# TOWARDS A PORT SUSTAINABILITY MANAGEMENT SYSTEM FOR SMALLER PORTS

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## ABSTRACT

This paper aims to analyse how smaller port authorities in Southwest England manage environmental sustainability. It extends recent research which developed a novel input-output business process approach to environmental management within a case study context of Falmouth Harbour Commissioners. Although maritime operations offer considerable potential for commercial development and growth, many smaller ports possess insufficient resources or technical expertise to engage an environmental specialist to assess the potential impact of maritime operations. Increasingly complex legislation and numbers of stakeholders make compliance, port development and progression of commercial activity challenging, often denying potential economic benefits. This work explores scope for development and dissemination of a Port Sustainability Management System to assist proactive environmental management. The system has facilitated achievement of port environmental, commercial and educational obligations and enhanced external engagement, stakeholder and local community involvement, engagement in policy debates and contributions to best practice.

*Keywords: Environmental Management, Smaller Ports, Sustainable Development*

# INTRODUCTION

This paper aims firstly to analyse how smaller UK port authorities manage environmental sustainability and secondly to extend applications of a novel business process re-engineering approach to environmental management to facilitate sustainable development and opportunities in ports. The first objective underpins research funded by the European Social Fund in collaboration with Falmouth Harbour Commissioners (FHC) to develop a port sustainability management system (PSMS) for smaller ports in Cornwall and Devon. Recent research developed a PSMS with FHC which promoted proactive environmental management, whilst achieving environmental and educational obligations, and assisting FHC to operate commercially (Dinwoodie et al., 2012a; 2012b). External engagement and stakeholder and local community involvement increased, along with engagement in policy debates and contributions to best practice. To create a system capable of dissemination across smaller ports, objectives of this follow-on project are to categorise the requirements for environmental planning in ports in Cornwall and Devon and analyse their sustainable development needs; to synthesise how they manage environmental sustainability; to assess port authorities' attitudes towards PSMS and to propose and evaluate a model to disseminate PSMS locally. This paper focuses on how environmental sustainability is managed.

The paper reports empirical data gathering which has engaged senior Harbour Masters and local officials to determine how they currently manage environmental issues and to canvass their views and attitudes towards PSMS. Based on interviews with five ports and two local government-based harbour authorities, this paper analyses how these smaller ports manage environmental sustainability. A theory extension type case study (Dinwoodie and Xu, 2008) builds on work undertaken in an earlier research partnership between FHC and Plymouth University. An inductive grounded theory approach to analysing empirical data which was gathered within a deductive research framework has been applied. This analytic process first involves the disaggregation of selected interview data into coding units, the identification of relationships between categories of concepts, and finally the integration of categories to formulate new theory relating to how smaller ports manage environmental sustainability.

This paper begins by reviewing environmental and sustainability management processes which are currently deployed across the ports industry. A methodology section summarises the strategy chosen for conducting interviews, the criteria which underpinned port selection and sampling and the processes whereby interviews were analysed. The analysis section investigates the methods which smaller ports currently use to conduct environmental assessments, the environmental management processes that they deploy and the existing management structures which they currently use. A discussion section reviews the appropriateness of the grounded theory approach within the context of this research and issues pertaining to the reliability, validity and authenticity of this work. The paper concludes by noting the implications for academia and the future work needed to commence testing and dissemination of PSMS.

# LITERATURE REVIEW

Empirical data collection revealed three processes which currently guide environmental and sustainability management in ports. The first process aims to build on an existing ports safety management system (SMS) which has been subject to an industry agreed code of practice since 2000, by supplementing an environmental element to that structure. Despite the importance of having an SMS to ensure safe navigation for commercial and leisure users, from a business stance the SMS represents a cost to ports. Although not having an SMS is not an offence, failure to follow good practice may be "relevant to whether the harbour authority is in breach of certain legal duties" (DfT, 2012:8). To develop an independent supplementary stand-alone environmental management system (EMS), merely increases their existing costs. A second process is to apply Total Quality Management (TQM) concepts to integrate quality development, quality maintenance and the improvement efforts of various organisational groups to facilitate full customer satisfaction at the most economical levels (Slack, et al 2010). FHC have adapted a holistic process towards managing the whole enterprise as a system in which the environment represents one element of the whole structure (FHC, 2011). This has resulted in achieving all three aspects of its sustainability mission including commercial, social and environmental dimensions. A third process involves outsourcing the whole environmental management process to an external body such as the Association of British Ports (ABP), or EcoPorts. ABP provides its members with guidance on how to manage their operations in a more sustainable way according to centrally established management standards, whereas EcoPorts offer a compliance scheme based on improved performance to their member ports. In Cornwall, following local government reorganisation in April 2009 several district authorities merged into one unitary authority (Cornwall Council, 2013). Consequently, municipal ports in Cornwall are now managed centrally, and more local authority ports have subsequently joined an extant ISO14001 accredited EMS.

The ports industry is now familiar with the importance of ensuring that port development is sustainable, and despite its diversity, has taken substantial measures to develop appropriate environmental management systems (Hall & Jacobs, 2010; Pettit, 2007; Asteris and Collins, 2007; Olivier & Sack, 2006). However, the continued existence of smaller ports as viable commercial entities is threatened if they possess insufficient resources to manage the potential environmental impacts of their maritime operations to comply with increasingly strict and complex environmental regulations. Many ports have chosen to develop an EMS internally. This decision is resource intensive, requires specialist expertise to implement, and may not be fit for purpose in smaller ports. Few smaller ports chose the ISO 14001 option which "specifies the requirements for an EMS" (ISO, 2004:1). ISO is a set of specific guidelines which an organisation must adhere to in order to be certified. These guidelines 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 intervals (ibid:1-17).

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). Both certification systems are designed with the "Plan, Do, Check, Act" approach in mind. However, the 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). 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. Further, company size plays a significant role in the success of an EMS as large organisational size is a "strong determinant of 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. Difference in resource availability between small and large ports is vast, which makes know-how unaffordable for some and environmental performance results potentially weaker.

Various tools have been devised to assist environmental or sustainability management in ports. Within the EcoPorts framework, a Self-Diagnosis Method tool assists self-audit of environmental issues (Darbra et al., 2004) and if deployed to establish areas for improvement, it may be used to benchmark port performance against the previous year. A Port Environmental Review System (PERS) offers guidelines and example documents with which to implement an EMS (ESPO, 2009). PERS certification should enable and encourage a port to maintain its progress towards ISO14001 certification (EcoPorts, 2006), but should also help to kick-start a port EMS which could be used for "proof of performance" within the EcoPorts environment improvement programme (ibid: 9). Having attained PERS certification, a port would aspire progressively to an EMS and eventually ISO14001 certification (Darbra et al., 2004). Because early attempts to develop a first step tool proved overly complex, a simplified Strategic Overview of Environmental Aspects tool was devised to identify and rank "significant" environmental aspects of ports (Darbra et al., 2005). This tool provides a base with the potential to implement an EMS but also guides ports in prioritising actions and gathering information for their legal and environmental responsibilities. Within a very different management framework, ABP developed a centrally-led initiative which is implemented in all member ports (ABP, 2013). However, although appropriate to large commercial ports, the cost of consultants or internal management resources required to implement these tools is significant. Alternative attempts to shoehorn specific port operations to fit a model template required in an outsourced management system beg the question of how far they are appropriate in smaller ports.

The cost element of ISO 14001 accreditation represents a similar concept to outsourcing environmental or sustainability system for ports. Outsourcing systems are not a current practice for the smaller ports in the Southwest due to financial restrictions, time limitations and the indefinite benefits of these systems to their operations. After applying the Self-Diagnosis Method, 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 environmental management 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, and the two which are 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, in Southwest England, FHC the largest port recorded £368k profit in 2011 (FHC, 2013) and some made a loss. Milford Haven and Peterhead are fundamentally different in scale in compared to smaller ports and have an EMS to support their scope of operations. Profitability issues underpin arguments by 900 smaller ports in the UK seeking a new discourse on sustainability.

The Port Marine Safety Code 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 harbour authorities across the UK to improve safety and manage marine operations to nationally agreed standards (DfT, 2012). When implemented in full, the code 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 code may be capable of adaptation to elements of sustainability management, and provide a management infrastructure for other initiatives including the environment.

If an EMS can be integrated within an overall organisational management structure, the marginal cost of establishing it is minimal. However, if a bespoke ISO 14001 EMS must be developed independently significant costs are incurred. 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). As a management philosophy, TQM emphasizes the importance of customer satisfaction from the perspectives of availability, delivery, maintenance, reliability and cost (Al-Mashari & 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". Prajago et al (2005) described two schools of thought associated with TQM, the first of which promotes unification of mind-sets and perceptions within an organisation "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 an important question for companies thinking of adapting TQM as a new management philosophy as to whether this approach is appropriate for them (Baird, et al., 2011). TQM initiatives failed because success factors 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 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).

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, 2012a). Three levels of decision making are presented in Table 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).

Table 1: Source: Adapted from Dinwoodie et al. (2012a)

| 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 | |

This three stage input–output process modelling framework is aimed at identifying "functional units and flows" that outline organisational processes by "defining the problem, system boundaries and functional flows and variables" (Dinwoodie et al, 2012a: 114). To set up operations, strategic inputs must be identified in which processes affect not only present day but also future operations, and their impacts. Next, processes that take place in everyday operations are analysed as service processes. Tactical service processes are required to ensure that service level and quality are guaranteed through the integrity of the processes. Finally, the output of these processes define an operational output level, where operational processes are defined. Because the potential environmental impacts extend beyond the control of one port authority, the framework is holistic and the three levels interact with each other.

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 2 provides a summary of environmental designations that are present in the ports interviewed for this paper.

Table 2: Summary of UK environmental designations

| Designation | Designating Body | Brief Description |
|---|---|---|
| Marine Conservation Zone | Department for Environment, Food and Rural Affairs (Defra) | These zones will protect a range of nationally important marine wildlife, habitats, geology and geomorphology (Defra, 2013). |
| Special Area of Conservation | EU Commissions Habitats Directive | Conservation of the 189 habitat types and 788 species (Defra, 2013) |
| Area 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) |
| 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) |
| Site of Special Scientific Interest | Natural England | The country's very best wildlife and geological sites (Natural England, 2013) |

The ports of Falmouth and Truro are located in the Fal Estuary, which is subject to environmental designations and subsequent protective measures. Sites of Special Scientific Interest border some of Falmouth Harbour Commissioners land side port limits with much of the coastline designated as Areas of Outstanding Natural Beauty, and Heritage Coast. Despite the environmental designation, the port is located adjacent to busy shipping lanes and borders the 5°W Emission Control Area (IMO, 2013). The process of developing a PSMS assisted FHC to safeguard its maritime operations and unlock new commercial opportunities and increase its bunkering sales. Padstow harbour incorporates a Site of Special Scientific Interest assigned to parts of the “rock and dunes” which is also an Area of Outstanding Natural Beauty and a candidate for Marine Conservation Zone status. Torbay harbour is a candidate for Special Area of Conservation status.

# METHODOLOGY

To analyse how smaller port authorities in Cornwall and Devon manage environmental sustainability empirical data was gathered through semi-structured interviews with ports and local authority officials to identify the processes of environmental management that are 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 3). 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 Cornwall and Devon currently deploy to manage environmental sustainability.

Strauss and Corbin (2008:145) defined theoretical sampling as concept driven. It enables researchers "to discover the concepts that are relevant to this problem and population, and… to explore the concepts in depth". The authors stressed the importance of researching new fields as the use of theoretical sampling "allows for discovery" (ibid). Data analysis for this ports study has been performed after conducting each interview which has helped to identify several saturation points. A snowball sampling strategy assisted in gaining access to data and in building strong working relationships, starting with a small group of Harbour Masters and then using their knowledge, expertise and suggestions of whom to approach next (Bryman and Bell, 2011). Following initial discussions with one Harbour Master one year ago the use of snowball sampling generated a twentyfold increase in the number of contacts. Semi-structured interviews with all participants commenced as shown on the prompt sheet (Table 3), 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.

Table 3: Interview prompt sheet for Harbour Masters

| |
|---|
| **1)** Which port authority / administration are you working 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 currently? |
| **7)** What are your port's main current sustainability needs? |
| a. How do you currently manage these? |
| b. What (e.g. systems, resources, training) would be required 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 PSMS 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? Profitability? Stakeholder issues? |
| b. Do you see yourself as being close to commercial customers and prioritise their needs? |
| c. Which initiatives seem to be working well within your community? |

Table 4 summarises the ports interviewed to date, and work is on-going. The selection spans a representative range of governance models and locations to allow richer data to emerge. A&P Falmouth owns Falmouth Docks and Engineering Company (FDEC) which is a private port authority within The Fal Estuary with its own Dock Master. The acronym "FDEC" refers to the port authority and "A&P" refers to the interview conducted.

Table 4: Summary of ports and interview participants

| Port/Harbour Authority | Location | Person Interviewed | Governance Type |
|---|---|---|---|
| FHC | Cornwall | Harbour Master | Trust |
| FDEC | Cornwall | Environmental Manager | Private |
| Padstow Harbour Commissioners (PHC) | Cornwall | Harbour Master | Trust |
| Truro | Cornwall | Harbour Master | Municipal |
| Torquay | Devon | Harbour Master | Municipal |
| Torbay | Devon | Executive Head | Municipal |

Interview data were analysed using Strauss and Corbin (2008) methodology of Grounded theory (GT). This method was chosen over the Glaser's approach to GT (Glaser, 1992) because it provides more flexibility and most importantly does not make constant comparison more important than a research paradigm and other tools used in the process (Walker and Myrick, 2006). The approach to coding of Corbin and Strauss (2008:66) is like "mining beneath the surface to discover the hidden treasures contained within data" as opposed to Glaser's (1992:38) view of "conceptualizing data by constant comparison of incident with incident, and incident with concept" which has more merit in this research. Viewed within a social constructivist paradigm, Harbour Masters represent "social actors" and stakeholders are "individual customers." Each has a different view of ports and their operations, and therefore has different levels of interaction such as whether to complain, to advise, to praise or to ask (Saunders, et al, 2009). This ontological stance views the reality as something that has been socially constructed, where different interpretations are likely to affect the nature of social interactions (ibid). Hence "mining" for the data "beneath the surface" as suggested by Corbin and Strauss (2008) in this research has been a successful approach to discovering new ideas and reaching partial saturation.

The PSMS introduced above 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. FHC have adapted a TQM type approach to organisational management, viewing issues from their customers' perspectives and taking a holistic approach to all parts of their organisation (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 lead to establishing close working relationships with regulatory bodies and various stakeholders through a Knowledge Transfer Partnership (KTP) with Plymouth University (KTP, 2012). Due to the unpredictable nature of ports 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 this project FHC had had a long-standing EMS, and whilst seeking further improvements have identified the importance of stakeholder management and engagement which was later "incorporated into

a broader sustainability management system" (Dinwoodie et al., 2012a: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.

To research the scope for implementing PSMS beyond FHC a theory extension type of case study was deployed (Dinwoodie & 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). In order to build a PSMS and disseminate it to smaller ports, synthesising how smaller ports manage environmental sustainability and why things are done in a certain way is a focal point of this paper and one of the key research objectives. 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., 2012a), 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.

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. Although port operations are often idiographic, maritime operations are more ubiquitous, which facilitates the development of a generic management system to frame their environmental impacts, appropriate for dissemination across smaller ports. With that in mind, maritime operations have been identified as terms of reference which would serve as the foundation for a PSMS. After conducting a comprehensive search of over 4000 journal articles, reports and industry publications it was revealed that maritime operations have rarely been defined in academic literature. Shortlisted results were analysed using Ethnographic Content Analysis which represents a systematic and analytical technique for document analysis (Altheide, 1987). Intercoder reliability has been established using Cohen's Kappa to test variance between coders (Lombard et al. 2002). Building on this analysis a preliminary definition was suggested based on existing literature namely: "*maritime operations comprise all routine procedures which ships and vessels undertake whilst in port for commercial and environmental purposes"* (authors). The views of some authors represented a form of reaction to a problem rather than an early diagnosis with regards to assessing the cost of environmental impacts and understanding the levels of risk involved. This definition validates traditional views, in which environmental systems only impact as a cost to the business, or business concepts of profit which compromises sustainable development. Once primary data collection had begun, a number of Harbour Masters were asked about their understanding of maritime operations with some specific port-related examples. Based on that, a final definition has been suggested which summarises individual operations identified during data collection, namely: *"maritime operations include a plethora of commercial water-based activities with potentially significant environmental impacts which vessels undertake for commercial purposes in ports, and*

*during their approach to port's aegis"* (authors). Examples of maritime operations are bunkering, anchoring, hull scrubbing, in-water surveys, ballast water exchange and others.

# ANALYSIS

## Port and maritime operations undertaken in the case study ports

This section analyses the diversity of port requirements identified to date, and summaries the associated port and maritime operations. The analysis of interview findings synthesises the processes deployed to conduct environmental assessment and the ways of managing environmental sustainability. A detailed investigation of the different management processes currently in use by smaller ports and the applicability of other management systems are presented. The locations of the ports which were researched in the Cornwall and Devon area of Southwest England are shown in Figure 1.

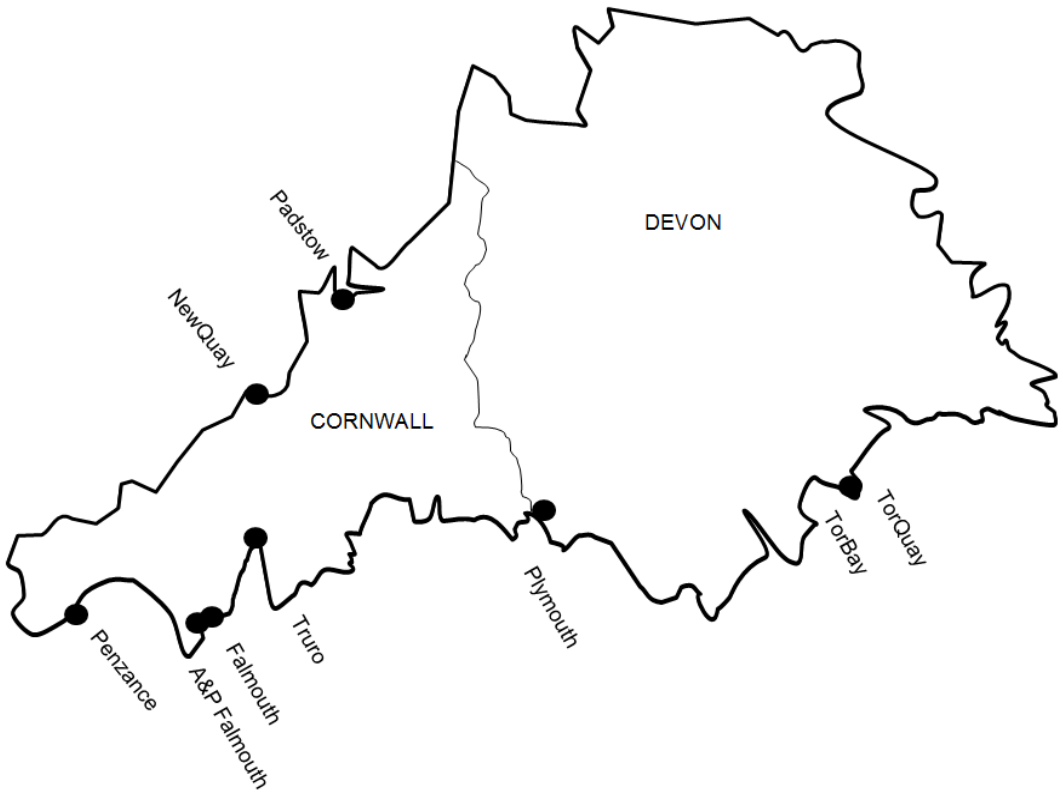


Figure 1: Port locations in Cornwall and Devon. Source (Authors)

Table 5 summarises the commercial operations found in the five ports and one local authority interviewed to date. Cornwall County Council's municipal ports category was excluded from several tables because out of 10 municipal ports, only one has been sampled to date. Table 5 highlights involvement and the scale of trades in different ports. Commercial

operations include water lease for renewable energy testing, casualty reception and land and infrastructure lease (LIL).

Table 5: Commercial operations by port

| Trade / Port | Wet Bulk | Dry Bulk | Fishing | Marina/ Leisure (M&L) | Other |
|---|---|---|---|---|---|
| FHC | Heavy and low sulphur fuel, marine gas oil, lubricants | | Crab, Prawns, Fish | 588 Moorings | water lease for renewable energy testing, casualty reception |
| FDEC Falmouth | Heavy and low sulphur fuel, marine gas oil | Animal feed, fertiliser, coal stone products | | | 40 000 cruise passengers, Ship repair |
| Truro | Petrol and Diesel | Sand, cement scrap metal, building, materials, grain | Oyster, Prawn, Mussels | 1200 moorings, Pontoons | 8 lay ups, commercial moorings, LIL |
| Torquay | Petrol | | Small fleet | 500 marina berths | Ship services at anchor, LIL |
| PHC | Lubricants, oils fishing fleet, leisure | Sand removal | Lobster, netters | 187 moorings | Ferry service, LIL |
| Torbay | Diesel | | 60 species | 1000 marina berths, 350 Moorings | LIL, casualty reception |

Through identifying the differing maritime operations undertaken this research aims to create a PSMS to assist ports to manage their sustainable development needs and to proactively identify new commercial opportunities. The process of assisting compliance with increasingly complex legislation is implemented using a business process approach. Table 6 reveals the diversity and scale of maritime operations in the ports sampled.

## Processes deployed to conduct environmental assessment

In April 2009, Cornwall County Council 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 County Council oversees the provision of certain services for the whole county. Since assuming the role of a harbour authority for municipal ports, Cornwall County Council appointed a Maritime Manager to manage ten municipal ports in Cornwall. The Maritime Manager had extensive previous experience as a harbour master and had developed an EMS for the ports of Truro and Penryn in 1995, later revised in 2012 (Port of Truro, 2012; Maritime Manager Interview, 2012). Newquay was the first new harbour to be added to the existing EMS post-unification of Cornwall County into a single authority. The Maritime Manager is an “ultimate” harbour master who is a line manager for municipal ports as well as overseeing aspects such as beach safety, licensing of boats and maritime strategy for the county (Maritime Manager interview, 2012). As it stands, Cornwall has a centralised county system for those ten municipal ports which entails financial support and strategic assistance for ports within that system to help them to achieve profitability

Table 6: Maritime operations by port

| Operation: Port/Area | Bunkering | Anchoring (commercial) | Anchoring (leisure) | Commercial Vessel Services | Leisure Vessel Services |
|---|---|---|---|---|---|
| FHC | Ship to ship | Designated anchorage, layup maintenance, casualty reception, pilotage, licenced explosive cargo anchorage | Moorings | Leisure | Educating users, winter stowage |
| FDEC | Ship to shore<br>Shore to ship | Berth | | Ship survey, ship repair, towage | Winter stowage, boat licensing, boatmen licensing |
| Truro | Ship to ship | Commercial berth, layup | Moorings, pontoon | | |
| Torquay | Shore to ship | | Moorings, 2 marinas | | Winter stowage |
| PHC | Shore to ship | Pilotage | Moorings | Ship Survey | Licencing of boatmen |
| Torbay | Ship to ship (ad-hoc)<br>Shore to ship | Designated anchorage, casualty reception, pilotage, coast hopping, pilotage | Moorings, marinas | Ship survey | Winter stowage |

(ibid). Some ports that represented a significant cost to the council have been turned around from a substantial deficit to either a much smaller deficit or even a profit. “Newquay harbour used to cost the council £80 000 per year and last year it cost £19 000. Three years ago St Ives harbour cost the Council £22 000 per year, and now it’s making a small profit of £2 000” (Maritime Manager interview, 2012). Future plans include revision of Harbour Orders and a creation of a single pot of money for all ten harbours to assist smaller ports with financial support until they can become commercially sustainable (ibid). Currently there are talks about eventually adding all ten harbours to the ISO 14001 system which would need to be revisited (ibid). Currently Truro, Penryn and Newquay’s EMS includes things like “water, electricity, gas use, etc.” (ibid). The Maritime Manager said that he wanted to simplify the EMS to make it more generic for harbours and concentrate on areas with environmental concerns (ibid). The creation of the system initially took nine months with costs of approximately £6 000 which in today’s money could be as much as £9 500 (ThisIsMoney, 2013). There is also a cost of the Harbour Master’s time to implement it, the cost of ISO accreditation and “£2 000 to £3 000 per year in terms of hard cash to the British Standards Institute who undertake our accreditation” (ibid).

When placing objects on the seabed or installing infrastructure (e.g. pontoons), consent from the Marine Management Organisation is required; this is often followed by an environmental assessment (Padstow interview, 2013). This process forms the basis for the environmental management aspect from the statutory side that every port has to comply with. A concept of “piggybacking” has been discovered during data analysis whereby ports and harbours use their mandatory 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, SMS are important vehicles for the safety of commercial and leisure users. Within such a system, environmental management 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 harbour authority's aegis. For an EMS to be commercially sustainable and represent a return on investment rather than a cost, a different approach to organisational culture is required.

After collating relevant data, Table 7 was compiled to summarise who conducts environmental assessment within the five 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 7, 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 bi-monthly regional meeting with harbour masters from several counties coming 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 Cornwall County Council's system which comprises ten municipal ports with a centrally run line management.

Table 7: Who conducts environmental assessment?

| | Initial Environmental Assessment | | | | | |
|---|---|---|---|---|---|---|
| | Outsourcing | | Best practice | Internal | | Centralised |
| | Consultant | Other | Trade Liaison | Environmental Officer | Harbour Master | County Model |
| FHC | ✔ | | ✔ | ✔ | ✔ | |
| FDEC | | | | ✔ | | |
| Truro | ✔ | | ✔ | | ✔ | ✔ |
| Torquay | | ✔ | ✔ | | ✔ | |
| PHC | | ✔ | ✔ | | ✔ | |
| Torbay | | ✔ | ✔ | | ✔ | |
| Cornwall Municipal Ports | | | ✔ | ✔ | ✔ | ✔ |

## The management of environmental sustainability

Table 8 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 interviewed to date. Being developed by a very small team of people, this software company is family-run and required investments up-front to be produced. Information sharing represents various meetings between harbour officials with government agencies, stakeholders, and other ports to discuss posing issues and plan ahead. This concept differs from trade liaison by being very specific in nature and focusing on issues local to the harbour.

Table 9 summarises current EMS deployed within the ports interviewed. Statutory systems represent a combination of safety management, Marine Management Organisation environmental impact assessments and legislation that prohibits unauthorised development without written consent and a valid licence. Information 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 a 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 environmental management.

Table 8: How are environmental issues managed?

| | Outsourcing | Best practice | | | Internal | | Centralised |
|---|---|---|---|---|---|---|---|
| | Consultant | Trade Liaison | Grouped Procurement | Information Sharing | Environmental Officer | Harbour Master | County Model |
| FHC | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | |
| FDEC | | | | ✔ | ✔ | | |
| Truro | | ✔ | | ✔ | | ✔ | ✔ |
| Torquay | | ✔ | | ✔ | | ✔ | |
| PHC | | ✔ | ✔ | ✔ | | ✔ | |
| Torbay | | ✔ | | ✔ | | ✔ | |
| Cornwall Municipal ports | | ✔ | | ✔ | | ✔ | ✔ |

Table 9: Systems deployed to Management environmental impacts

| | Systems Deployed to Manage Environmental Impacts | | | |
|---|---|---|---|---|
| | | | Bespoke EMS as part of | |
| | Statutory | IMS/TQM | PSMS | ISO14001 |
| FHC | ✔ | ✔ | ✔ | |
| A&P Falmouth | ✔ | | | ✔ |
| PHC | ✔ | | | |
| Truro | ✔ | | | ✔ |
| Torquay | ✔ | | | |
| Torbay | ✔ | | | |

# DISCUSSION

Truro EMS poses a question of whether better environmental management is related to governance and tighter control. Municipal ports are the most transparent out of three governance types in the UK and are run for the benefit of stakeholders, evidenced by the public availability of the EMS for Truro, Penryn and Newquay on the Truro website. Stakeholder emphasis and transparency can stand in the way of commercial decisions if proof can be found that these decisions might affect the benefit received by stakeholders (interview with Truro, 2012). A summary of different port governance types and their features emerged during the interviews and has been summarised in Table 10.

Table 10: Summary of port governance types and features

| | Port governance feature | | | | |
|---|---|---|---|---|---|
| | Level of Transparency | Emphasis on Commerce | Level of Stakeholder engagement | Level of Access to Expertise | Level of Bureaucracy |
| Private | Very little | High | Varied | High | Varied |
| Trust | Medium | Medium | High | Medium-high | Medium |
| Municipal | High | Varied | High | Varied | Very high |

Table 10 illustrates that the diversity of ports offers one reason why few smaller ports have access to the resources required to adapt a proactive stance on sustainability. Previous research has shown that lack of attention towards organisational culture is one of the reasons for failures to implement TQM systems across US, UK and Australian companies (Baird et al., 2011). By implementing a business process approach to environmental management, FHC have succeeded in creating their own bespoke information management system based on the principles of TQM. A key point emerged from this research, namely that to be sustainable a port authority must have environmental management embedded into fundamental statutes of the port. Performance beyond statutory compliance represents good practice, but governance can hinder the process of developing commerce using traditional thinking if port authorities are unable to afford bespoke environmental officers or subscriptions to recognised management systems.

Issues relating to environmental management and sustainable development are international. Unless ports can adapt to the changing nature of shipping where vessels are becoming increasingly large and require larger draught and can safeguard their existing business or

unlock new opportunities, numerous smaller ports will become commercially unsustainable and may go out of business. A company that is losing money is unlikely to invest heavily into environmental management where jobs are at stake, making risk of closure ever greater. The aim of PSMS is to view environmental management as a business process approach with which to supplement statutory requirements and help to generate new business which aims to create employment and increase turnover. Identifying maritime operations and synthesising how smaller ports manage environmental sustainability is a first step in a new discourse for sustainability.

# CONCLUSION

This paper analysed how smaller ports manage environmental issues sustainability and investigated various management processes currently in place. By understanding the value of a business process approach to environmental management, at least one harbour authority has reconsidered its management structures and organisational approaches. Incorporating environmental management and making it integral to the whole port management process is imperative to be able to safeguard existing commercial revenue streams and help unlock new resources and potential new business. One of the issues discovered during data collection is the view of environmental management as a cost which some ports can ill-afford, rather than as a vehicle for sustainable development and a reason for a new discourse.

More data are required to enable the creation of PSMS and subsequent dissemination across ports. Governance is likely to become a focal point which will determine how well the PSMS can be applied in certain ports. Other issues which need to be investigated include the status of local authorities, attitudes to investment into new IT infrastructure and the levels of organisational change ports are prepared to go through.

This paper has provided a different angle on environmental management in ports. Academic literature is often focused on large container ports which have vast revenues compared to smaller ports that are important for local communities and do not generate such income. Application of existing EMS is often not transferrable to smaller ports; hence a new discourse is required. A definition of maritime operations provided in this paper will assist with managing semantics used within the shipping industry and differentiate maritime operations from port and marine operations.

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