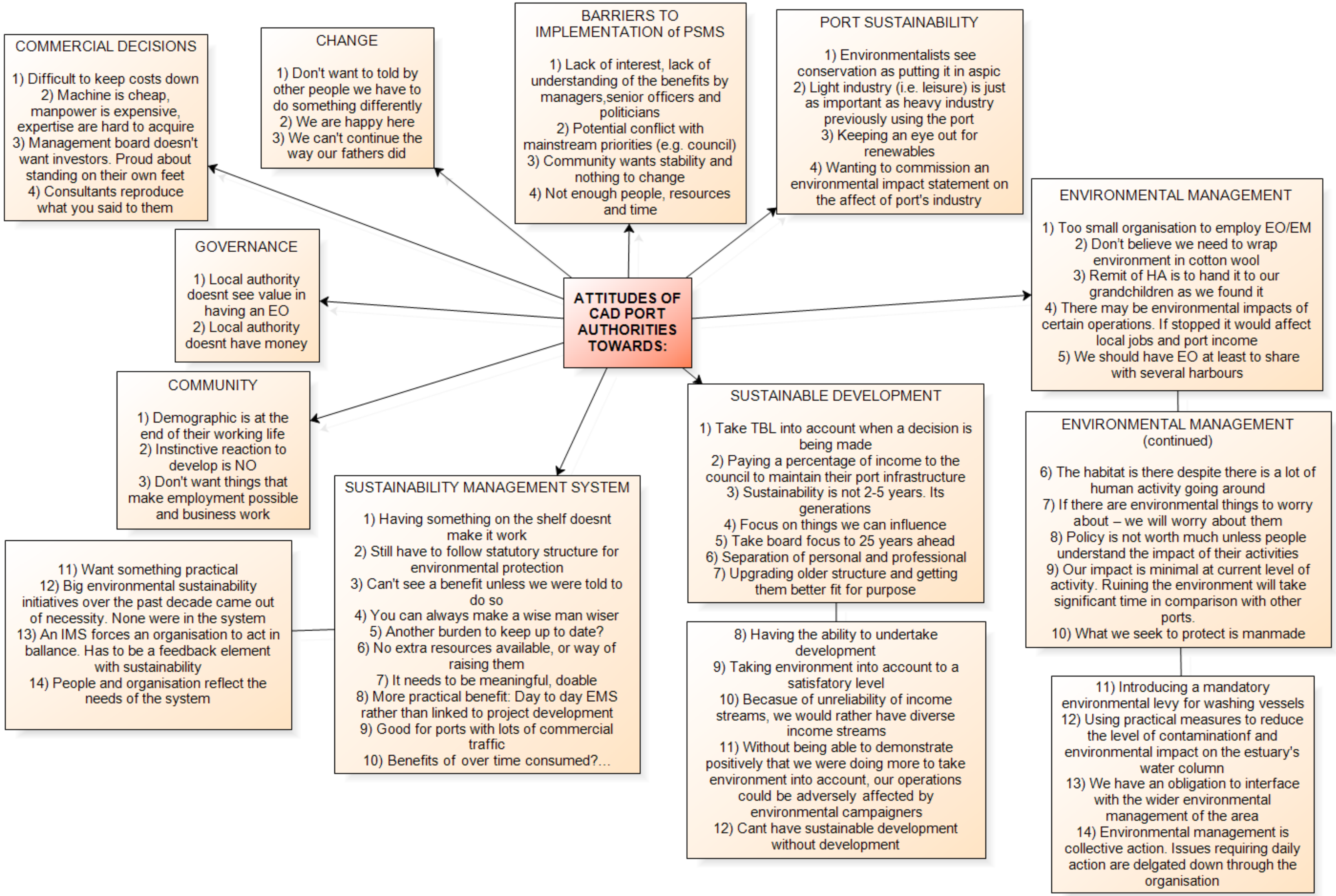
Appendix F: PSMS v2
Source: Author

Appendix G – PSMS v3



Appendix G: PSMS v3
Source: Author

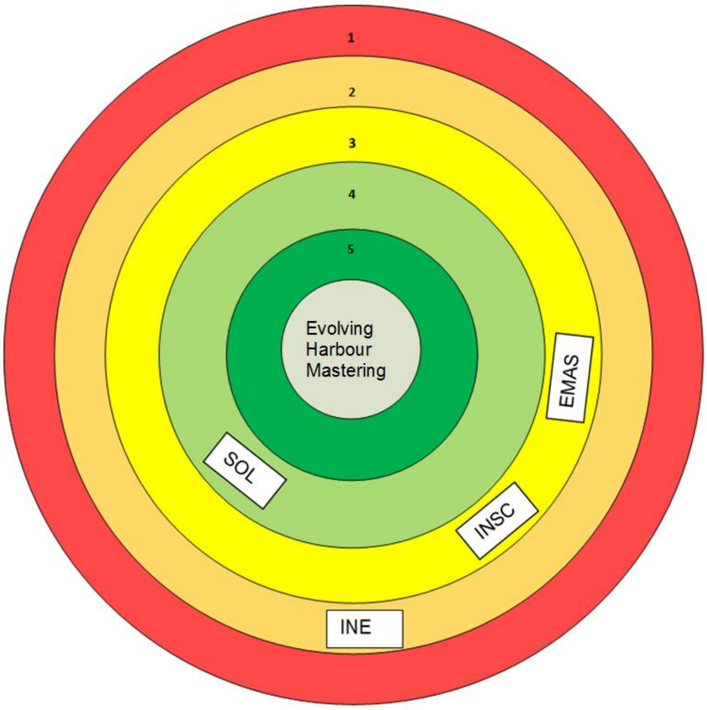
Appendix H – Attitudes of CAD port authorities



Appendix H: Attitudes of CAD port authorities

Source: Author

Appendix J – PSMS v4.2 and score comparison table



Appendix J: PSMS v4.2
Source: Author

Theme	CODE	SCORE	GOAL GRADE		Lowest	Highest	Action Plan Created (Y/N)
Infrastructure: Structure and Conditions	INSC						
Infrastructure: Efficiency	INE						
Safety Of Life	SOL						
Environmental Management: Awareness	EMAS						
Environmental Management: Application	EMAN						
Community Engagement: Harbour users and Community	CEUC						
Community Engagement: Governing Bodies	CEGB						
Harbour Profitability	HP						
Relevance of Management Tools	RMT						
Customer Satisfaction	CS						
Working Together	WT						
Natural Evolution	NE						
Being Prepared for the Future	BPF						

Appendix J: Score Comparison Table for PSMS v4.2

Source: Author

Appendix K – Criteria for PSMS v4.2

SUSTAINABILITY THEMES AND CODES	SCORE	CRITERIA
INSC	1	A lot of our infrastructure is in poor condition/have had collapses in the past. Immediate attention is required.
(INFRASTRUCTURE: Structures conditions)	2	Some structures will be needing attention within the next 5 years or sooner.
	3	Our infrastructure has good life expectancy, however repairs would have to be done using harbour reserves
	4	Our infrastructure has good life expectancy and has a financed plan for repairs and maintenance.
	5	Our infrastructure is evolving with requirements, being rebuilt and upgraded to better fit its purpose using a dedicated finance plan.
INE (INFRSATRUCTURE: Efficiency)	1	Some of our infrastructure has been seriously damaged by the harbour users and requires immediate attention
	2	We have excess of unutilised infrastructure which requires maintenance and does not generate enough revenue to pay for it.
	3	Our infrastructure is serving its intended purpose and we don't see huge increase in demand.
	4	We keep our vacant mooring numbers to an efficient minimum and balance it with extra navigation space.
	5	Efficient provision of infrastructure creates a sufficient surplus to finance repairs and maintenance
SOL (SAFETY OF LIFE)	1	Having an inconsistent safety record: Having to react to incoming safety requirements. Improving safety at any financial cost.

	2	Being safety driven (e.g. having an exposed harbour with potentially adverse weather conditions) - safety is still becoming an increasing cost.
	3	Having a good safety record and a strategy for managing safety liability (e.g. designated anchorages)
	4	Having a good safety record of navigation through the regular/ad-hoc program of dredging (not every harbour can afford dredging). Benefiting from cost efficient safety measures.
	5	Being safety efficiency driven: Reusing dredge spoil in building/farming/restorative projects. Continuous work and improvement of minimising the costs of safety measures with no impact on the safety record.
EMAS (ENVORONMENTAL MANAGEMENT: Awareness)	1	Not knowing the quality of seabed habitat in the harbour
	2	Relying on others to provide environmental warnings to the Harbour Authority relating to the quality and sustainability of habitats.
	3	Relying on own personal experience (past or present) of the quality of seabed habitat
	4	Conducting an Environmental Impact Assessment on every marine and maritime operation at least at one point in its lifecycle
	5	Conducting research to find tangible evidence to support what we are trying to do, since good science is hard to challenge.
EMAN (ENVIRONMENTAL MANAGEMENT: Application)	1	Relying on commonly accepted practice for managing environmental impacts
	2	Relying on Statutory protection mechanisms for comprehensive level of environmental management and protection
	3	Relying on instinctive professional view, rather than a formal process
	4	Using research as a mechanism for environmental management – applying measures to mitigate environmental impacts
	5	Proactively looking after Harbour Authority’s waters: collaborating with stakeholders and governing bodies to **systematically** minimise **potential** environmental impacts at an early stage **before they become an impact**.

CEUC (COMMUNITY ENGAGEMENT: Harbour Users and Community)	1	Engaging with the community to a **minimum** due to having a bad working relationship and disagreeing on most things.
	2	Giving back to the community (e.g. Supporting young people, maritime events and sailing at lower price)
	3	Softening conflicting interests and bringing more people to the negating table and getting people’s views on environmental management and other issues
	4	Educating harbour users and stakeholder groups about issues relating to harbour sustainability and agreeing on a joint course of action.
	5	Achieving **change** in Stakeholder’s perception: Seeing **results** of joint efforts to tackle harbour sustainability (e.g. improvement in water quality, evolving stakeholder understanding and attitudes towards harbour management)
CEGB (COMMUNITY ENGAGEMENT: Governing Bodies)	1	Engaging with governing bodies to a **minimum** due to **not having** any pressure relating to environmental or social issues
	2	Conflicting with governing bodies regarding proposed levels of environment al designations and its impact on the Harbour and the community
	3	Establishing a working relationship with Governing bodies to engage in ad-hoc collaboration
	4	Continuous collaboration with Governing bodies to engage in information sharing and strategic planning
	5	Taking part in joint projects with Governing bodies to help safeguard local community and deliver a more pleasant user experience
HP (HARBOUR PROFITABILITY)	1	Having our “eggs” pretty much in one basket with little or no surplus to make any significant improvements.
	2	Planning and financing for infrastructure replacement: Continual investment and development around the main source of revenue
	3	Reducing operational cost using maximum efficiency savings (e.g. introducing flexible working). Making considerable surplus as a result.

	4	Diversifying income streams to decrease reliance on a single source of revenue. Continuing to make a considerable surplus.
	5	Having dedicated saving programmes for various long-term planning and improvement initiatives. Engaging Board’s strategic thinking and continuing to innovate around existing and new sources of revenue. Following commercial demand with maximum efficiency. Significantly increasing harbour’s resilience to economic climate.
RMT (RELEVANCE OF MANAGEMENT TOOLS)	1	Having something on the shelf which was not applied/used
	2	Including every possible impact/procedure into the management system, making it unusable on daily basis.
	3	Evolving thought processes into formal systems for internal use
	4	Having formal management system(s) for every major aspect of the Harbour’s operations, including statutory, voluntary and best practice.
	5	Achieving clarity of thought in all management systems, streamlining their functionality to **maximise efficiency**. Continually improving management systems using feedback and performance measurements. Having people and organisation **to reflect the needs of management systems**.
CS (CUSTOMER SATISFACTION)	1	Lecturing customers on how they should use the estuary. Not measuring customer satisfaction and continuing with previous course of action.
	2	Delivering a safe customer experience.
	3	Knowing what the customer wants and knowing many of your customers to be able to slightly tailor products and services to suit individual needs.
	4	**Being flexible and accommodating -** Knowing almost all of your customers and having individual working relationships with them. Having a dedicated person be a first point of call for a particular customer (*divide and conquer*)

	5	Being flexible and accommodating. Engaging with customers and using practical measures to deliver a cleaner and safer estuary. Constantly balancing the need for infrastructure with the need for navigation to allow more people to use the harbour. Reducing the surplus of infrastructure to an efficient minimum. Gathering customer feedback to make improvements.
WT (WORKING TOGETHER)	1	Conflicting with stakeholders and governing bodies. Having to react to bad press and being perceived as "an enemy".
	2	Knowing your stakeholder groups. Having a working ad-hoc relationship with stakeholders.
	3	Working together with other harbours – forming estuary partnership group to share best practice and jointly fund an Environmental Officer. Establishing good working relationship with governing bodies.
	4	Working together and/or incentivising stakeholders to implement practical measures to reduce environmental impacts in the harbour. Educating harbour users about practical measures of protecting the harbour
	5	Working together with governing bodies and stakeholders to monitor environmental factors in the harbour. **Educating** harbour users. **Sharing** best practice. Planning for **commercial contingency**. Using harbour's **environmental credentials** to argue against extra levels of designation to **safeguard harbour's** profitability and resilience for the future.
NE (NATURAL EVOLUTION)	1	Accepting the need for a change since a large number of previous practices are unacceptable in today's society (e.g. poring oil down the drain). Evolving knowledge from own experience of dealing with pressing issues.
	2	Realising the need to evolve and give customers what they want. Accepting evolving roles and responsibilities of the harbour authority and new duties that come with it.

	3	Evolving **practical** expertise, knowledge and awareness of applying sustainability related practices in day-to-day operations.
	4	Adapting a different mind-set to conduct the same operations in a different manner to **benefit port sustainability** (e.g. less environmental impact) Adapting to changing legislation, requirements and expectations of harbour authority. Taking the local environment into account in the way we manage things. Adapting to **limited choices** regarding physical development.
	5	Being able to **fully adapt** to changing requirements, legislation and restrictions placed on the harbour authority by the evolving society with **maximum efficiency** and **minimum impact** on commercial sustainability. Presenting a **united front** with stakeholders and governing bodies relating to the issues of harbour sustainability. Constantly evolving and incorporating changing requirements and expectations into port's management practices.
BPF (BEING PREPARED FOR THE FUTURE)	1	Focusing on current statistics and not being able to plan for the future. Not taking actions might have an impact on the harbour in the next decade.
	2	Accepting the inability to influence some things, but **being able to influence** long-term sustainability of the harbour.
	3	Putting more resources into environmental management. Establishing an active dialogue with governing bodies and stakeholder groups. Proactively safeguarding main commercial sources of revenue through management initiatives (e.g. environmental management practices).
	4	Proactively collaborating with governing bodies to learn how to manage **voluntary designation zones/new environmental legislation** before it becomes mandatory. Trying to **integrate** various management practices to enable fluid and more comprehensive harbour management practices.

	5	Proactively identifying and replacing **unsustainable policies** that have been inherited by the harbour and are unsuitable for modern society. Having a clear understanding of requirements for moving forward. Having financial contingency plans in place. Making regular savings to get EU match funding for repairs and maintenance projects therefore safeguarding long-term sustainability of the harbour.

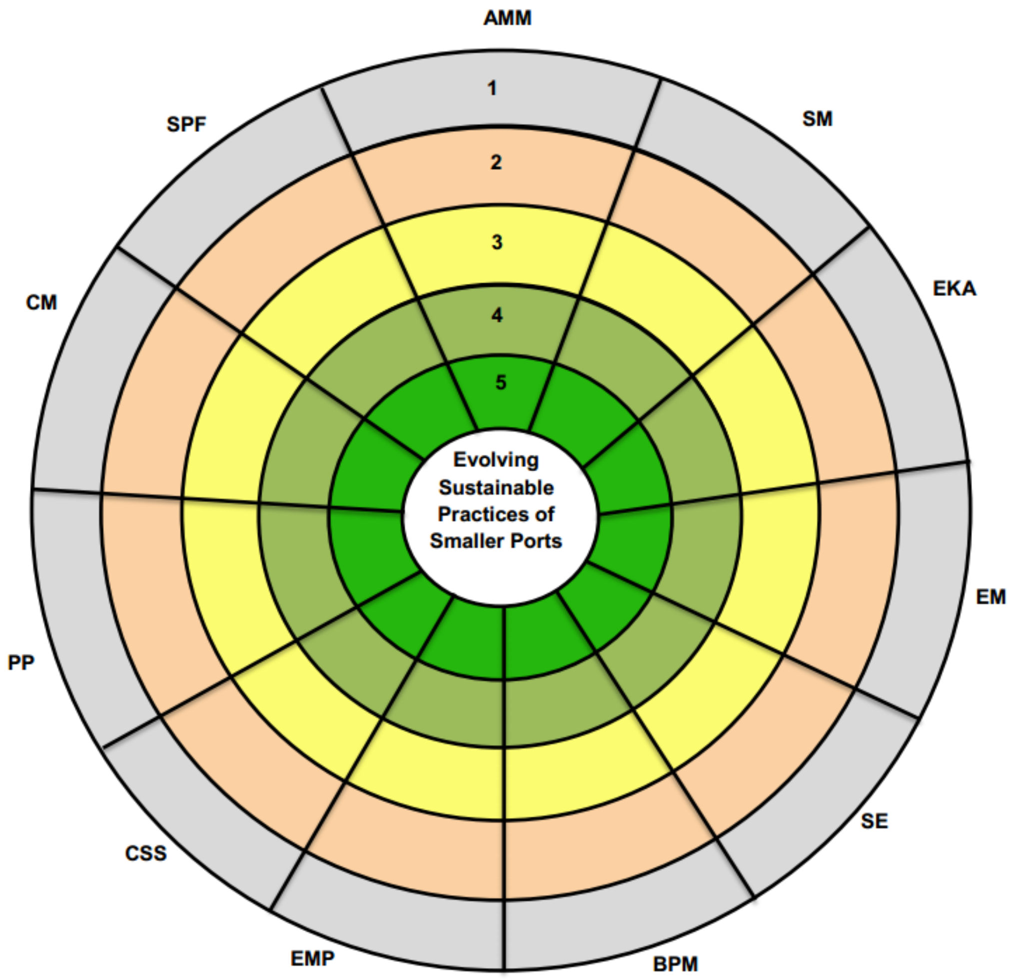
HARBOUR GOALS AND CODES	GRADE	CRITERIA
HUG (Harbour's ULTIMATE Goal)	A	**Commercially Efficient AND Environmentally Friendly AND Socially Acceptable**
Commercially Efficient, Environmentally Friendly, and Socially Acceptable	B	Commercially Efficient **AND** Environmentally Friendly
	C	Environmentally Friendly
	D	Socially Acceptable
	E	Commercially Efficient
	F	Commercially **Inefficient,** Environmentally **Unfriendly,** Socially **Unacceptable**
H1G (Harbour's 1-st Goal)	A	**Making your inefficiencies as efficient as possible**
Making your inefficiencies as efficient as possible	B	Inefficiency costs are accruing **slower** due to streamlining of harbour's operations
	C	Costs related to inefficiencies are putting an increasing strain on the Harbour
H2G (Harbour's 2-nd Goal)	A	**Having a fully developed commercial industry, with maximum efficiency and little waste**
Needing an industry to generate funds for conservation	B	Continuously **exploring** commercial development **opportunities** to maximise harbour's income
	C	**Breaking even** commercially year on year. Increasing generation of conservation funds
	D	**Making a loss** and having to fund it out of harbour reserves. No money for conservation

Appendix L – Extract from electronic PSMS v4.2

	A	B	C	D	E	F	G
1	HARBOUR GOALS AND CODES	GRADE	CRITERIA				
2	HUG (Harbour's ULTIMATE Goal)	A	**Commercially Efficient AND Environmentally Friendlier AND Socially Acceptable**				
3	Commercially Efficient, Environmentally Friendlier, and Socially Acceptable	B	Commercially Efficient **AND** Environmentally Friendlier				
4		C	Environmentally Friendlier				
5		D	Socially Acceptable				
6		E	Commercially Efficient				
7		F	Commercially **Inefficient,** Environmentally **Unfriendly,** Socially **Unacceptable**				
8	**H1G (Harbour's 1-st Goal)**	A	**Making your inefficiencies as efficient as possible**				
9	Making your inefficiencies as efficient as possible	B	Inefficiency costs are accruing **slower** due to streamlining of harbour's operations				
10		C	Costs related to inefficiencies are putting an increasing strain on the Harbour				
11	**H2G (Harbour's 2-nd Goal)**	A	**Having a fully developed commercial industry, with maximum efficiency and little waste**				
12		B	Continuously **exploring** commercial development **opportunities** to maximise harbour's income				
13		C	**Breaking even** commercially year on year. Increasing generation of conservation funds				
14		D	**Making a loss** and having to fund it out of harbour reserves. No money for conservation				
15							
16							
17	**SUSTAINABILITY THEMES AND CODES**	**SCORE**	**CRITERIA**	**CODE: INCS**	**SCORE:**		
18	**INSC (INFRASTRUCTURE: Structures conditions)**	1	A lot of our infrastructure is in poor condition/have had collapses in the past. Immediate attention is required.	Examples:	Cracks, significant wear and tear significant errosion…		
19		2	Some structures will be needing attention within the next 5 years or sooner.	Examples:			
20		3	Our infrastructure has good life expectancy, however repairs would have to be done using harbour reserves				
21		4	Our infrastructure has good life expectancy and has a financed plan for repairs and maintenance.				
22		5	Our infrastructure is evolving with requirements, being rebuilt and upgraded to better fit its purpose using a dedicated finance plan.				
23				**CODE**	**SCORE GIVEN**	**GOAL ACHIEVED**	**GOAL GRADE**
24	**INE (INFRSATRUCTURE: Efficiency)**	1	Some of our infrastructure has been seriously damaged by the harbour users and requires immediate attention	**INE**			
25		2	We have excess of unutilised infrastructure which requires maintenance and does not generate enough revenue to pay for it.				
26		3	Our infrastructure is serving its intended purpose and we don't see huge increase in demand.				
27		4	We keep our vacant mooring numbers to an efficient minimum and balance it with extra navigation space.				

Source: Author

Appendix M – PSMS v5



Acronym	Description	Score
AMM	Asset Management and Maintenance	
SM	Safety Management	
EKA	Environmental Knowledge and Awareness	
EM	Environmental Management	
SE	Stakeholder Engagement	
BPM	Business Planning and Management	
EMP	Effectiveness of Management Processes	
CSS	Customer Service and Satisfaction	
PP	Proactive Partnerships	
CM	Change Management	
SPF	Strategic Planning for the Future	

To calculate average:

Add up all the scores and then divide the total by 11

AVERAGE PORT SUSTAINABILITY INDICATOR

Name and Job Title			
Today's Date		Next Assessment Due	
For Attention Of			

Appendix M: PSMS v5
Source: Author

Appendix N – Criteria for PSMS v5

SUSTAINABILITY THEMES AND CODES	SCORE	CRITERIA (please circle relevant score)	EXAMPLES AND ACTION PLANS
ASSET MANAGEMENT AND MAINTENANCE **AMM**	**1**	A lot of our assets are in poor condition. Immediate attention is required.	Cracks, significant wear and tear significant erosion…
	2	**Some** assets will be needing renewal or extensive **maintenance** within the **next 5 years**.	
	3	Our assets have **good** future **life expectancy**.	
	4	Our assets have good life expectancy and have a **financed plan** for repairs and maintenance.	
	5	As per 4 Above An asset **development** plan is in place with funding identified	
SAFETY MANAGEMENT **SM**	**1**	Have an **unacceptable** safety record in the harbour **urgent action** is required	
	2	The safety record in the harbour gives **cause for concern**	
	3	Having a **good safety record** and a strategy for managing safety liability (e.g. -->)	Designated anchorages, etc.
	4	Having a good safety record and an **effective** safety management system	
	5	Having a good safety record and a **highly effective** safety management system (accredited / continually improving)	Accredited by a recognised body and continually improving year on year
ENVIRONMENTAL KNOWLEDGE AND AWARENESS	**1**	**No** relevant **data** relating to the quality of seabed and **marine** habitats in the harbour	
	2	**Relying on** external **stakeholders** to provide environmental warnings to the Harbour Authority relating to the quality and sustainability of habitats.	Conservation groups (local and national), local community,

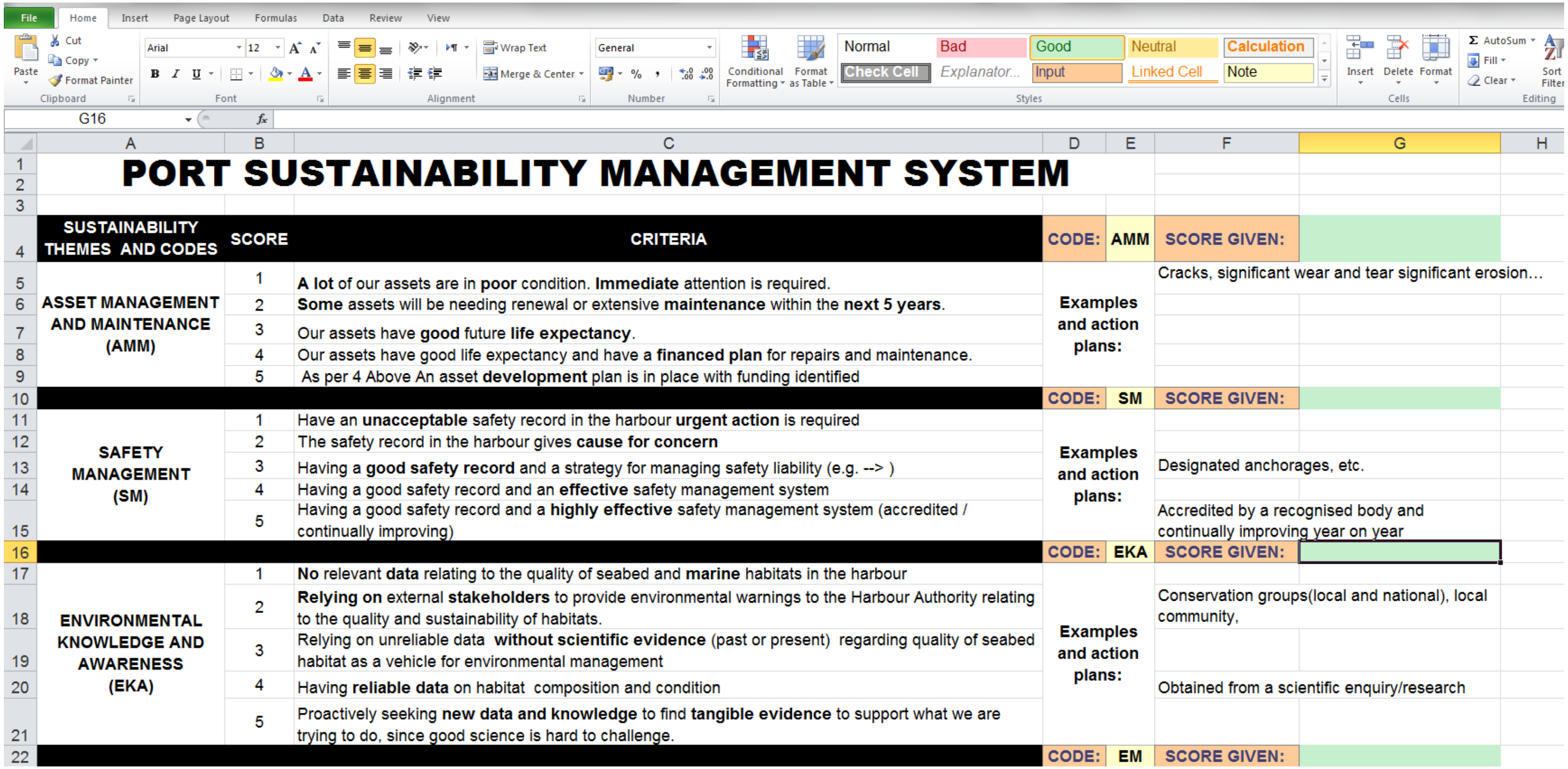
EKA			
	3	Relying on unreliable data **without scientific evidence** (past or present) regarding quality of seabed habitat as a vehicle for environmental management	
	4	Having **reliable data** on habitat composition and condition	Obtained from a scientific enquiry/ research
	5	Proactively seeking **new data and knowledge** to find **tangible evidence** to support what we are trying to do, since good science is hard to challenge.	
ENVIRONMENTAL MANAGEMENT **EM**	1	**No** environmental management **practices** in place, environmental legal issues are being raised	
	2	Implementing management practices **based on instinctive** professional **view**, rather than a formal environmental assessment process	
	3	Using **research as a mechanism** for environmental management – applying measures to mitigate environmental impacts	Use research to identify environmental issues and measures to mitigate impacts
	4	Undertaking appropriate **environmental assessment** on routine and non-routine operations in the harbour	
	5	Having **accredited environmental management system** to **establish** the **cause** and mitigate the environmental impacts of significant operations	
STAKEHOLDER ENGAGAMENT **SE**	1	**Reactive measures** based on community and stakeholder concerns and conflicts.	
	2	Benefiting our stakeholders i**s a part of our strategy**(e.g. Supporting young people, maritime events, sailing at lower price)	Supporting young people, maritime events, sailing at lower price
	3	**Proactively consulting to listen and soften** conflicting interests and bring more people to the negotiating table	Committees, Partnerships, Working Groups, Think tanks, SAC Management forums
	4	We **educate harbour users** and are effectively engaging stakeholder groups about issues relating to harbour sustainability and putting a **communication strategy in place** (e..g. -->)	Management, issues, incoming legislation, interpretation of existing legislation

	5	**Proactive engagement** with stakeholders and **ability to influence** stakeholder's perceptions (e.g. governing bodies). Establishing working partnerships and **taking part in joint projects** to benefit the harbour and local community.	
BUSINESS PLANNING AND MANAGEMENT **BMP**	**1**	We have **little or no annual surplus**, no resources to undertake development, little or no increase in demand and unused infrastructure.	
	2	Investment and development takes place only **around the main source of revenue** of the harbour	
	3	We **balance supply and demand** of assets and infrastructure to **reduce maintenance costs**, resulting in a **consistent surplus**.	
	4	Applying **business measures to increase efficiency** helps to reduce overall operational costs and increases surplus.	Applying business measures to make inefficiencies as efficient as possible
	5	Having **dedicated saving programmes** for various long-term planning and improvement initiatives. Significantly increasing harbour's **resilience to economic climate** through contingency planning. Engaging Board's strategic thinking and **continuing to innovate** around existing and new sources of revenue.	
EFFECTIVENESS OF MANAGEMENT PROCESSES **EMP**	**1**	We have **documented** our management process and policies	Policies that are not actively used
	2	We have **documented** our management process and policies and they are **inclusive all of our procedures and impacts** and have been communicated to the relevant personnel.	Very comprehensive policies that are not actively used
	3	We are **evolving** our processes **into a formal systems** for internal use	
	4	We have **formalised** management **systems** covering a range of harbour processes, including statutory, voluntary and best practice	
	5	We have achieved management system **accreditation**, and our management **systems are reflecting the needs** of the people and the organisation.	

CUSTOMER SERVICE AND SATISFACTION **CSS**	**1**	We **expect** our customers to **adhere** to our policies on the use of the harbour and the estuary. We do not measure levels or customer satisfaction	No room for negotiation
	2	We have policies and procedures which we **communicate** to our customers in order to **promote** the concept of a **safe** customer **experience**	Explain why we do what we do. Expect customers to follow set rules
	3	We **inquire** about our **customer needs**, and deliver products and services that **meet these needs**, and ask our customers for helpful **feedback**	How big is their boat? What mooring is needed? How Could we improve our service?
	4	We establish **individual customer needs**, are flexible and accommodating, have good working relationships with our customers and **deliver tailored products** and services that **meet individual customer needs**.	
	5	We **engage with our customers** and gather customer feedback in an effort to **improve** the **customer experience**; tailor products and services, as well have a **dedicated person** as a first point of call for each customer	Bilateral client focus
PROACTIVE PARTNERSHIPS **PP**	**1**	We have **experience of conflicting** with stakeholders and governing bodies, (i.e. see action plan). We **have not undertaken** a stakeholder analysis to identify all possible stakeholder groups.	Having to react to bad press and being perceived as "an enemy"
	2	We have **identified**/have knowledge of our **stakeholder groups**, but have **no programme** in place **to manage** stakeholder relationships	
	3	We have an **informal programme** in place to manage our stakeholder relationships. We are **starting to form** working partnerships to **share best practice** with stakeholders.	
	4	We have **established** good working relationships with governing bodies and have **developed** working partnerships which implement practical measures, share best practice and help reduce operational impacts.	
	5	We have **influential relationships** with governing bodies and stakeholders and **share operational costs/responsibilities** for factors affecting the harbour. We **educate** harbour users, **openly share** best practice and **jointly contribute** towards improving the harbour credentials.	

CHANGE MANAGEMENT **CM**	**1**	We have **accepted and recognised** the need for change due to unsuitability of current harbour in the modern society.	
	2	We have **identified critical areas** of the harbour operations which require change	
	3	We have **started to change** our expertise, knowledge and raise awareness in relevant critical areas	
	4	We are **changing our mind-set** attitudes and introducing sustainable practices. We are recognising relevant changes in legislation.	
	5	We have **fully integrated** sustainable practices, are **proactive** with changing legislation and are **continually improving** and innovating the organisation.	
STRATEGIC PLANNING FOR THE FUTURE **SPF**	**1**	We are **reactive** to improving current issues	Wait for something to happen and become mandatory
	2	**Accepting the need** to be proactive and address long-term sustainability of the harbour.	
	3	We **plan** for the appropriate use and requirements of **future resources**. **Starting to engage** in strategic thinking and forecasting future trends	
	4	We **start to address** unsustainable business practices through the implementation of a strategic business plan.	
	5	We have **addressed** unsustainable business practices through the implementation of a **strategic business plan** outlining the short, medium and long-term sustainability of the harbour which is **reviewed and updated regularly**.	

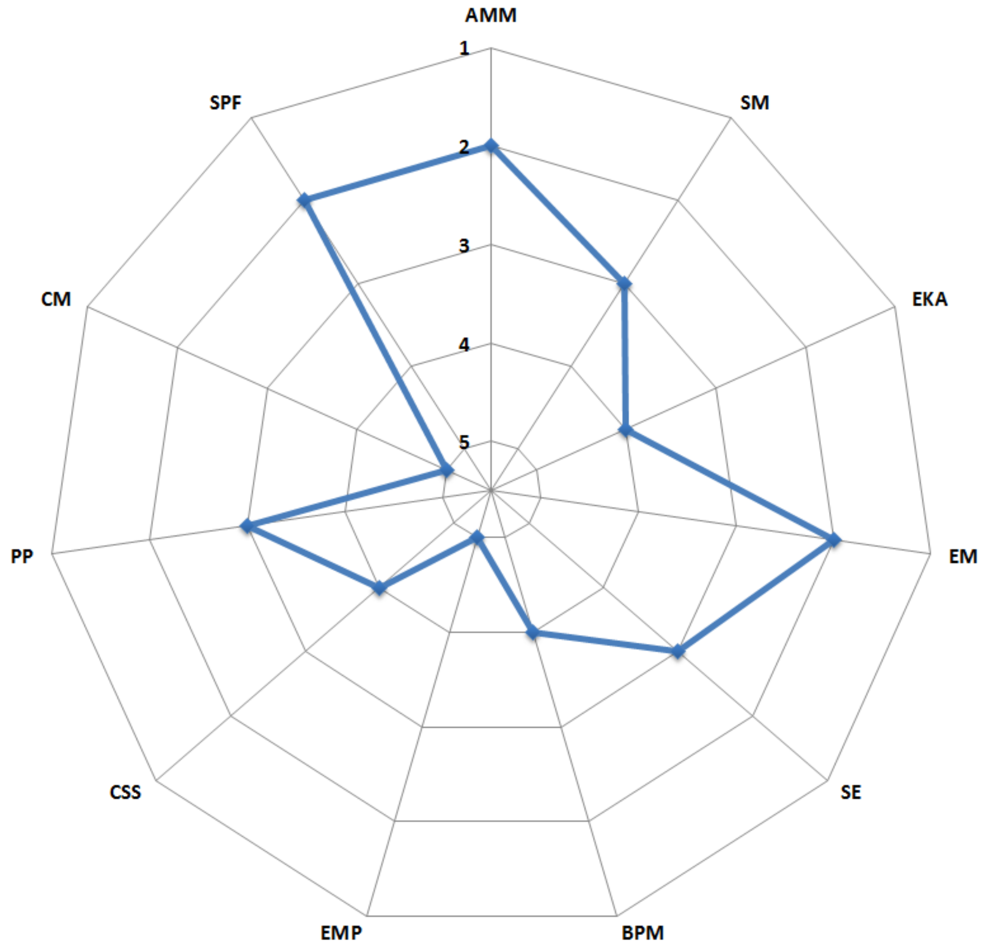
Appendix O – Extract from electronic PSMS v5



	A	B	C	D	E	F	G
1	**PORT SUSTAINABILITY MANAGEMENT SYSTEM**						
2							
3							
4	**SUSTAINABILITY THEMES AND CODES**	**SCORE**	**CRITERIA**	**CODE:**	**AMM**	**SCORE GIVEN:**	
5	**ASSET MANAGEMENT AND MAINTENANCE (AMM)**	1	**A lot** of our assets are in **poor** condition. **Immediate** attention is required.	**Examples and action plans:**		Cracks, significant wear and tear significant erosion…	
6		2	**Some** assets will be needing renewal or extensive **maintenance** within the **next 5 years**.				
7		3	Our assets have **good** future **life expectancy**.				
8		4	Our assets have good life expectancy and have a **financed plan** for repairs and maintenance.				
9		5	As per 4 Above An asset **development** plan is in place with funding identified				
10				**CODE:**	**SM**	**SCORE GIVEN:**	
11	**SAFETY MANAGEMENT (SM)**	1	Have an **unacceptable** safety record in the harbour **urgent action** is required	**Examples and action plans:**			
12		2	The safety record in the harbour gives **cause for concern**				
13		3	Having a **good safety record** and a strategy for managing safety liability (e.g. -->)			Designated anchorages, etc.	
14		4	Having a good safety record and an **effective** safety management system				
15		5	Having a good safety record and a **highly effective** safety management system (accredited / continually improving)			Accredited by a recognised body and continually improving year on year	
16				**CODE:**	**EKA**	**SCORE GIVEN:**	
17	**ENVIRONMENTAL KNOWLEDGE AND AWARENESS (EKA)**	1	**No** relevant **data** relating to the quality of seabed and **marine** habitats in the harbour	**Examples and action plans:**			
18		2	**Relying on** external **stakeholders** to provide environmental warnings to the Harbour Authority relating to the quality and sustainability of habitats.			Conservation groups(local and national), local community,	
19		3	Relying on unreliable data **without scientific evidence** (past or present) regarding quality of seabed habitat as a vehicle for environmental management				
20		4	Having **reliable data** on habitat composition and condition			Obtained from a scientific enquiry/research	
21		5	Proactively seeking **new data and knowledge** to find **tangible evidence** to support what we are trying to do, since good science is hard to challenge.				
22				**CODE:**	**EM**	**SCORE GIVEN:**	

Appendix O: PSMS v5 Electronic
Source: Author

Appendix P – Extract from electronic PSMS v5



Acronym	Description
AMM	Asset Management and Maintenance
SM	Safety Management
EKA	Environmental Knowledge and Awareness
EM	Environmental Management
SE	Stakeholder Engagement
BPM	Business Planning and Management
EMP	Effectiveness of Management Processes
CSS	Customer Service and Satisfaction
PP	Proactive Partnerships
CM	Change Management
SPF	Strategic Planning for the Future

NOTES

Appendix P: Automatic chart generation in electronic PSMS v5
Source: Author

Appendix Q – Pilot test introduction

PORT SUSTAINABILITY MANAGEMENT SYSTEM (PSMS)

Welcome to the first pilot test of PSMS

WHAT IS PSMS? Based on discussions with local Harbour Masters (HMs) over the last 2 years, a practical tool has emerged which seeks to help you to undertake a comprehensive analysis of your port's sustainability priorities and to devise your own action plan. The issues identified have been raised after analysing the concerns expressed during interviews with HMs in Cornwall and Devon. PSMS is designed to assist HMs to identify and document any concerns they may have.

PSMS is an **internal, strategic tool to help HM's to appraise sustainability practice in the harbour they are responsible for**. Its **aim** is to allow HM's to define where they are within the parameters of their operations in order to **set targets** and make plans for progress. It combines eleven themes of harbour operations which, if taken together, make up harbour sustainability. This system is based on the real issues identified from thirty hours of interviews and continuous collaboration over a period of two years. Since it is very difficult to find targets that would fit more than one particular port, conducting a self-appraisal and creating and incorporating your own targets into your port management plan, we think, is the way forward. This tool was intended to **support HMs in their work** and **NOT** to put additional pressure by judging ports and their performance based on the scores assigned.

HOW DOES IT WORK?
PSMS allows the user to plot scores obtained from a self-evaluation process on a visual graph **without the fear** of having to publish or reveal ones practices. This graph would then serve as a reminder of the current state of affairs, and would help to identify areas that require more, or perhaps even, immediate attention. The user can always go back to PSMS to **see the criteria for getting a higher score** in a particular category and **make targets based on that**.
PSMS caters for HMs wanting an **electronic** version of a management system (excel spread sheet), HMs wishing to have a **hardcopy** (PDF file), or a **combination** of both. The system is easy to use and is readily available.

POTENTIAL BENEFITS OF PSMS
Everyone has huge difficulties comparing port performance at the moment. Comparing an average PSMS index between ports by averaging out the combined score could be used for benchmarking between partner-ports and associations. **We now need input from more ports to pilot test the system and to identify its potential benefits to them.**

Source: Author

Appendix R – PSMS Pilot test Instructions

TO CONDUCT A SELF-APPRAISAL, please complete the following**:**
1) Quickly read through each of the **Sustainability Themes and Codes**
2) For each theme,
   a) **Select** the criterion which best describes the current state of your port
   b) **Score** your port's current situation against each criterion.

After **printing** the **hardcopy version** preferably in colour, you will need to **circle** the categories shown on pages 2-4

For the **electronic version, input** your score into the green coloured cell next to the box entitled ***Score Given*** for each section in the **Excel** spread sheet.

3) When you have worked through all eleven categories please complete instructions for **either** the hardcopy, **or** for the electronic file:

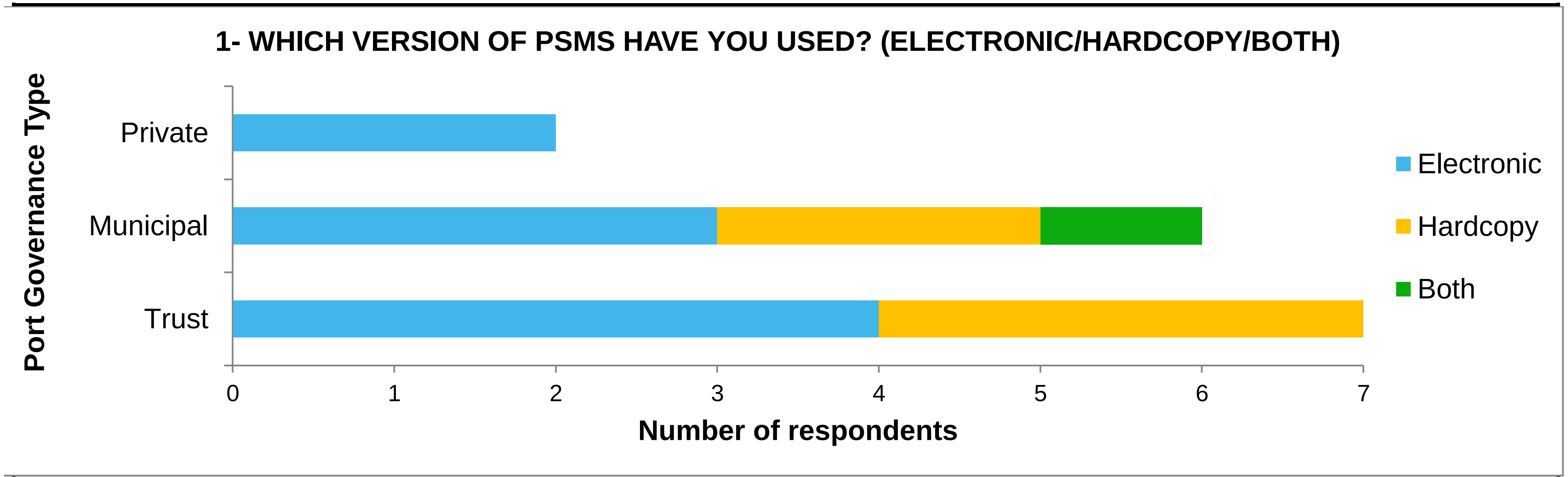
For the **HARDCOPY version,**
   a) **Read** page 1 which consists of a "bulls-eye target", a table with acronyms which reminds the user about the full title of each category, and gives instructions to calculate the average score manually.
   b) **Input** the scores you have assigned from pages 2-4 into the table on page 1.
   c) **Plot** your scores on the "bulls-eye target" to obtain a visual representation of your harbour's sustainability practices.
   d) **Calculate** your average score by adding up all scores and dividing the total number by 11.
   e) **Plot** your average score into the *Average Port Sustainability Indicator* box on page 1.

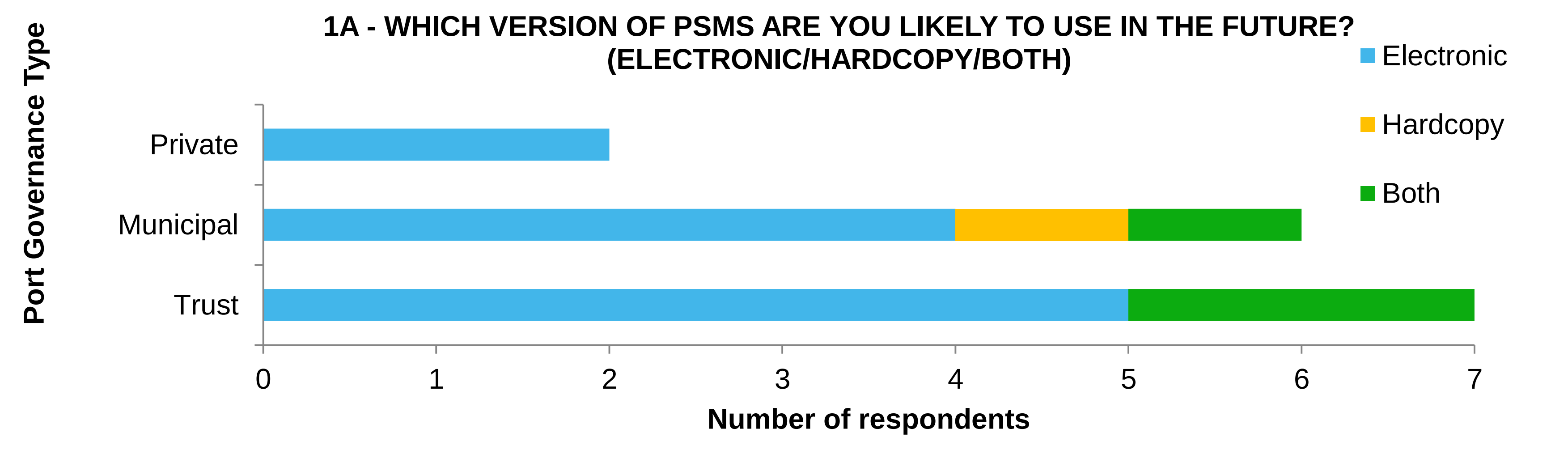
For the **ELECTRONIC version,** this will **automatically**

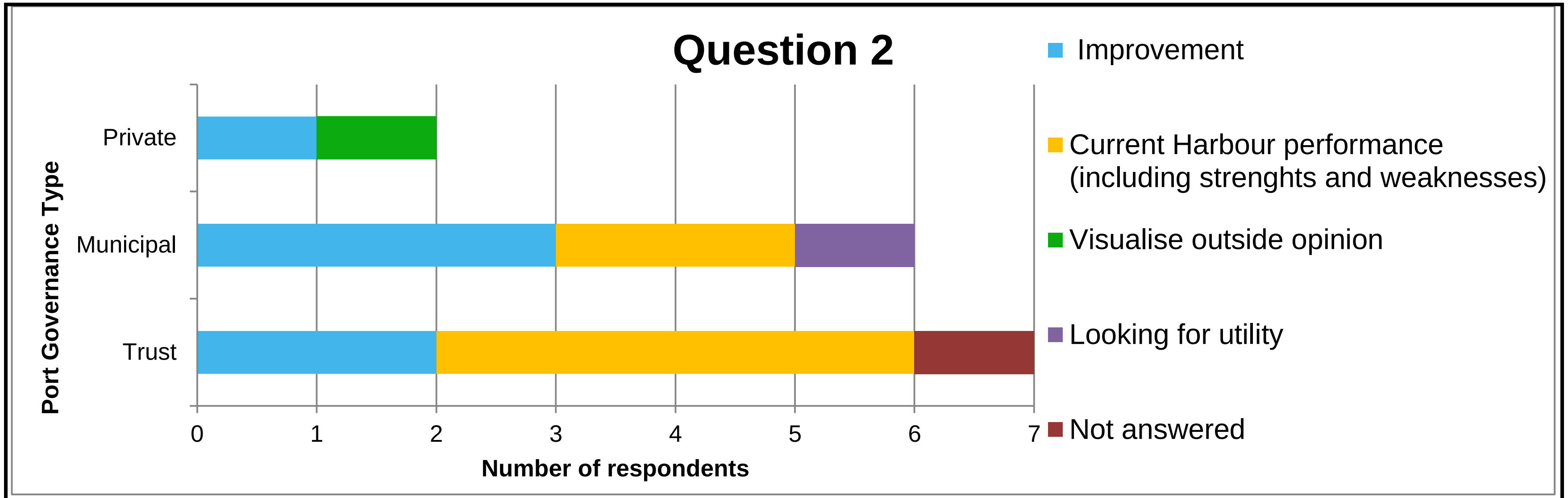
   a) **Calculate the average score** which is shown underneath category SPF
   b) **Plot the data** on the charts for enhanced visual representation in a **bar** and a **radar** format. Please click spread sheets entitled: *Bar Chart* and *Spidergram* to view the charts.

Pilot test instructions
Source: Author

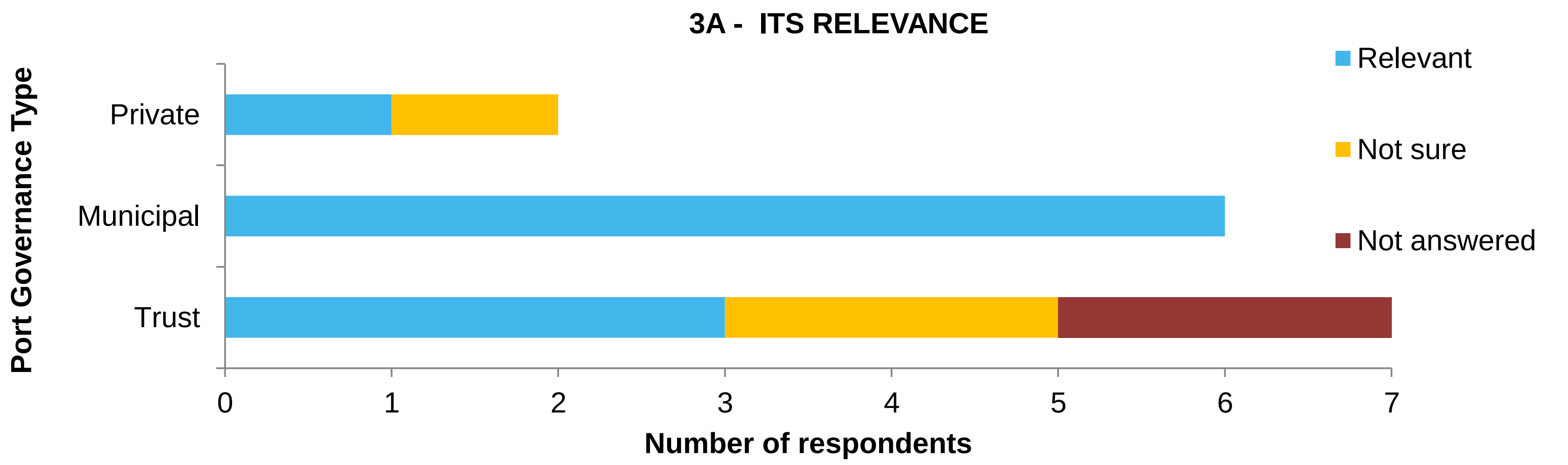
Appendix S – PSMS v5 pilot test results

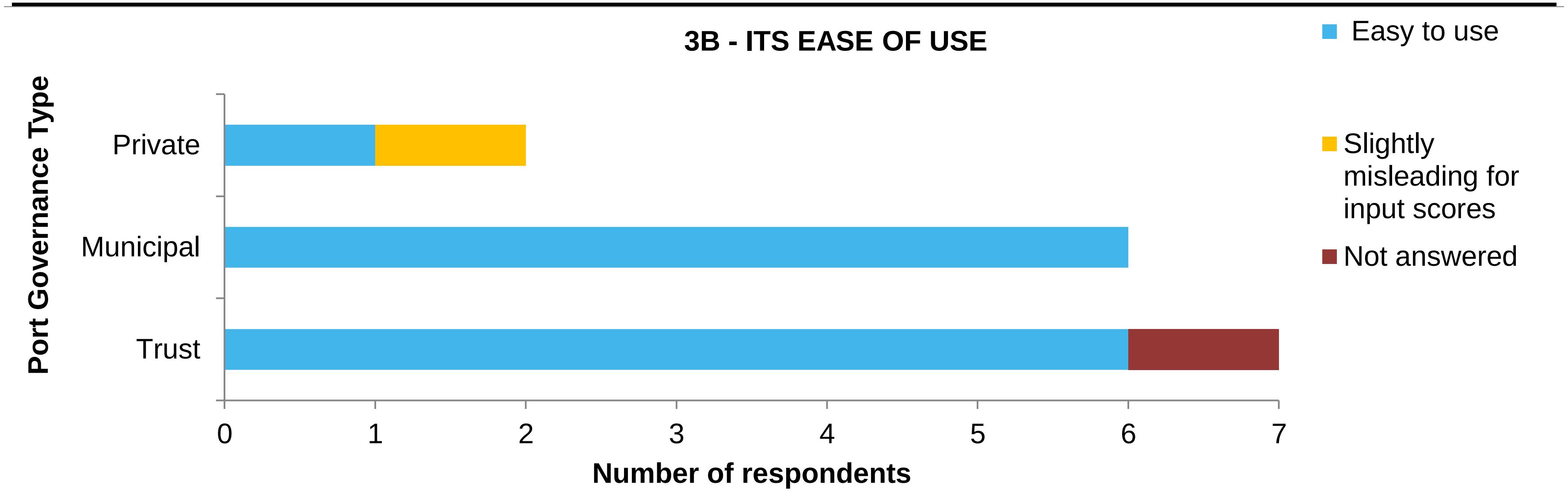


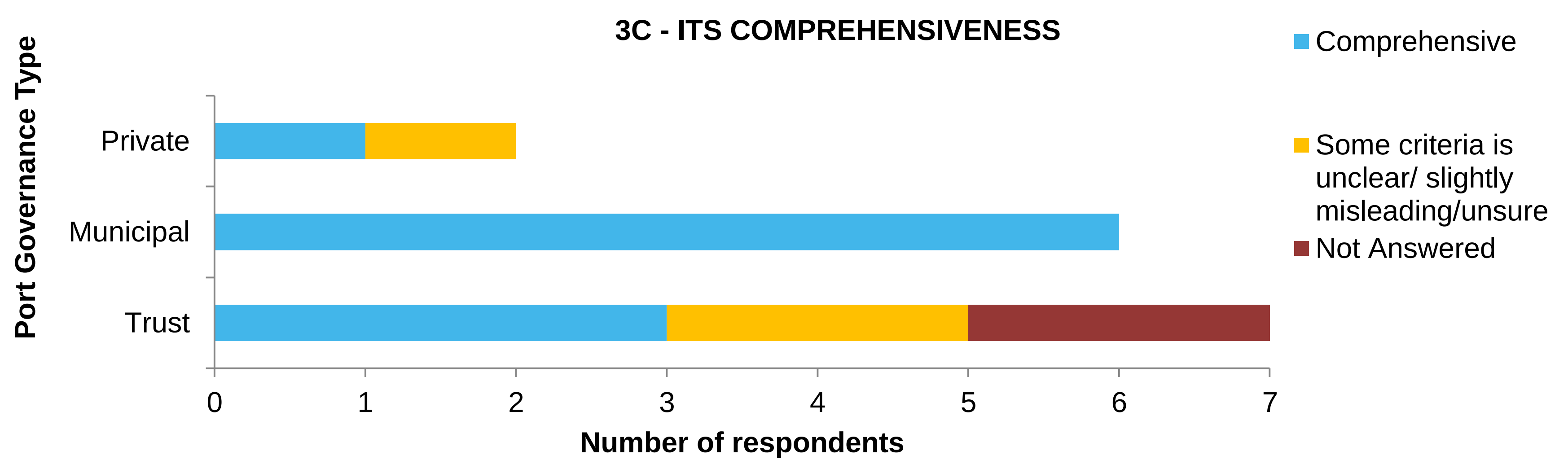


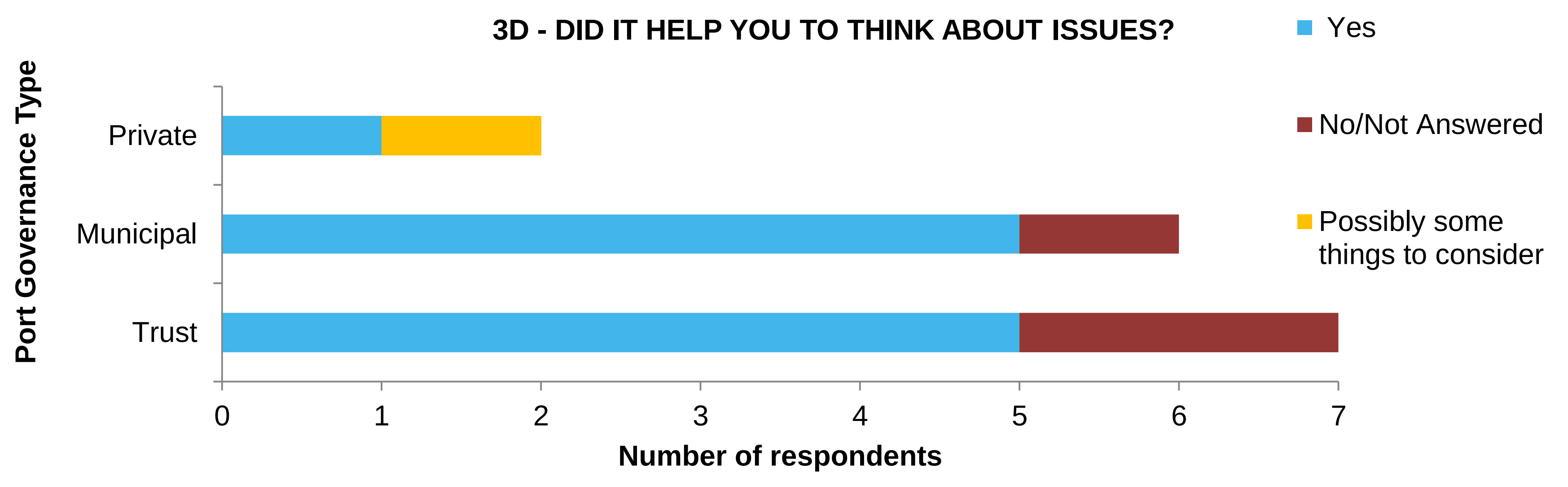


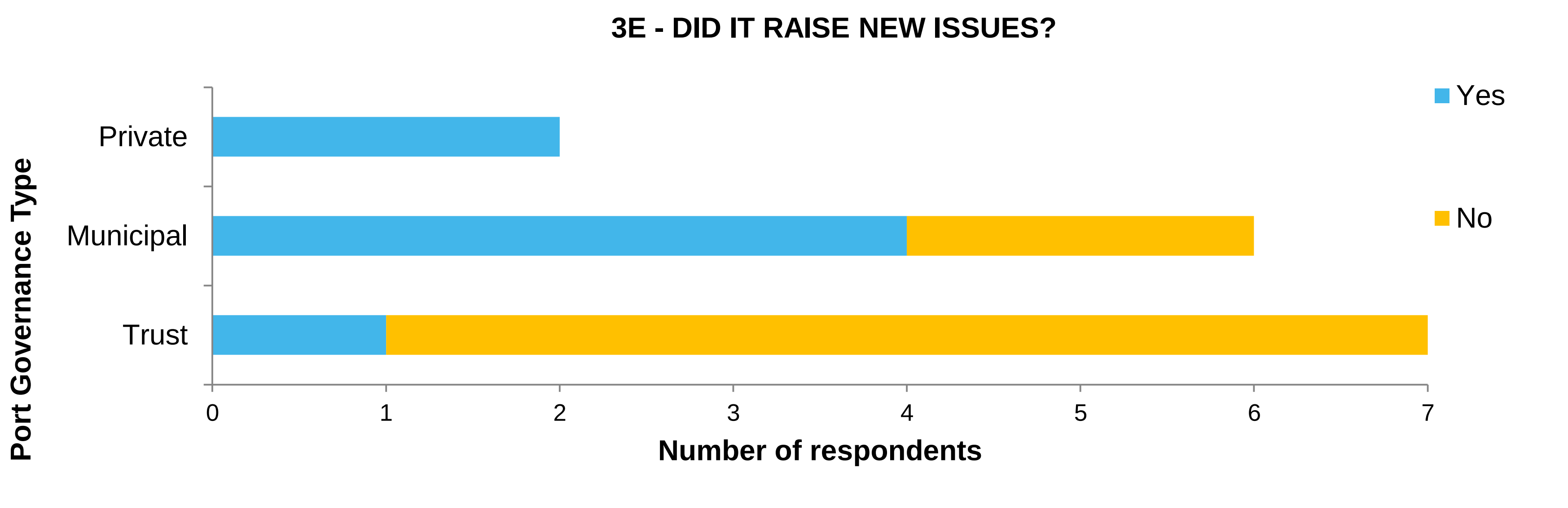
3 - PLEASE DESCRIBE YOUR EXPERIENCE OF COMPLETING A PSMS SELF-APPRAISAL REGARDING FOR EXAMPLE

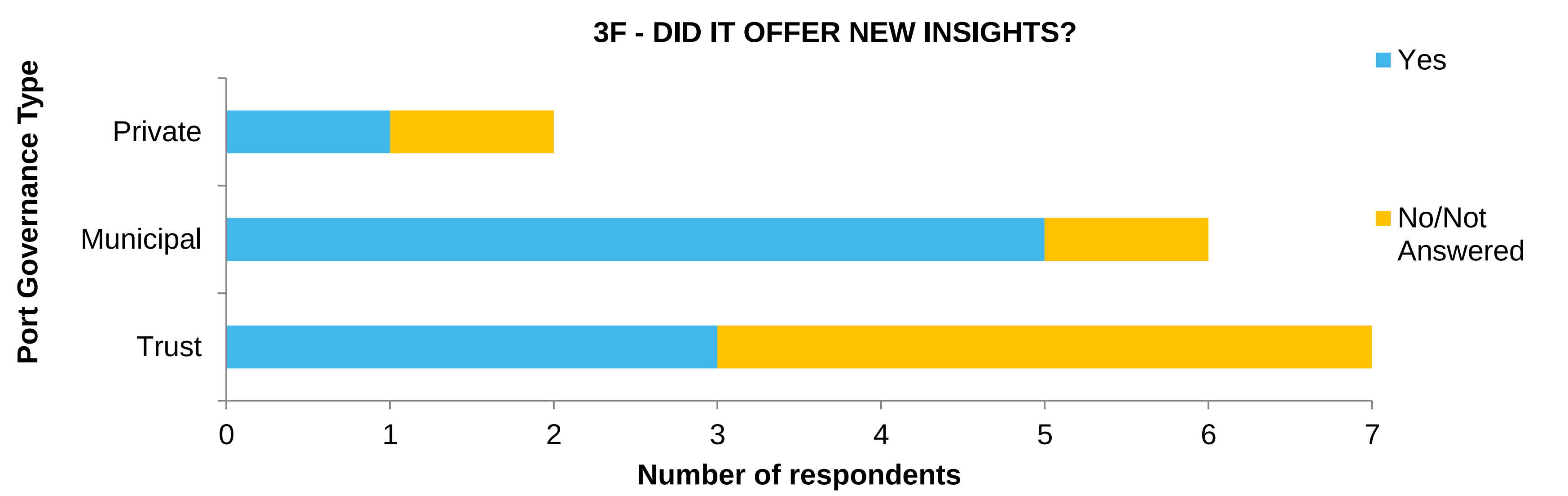


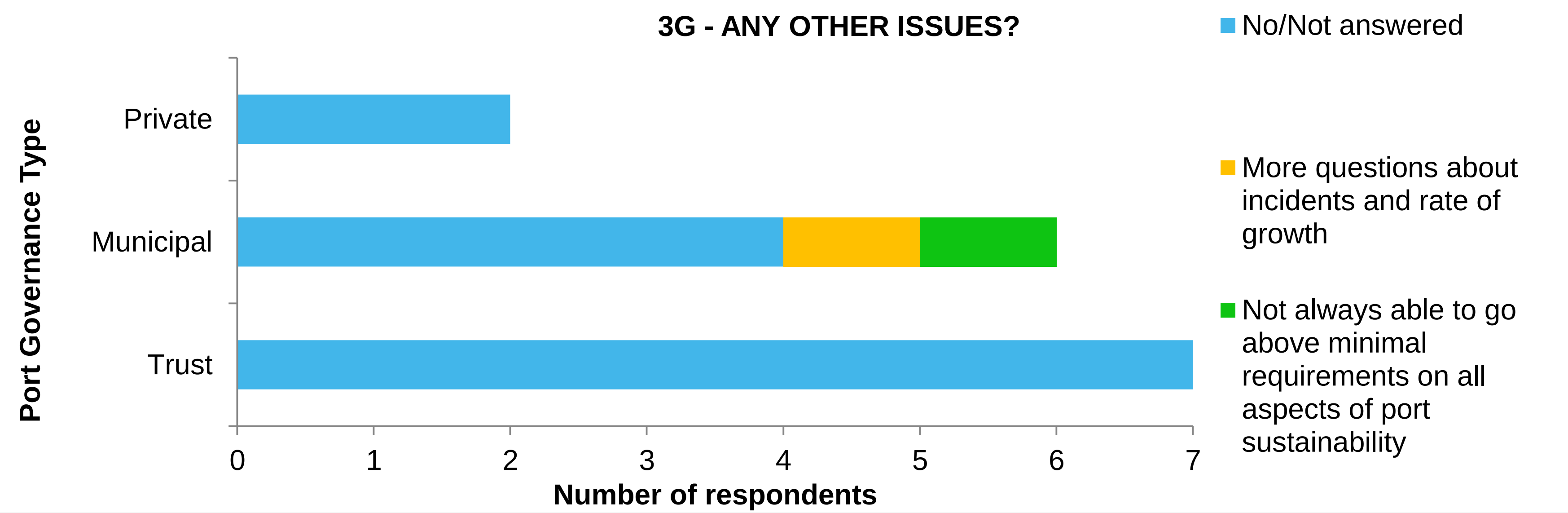

3B - ITS EASE OF USE
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Easy to use
Slightly misleading for input scores
Not answered

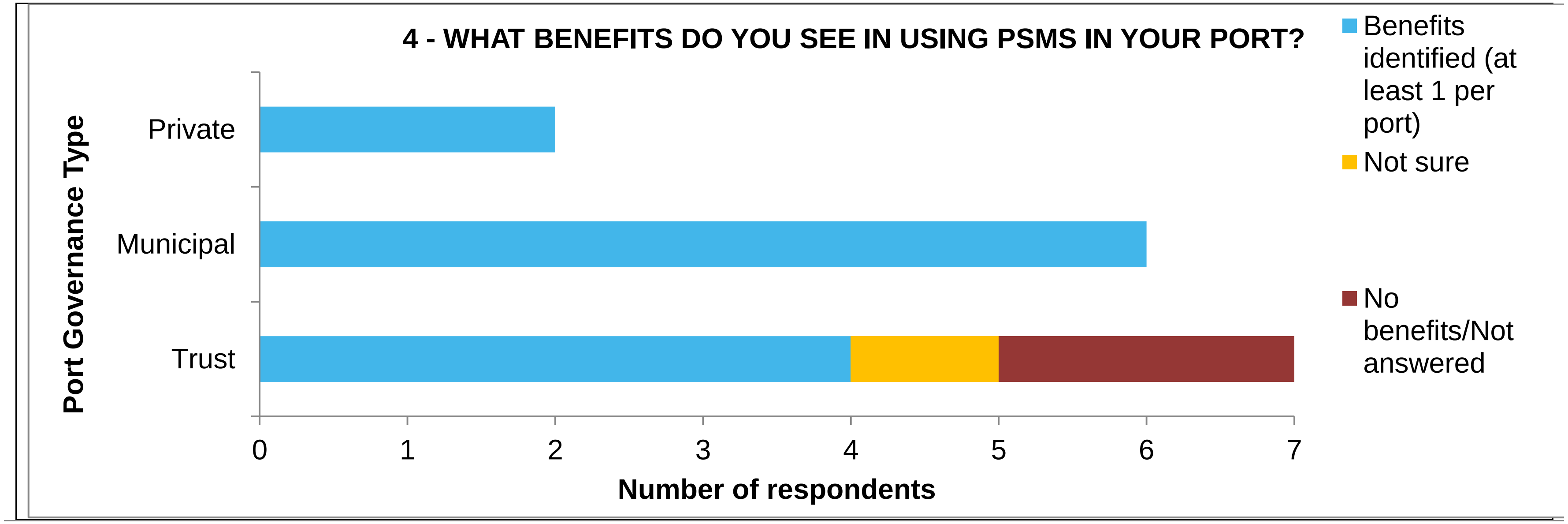

3C - ITS COMPREHENSIVENESS
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Comprehensive
Some criteria is unclear/ slightly misleading/unsure
Not Answered

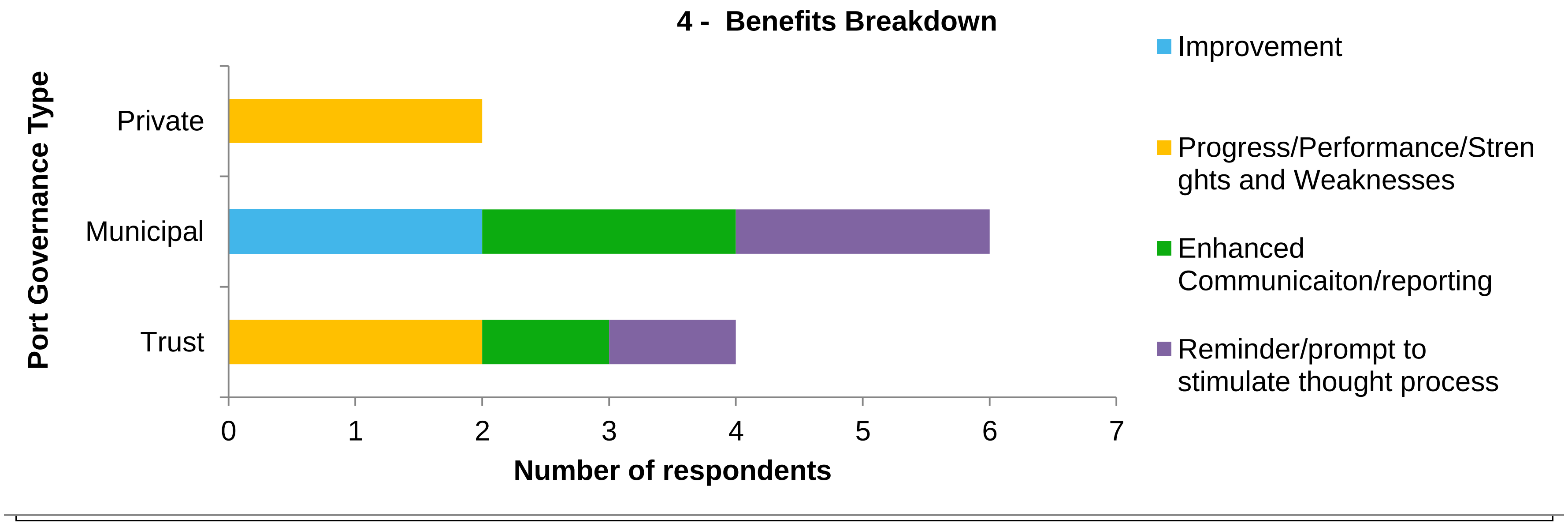

3D - DID IT HELP YOU TO THINK ABOUT ISSUES?
Yes
No/Not Answered
Possibly some things to consider
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents

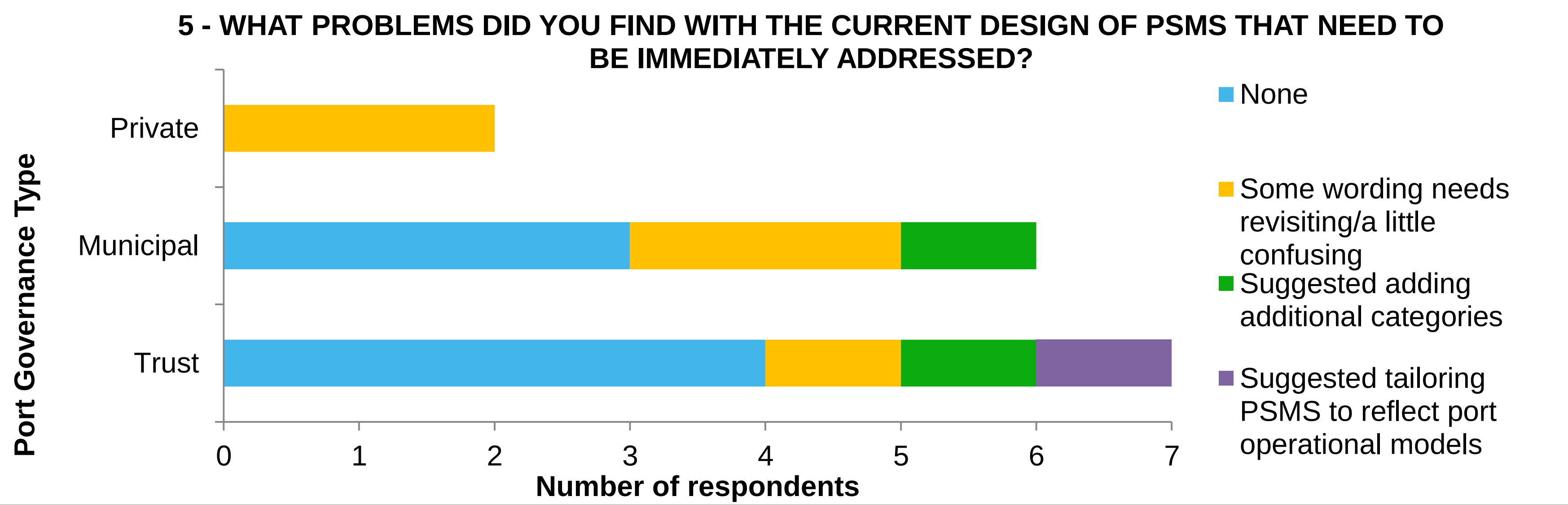

3E - DID IT RAISE NEW ISSUES?
Yes
No
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents


3F - DID IT OFFER NEW INSIGHTS?
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Yes
No/Not Answered

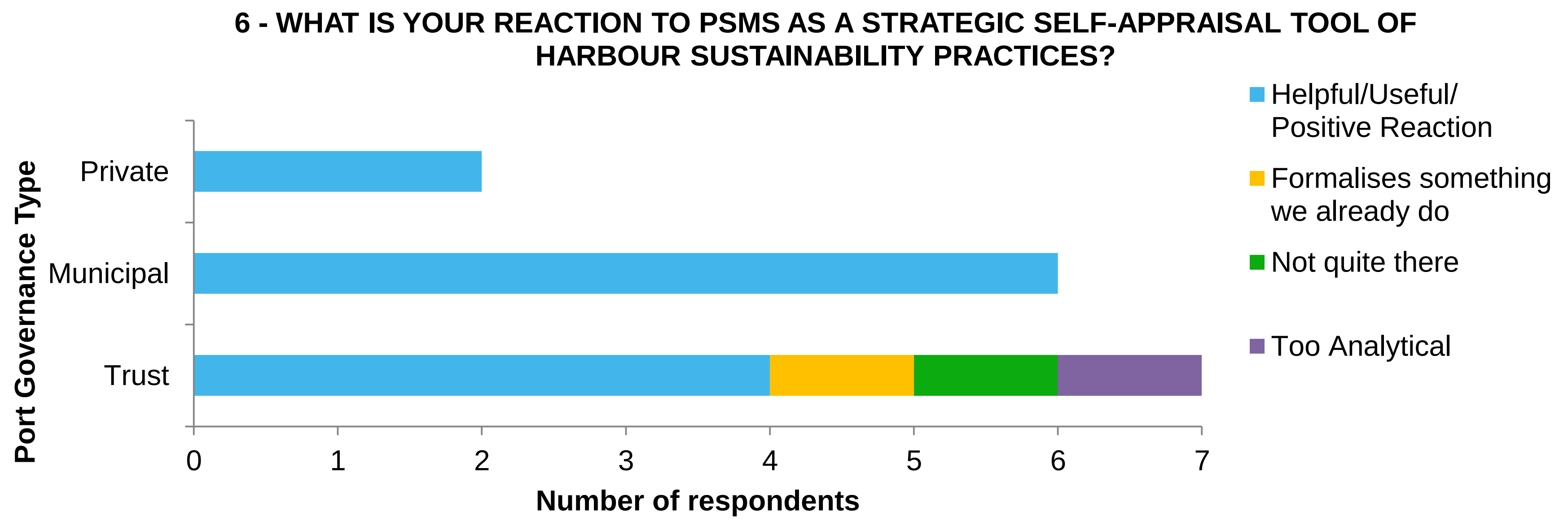

3G - ANY OTHER ISSUES?
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
No/Not answered
More questions about incidents and rate of growth
Not always able to go above minimal requirements on all aspects of port sustainability


4 - WHAT BENEFITS DO YOU SEE IN USING PSMS IN YOUR PORT?
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Benefits identified (at least 1 per port)
Not sure
No benefits/Not answered

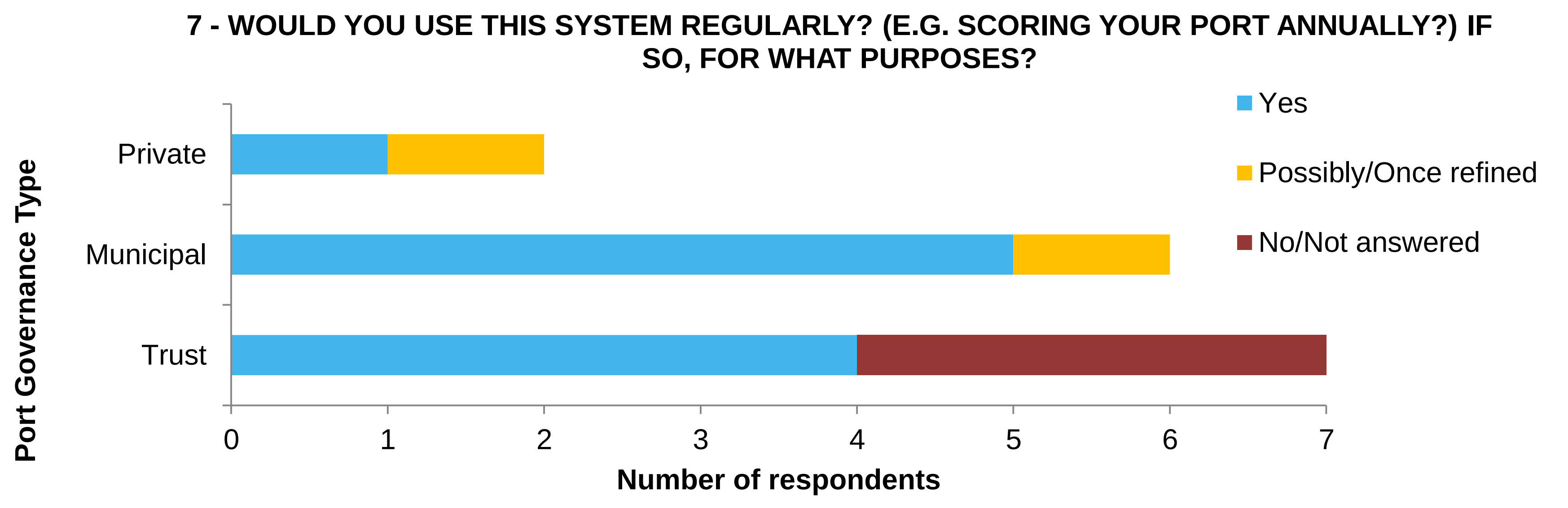

4 - Benefits Breakdown
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Improvement
Progress/Performance/Strengths and Weaknesses
Enhanced Communicaiton/reporting
Reminder/prompt to stimulate thought process

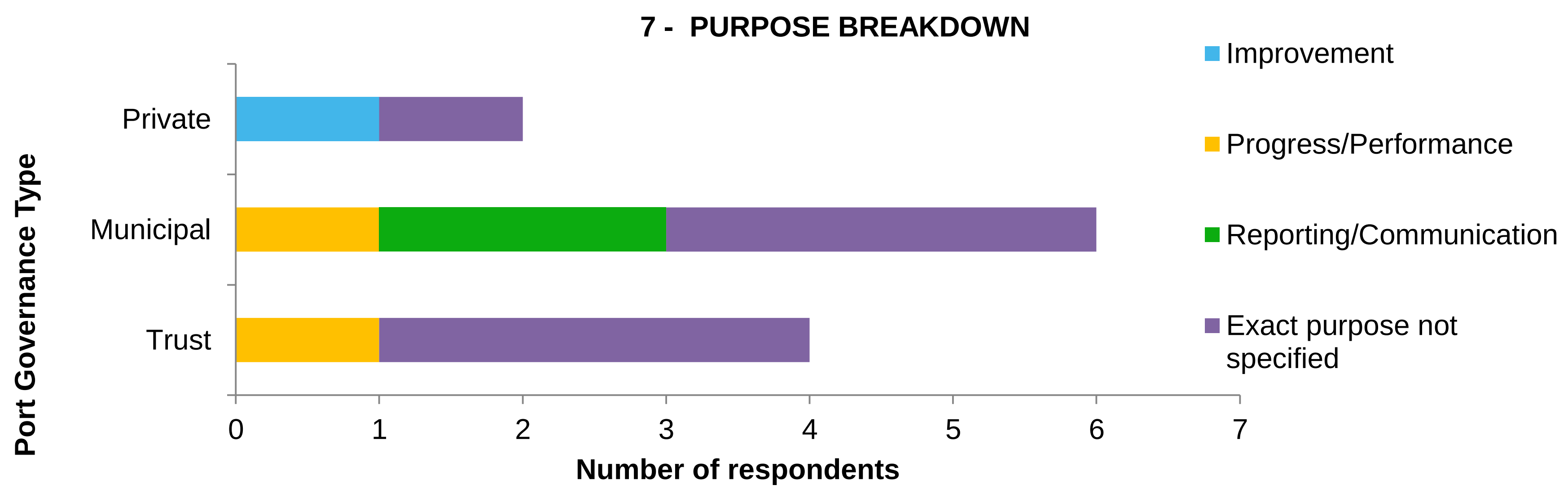


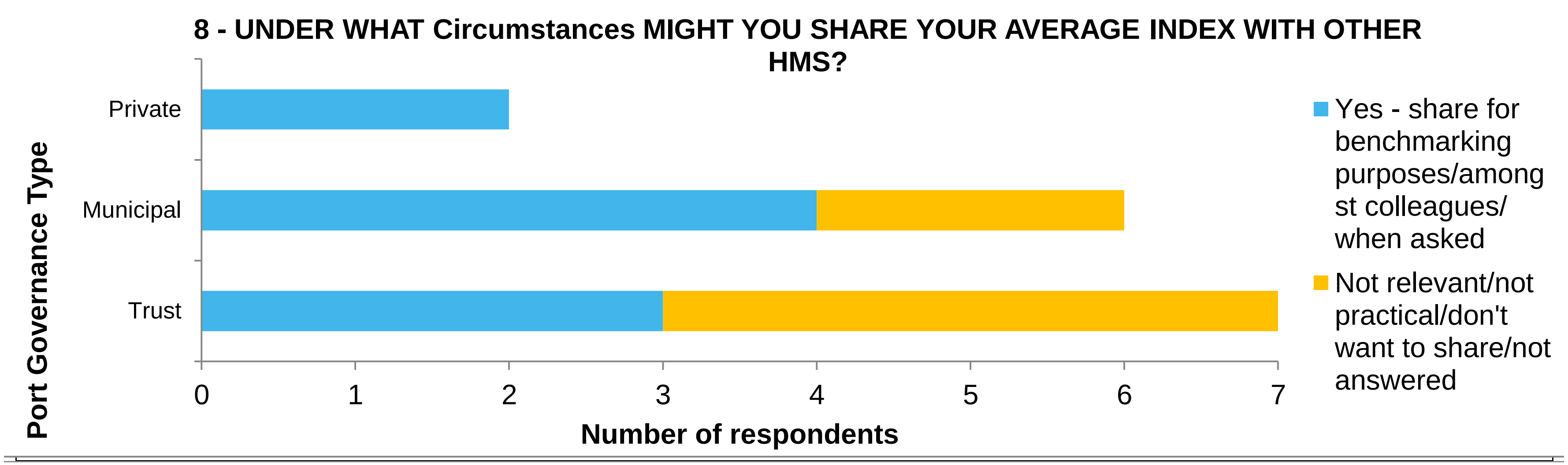
5 - WHAT PROBLEMS DID YOU FIND WITH THE CURRENT DESIGN OF PSMS THAT NEED TO BE IMMEDIATELY ADDRESSED?
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
None
Some wording needs revisiting/a little confusing
Suggested adding additional categories
Suggested tailoring PSMS to reflect port operational models

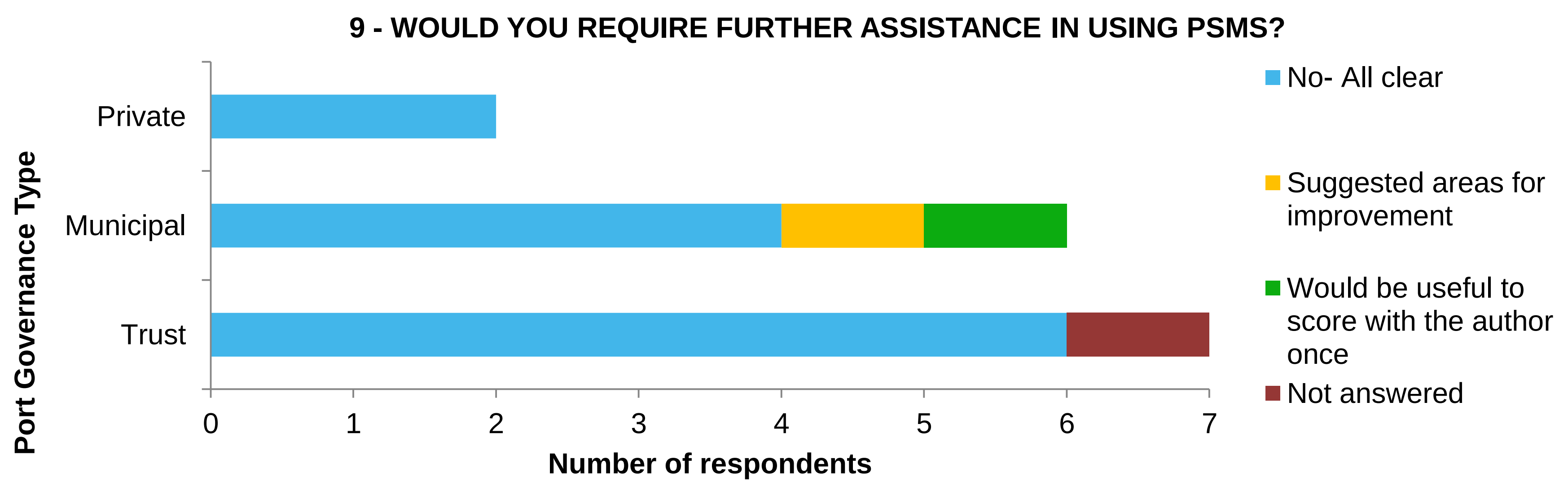


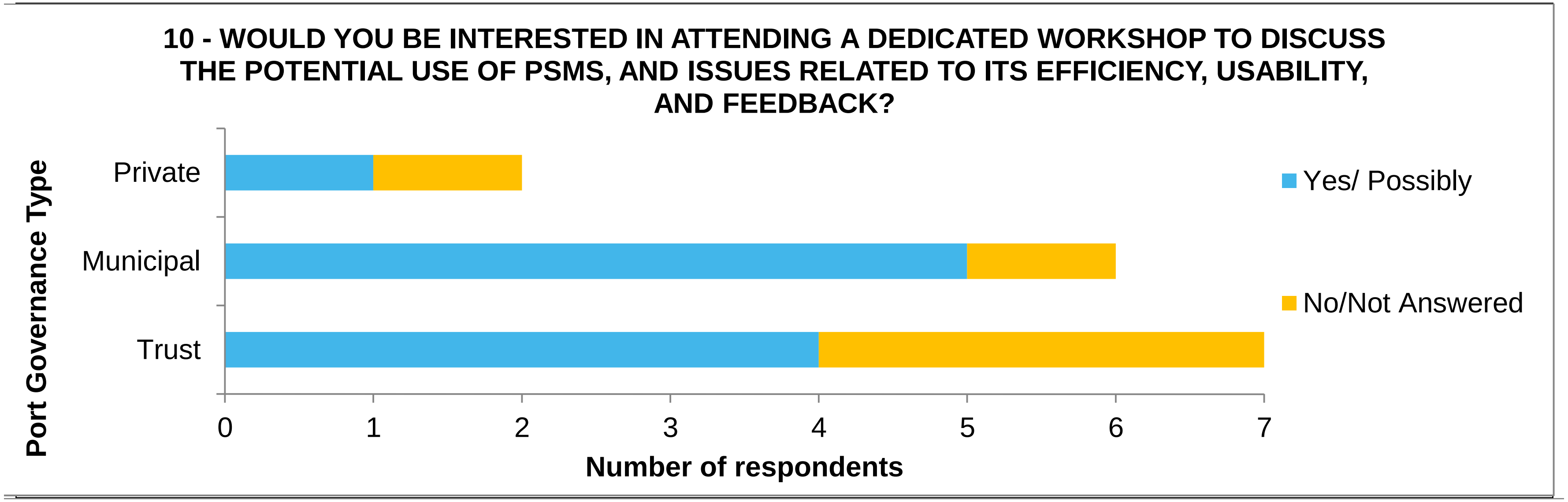
6 - WHAT IS YOUR REACTION TO PSMS AS A STRATEGIC SELF-APPRAISAL TOOL OF HARBOUR SUSTAINABILITY PRACTICES?
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Helpful/Useful/ Positive Reaction
Formalises something we already do
Not quite there
Too Analytical

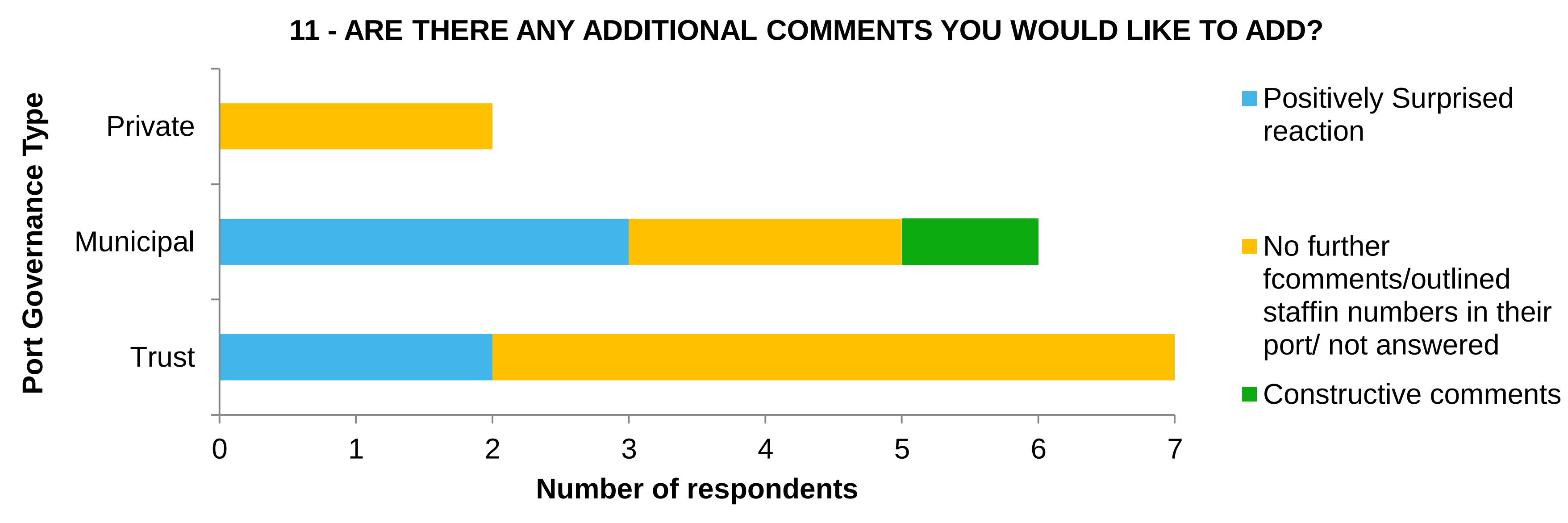

7 - WOULD YOU USE THIS SYSTEM REGULARLY? (E.G. SCORING YOUR PORT ANNUALLY?) IF SO, FOR WHAT PURPOSES?
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Yes
Possibly/Once refined
No/Not answered


7 - PURPOSE BREAKDOWN
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Improvement
Progress/Performance
Reporting/Communication
Exact purpose not specified


8 - UNDER WHAT Circumstances MIGHT YOU SHARE YOUR AVERAGE INDEX WITH OTHER HMS?
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Yes - share for benchmarking purposes/amongst colleagues/ when asked
Not relevant/not practical/don't want to share/not answered


9 - WOULD YOU REQUIRE FURTHER ASSISTANCE IN USING PSMS?
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
No- All clear
Suggested areas for improvement
Would be useful to score with the author once
Not answered


10 - WOULD YOU BE INTERESTED IN ATTENDING A DEDICATED WORKSHOP TO DISCUSS THE POTENTIAL USE OF PSMS, AND ISSUES RELATED TO ITS EFFICIENCY, USABILITY, AND FEEDBACK?
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Yes/ Possibly
No/Not Answered


11 - ARE THERE ANY ADDITIONAL COMMENTS YOU WOULD LIKE TO ADD?
Port Governance Type
Private
Municipal
Trust
0
1
2
3
4
5
6
7
Number of respondents
Positively Surprised reaction
No further fcomments/outlined staffin numbers in their port/ not answered
Constructive comments