

Final Report

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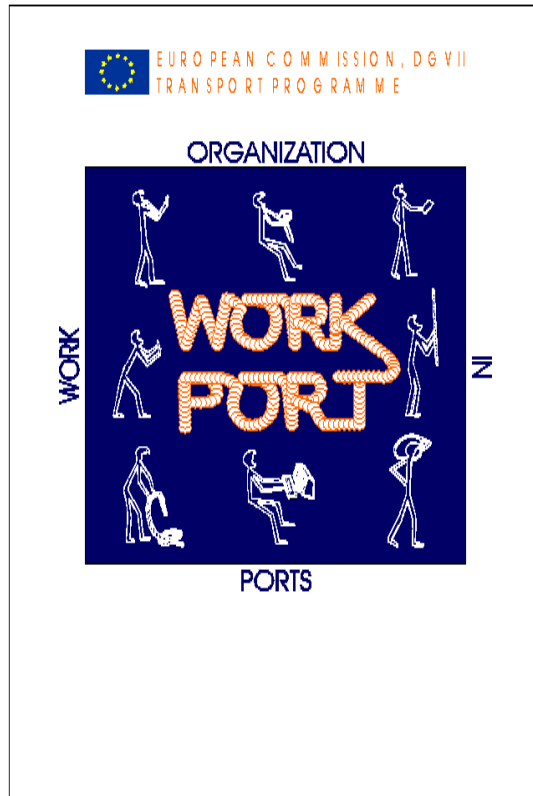
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Work organisation in ports

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ABSTRACT

The project's main aim was "to assess the impacts of new technology in the port work environment and to consider the application of new organisational and management concepts to meet new demands for ports".

For the purpose of the project new technologies are defined as technologies that have been recently implemented or are expected to be implemented in the immediate future.

The WORKPORT Consortium initially carried out a literature survey to identify the main new organisational and management concepts successfully used in other industrial sectors. A long list has resulted and is presented in the respective deliverable (WORKPORT Del. 2).

Next their transferability to the port sector was considered by means of a Delphi study among experts, within and outside the WORKPORT Consortium. Furthermore, the application of these concepts was considered in the port case studies. The main concepts considered in this exercise

WORKPORT has reviewed the factors for change in ports and the response options available, identified the future demands that the ports have to face and also considered how the new organisational forms can help them to meet future challenges. These issues are now summarised and discussed.

Current status in European ports, Public-Private partnerships in ports, Organisational and management changes, Safety in ports, Environmental issues in ports, Future demands, Future technical environment in ports, Future organisational forms.

WORKPORT has developed and applied a methodology for a structured research into the socio-economic impact of the organisational concepts and technologies applied in ports.

The assessment methodology consists of different elements in order to discover and integrate the opinion of people working in the port about the impact of new technology and new organisational concepts on the port's working culture. These elements are:

- Stated Preferences Analysis (SPA);
- Multi Criteria Analysis (MCA); and
- The Social Impact Questionnaire

The case studies were conducted at the ports of, Rotterdam (The Netherlands), Immingham (United Kingdom), Gothenburg (Sweden), Kotka (Finland), Thessaloniki (Greece) and Duisburg (Germany). For the successful fulfillment of each case study interviews with port experts, managers and workers from the various departments in the port authority and in port based companies were conducted using a questionnaire developed as part of the WORKPORT project.

The WORKPORT Consortium has derived a schematic model, which describes how the European port industry has evolved since the 1960s and identifies key factors and milestones in this transition process. The WORKPORT schematic model describes in detail the transition process and its main phases for European ports. However, it should be noted that not all European ports have followed these phases because they are affected by different external factors.

An appropriate strategy for implementing and managing organisational change is described in the literature. Its application to ports has been considered in examples derived from the port case studies of WORKPORT. Although the examples differ from each other, they illustrate both the problems arising from organisational change and how these problems may be resolved, thereby identifying the factors that are likely to lead to its successful accomplishment.

There is a need for an appropriate updating of port workers' education and qualifications, which has been increasingly recognised during the past 10 years in most European countries. As various port surveys interviews and personal experience have testified, the integration and co-ordination of training initiatives are of fundamental importance.

Best practice with respect to the implementation of new technologies and new organisational concepts has been studied in six European ports in the WORKPORT project. It is recommended that best practices in other European ports is also studied in order to establish a network for the exchange of best practices between different European ports.

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1. Partnership

Main partners

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2. University of Cardiff (UWC)
3. Netherlands Economic Institute (NEI)
4. Gerhardt- Mercator University of Duisburg (DUI)
5. VTT Automation, Risk Management (VTT)
6. Chalmers University of Technology (CHALMERS)
7. Port And Transport Consulting Bremen (PTC)

Subcontractor

8. Cooperation Agency For Europe of The Sea (ACEM)

2. Executive Summary

The WORKPORT project lasted two years from 1 January 1998 to the end of December 1999 and produced eight public deliverables and several additional internal reports. Seven main contractors and one subcontractor participated in the study, from 7 EU countries of which four were Universities, two were consultancy companies, one was a research centre and one a cooperation agency.

The project followed a clearly specified work programme consisting of eight main workpackages broken down into twenty-six activities. Literature reviews, Delphi and questionnaire surveys, expert meetings and workshops were employed to tackle the project issues both at a practical as well as theoretical level. Empirical research was carried out at six selected case study ports.

The project's main aim was "to assess the impacts of new technology in the port work environment and to consider the application of new organisational and management concepts to meet new demands for ports".

The main findings of the eight project deliverables, which are presented in this report, are now outlined below.

New technologies in ports and their interaction with shipping.

For the purpose of the project new technologies are defined as technologies that have been recently implemented or are expected to be implemented in the immediate future.

In the sea ports area the new technologies influencing port operations for the purposes of this study, have divided into five main categories: *sea operations; port operations; sea side port operations; transshipment sea-land, port operations; land side port operations; and connections to hinterland.*

The main new technologies identified include: *Mobile communications, Global Positioning Systems, Increase in ships' size, Vessel Traffic Services, Navigational support, Manoeuvring and collision avoidance support, Automated Crane Control, Automated Guided Vehicles, Automated Stacking Cranes, Robotic Container Handling, Electronic Data Interchange, Cargo Card, Tracking and Tracing, Warehouse systems, Rail transshipment systems, Barge container transshipment systems.*

The new technologies listed are to a large extent container oriented, since this type of transport shows dynamic developments and therefore has become the focus of this study.

In the *inland waterways area* the new technologies have been divided into broadly the same main categories as previously but here River operations has also been added as a category. The main new technologies identified here include:

Modern river sea-ships, ships suited for dangerous liquid cargoes, changes in the infrastructure of rivers and channels, changes in ship's size, use of ICT in bureaucratic customs procedures, Trends of seaports concentration and the necessity of inland ports as distribution centres, changes in the area of cruise and ferry operations, creation of more port area, improvement of the sea-shore interface, combined traffic, inland ports as customer oriented logistic service centres, Adaptation of infrastructure to sea port's requirements, Facilities to handle multimodal traffic in the hinterland.

For the analysis of the possible *interactions between new technologies in ports and shipping* the technologies have been grouped as:

Ship technology: Increased ship size leads to operational problems in ports since appropriate infrastructure is required. Increased ship speed leads to shorter turnaround time, and demands on the navigational support systems. While the container is heavily standardised, the Ro-Ro technology can use several types of load carriers (trailers, cassettes, boxes) leading to difficulties.

Navigation technology: Different technologies for navigation and communications are available, here the systems used onboard ships must correspond to the systems used in the ports. The development of equipment to be used onboard must match the development of equipment to be used in ports, thus utilising available resources and increasing efficiency and safety.

Communication and information systems: New information and Communication Technologies (ICT) make it possible not only to exchange information concerning navigation and traffic regulations, but also provide information on precise arrival times, load plans and information about the cargo such as supplier, content, means of continued transportation, final destination and receiver. With this information available, the port operators can better plan and prepare the unloading and transshipment, increasing efficiency and improving results.

Port container handling: Several attempts are currently being made to increase capacity and efficiency in port operations. One way is to automate the handling of containers either from the unloading or to the loading of ships (ACC), including ground transportation (AGV, RCH) and storage (RCH, WS). Also, systems for the inward and outward flow of containers are being developed such as warehouse systems, rail transshipment systems, and barge container transshipment systems. These systems will increase the flow and make loading and unloading to and from different carriers more efficient. So, for the ship, the turnaround time (terminal time) will be reduced.

Identification of new organisation and management concepts successfully used in other industrial sectors and consideration of their transferability to the ports environment.

The WORKPORT Consortium initially carried out a literature survey to identify the main new organisational and management concepts successfully used in other industrial sectors. A long list has resulted and is presented in the respective deliverable (WORKPORT Del. 2). Next their transferability to the port sector was considered by means of a Delphi study among experts, within and outside the WORKPORT Consortium. Furthermore, the application of these concepts was considered in the port case studies. The main concepts considered in this exercise were:

Lean production. Even though Lean Production is a way of organising mass production in a cost efficient manner, many of the ideas stemming from it can be applicable to a port e.g. Lean thinking, dependability, flexibility, waste elimination.

Just in time (JIT). JIT is a reality in manufacturing industry today and ports must adapt to this fact; if they do not, the potential for them becoming a bottleneck in the transport chain is high, and customers of a port that does not adapt appropriately will probably choose another route for their goods. JIT, when adopted by manufacturers can have a big impact on the work performance in a port. The demand for rapid and

reliable handling of cargo creates stressful working conditions and increase the risk of accidents among workers as well as wear and tear on goods.

Kaizen. Meaning incremental, frequent, continuous improvement in all aspects of working life, as a concept seems to be applicable in the ports' environment but small-group activities (e.g. Quality Control Circles) must be performed during normal working hours and not on voluntary basis after normal working hours (as in its original application in Japan).

Value chain. A products value chain is the series of activities that create or add to the product value which the customer pays for. The concept is applicable to the port environment but by applying it management can obtain a clear picture of the company's business activities, identifying the primary and support functions of the provided services.

Total quality management (TQM) is a strategic integrated management system, which involves all managers and employees using quantifiable methods to continuously improve an organisations processes, to meet and exceed customer needs, wants and expectation. Its philosophy seems to be highly applicable in the port environment.

Business Process Reengineering (BPR) is a fundamental rethinking and radical redesign of a business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed. There is no direct reason for BPR not to be applied in ports but its important to realise that as many as 70%-80% of the companies that try to apply BPR do not succeed in re-engineering the process. The SPHERE project results, if appropriately utilised, may reduce the risk for port applications of BPR.

Virtual company. A virtual company or corporation consists of a network of independent organisations or professionals, each with an experience within a respective area of expertise, cooperating to achieve what none of them could possibly achieve alone. Considering the way ports are structured and work one can find many analogies with the above definition but a significant difference with a virtual company is the fact that human labour is used in ports. There is no explicit wish or intention to achieve a totally automated chain of transportation or a totally automated flow. Concerning the flow of information, though, between different actors, one can find analogies with the virtual company concept and possibly utilise it there.

Anthropocentric Production Systems (APS). The concept can be defined as forms of advanced, computed aided manufacturing, which are dependent upon human skills, collaborative work organisation and adapted technologies. Different obstacles have been defined in its application in the European industry; however, the principal idea of letting human beings have a central role in work, and solving problems by developing and using the human potential must be of high interest to ports.

Learning Organisation. A learning organisation can be understood as an enterprise that focuses on the continuous improvement of its processes, products, and services; that facilitates the learning of its members, both individually / independently and as groups / teams; that continuously transforms itself in order to meet its strategic goals. The applicability of the Learning Organisation concept in ports has to be verified carefully before its introduction. Benefits can be seen especially for periods of the management of technological and organisational change. Within ports it can be supposed that the efficiency of work in management and port development could be increased by Learning Organisation concepts.

Outsourcing is the replacement of internal resources of an enterprise by external resources. In a port environment services can either be provided by public port authority or by private port operators. In both cases outsourcing is a possible option.

Strategic Alliances and joint ventures. Strategic Alliance /Joint Venture is a term used to characterise structural organisation of enterprises, which join together human, financial or technical resources or know-how in a unit involving two or more partners. General socio-economic impacts of Strategic Alliances cannot be indicated. They depend of the characteristics of the Strategic Alliance e.g. on the kind and degree of co-operation, on its objectives and on the organisational changes which accompany its implementation.

Occupational Health and Safety Management Systems (OHSMS). Occupational Health and Safety Management Systems, OHSMS, are management frameworks, specifically tailored for the Occupational Safety and Health. In recent years several countries have developed national standards for the implementation of OHSMS. They are partly inspired by the ISO 9000 and TQM developments. The spirit of European work safety directives and their implementation has also driven the efforts in respect of this in national regulations.

The cooperative Resource Management for Transport of Unit Loads

This concept is used in order to ensure a smooth transition at the road/sea interface by establishing procedures for operational cooperation within and between companies in the transport area.

Main trends in today's ports and new challenges to be met

WORKPORT has reviewed the factors for change in ports and the response options available, identified the future demands that the ports have to face and also considered how the new organisational forms can help them to meet future challenges. These issues are now summarised and discussed.

Current status in European ports

In Europe, ports are an important part of the logistic cargo transport chain. Ports have also changed from places of cargo exchange to functional elements of the total logistic chain. Also, the services that ports provide for the port users have expanded. The provisions of sufficient and appropriate warehousing and storage areas are examples of the services provided today. Besides this, ports need to establish new communication systems to ensure effective loading and unloading of the ships, flexible handling of the customs activities, and safe operation with minimum environmental impacts.

Public-Private partnerships in ports

Privatisation of ports assets is under discussion in many European countries with seaports. The role that the private sector can play in seaports differs but trends show that many of activities carried out by municipal or state organisations are being transferred to private sector. There are many potential negative outcomes if privatisation is not implemented efficiently, since it is a radical port reform. In many cases, a public-private partnership in ports is more appropriate than total privatisation since it can bring similar benefits to the port and its users with fewer risks of failing to meet business and social objectives.

Organisational and management changes

The need for organisational changes in ports is due to several developments. The need for increased effectiveness is one reason, but also rapid technological development creates the need for the redefinition of work methods and practices. Often the

organisational changes affect all organisational levels; the role and tasks of line-management, supervisors, and the dock workers are thus redefined.

Safety in ports

Ports are one of the most dangerous working environments. Lost workdays due to an accident or injury can be up to 70 % higher in ports than in other industrial sectors. There are several reasons for this. Firstly, ports are workplaces where a lot of potential accident sources are present. Despite increased automation, work in ports still includes a lot of manual handling of loads. Work is also done in various weather conditions; in the dark, in the rain and in wintertime. Secondly, ports have only recently started to implement systematic safety management systems.

Environmental issues in ports

Environmental issues have been high on the agenda in international forums during the past 7-8 years. Environmental awareness of port and harbour operations is taking on a consistently higher profile as the port sector responds to the challenges of new and evolving legislation aimed specifically at environmental protection. The ESPO's environmental Code of Practice and several EU funded research projects have contributed both to policy development and effective implementation methodology. Recently, several organisations have introduced environmental protection schemes and initiatives for ports. These include MARPOL, which provides the principal international legislative control over ship pollution within and outside ports. The OSPAR convention from 1992 is another attempt to limit environmental pollution. Besides this, much of the legislation produced by the European Union can be described as pure environmental protection legislation. As with safety management, also environmental hazard management should be a company driven activity. Systems like EMAS and the ISO 14001 are applicable starting points for developing a company's environmental management system.

Future demands

The future demands that ports will need to face include external factors like new legal requirements, commercial developments and new technological innovations. In Europe, the majority of legislation will be produced within the European Union. The EU regulations and directives concern many port activities, for example, trade, safety and environmental issues. Future commercial development is more difficult to estimate. Economic growth has been high in the latter part of 1990s, but it may not continue. Furthermore, the tendency of trading nations to form blocs whilst promoting trade within the bloc can be a threat to wider international trade, and thus to ports which engage in global trade.

Future technical environment in ports

The technical environment in ports will continue to change. The interface between land and water, transshipment of goods, interaction between the different transportation systems, services provided around goods as well as telematic and information services are the most important areas where the new technologies will be used. The technology will include both new transport systems and new information and communication systems. Often these two systems are developed hand in hand. New transport systems like Automated Guided Vehicles (AGV) or Automated Stacking Cranes (ASC) include a lot of information technology. Piloting is another activity that will benefit from the new information and communication technology.

For example, it is probable that VTS and its modifications will become standard solutions for maritime traffic management problems. Furthermore, the use of uniform data exchange systems between different port operators, like shipping agents, port authority and customs office, improves effectiveness and the quality of port services.

Future organisational forms

As was stated previously, many of the technological innovations require profound changes in the management and organisation of ports. This trend is going to continue, and most probably more rapidly than before. Many European ports have started to implement new organisational forms to manage technological developments better, and to be able to meet the challenges of the world market and national and international regulatory controls.

From the point when a new organisational concept is introduced, it can take 3-5 years before most of the employees have committed themselves to the new way of working and thinking. Furthermore, new effective organisations need qualified and well trained personnel. The skills that workers have today may not be adequate to meet the demands of new organisational concepts. This must be taken into account when, for example, training schemes are planned.

Identification of socio-economic impacts of the introduction of new technology and new organisational / management concepts.

WORKPORT has developed and applied a methodology for a structured research into the socio-economic impact of the organisational concepts and technologies applied in ports.

The assessment methodology consists of different elements in order to discover and integrate the opinion of people working in the port about the impact of new technology and new organisational concepts on the port's working culture. These elements are:

- Stated Preferences Analysis (SPA);
- Multi Criteria Analysis (MCA); and
- The Social Impact Questionnaire

In order to test the practical applicability of the developed assessment methodology, the WORKPORT project partners conducted a number of trial interviews using the Social Impact Questionnaire and SPA. Based on this input, the WORKPORT Consortium performed a MCA with the help of "Qualiflex"¹. This trial impact assessment was based on 53 interviews with port workers and port managers in the ports of Kotka (Finland), Rotterdam (the Netherlands), Thessaloniki (Greece) and Immingham (United Kingdom).

The methodology that was developed for a structured assessment of the impacts of new technology and new organisational concepts on the port working culture has proved to be sound and suitable for this type of research, and thus can be used for further research in this area. This is important, since not much research has until now been done in the field of assessing socio-economic impacts on the port environment.

¹ "Qualiflex": A multicriteria Analysis tool developed by NEI

The assessment methodology has been shown to be useful in gathering information about this subject directly from the people working in the port area. Moreover, recommendations have resulted from this exercise to improve this assessment methodology for future use.

Case studies in six ports to identify the applicability of new organisational concepts.

In this part of the project the research objectives were:

- To analyse the existing situation in the case study ports with respect to technological, organisational/managerial change;
- To examine the effects of these changes in working practices and the organisational procedures, focusing, in particular on health and safety, and the environment;
- To define possible barriers to the application of new technological and new organisational/ management concepts; and
- To define possible threats and opportunities in various application environments.

The case studies were conducted at the ports of, Rotterdam (The Netherlands), Immingham (United Kingdom), Gothenburg (Sweden), Kotka (Finland), Thessaloniki (Greece) and Duisburg (Germany). For the successful fulfillment of each case study interviews with port experts, managers and workers from the various departments in the port authority and in port based companies were conducted using a questionnaire developed as part of the WORKPORT project. This questionnaire was drawn up so as to analyse how the main companies in different ports deal with the adoption of new technologies and new organisational/management concepts. To analyse the changes in the working culture in ports, use was made of the assessment tool that was described in the previous section.

The main findings of this empirical research were:

- ◆ The *human element* is the key to all successful managerial and organisational change in ports. Not paying proper attention to the employees first may result in the transition effort ending in total disaster. *Work empowerment*, however, will involve the workforce in the decision making process and in the development of innovations and is thus likely to lead to successful change.
- ◆ *Team spirit* cultivation among the employees in ports will give port management the opportunity to fully integrate the workforce in the transition process and will result in an improvement in internal communication and will influence developments in all aspects of every day work.
- ◆ *Education and Training* of the workforce especially in computers and information technology is a catalyst in many change processes.
- ◆ *Commercialisation* is essential if a port is to develop and compete against other successful ports.
- ◆ The introduction of new technology in ports should be accompanied by

organisational change. This change is possible with the use of new management concepts.

- ◆ The *public-private partnership (p.p.p.)* is a very promising change allowing two companies, one public and the other private to operate at the same time with different status within the same port area.
- ◆ *Legal awareness* in terms of environmental, health and safety and employment legislation helps port management to avoid exposure to great risks and liabilities.
- ◆ *Management accountability* improves port management and leads to healthy and viable development.

The Transition Process in European Ports.

The WORKPORT Consortium has derived a schematic model, which describes how the European port industry has evolved since the 1960s and identifies key factors and milestones in this transition process. The model, which is largely based on the findings of the WORKPORT research, also indicates a number of important continuing trends. The WORKPORT Consortium initially considered the widely known UNCTAD 3 port generation model and tried to revise and extend it. But, following extensive discussions among the partners it finally rejected the notion contained in the UNCTAD model that the evolutionary process can be best described in terms of successive port generations each with its own well defined set of characteristic features. This is because of the difficulty of deciding which features determine whether a port belongs to a particular generation category, a process that is subjective and rendered virtually impossible by the fact that all ports are, to some extent, unique.

The WORKPORT schematic model describes in detail the transition process and its main phases for European ports. However, it should be noted that not all European ports have followed these phases because they are affected by different external factors.

An appropriate strategy for implementing and managing organisational change is described in the literature. This model, which gives structure to the change process, involves the following sequential steps, namely,

- identifying the need for change,
- goal setting,
- analysis of the possibilities to begin the change process,
- choice of implementation methods,
- implementation, and
- follow up.

Its application to ports has been considered in examples derived from the port case studies of WORKPORT. Although the examples differ from each other, they illustrate both the problems arising from organisational change and how these problems may be resolved, thereby identifying the factors that are likely to lead to its successful accomplishment.

Education and training for port workers to facilitate transition

The use of technology and the changing nature of general port work require thorough practical skills and in some cases theoretical knowledge.

There is a need for an appropriate updating of port workers' education and qualifications, which has been increasingly recognised during the past 10 years in most European countries. As various port surveys interviews and personal experience have testified, the integration and co-ordination of training initiatives are of fundamental importance.

Some main results – observations resulting from the case studies, as well as from the Stated Preference Analysis, concerning Education and Training of port workers are:

- The requirements for education and training that the introduction of new technology and new organizational concepts have imposed are accepted and considered by ports.
- Ports make provision for training and education of newly recruited employees
- Most training is provided on a demand - led basis.
- The most often used method in training is 'on the job' training.
- The need to include safety and health issues in the education and training activities has been identified and in most cases taken account of.
- Environmental policies in most ports are creating greater environmental awareness among employees.
- New organizational concepts, where implemented, do not address the training and education issue in a systematic way.
- New technology is rarely used for training.
- There are no standards for qualifications and minimal co-operation with other bodies (government, educational institutions, other ports, training providers)
- Port workers attach more significance to the level of training and education they require, than do port managers. This difference may account for the lack of training provision in new organisational plans of many ports since such plans are designed and imposed by the port's management.
- There seems to be no direct link between education and training and career development and job rotation (multi-skilling). It has been stated, though, that education and training is a prerequisite to multi-skilling and is closely related to career advancement. However, both workers and, to a greater extent port management have rated career development as being more important to the port workers' job satisfaction than training and education.

Ways to promote European Port Education and Training, and therefore plug the present gaps in the schemes that have been identified include:

- EU level standardisation and certification.
- European level networking and co-operation.
- Utilize lessons learned from other Industrial sectors.
- Promote best practice examples.
- Increase cost effectiveness of Port education and training provision schemes.
- Mobilisation of European funds dedicated to training.

Main conclusions and observations

- There is an increasing diversity of port related activities.
- Among the European ports there is a preference for developing/ upgrading existing technologies rather than developing new technologies because of the financial risk attached to the latter.
- Successful technological change needs to be supported by organisational change in the ports.
- The main barriers for the application of new technologies and organisational concepts are acceptance on the side of the workforce, and conservatism, lack of planning (short-term investment strategies), lack of financial means and lack of education on the side of the management.
- Legislation, public opinion and cost advantages are the driving forces in the implementation of Environmental Management Systems in ports. The approach is currently to encourage compliance with high standards through voluntary self regulation.
- Compliance with environmental standards is best served by partnership between legislative and self regulatory approaches because of the inherent diversity of port characteristics. EU legislation needs to be applied uniformly in order not to distort competition.
- Health and safety and environmental management are becoming increasingly integrated. This is especially true of the management of risk with reference to both the workspace and the wider environment.
- Education and training of port workers needs to be further enhanced especially when new technology and/or organisational concepts are introduced.
- The type of employees that will be willing to work in a port in the immediate future is not expected to change radically.

Further research

In the WORKPORT project a methodology has been developed for the structured assessment of the impacts of new technology and new organisational concepts on the port working culture that has proved to be sound and suitable for use in further research in this area. This is important, since not much research has until now been conducted in the field of assessing socio-economic impacts on the port environment.

Best practice with respect to the implementation of new technologies and new organisational concepts has been studied in six European ports in the WORKPORT project. It is recommended that best practices in other European ports is also studied in order to establish a network for the exchange of best practices between different European ports.

3. Project Objectives

The project's main aim was:

“to assess the impacts of new technology in the port work environment and to consider the application of new organisational and management concepts to meet new demands for ports”

- To identify main new technologies used in ports and shipping in sea as well as in inland waterways and also their interaction.
- To consider the applicability in relation to the ports' environment of new organisational and management concepts successfully used in other industrial sectors.
- To identify new organisational and management concepts for ports and new challenges to be met by new organisational forms.
- To identify the main impacts of new technology on the human factor and more specifically, on safety at work, on social environment, on qualification education and training demands.
- To analyse current training practices, consider possibilities for improvement and identify future training needs for port workers.
- To define best practice examples from the 6 case study ports examined.
- To propose strategies for the introduction of new organisational and management concepts facilitating ports transition.

4. Means used to achieve the objectives

4.1 Means and techniques used

The project has followed a clearly specified workprogramme including 8 main workpackages split in 26 activities. Seven main contractors and one subcontractor participated, of which four Universities, two consultancy companies, one research centre and one cooperation agency, from 7 EU countries.

In order to achieve the stated objectives the WORKPORT consortium used the following means.

1. Literature Reviews
2. Consortium meetings
3. Delphi surveys
4. Questionnaire surveys
5. Net meeting
6. Organisation of two workshops

4.2 Methodology followed

Figure 1 outlines the methodology and main project stages followed.

Initially three reviews were taken place in parallel to produce “state of the art” findings concerning:

- New technologies under introduction in ports and shipping
- New organisational and management concepts successfully used in other industrial sectors for transfer to the ports environment
- Existing and new organisational and management concepts for ports.

An appropriate tool has been adopted and adapted for the assessment of socio-economic impacts of the introduction of new technology and new organisational and management concepts for ports.

In parallel case studies in six selected European ports have been made to examine in detail, how new organisational methods, new technologies, and new challenges are applied or faced by them.

Immingham (U.K): The case study ports are: The east coast’s busiest Ro-Ro port, fully privatised, applying among others interesting techniques concerning environmental management.

Duisburg (D) Europe’s largest inland port combining several sea port functions.

Thessaloniki (GR) A port of high importance to the Balkan hinterland (import – export) undergoing now a major restructuring.

Gothenburg (S). The largest port in Scandinavia where innovative work organisation methods are applied.

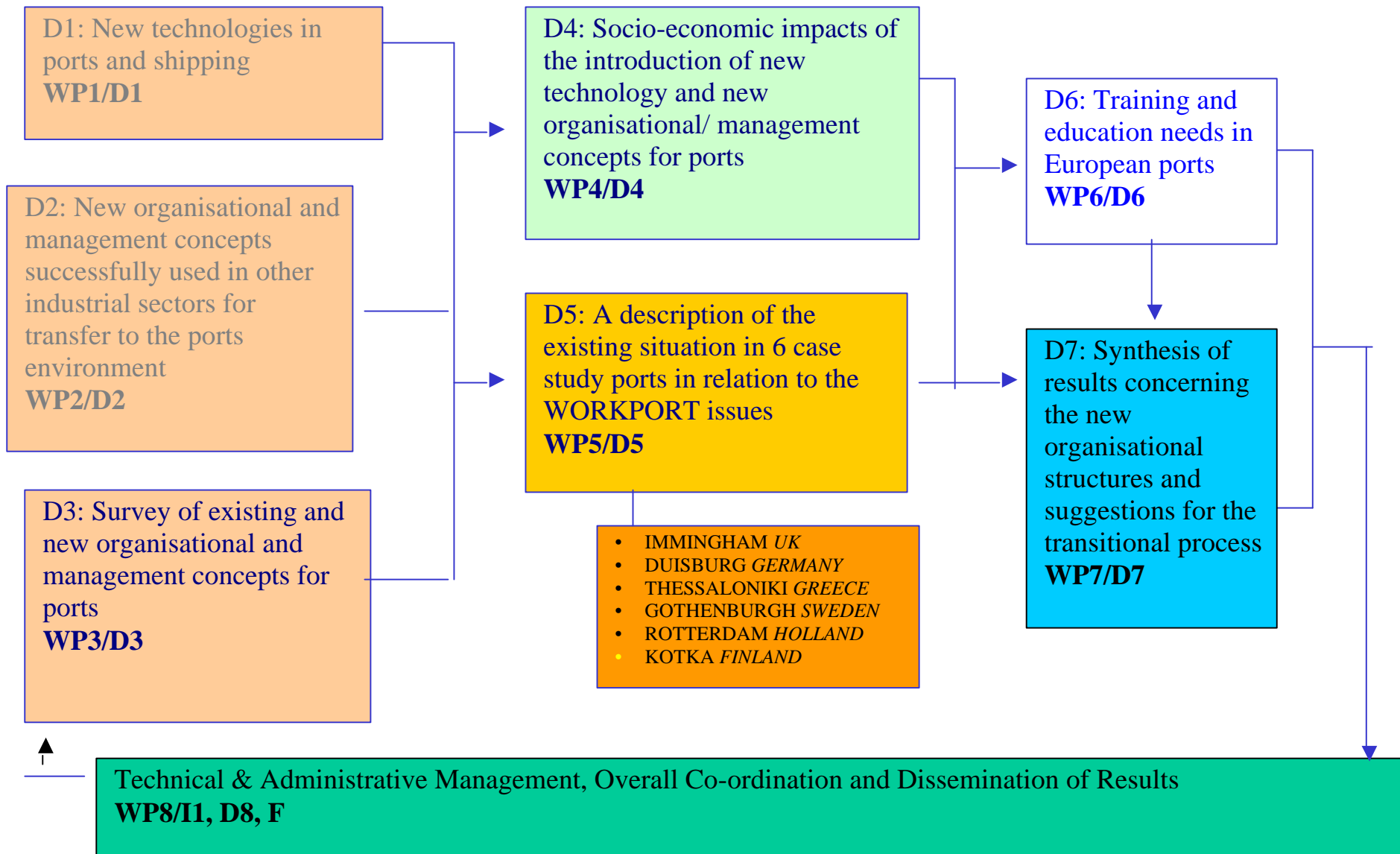
Rotterdam (NL). The largest port in the world and 4th in container handling, applying innovative organisational methods and new technologies.

Kotka (FI). A major transit port for goods shipped to Russia and other Eastern European countries applying innovative work organisation and environmental management methods.

Results of both the socio economic impacts assessment as well as of practices followed in the case studies, together with results of literature review were used to examine the issue of education and training for port workers.

Evidence from case studies was also utilised to describe the port industry transition process and also strategies for implementing change in ports.

Fig. 1 WORKPORT Methodology and main project stages



5. Glossary of Terms used

Accident	The realisation of a hazard.
Automation	The process of replacing human labour for machinery.
Autonomy	The right to make decisions regarding processes.
Cargo handling	The way cargo is loaded and unloaded.
Cause	An event, possibly of a little significance in isolation, providing an important link in the chain of events leading to an accident.
Commercialisation	Any measures by which a greater private sector perspective is introduced into a previously public sector enterprise.
Communication	Exchange of information.
Consortium	A group of companies working together on certain projects.
Corporatisation	The transformation of public organisations into private sector companies of which the government holds the shares.
Deregulation	The retraction of restrictive regulations.
Economic crisis	The period when the economy of a country or region (EU) is faced with high inflation, high unemployment and decreasing demand for goods and services.
EDI	Electronic Data Interchange: a communication and information system to enhance the flow of information along with the movement of goods.
Efficiency	The most convenient, useful and practical way.
Ergonomic design	The design of equipment in accordance with the mental and physical characteristics of operators.
External factors	Factors that have influence on a process but are not part of the process itself.
Globalisation	The trend of spreading the production of parts and the assembly of the product over various countries for cost and efficiency reasons.
Hazard	A condition with the potential to result in an accident or commercial loss.
Hinterland	The region “behind” the port, where most of the products are transported to.
Human Factor	The study of how humans accomplish work-related tasks in the context of human-machine system operation, and how behavioural and non-behavioural variables affect the accomplishment.
ICT	Information and Communication Technology: the technology to facilitate and improve the flow of information and communication.
Individualism index	An index reflecting the relative importance of the individual compared to the group.
Job rotation	Regular shift of jobs between employees within a company.
Job satisfaction	The extent to which employees derive satisfaction from their job.

Just-In-Time (JIT)	The production process in which the input is continuously processed without stopping. No buffer stock is created.
Labour pool	A collection of employees which remain under contract with a company, even in times when there is no work for them.
Lean Production	The production process with the least loss of time and the highest total quality for the costs incurred.
Liberalisation	The process of allowing the private sector to provide the same services as the public sector.
Logistics	The whole process of the physical distribution of raw material, finished and semi-finished products through the entire production process.
Masculinity index	An index reflecting the relative importance of masculine aspects in a society compared to feminine aspects.
Mental work demand	The relation with the perceptual-cognitive demands of monitoring the technical systems.
Modality	Way of transport.
Modernisation	The upgrading of the company to modern standards.
Monopoly	The market situation with only one supplier of a certain good or service.
Multi Criteria Analysis	A method to make comparisons between qualitative and quantitative data.
Multi-skilling	The ability to perform different tasks.
New technology	A technology that has recently been implemented and/ or is expected to be implemented to a larger extent in the near future.
Organisational reform	Improving the organisational structure.
Outsourcing	The production of parts of the product by other companies.
Physical conditions	Physical burdens, such as noise, working outdoors and lifting heavy goods.
Power Distance index	An index reflecting the relative distance between people who have power and people who have not.
Qualiflex	A computerised Multi Criteria Analysis.
Privatisation	The shift from a state-owned company towards a company in private hands.
Standardisation	The creation of specific standards/ rules or order of procedures to perform a process.
Social Impact Question	A questionnaire used to find out about the relation between elements of the working culture (socio-economic indicator) and new technological and organisational developments.
Social Impact Table	A table used to indicate the relation between elements of the working culture (socio-economic indicator) and new technological and organisational developments.
Stated Pref. Analysis	A method, which facilitates the ranking of alternatives.
Strategic Alliance	The co-operation between companies on certain parts of the production process in order to reduce costs or increase efficiency.
Subsidisation	Financial aid by the government.

Total Quality Mgt.	A strategic, integrated management system, which involves all managers and employees and uses quantitative methods to continuously improve an organisation's process to meet and exceed customer needs, wants and expectations.
Uncert. Avoidance index	An index reflecting the way in which people in a society react to new, uncertain or unknown experiences or situations.
Virtual Company	A co-operation between companies in order to produce one specific good in which each company is responsible for only one part (their core business) of the whole production process.
Working culture	Socio-economic indicator: Combination of elements that determine the job satisfaction in the port.
Working culture elements	Elements that determine the working culture, for example: physical conditions, working time, autonomy, etc.
Working time	The amount of hours worked by the port worker, sometimes containing night shifts.
Workload	The psychological appreciation of the amount of work that has to be done by a person.

6. Scientific and technical description of the project

1. Introduction

1.1 Background

Sea and river trade constitute a significant proportion of the internal relations within the European economic area. Economic exchange with bordering regions (for example large parts of Africa, the Black Sea countries, and in the North the inhabited areas of the Baltic Sea) is also carried out to a large extent on waterways. The ongoing international integration into the global economic framework ensures that shipping connections continue to be of importance world-wide. The significance of sea ports as links connecting sea and land trade is crucial.

The capabilities of the European ports are primarily determined by the standards of qualifications, how work is organised, and investment in infrastructure. Their functionality is secured within the scope of entrepreneurial initiative by their inclusion in policies on a regional, national and European basis.

The introduction of new technologies in ports is expected to have positive impacts for economic development on a global scale. Their introduction though requires appropriate assessment of their impacts prior to their implementation, appropriate organisational restructuring, if necessary and careful monitoring, when applied. The port sector is rather a follower in relation to other industrial sectors. There are many management techniques and organisational forms applied successfully in other industrial sectors of which the port sector could benefit. Identifying the appropriate methods and techniques appropriate for application in the port sector is a challenge. Every port is rather unique but it is of common interest across Europe to explore variations in the way that ports face challenges, organise work, utilise new tools and ideas, implement new technologies in order to identify good practice examples and consider their wider applicability.

The port industry is changing, but it is interesting to know how this transition process takes place in various ports, what strategies could one apply for facilitating transition, how one can learn from the others and utilise their experiences.

1.2 Work content

The ports involved in the case studies represent examples of European ports of different size, level of technology implementation, organisational structure, ownership status, working practices followed. In order to establish a common basis of data collection and comparison a detailed questionnaire was established. Results of the case studies and best practices identified are presented mainly in chapter 6 of this report but they are also used to support issues discussed in other chapters. The main new technologies under introduction in sea ports, as well as in inland waterways ports were identified and their interaction with shipping are presented and discussed in chapter two.

Numerous new organisational and management concepts are used in other industrial sectors successfully. A review of them has been made and their applicability in the port sector was examined employing expert judgement via the Delphi technique. The main results of this exercise are presented in chapter 3.

In chapter 4 main trends in organisational and management concepts for ports are presented together with the main challenges to be met by them, defined by the WORKPORT experts.

The identification of impacts resulting from the introduction of new technology and the new organisational structures is presented in chapter 5. Initially an overview of identified impacts is presented, next the development of a socio-economic assessment methodology and finally the results of the application of the assessment methodology.

In chapter 7 a model developed by WORKPORT describing the transition process in ports is presented and next the issue of strategies to implement transition together with examples from the case studies.

The issue of education and training for port workers is discussed in chapter 8 where existing practices and also emerging requirements are defined.

Finally, main conclusions and suggestions are presented together with suggestions for follow up work.

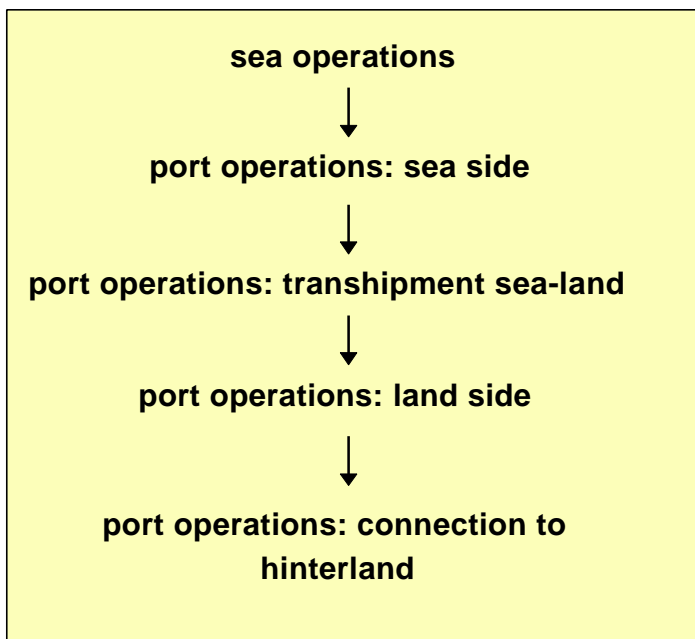
2. Introduction of new technologies in ports and their interaction with shipping.

2.1 Overview and categorisation of new technologies in sea ports area

For the whole project, the important notion of new technologies is defined as technologies that have recently been implemented and/or are expected to be implemented to a larger extent in the near future. The WORKPORT project concentrates on the new technologies that are expected to have an impact on the working culture in ports.

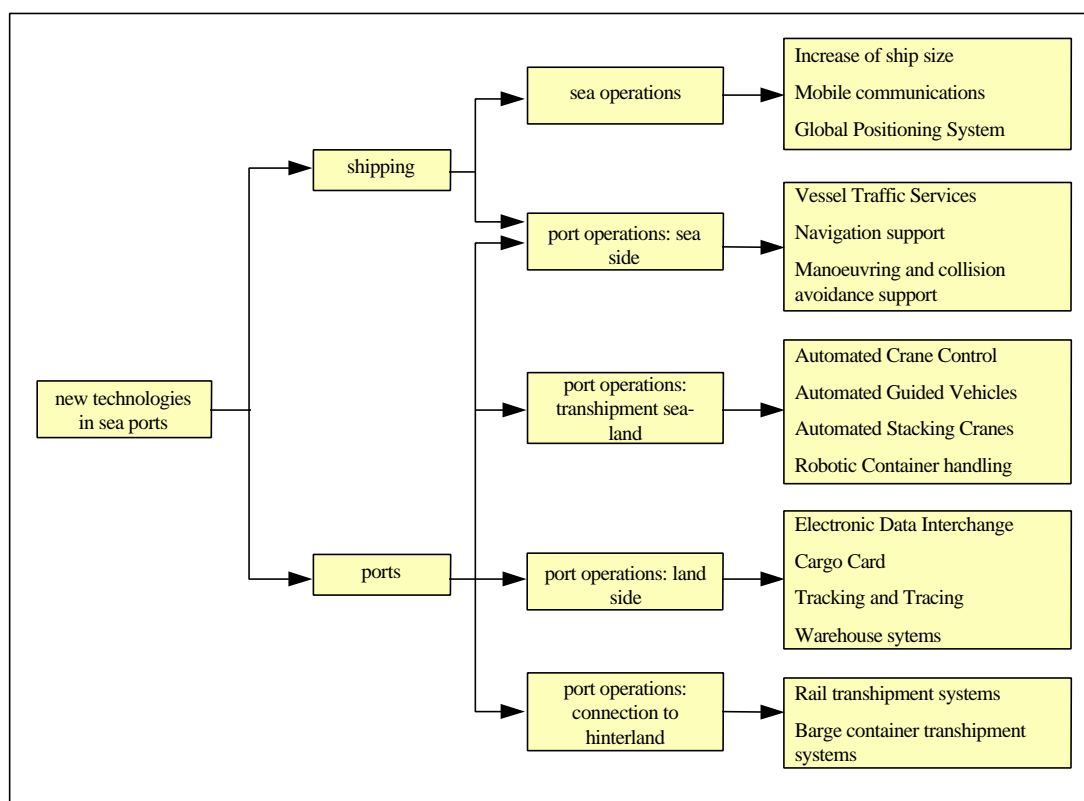
New technologies, influencing operations in the port sector, are for the purpose of this study divided into five main areas, based on the sequence illustrated in table 1. The sequence reflects the part of the chain of transport that is relevant for operations within the port sector.

Table 2.1: Main areas of new technologies



An overview of new technologies in seaports is presented in table 2.1. A first separation is made between technologies in shipping and in ports. Since the main focus of this study is on ports, new technologies in shipping are only included when influencing port operations. An example is the increased ship size, to which the ports have to adjust their operations, infra- and superstructure.

Table 2.2: Application of new technologies in sea ports



Based on the first categorisation in shipping and ports, a sub-categorisation is made in the main areas. For each sub-category, a number of relevant technologies are listed. It should be noted that some technologies, such as mobile communications and Electronic Data Interchange (EDI), are not limited to one sub-category.

The new technologies listed in table 2.2 above are to a large extent container oriented. Container transport is developing at a very fast rate and so are the container oriented new technologies. Container transport shows dynamic developments and therefore this study focuses on that sector.

2.1.1 Sea operations

In the sub-category sea operations, the increasing ship size is enlisted because of its complementary effects on infrastructure, e.g. depth of waters and number of berths, technical equipment, such as gantry cranes and straddle carriers and the operations in the port, e.g. minimum waiting time in the port. Potential impacts on the human factor resulting from that development are the reduction of personnel on board single ships and in the total fleet. However, no significant education or qualification requirements arise from it and the human well-being of the staff is not supposed to be affected.

Mobile communications and Global Positioning System (GPS) is included here because through those technologies, operations on sea are no longer isolated from operations ashore, rather they merge to a combined and co-ordinated action. While both will not lead to any major changes in the number of people employed, the quality

of jobs is definitely affected by the introduction of mobile communication: extensive user training is required to make maximum use of the new technological possibilities. Increased job satisfaction by improved communication possibilities can be expected as well as working improvement for the planner. Experiences show that GPS does not simply replace bridge officers but is rather used by them as an assisting work tool in fulfilling their tasks. New qualifications related to the use of this system connecting different agents in the sea and land area have to be acquired by the users. As a reliable navigational system it will increase the safety of the crew on board and help avoiding accidents.

2.1.2 Port operations, sea side

In port operations: sea side, Vessel Traffic Services (VTS), navigation support and manoeuvring and collision avoidance support are included because of their effect on port operations on the one hand and safety and pollution control on the other. If VTS is used as a traffic control system the role of the port pilot needs to be reconsidered, thus leading to changes of the role of the pilot and necessitating training of operators both ashore and on board. Navigation support systems lead to a reduction of the number of personnel while at the same time requiring new qualifications from the employees, e.g. working with electronic charts. This will reduce navigational workload and thereby increase the safety on board. The manoeuvring and collision avoidance support presents a step in the process towards integrated bridge systems - and One-Man Watches (OMW). Enriched tasks require a broader qualification and will increase the safety on board, too.

2.1.3 Port operations, transshipment sea-land

In port operations: transshipment sea-land a number of new technologies are introduced in order to improve port performance. Automatic crane control (ACC), used to tranship containers from ship to shore, is not used on a frequent basis yet. Automated Guided Vehicles (AGV) and Automated Stacking Cranes (ASC) are more frequently used in order to move containers from the quay to the stacking yards. Robotic Container Handling (RCH) is another concept to automatically tranship containers. All those semi- or fully-automated transshipment technologies will reduce the number of quay operators and stacking workers employed in that area up to now. The remaining tasks will mainly consist of handling and controlling these machines, making job redesign and training on those technical systems a prerequisite for their successful implementation. The detachment of the remaining staff in the transshipment area from the physical procedure increases the job safety and working conditions there.

2.1.4 Port operations, land side

In the sub-category port operations: land side, EDI, Cargo Card, Tracking and Tracing systems are examples of new technologies making use of new information technology to improve performance in the port. Warehouse systems are included as a cluster of new technologies related to automated processes in (port) warehouses. All of these innovations will reduce the number of staff required and demand for changed qualifications according to the technical systems used. The EDI rather reduces repetitive jobs; increases job satisfaction by more interesting work contents. The cargo card has proved to eliminate one "social" element in the work community. Tracking and tracing systems reduce possibilities to make certain errors, contributing thus to more efficient and cost-saving procedures. The introduction of warehousing

systems reduces on the one hand conventional jobs involved in warehousing activities, but creates some new, task enriched jobs on the other hand, requiring new qualification to manage complex warehouse systems. Experiences have shown that these systems reduce accidents and thus improve the working conditions for the people employed in that area.

2.1.5 Port operations: connections to hinterland

In the sub-category, port operations: connection to hinterland, the floating container 'pick-up' and new technologies used in Rail Service Centre, such as computer navigated loading machine, are examples of new technologies designed to improve the interaction between different modes of transport and the transshipment to the connecting modes to the hinterland. Rail transshipment systems are responsible for a more efficient working to capacity of transportation means, thus time and transport costs can be reduced. Through the automation of the transfer process, the number of personnel involved in the transfer process of containers is expected to decline. Advanced training is required to work with the new systems and higher qualified personnel might be needed. Though the barge container transshipment systems need to be manned, employment at the terminal and in intra-port road transport may decrease. Special training on those systems is required and inland waterway vessels will spend less time in ports.

2.1.6 Information Technology

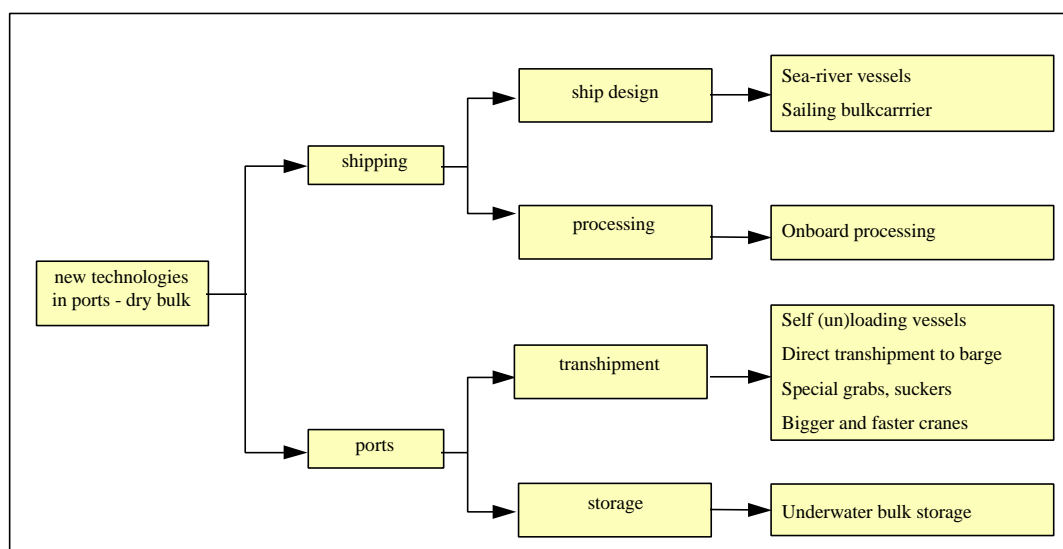
What is stated below is true for both, the sea and the inland area, so it will just be stated once at this place.

There is general consensus that information technology will play a more and more important role in all main areas of ports and shipping. The implementation of information technology may create new jobs on the one hand, may eliminate jobs by standardisation of work processes on the other. Newly created jobs in connection with information technology may be characterised by a special demand in training. With the constant rapid change in this field of technology, the corresponding training of employees needs to be reconceptualised as a life long process of learning. Only then, it can remain flexible and be ready to meet the changing demands of the labour market. General stress caused by use of information and communication technology, well known in other branches, can be expected.

2.1.7 Dry bulk area

Because of the importance of the cargo category 'dry bulk', a separate paragraph is required to deal thoroughly with this cargo's implication for technology in ports and shipping. Based on the main categorisation of new technologies in ports and shipping depicted in table 2.2, a new modified table 2.3 extends as a branch of the former graphic and depicts the technological developments regarding 'dry bulk'.

Table 2.3: New technologies in the dry bulk area



In the shipping area, the following technological developments are topical:
 Ship design-type of ships: in the dry bulk sector, developments in ship design and new types of ships are not as dynamic as in the container sector. This is a general development, which is not just related to ship design but also other areas, notably transshipment.

A number of interesting developments have taken place or are in the making. Examples are newly designed (manoeuvrable) pushing convoys, wider ships with less draught for special waterways and sea-river vessels. A reason behind the introduction of new concepts is the minimisation of transshipment time in ports to thereby to reduce costs. In addition, scale increase in inland waterways plays a role.

More examples of new ship design are the sailing bulk carrier and the cassette ships. The concept of the sailing bulk carrier more or less speaks for itself. Advantages can be found in fuel savings and the minimisation of pollution. Disadvantages are the increased construction and operational costs. The feasibility of the concept is currently being studied. The cassette ship is a more concrete case, which is briefly presented below.

The cassette ships are part of a new developed logistical concept in which cargo is transported and transhipped on large cassettes. The system is developed by the Swedish company SCA for the transportation of paper, but the system can in principle be used for all types of cargo. With the use of small cars, the cassettes can be transhipped at a very fast rate. The cassettes are able to carry weights up to 70 tons.

Processing: on board processing ships with cargo processing capabilities on the ship. An example is the BIBO (bulk in, bags out) concept, in which the cargo on board the ship is bagged. On arrival in the port, the ship can be discharged through an automated system.

In the port area the following technological developments are topical:

Transshipment: in general, many new developments in transshipment are triggered by the fact that in comparison with the costs of actual transport, the transshipment costs are too high. This also applies to dry bulk cargo, but to a lesser extent than to container transport. As a result, a number of new developments can be seen, e.g. bigger and faster cranes, systems making use of special grabs and bobcats together with conveyor belts and bulldozers, cranes on ship to attend very small ports with little infrastructure, direct transshipment from deep sea ships to inland waterway vessels, and special containers for dry bulk and waste transport.

In the transshipment process of dry bulk, e.g. for grain, the problem of clogging of the cargo is partly overcome by crushing the cargo in the discharging process. Covered conveyor belts prevent dust pollution.

Storage: in general, the storage of dry bulk has not changed extensively through the years. However, increased demands on the quality of the cargo and the ability to measure the quality of cargo, i.e. in parts per million (PPMs), lead to increased storage requirements. This development has led to conditioned sheds and silos, in which temperature and humidity can be kept at a constant level. In addition, covered terminals for steel and iron terminals are constructions to protect the cargo from oxidation.

A very specific and innovative new technology within the field of storage of dry bulk is underwater storage of especially coal and ores. A cost-saving system has been developed that has a potential to save valuable land storage space. The system is based on the use of a basin in which cargo is stored. The transshipment to and from the basin is conducted through a hydraulic system and a conveyor belt.

The introduction of (semi-)automated transshipment systems, such as conveyor belts, elevators and excavators results in a reduction of the number of personnel required in the (un)loading process. By not making a stop at the seaports, sea-river vessels obviously have an impact on the required labour in the port.

Another important aspect regarding the number of labour required for transshipment is the fact that quite an amount of break-bulk cargo nowadays is transported in containers. With this process, the labour intensive break-bulk cargo is replaced with container cargo, resulting in a strong reduction of required port labour.

As a result of the trend of having work that is normally done in the port carried out on board the ship, the need for port related labour partly disappears. Examples of this phenomenon are self(un)loading vessels and on board processing, replacing port activities (transshipment and packaging).

New transshipment techniques may require a new type of port worker. The traditional, heavy labour, porter type of work might disappear and be replaced by a type of work for the operation of (semi-)automated systems, requiring more skills and education.

As in all sectors, the introduction of new technologies in the dry bulk sector will only be effective if the port workers know how to operate the new systems properly.

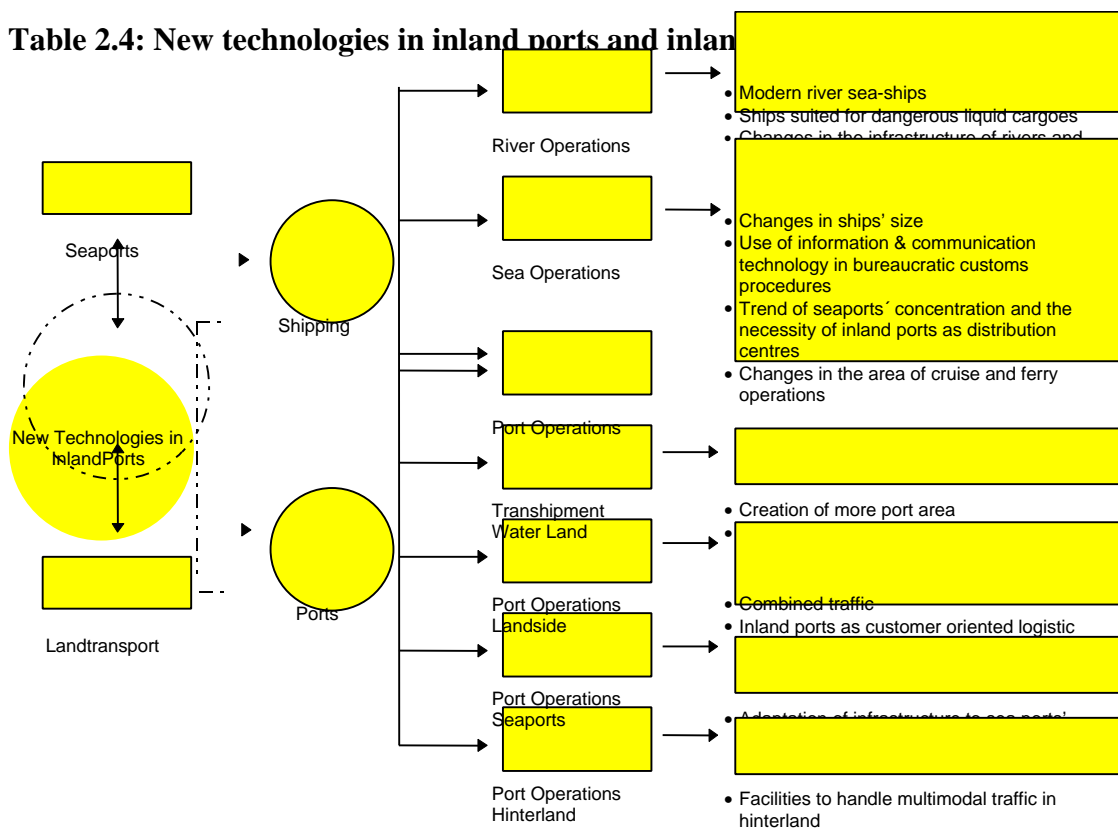
Therefore, training programmes need to be developed in order to teach and train the workers how to use the systems.

In the dry bulk sector, pressure on the entire chain of transport is increasing. The port workers need to operate in a more flexible way.

By automating parts of the transshipment process, the heavy physical labour will be partly replaced, especially in the field of break-bulk. As a result, the number of health problems will be reduced. In addition, safety and security on the workplace will improve as a result of a more and more organised transshipment and stacking process.

Dust related problems, for example in the transshipment of grain, are tackled by making use of covered conveyor systems. This obviously has a direct impact on the health of the workers involved in this process.

Table 2.4: New technologies in inland ports and inland shipping



2.2 Overview and categorisation of new technologies in inland waterways area

In table 2.4, an overview of new technologies and developments in inland ports and inland shipping is presented. Although the main focus of this study is on the ports' environment, new technologies in shipping are included whenever they have any significant influence on port operations. An example is the increased ship size, which requires infrastructure adjustments from ports.

2.2.1 Port operations, water side

In the sub-category *river operations*, the modern river-sea ship is enlisted because of its technological innovative status. It is equally well equipped to handle sensitive high-tech cargo as well as dangerous liquid cargo, categories of cargo of growing importance in inland waterborne transport. Accordingly, ports have to provide storage and transshipment facilities of the same quality. Infrastructure changes of rivers and channels allow for a wider range of ships' sizes, and demand thus corresponding adjustments at ports. This development will lead to the loss of low qualified jobs; manual work will be replaced by the use of machines. A need arises for specially trained personnel on board to fulfil the enlarged and enriched jobs. Generally the systems become more complex, thus the responsibility of the workers grows.

In *sea operations* the change in ships' size is enlisted because of its requirements on port infrastructure. In this section, the developments and changes in the whole area of cruise and ferry operations at seaports are also added. Furthermore, in this category, one special field of application for information technology, the bureaucratic customs procedures in international transport is included.

The trend of concentration of seaports directly affects the inland ports, which have to serve as distribution centres guaranteeing the distribution of goods to the hinterland. New jobs in the broadened offer of logistic services will be established, with changed qualification, increased service mentality and orientation and more complex tasks working together with many partners to facilitate multi-modal transports.

2.2.2 Port operations, transshipment water-land

In *port operations: transshipment water-land* there is one main trend concerning ports' infrastructure, that is the creation of new port area. This is connected with the necessity to improve the sea-shore interface in ports. In which way this development and innovation will directly affect employment, qualification needs and the well being of the workers cannot be estimated.

2.2.3 Port operations, land side

In *port operations: land side* the most important and far reaching change for ports is their adaptation to a role as modern customer oriented logistic service centres. Though in many ports already more or less established facilities for combined traffic will remain very important in the future. They have always to be kept on a high level technologically to handle different vessels of transportation adequately. New jobs are created by new services; also some loss of jobs can be foreseen by rationalisation and standardisation of procedures. New qualifications such as customer and service orientation and the ability to use information technology will be more and more a prerequisite for any kind of job in this area.

2.2.4 Port operations, sea ports

In the sub-category *port operations: seaports* an extensive description of the necessary infrastructure adjustments of inland ports to seaports' requirements is given. For the human factor no direct impacts can be estimated from those measures.

2.2.5 Port operations, hinterland

In the last sub-category, *port operations: hinterland*, all kinds of facilities and technologies to improve the interaction between different modes of transport and transshipment to the connecting modes to the hinterland are presented. They involve a number of innovations in terms of transferment technologies as well as information technologies, all of those requiring changed qualification and training of the employees. In general, a consciousness of the whole process of transport along the chain has to be developed by the workers in order to co-operate successfully and flexibly with all the partners in the chain.

2.3 Interaction between new technologies in ports and shipping

For the analysis of the possible interactions between new technologies in ports and shipping, the technologies mentioned have been grouped in the way shown below.

➤ **Ship technology**

- Increase of ship size

- Increase of ship speed

- Lo-Lo (containers)

- Ro-Ro (trailers, cassettes, boxes)

An increased ship size leads to operational problems in ports. The water depth must be sufficient, and the width of the navigational passages and turning space must be enough to accommodate the larger size and the decreased manoeuvrability of the ships. Also, larger berth length is required as well as larger cranes with sufficient width and possibly new method to control the cranes (positioning guidance, automation). The system that is used onboard the ships must of course match the system that is used by the port equipment and the system must be standardised in-between ships and ports. The much larger number of containers per shipload puts requirements on storage areas and speed of transshipment and hinterland connections. The larger storage areas lead to increased travel time if intermediate storage and retrieval cannot be made more efficient. It will be necessary to start the transportation of the cargo from the storage area before the ship is fully unloaded. This in turn requires that full information on where a special container is at a certain time is available to the planners of the port-side operations.

An increased ship speed leads to shorter turnaround time. That in turn can put requirements on the port capacity, but the number of ships is a more important factor. If an increased speed shall be maintained close to the port, this puts demands on the navigational support systems so as not to endanger safety.

Container transport, that is lift on lift off handling, is dominating over roll on roll off handling. While the container is heavily standardised, the Ro-Ro technology can use several types of load carriers (trailers, cassettes, boxes). The principles and the equipment for handling and stowing onboard must be adapted to the equipment used for the port operations. The larger variety of load carriers leads to difficulties.

- **Navigational Support**
 - Global Positioning System
 - Vessel Traffic Services
 - Manoeuvring and collision avoidance support
 - Other navigation support systems

The purpose of the navigational support systems is to increase the precision of the control of a ship's course, position and speed. At sea, the captain of a ship is fully in charge, but when approaching a port, the navigation is taken over by a pilot. When the traffic volume in the port vicinity increases, it becomes necessary to regulate the traffic flow and then the control must be taken over by the port authority. For this different technologies for navigation and communications are available as outlined in the studies' fourth chapter. Here the systems used onboard ships must correspond to the systems used in the ports. The development of equipment to be used onboard must match the development of equipment to be used in ports. The overall purpose is to utilise available resources better and increase efficiency and safety.

- **Communication and Information Systems**
 - Mobile communication
 - Electronic Data Interchange
 - Cargo Card
 - Tracking and Tracing Systems

The communication and information systems used in transportation have different purposes. New Information and Communication Technologies (ICT) make it possible not only to exchange information concerning navigation and traffic regulations, but also provide information on precise arrival times, load plans and information about the cargo such as supplier, content, means of continued transportation, final destination and receiver. With this information available, the port operators can better plan and prepare the unloading and transshipment. In this way, the handling can be made flow oriented with a shorter storage time and increased efficiency as result. Similarly, it will become possible to increase also loading efficiency and consider the unloading order in the next port already when loading the ship. In order to accomplish this, each container must be uniquely marked. It is also necessary to have a system to keep track of each container as long as it is in the port area or onboard a docked ship.

- **Port Container Handling**
 - Automatic Crane Control
 - Automated Guided Vehicles
 - Automated Stacking Control
 - Robotic Container Handling
 - Warehouse Systems
 - Rail Transshipment Systems
 - Barge Container Transshipment Systems

Several attempts are currently being made to increase goods handling capacity and efficiency in port operations. One way of contributing to this is to automatise the handling of containers from unloading and loading of ships (ACC), ground transportation (AGV, RCH), and storage (RCH, WS). Also the inward and outward

flow of containers is being considered and different new systems are being developed such as warehouse systems, rail transshipment systems, and barge container transshipment systems. These systems will increase the flow and make loading and unloading to and from different carriers more efficient. For the ship the turnaround time (terminal time) will be reduced.

Another way is to aim for an increased flow orientation of the handling operations. This means that when a container is unloaded it should be on its way to its destination as soon as possible. Correspondingly, when a container has arrived it should be placed in intermediate storage as soon as possible, in such a way that the loading of the ship with the containers in the right order can be done without further marshalling. A result of this is shorter storage times and reduced need for container storage areas.

The success of these efforts relies heavily on the availability of effective systems for communication and information processing. Irrespective of whether the container carriers are automated or manually controlled, marshalling and storage can be planned and optimised by means of specially developed computer programmes.

3. New organisational and management concepts successfully used in other industrial sectors and their transferability to the ports environment

3.1 Objectives and definitions of concepts

It is well understood that the port is not just one company or organisation but a network of different companies acting together. There are the port authorities, the port operators, stevedores, forwarders, customs, shipping companies just to mention some of the involved. If different organisational concepts or ideas were to be applied by these different actors the results would most likely be different between the companies. Some of the concepts might even be totally wrong, or impossible to apply for some participants.

In this chapter first the identified main new organisational and management concepts successfully used in other industrial sectors are defined or described in brief. Next their transferability in the port sector is discussed based on the results of a Delphi among experts performed by WORKPORT. Furthermore their application in the port case studies considered is examined in chapter 6.

The objectives of the new organisational and management concepts transfer to port environment are to improve:

- efficiency,
- human factors
- occupational safety
- transport safety
- pollution prevention.

- **Lean Production**

Lean production is a manufacturing principle that identifies value and eliminates waste in manufacturing, improves quality, offers customer responsiveness, and reduces inventory and set-up time. This is achieved by using various techniques, multi-skilled workers, cross-functional teams, integrated communications, supplier partnerships, and highly flexible automated machines – and with a minimum of resources.

- **JIT – Just In Time**

JIT is an approach to improve quality and productivity through the elimination of all waste. It is based on producing only the necessary units in the necessary quantities at the necessary time by bringing production rates exactly in line with demand.

- **Kaizen**

Kaizen means incremental, frequent, continuous improvement in all aspects of working life.

- **The Value Chain**

A product's value chain is the series of activities that create or add to the product value which customers pay for.

- **TQM – Total Quality Management**

TQM is a strategic, integrated management system, which involves all managers and employees using quantitative methods to continuously improve organisation's processes to meet and exceed customer needs, wants and expectations.

- **BPR – Business Process Reengineering**

Business Reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed.

- **The Virtual Company**

A virtual company or corporation consists of a network of independent organisations or professionals; each with an experience within a respective area of expertise, co-operating to achieve what none of them could possibly achieve alone. This sort of arrangement makes it possible for each participant to concentrate on its core competencies.

- **APS – Anthropocentric Production Systems**

The concept can be defined as forms of advanced, computer aided manufacturing, which are dependent upon human skills, collaborative work organisation and adapted technologies. They embody many of the principles of the tradition of human-centred technology design as well as new principles concerning the organisation of work design and reduced division of labour, the unity of conception and execution of work, decentralised decision making and skill enhancing job design.

- **Learning Organisation**

A learning organisation can be understood as an enterprise that focuses on the continuous improvement of its processes, products, and services; that facilitates the learning of its members, both individually / independently and as groups / teams; that continuously transforms itself in order to meet its strategic goals.

- **Outsourcing**

Outsourcing is the replacement of internal resources of an enterprise by external resources. Services, which had previously been provided by organisational units of the enterprise, are instead supplied by an external enterprise.

- **Strategic Alliances and Joint Ventures**

Strategic Alliance/Joint Venture is a term used to characterise structural organisation of enterprises, which join together human, financial, or technical resources or know-

how in a unit involving two or more partners. The benefits from the alliance can be expected to be more successful on the market than if each company acted by itself.

- **Occupational Health and Safety Management Systems, OHSMS**

Occupational Health and Safety Management Systems, OHSMS, are management frameworks, specifically tailored for the application in Occupational Safety and health. They intend to implement the legal regulations in an enterprise or a working facility.

- **The Co-operative Resource Management for Transport of Unit Loads**

This concept is used in order to ensure a smooth transition at the road/sea interface by establishing procedures for operational cooperation within and between companies in the transport area.

3.2 Overview of main concepts applied successfully in other industrial sectors and assessment of transfer effects

Lean production

The main and most obvious thing that distinguishes a port from a factory or a manufacturer is the actual output. A factory manufactures products but a port produces services. Common though is the flow of physical objects. Even though Lean Production is a way of organising mass production in a cost efficient manner many of the ideas will be applicable to a port.

In the book “Lean Thinking – banish waste and create wealth in your corporation”² the author tries to form a vision of what might be possible by giving examples from service providers such as long-distance travel, medical care etc. There will be a need for the organisations that carry the traveller “*to jointly think through the total trip to identify the value stream and eliminate all of the unnecessary waiting, confusion, and wasted steps in order to create continuous flow upon request*”.

Within medical care “*the patient would be placed in the foreground, with time and comfort included as key performance measures of the system*”. There will be a need of rethinking the departmental structure and “*reorganise much of its expertise into multi-skilled teams.*” In order to do this “*the skills of nurses and doctors would need to be broadened.*”

These thoughts by the author indicate that it should be possible to apply ideas of Lean Thinking in the port environment.

Issues like dependability, flexibility, waste elimination and quality will affect the ways of how to perform work. The involvement of everyone will have an impact on the work organisation. The layout of the port should promote the smooth flow of cargo etc.

² Womack, J.P. & Jones, D.T., *Lean thinking: banish waste and create wealth in your corporation*, Simon & Schuster, New York, (1996)

JIT- Just in time

The question is probably not if this concept can be transferred to the port environment or not. JIT is a reality in manufacturing industry today and the port must adapt to this fact. If not, the potential of becoming a bottleneck in the transport chain is high, and the customers of the port will probably choose another direction for the goods.

One thing for sure is that the JIT concept, highly adopted by manufacturers will have a huge impact on the work performed in the port. As previously mentioned some of the demands of JIT were speed, dependability and avoiding non-value-adding processes such as waiting-time and transportation. This will of course affect the traffic of goods from and between suppliers, manufacturers and customers. The need for fast and reliable transports from point A, which passes through a port will force the port to work quickly and efficiently when loading and unloading cargo, in order to make the total transportation time as short as possible. (This could be expressed as “creating a “seamless” supply chain”.)

This rapid handling of the cargo creates a stressful work condition and it increases the risk of accidents among workers as well as damaging the goods.

Kaizen

There is no obvious reason why the concept couldn't be transferred to the port environment. In Japan the use of small-group activities, such as Quality Control Circles are performed on a voluntary basis, after normal working hours. This principle has always been problematic or even impossible to implement outside Japan and the port is probably no exception to this. This means that small-group activities must be performed during normal working hours.

Value chain

The concept is valid for all sorts of business activities and could therefore also be applied to the port environment. The concept should be of interest to the port management in order to obtain a clear picture of the company's business activities.

By using for example the Value Analysis method, it should be possible to find the primary and support functions/activities of the provided services. Awareness of these will result in necessary, if needed changes of the functions/activities. The ability to allocate appropriate resources to the functions will also enhance.

Total quality management (TQM)

The philosophy of TQM should be highly applicable to ports. Offering 24-hour operation would be one way of applying customer focus. Introducing work teams, responsible for the goods from arrival to loading would be another, since the customer could deal with the same people all the time when following up the cargo. To give increased responsibility in the lower ranks of the organisation would be an example of empowerment.

Business Process Reengineering (BPR)

There is no direct reason for BPR not to be applied in ports but as always with this concept it's important to remember the fact that as many as 70-80% of the companies that try to apply the theories of BPR fail. The yield is high for those who succeed but the risk of failure is enormous. The choice of improving an existing process or create

a new one must always be done by considering the costs, the need of improvement and the risk of failure.

Another problem to consider is how and when to implement totally new operations in a company that works 24-hours a day? The operation functions of the company have to go on uninterrupted at the same time as new procedures are introduced and established.

An assessment of specific effects is almost impossible to do but the least one should expect is increased efficiency.

Virtual Company

If a definition of a port was to be made the one given for the Virtual Company would be very appropriate. The port is already a network that consists of different actors, working together achieving what none of them could achieve alone, in this case to make it possible for goods to be transported from land over seas. But going as far as calling a port a Virtual Company would probably not be correct. One significant difference would be the transfer of the vision of “The Unmanned Factory”. It is true that the port is using a lot of equipment that automates work and corollary reduces the involvement of manual labour. Within ports this is highly evident in the area of container handling technology. The reason for using this equipment is to improve performance, reduce lead times, increase efficiency and safety etc. but there is no explicit wish or intention to achieve a totally automated chain of transportation or a totally automated port.

To secure the flow of information between the different actors will be as vital for the port as for the Virtual Company.

Anthropocentric Production Systems (APS)

The development of APS in European industry is still slow and uneven. Examples of different types of obstacles and impediments are:

- ✓ Technology for computer-integrated production often contains a bias towards tayloristic work and firm organisation.
- ✓ Management strategies concerning the application of computer-based production technology are often oriented at tayloristic production concepts.
- ✓ Rigidities in organisations, status systems and wage structures are widespread factors hindering the development of APS.

If these obstacles are found in the port environment the result will probably be the same. However the idea of letting human beings have a central role in work, and solving problems by developing and using the human potential must be of high interest.

Learning Organisation

The applicability of Learning Organisation in ports has to be verified carefully before their introduction. Benefits can be seen especially for periods of the management of technological and organisational change. Within ports it can be supposed that the efficiency of work in management and port development could be increased by Learning Organisation concepts.

Outsourcing

In a port environment services can either be provided by public port authorities or by private port operators. In both cases outsourcing is a possible option.

Strategic Alliances and Joint Ventures

If strategic alliances and joint ventures are to be applied in the port environment it is likely to have impacts as the following

Work efficiency is normally not directly influenced by Strategic Alliances as such, but the implementation process may have impacts on work efficiency as a side effect. Strategic Alliances may also aim at the optimisation of business processes and can by this improve the efficiency of the processes.

On the other hand barriers in co-operation might appear in Strategic Alliances that decrease work efficiency. Unfavourable design of contracts or missing agreements in Strategic Alliances may impair work efficiency as well.

General socio-economic impacts of Strategic Alliances cannot be indicated. They depend on the characteristics of the Strategic Alliance, e. g. on the kind and degree of co-operation, on its objectives and on the organisational changes, which accompany its implementation. Examples of possible socio-economic impacts are:

- As soon as representatives of strategic partners work together at the same work site a new situation in occupational health and safety is created. If the co-operation does not result in changes at work sites an effect will not be observed.
- Strategic Alliances might influence workload. In favourable cases sharing tasks within the alliance can reduce high stress.
- When the alliance include unification of the organisational management system, the effects might be positive. Partners can, for example, learn from each other's safety and health management systems. Very good experiences have been reported from cases where an international, high safety level enterprise has built an alliance with a local, lower safety level company.
- In case joint ventures are part of the Strategic Alliance, the contractual conditions including salaries might change.
- Strategic Alliances with a rationalisation effect can also lead to a loss of jobs, e. g. if facilities are closed, because tasks are taken over by a strategic partner.
- International alliances might require more mobility from personnel and might lead to a national mix at work sites.
- Strategic Alliances might result in new qualification and training demands, among them, for plausible reasons, information and communication technologies and foreign languages.

Occupational Health and Safety Management Systems (OHSMS)

In recent years several countries have developed national standards for the implementation of OHSMS. They are partly inspired by the ISO 9000 and TQM developments. The spirit of European work safety directives and their implementations also drove the efforts in national regulations.

A high impact can be expected on the occupational health and safety system of an enterprise. **Work efficiency** in this specific area is expected to be improved and the occupational **health and safety** standard will increase.

Moderate **socio-economic** impacts can primarily be expected within the personnel, related to safety and prevention. In case the introduction of an OHSMS in an enterprise will lead to a participatory approach to health and safety issues, the whole personnel will be concerned to a certain extent. Especially further qualification and training could be the result.

The cooperative Resource Management Systems (OHSMS)

The need for performing resource management by each transport operation is increasing nowadays. The concept of resources includes trucks for a road transport operator, vessels for a shipping company, straddle carriers in a container terminal and personnel for all areas.

The potential market for introducing Computer Supported Cooperative Work (CSCW) applications in intermodal transport is increasing because the clients require the integration of services. In overseas transport there are up to 20 parties involved in the organization, authorization and management of the transport chain making an efficient cooperation absolutely necessary. This concept has been applied with positive results in the case of the COREM project of DGXIII involving certain port areas.

3.3 Main preliminary conclusions on the transferability of main concepts

Transport safety and pollution prevention

Generally the concepts have no direct impact on the issues of transport safety or pollution prevention, mainly because they are not focusing on these matters. This is true both for the industry and the port environment. However side effects, positive and negative, can occur especially for the concepts of Lean Production and JIT.

- + By not wasting resources a natural result will be less pollution than if the same resources would be used in a wasteful manner.
- Zero time of response and zero inventories might lead to both faster transports and higher transport frequencies. The result will be increased pollution.

Concerning the concepts of Strategic Alliances and Joint Ventures, the possibility of learning good practices from a partner might have a positive effect on transport safety and/or pollution prevention

To assure positive results in the areas of transport safety and pollution prevention, more specific concepts focusing on these areas must be applied. Relevant examples for the port could be

- ✓ ISO 14 000,
- ✓ ESPO's Environmental Code of Practice, or
- ✓ IMO's International Safety Management Code.

Socio-economic impacts

Even if the port is a service company there is no reason to believe that the impacts of the concepts in general will be much different compared to the impacts within the manufacturing industry.

- **Occupational health and safety**
Conditions like efficiency, cost cutting, strong competition, and the impact of JIT have put the time aspect in focus, i.e. work has to be performed at time pressure. If work has to be executed at high speed it could hazard the safety and lead to accidents. The concepts often view the workforce as an important resource. This leads to the attitude that questions concerning health and safety are important and can not be neglected.
- **Job qualification and training**
Characteristically for the concepts is their dependence on highly skilled and educated personnel, independently of position within the organisation. This is a prerequisite for being able to give employees responsibility and ability to act correctly in different situations.
- **Employment**
Conditions like strong competition, responsibility and flexibility not only require highly skilled and educated personnel. It creates a situation where further education and up-skilling continuously is needed. The decision whether to train the old workforce or hire new people with the required education or skills will of course make a big difference for the existing personnel's situation.
- **Human well-being**
The conditions mentioned in the previous point about health and safety also have a potential of creating stressful working conditions. If work constantly will have to be performed with a lack of time and insufficient recourses, the employees will become very stressed and feeling bad.

The notion of giving authority and responsibility can create a situation where the employee can feel enthusiastic about the challenge and become highly motivated. Or he/she can feel threatened by it due to fear of failure, fear of the unknown or simply feeling not qualified.

Implementation

There are a lot of different ways of attacking a change process, it could be by using different techniques or theories. They all emphasise different aspects but yet many of them have common parts such as viewing the company as customer focused, as a value-adding system, as quality focused etc.

When implementing these concepts it's important to bear in mind that there is no right way of doing this successfully in an organisation, due to the fact that each organisation is different, all with various organisation cultures. It is therefore of significant importance that the different concepts and methods are adapted to the

actual company's situation and distinctiveness, not just copied straight off as some kind of magic formula.

Some points worth reflecting on are the following:

1. There must be an awareness of the need of change within the company.
2. Recognise that your organisation is unique. Do not copy someone else's experience.
3. Know your company and your business. If you don't know your present situation you will not be able to measure your progress or develop improvement or change plans.
4. Identify your customers and their requirements.
5. During the implementation phase start small and simple. It's better to do this and get actual results than to start in a large scale and achieve nothing.

Potential barriers for implementation

Possible barriers for implementation could be technical, organisational or could depend on the lack of competence among those who lead and plan the change process.

- ✓ If a change program isn't well rooted within the organisation nor includes co-operation from all involved – the company management, the union, as well as the employees – it could endanger the implementation. Involvement of the employees usually leads to easier acceptance of the changes and it could also reduce the need of training and implementation time.
- ✓ If reorganisation aims at giving employees more responsibility and widened work content – lack of skill and/or sufficient education, training, and knowledge among the workforce could prevent it.
- ✓ Fear of the unknown might lead to resistance against any change.
- ✓ Elder persons in leading positions often have a tayloristic view on work that might prevent giving workers extended authority and overall responsibility for results.
- ✓ Not having a clear objective for the changes, comprehensive as well as broken down in smaller parts for individual groups must be avoided.
- ✓ The fact that people, in time, adapt to the work and working conditions, doing not more nor less than expected. Sometimes this attitude will follow with increasing age, but there will always be individual differences among people. The ability to motivate these people to changes will be crucial and is something that must be dealt with in a change program.
- ✓ Lack of resources such as money, technical equipment, and time in particular could endanger the implementation.

4. Main trends in today's ports and new challenges to be met

4.1 Trends in today's ports

4.1.1 General trends

One of the main current trends in ports is the internationalisation and globalisation of transport. Increasing competition has forced ports to restructure their organisations to achieve more effectiveness. Part of this re-organisation also effects the port ownership. Co-operation between the international port operating companies has created global shipping alliances. Ports have also changed from places of cargo exchange to functional elements of the dynamic logistic chain. A continuing trend is also the containerisation of cargo. Furthermore, the increase of ship size is a trend that sets requirements for the port's infrastructure. Finally, ports are expected to provide several new value-adding services to the port users, including industrial, administrative, commercial, logistic and environmental services.

4.1.2 Private-public partnerships

Nowadays, one of the most popular port strategies for gaining better competitiveness is to expand the role of the private sector in ports. Privatisation means the gradual transfer of management and ownership of basic port functions to private companies. The privatisation can have different forms; it can be based on a simple lease contract or it can include a complete sell-off of port assets and capital to private sector. Privatisation has its benefits and potential risks. The benefits can include better management, reduced port liabilities, improved marketing, and reduced business risks. The negative outcomes of privatisation can include: establishment of a private monopoly, priority given to corporate goals over public service objectives, deterioration of workers' conditions and loss of control of port infrastructure development. Privatisation is a radical port reform and not an appropriate strategy for all types of ports while an enhanced private-public port partnership (e.g. in Irish ports) can bring similar benefits to the port and its users with fewer risks of failing to meet business and social objectives.

4.1.3 Move towards flexibility of employment

A driving force behind the current changes in the socio-economic framework is technology, which is creating new applications that enable a redefinition of the working environment in ports, affecting amongst others the size and the profile of the labour force. Many port employees can see threats in this move towards flexibility. White-collar employees may see their life-long employment guarantees disappear as their previous status as civil servants disappear with the outsourcing of operations. Blue-collar workers can experience growing short-term employment, "irregular" work, and they might be dismissed more easily under the flexibility-enhancing schemes. However, when we look at the current legislative developments and practices on national, European and international level, many of the negative

outcomes can be proven wrong.

4.1.4 New relationships in management and employment

In many European ports, the traditional professional categorisation is still in effect. However, today's ports are continuously seeking for flatter and more flexible management structures. Besides better effectiveness, it is often argued that these "lean" organisations contribute to better working conditions through personal empowerment, less routine and humanisation. The ultimate outcome of re-organisation depends on how the changes have been managed. The management plays a crucial role, for example in accommodating its employees during and after the organisational re-structuring.

Traditionally, public authorities from various levels have been rather strongly involved in port management, often resulting in inefficiencies and complicated procedures, in particular when several government departments with overlapping and/or conflicting interests have been involved. In today's competitive environment, port authorities and administrations need freedom from politically motivated interventions. Experience shows that fruitful cooperation between a competent public authority and private companies in the port is often a prerequisite for success.

4.1.5 Structural requirements for occupational safety and environmental protection

Traditionally, Trade Unions have sought to protect their members from dangerous practices and unhealthy work environment. On the other hand, the employers and the public authorities have invested in measures that can reduce the amount of sick-days and job-related injuries, and thus the social security payments. As a result, health and safety matters have normally been included in tripartite negotiations, and continue to involve the social partners, even in a deregulated market.

Ports are one of the most dangerous work environments. The Lost Workday Incidence Rate (LWIR) is commonly up to 70 % higher in ports compared to other industrial sectors. The incidence rates also seem to follow the economic trends; the more working hours are done in the port, the higher is the incidence rate. Also absenteeism rates are high in ports; typically double compared with other industrial sectors. Despite of the increased automation, physical working conditions are still inadequate in many work tasks. This can be seen, for example, when the occurrence of musculo-skeletal disorders has been studied among port workers.

The improvement of safety in ports requires several activities. These include better organising of safety activities, improving of the visible work environment, identification of potential hazards, and preparing procedures to emergency situations. At the national level, legislation concerning work environment still differ between the countries. The policies are to a large extent influenced by the individual country's type of industrialisation, which defines the general concept of work and the status accorded to human beings in their work.

Environmental protection issues are of newer date than safety issues. Despite the fact

that movements for sustainable environmental development can be traced back beyond the Industrial Revolution, discussions have tended to involve mainly governments and companies. Additionally, the link between industrial relations and the environment is said to be still in the early stages. It is nevertheless worth noting that environment has been high on the agenda in international forums the past 7-8 years.

The Marine Environment Protection Committee MEPC of the IMO is preparing a "Comprehensive Manual on Port Reception Facilities" based on MARPOL 73/78 for the development of a waste management strategy. The dumping of plastic item into the sea anywhere in the world is now prohibited under MARPOL. All ships of 400 gt and above and every ship certified to carry 15 persons or more must now carry a Garbage Management Plan. In addition, certain port-specific organisations like the European Sea Port Organisation (ESPO) lobby to promote environmental friendly ports and co-operation between port authorities and port operators on health and safety issues.

4.2 New challenges to be met by the new organisational forms

The new challenges that the ports have to face, can be divided into the following categories: 1) external factors, 2) health and safety demands, 3) environmental factors, 4) the use of new technologies, and 5) the new organisational concepts. These are discussed in the following.

4.2.1 Objectives and methodology

The objective of the study was to identify the new challenges being faced by ports and to assess the new organisational concepts required in order for ports to meet these challenges. This was to be achieved through a number of approaches; the initial literature review undertaken was extended; archive material obtained during previous studies was utilised and, information derived through work undertaken with port and shipping companies and port industry representative organisations was integrated.

Within each of the new challenges, there were a number of challenge types, which would be addressed and were to be ascertained during the course of the research. The individual partners who then assessed how compliance might occur and the response options adopted identified the challenge types.

4.2.2 External factors

External demands that ports have to face arise from the legal, regulatory, commercial and technical developments. Today, legislation is to great extent produced in European level, in the European Union, and released as EU Council Directives. Member States then adopt these directives to their national legislation.

The principal factor driving port development has been the expanding trade. During

the post war era world trade has increased enormously as a consequence of economic growth and structural change in economies. More recently there has been a tendency for trading nations to form blocs. These blocs establish common external tariffs for their members while removing trade barriers amongst them, thus creating a regional free trade area. This development promotes the growth of intra-regional trade at the expense of inter-regional trade.

As stated earlier, privatisation is a concept, which is rapidly spreading among ports around the world as they seek to become more competitive. In the UK, the privatisation process of the 1980s and early 1990s left only a handful of ports in the public sector.

The flexibility of the labour market is now a significant factor in many port operations. Deregulation has brought about fundamental and lasting changes in port employment practices and in this context has been as important as privatisation in increasing efficiency within the sector. There has also been a trend towards the abolition of legislation specifically protecting the rights of dock workers. This may include the repeal of collective bargaining rights, changes in social security measures or, as in the case of the UK, the abolition of schemes protecting the employment of the dock worker. This results in a situation where the port can establish its own contractual arrangements.

Finally, the trend towards larger vessels places demands on ports to provide more deepwater berths as well as appropriate land-side facilities to store temporarily different types of cargo.

4.2.3 Health and safety demands

Work and work organisations are changing in all industrial sectors and this also applies in the port sector. New management concepts such as Just-In-Time (JIT), Lean Production, and Business Process Re-engineering (BPR) have been introduced in many ports. These changes will also have effects on health and safety of port work.

The harmonisation of European acts and standards is a development towards better consistency. Article 100a of the Single European Act (1987) requires harmonisation of national legislation. The Article 118a of the Act lays down minimum requirements concerning health and safety at work. According to this principle, Member States must raise their level of protection if it is lower than the minimum requirements set by the directives.

Several countries have experienced improved figures for occupational injuries during the past decade. Fatal accident rates have continued to fall in most countries. However, it seems that the reasons for the decline are attributed to changes in patterns of employment, with movement away from hazardous industries. In many cases there have been no specific safety programmes or safety activities. However, improvements in other areas, for example implementation of quality management systems, have a positive impact on safety. Besides this, the reduction in accident rates is closely tied to economic trends. The lower the accident rate, the higher the unemployment rates. For example, when more people are unemployed, fewer accidents happen.

It should also be discussed how the current global developments affect health and safety. These developments include increased unemployment, concerns over job security, precarious employment, part-time and temporary work, the move from larger to smaller business units and changes in management style. For example, it can be argued that when the unemployment rate is high, only the most skilled and experienced workers are employed, and this would decrease the accident rate. On the other hand, when work is done with minimum number of workers, the physical and mental workload of a single worker is higher than normally, thus increasing the probability of accidents and injuries.

The technical changes in ports can be related to mechanical technology, including machines and equipment, and to information technology, including the communication and supervising technology. It can be assumed that the use of these new technologies will have mainly positive effects, and that the negative effects can be minimised or avoided with careful planning of the implementation of these technologies.

Automated transport systems will very probably decrease the rate of accidents and musculo-skeletal disorders. Also, transport systems where the worker can sit most of the work time in a cabin probably decreases this type of accidents. On the other hand, introduction of any new technologies, including automation, can cause unwanted mental load to workers. Often this load is due to lack of information on the effects of the new technology, including uncertainty of the employment and fear of the ability to learn new skills. The management can reduce the unnecessary fears by giving adequate information on the future changes as early as possible.

The introduction of new technical systems may also raise questions relating to the quality of the workforce. Ageing of the workforce is a major problem in the whole society. The average age of workers in the "traditional" industrial sectors is very high, often around 50 years. The advantage of experienced workers is that they are familiar with their work. On the other hand, they are not as capable of undertaking physically demanding tasks as younger people. Another problem with the older members of the workforce is that they may be less willing to change their working methods. In a world where work organisations, work methods and tools change continuously, older workers require special attention.

A main difference between ports and many other industrial sectors is that the ports' environment is continuously changing. This puts great demand on health and safety actions in ports. Many vessels arriving in ports are not in satisfactory shape and this causes extra actions and even hazardous situations for port workers.

Effective control of health and safety hazards requires that a company has adopted a systematic safety management system. Defining the company's safety policy is seen as the duty of the top management. Many of the safety activities can be and should be delegated to lower levels of the organisation. Identification of the hazards at work is often seen as the duty of every person working in the company. Audits, on the other hand, should be expert judgments although the auditor can be external or internal to the company.

In other industrial sectors, especially in chemical, oil and metal industry, safety management systems with effective audit procedures have been common for several decades. In ports these activities have not been very systematic. As a result of this, accident frequencies in the best industrial branches are relatively low compared to port companies. However, there is no reason why ports should not reach high level of health and safety. The general safety management principles, presented e.g. in the BS 8800 standard are very applicable also in ports.

4.2.4 Environmental demands

It is inevitable that both port companies and the operators within ports will be faced with direct environmental considerations in their day-to-day operations. Port operations have water column, land based and airborne impacts. A wide range of impacts from land, sea and atmospheric sources can affect the water quality within the port area. The issues that should be considered include dredging, disposal of the dredging material, port development, ship discharges, ship repair and maintenance, waterfront discharges, spillage, and river input. The land-based impacts are created through the utilisation of land for port operations. These include the various everyday port activities as well as the waste disposal activities. The principal forms of airborne pollution are noise, air quality and light.

Environmental legislation at international level is developed by bodies such as the UN and its subsidiary organisations and in the context of Europe and the EU. The United Nations Law of the Sea Convention, which entered into force in 1994, contains many provisions, which are the accepted starting point for more detailed discussions occurring within the IMO. The IMO is responsible for developing international and regional environmental conventions in respect of the protection of the marine environment. At an international level the MARPOL convention is the most important while at the regional level the OSPAR convention is of most relevance.

New approaches to the management of environmental concerns and initiatives are derived from a number of sources. These include national and international standards and regulations, technological development, and the need for increased efficiency. If ports are to meet the environmental objectives, they will need to develop management systems in which environmental goals are set and where continuous monitoring is undertaken to ensure that the objectives are met.

Environmental awareness of port and harbour operations is taking on a consistently higher profile as the port sector responds to the challenges of new and evolving legislation aimed specifically at environmental protection.

Although the environment in a number of guises has always been of the utmost importance to ports, it is only in recent years that the sector has been able to formalize its policies and embark on a programme of action. This has largely resulted from structural changes within the sector and particularly the formation of the first EU member states' independent port sector representative organization, the European Sea Ports Organisation (ESPO). Until the setting up of ESPO in March 1993, port affairs had been handled by port representatives working jointly with the Commission without the benefit of an independent organization funded and organized by its

members. ESPO has allowed ports to establish their own policies based on day to day operational experiences.

One of the first actions taken by ESPO was to set up an Environmental Committee whose initial task was to write an environmental Code of Practice (ESPO, 1994). This was published in December 1994 and combined recommendations on a management approach with targets and objectives for priority areas such as monitoring, dredging, port planning and development and emergency response plans. The Code had to take into account the remarkable diversity of the port sector. For example, it has been estimated that ESPO represents the interest of over 700 ports, each dealing with environmental problems related to their location, size, type of operations and national and local policies. It was crucial therefore that the Code should take into account this diversity.

The ESPO's environmental Code of Practice and several EU funded research projects have contributed both to policy development and effective implementation methodology. Port management responses now include a variety of organizational, procedural, operational and technical options. A survey of the status and implementation of environmental management responses in 281 ports from 15 European maritime member states confirmed the diversity of port characteristics, the major issues of concern, the resources and provisions currently applied and the challenges still to be addressed (Wooldridge et al., 1998). However laudable the policy statements, targets and objectives, effective management depends on sound science and relevant criteria if compliance is to be confirmed and performance monitored.

ECEPA (Environmental Challenges for European Port Authorities) was established at the same time as ESPO to provide a vehicle for setting up joint environmental research projects between ports from different member states (de Brujin, H. et al, 1997). It has its own secretariat and from a small beginning with only a few ports ready to participate, the latest project (ECO-Information, see below) now involves 50 ports, each of which is contributing to the research. ECEPA has close contacts with the Commission and receives funding from the various framework programmes; in 1997 it completed work on soil recycling. One of the important motivations for ECEPA is removing the element of competition between ports over environmental matters, something demonstrated by the success of projects already initiated.

ESPO's environmental Code of Practice provides :

- A check list of crucial environmental issues and concerns.
- Recommendations on best practice, objectives and targets.
- A basis on which to establish and encourage common policies and procedures, and to promote exchanges of information and best environmental practice.

The Code is endorsed by each delegate member of ESPO and recommends each port to :

- Initiate steps to consider the potential for the improvement of environmental standards beyond those required under legislation.
- Nominate representatives from senior management positions to take responsibility for co-ordinating policy and action within the port's sphere of competence.
- Promote environmental awareness to all those working within the port and all those associated or connected with it.
- Promote regular surveys and appraisals of policies which take into account

of research related to environment, the dynamics of trade and economic, legislative and social trends.

Originally published in a joint English/French version, the Code has subsequently been translated into every Member State language and circulated extensively both within the E.U. and elsewhere.

As a response to the need for some form of quality assurance against which environmental reviews and audits can be judged, and for a method by which environmental management policies can be formulated, environmental management systems and standards are continually being developed and refined. As the first of its kind in Europe, the British Standard BS 7750 -A Specification for Environmental Management was developed in the UK and came into effect in 1992. In Europe the Eco-Management and Audit Scheme (EMAS), which can be supported by BS 7750, was published in 1993 and came into force in April 1995. The newly published ISO 14000 series is now attracting more interest and in complementing its equivalent Quality Management Standard ISO 9000, it provides internationally accepted standards for the implementation of environmental management systems. ISO 14000 does not state environmental performance criteria but requires that organisations control their significant environmental aspects and associated impacts.

Although challenges and problem areas remain, there is a substantial capacity and capability within the ports industry to develop and implement solutions. Resources, both financial and personnel, effective management and training initiatives will be the key factors in further implementation of environmental protection schemes.

4.2.5 Demands due to the new technologies

The international port sector is being challenged by the technological innovations. These innovations change traditional port activities, make some work procedures obsolete and at the same time provide new fields of employment. The interface between land and water, transshipment of goods, interaction between the different transportation systems, services provided around goods as well as telematic and information services are the most important areas where the new technologies and new organisational forms are currently implemented.

To play an active role in the intermodal transport chain from supplier to customer it is inevitable that ports become nodal points for the different modes of transportation. The overall aim of technological innovations in intermodal cargo transfer activity is a standardisation of loading/unloading processes and a standardisation of loading units. This leads to a higher volume capacity with less operating personnel and faster data processing when Electronic Data Interchange (EDI) systems are used.

Technological innovations have also changed the transshipment of dry bulk, though not to such an extent as that of containers. The trend is towards the increased use of (semi-) automated transshipment systems facilities.

The technological innovation in the Roll-On, Roll-Off area are geared towards a higher speed of (un)loading procedures. Together they help to make the ship schedule

more reliable. Usually Information and Communication (I&C) -technology is used to meet this aim and streamline the documentation accompanying Ro-Ro processes.

Some of the new technology induced workplaces will not necessarily arise in the port area. With self-unloading vessels, for example, the possibilities of on-board processing such as bulk in - bag out, traditional port activities such as transshipping and packaging become replaceable and the amount of labour reduced.

A growing trend in containerisation can be observed in the area of general dry bulk. The use of containers set new demands for port facilities, port infrastructure, storage areas and handling device. The modern technology used in container transshipment includes Automatic Crane Control (ACC), Automated Guided Vehicles (AGV), Automated Stacking Cranes, and Robotic Container Handling (RCH).

The services provided for port users have expanded. The provision of sufficient and appropriate warehousing and storage areas is an especially important service for inland ports in their co-operation with sea ports. Information centres for the port's customers is another service customers require today. Active communication between all agents involved in the transportation process improves the process quality. The further processing of transhipped cargo both incoming and outgoing is the most important part of the value-added services at the port's location. The consolidation and breaking, palletising, weighing and (re)packing of cargo adapted to the transport type involved are the most important services around the goods. Provision of up-to-date information on the inventory and cargo movements is also possible with modern technology. Real time information on the location of a product is also an essential part of 'just-in-time' concept. Finally, computer network systems have a potential to allow quick and effective execution of the customs activities.

Many of the technological innovations are I&C based and require changes in the management and organisation of ports. Generally, new technology allows for a better allocation of manpower by improved planning and organisation of technology based work processes. Also, the traditional division between blue and white-collar workers in the ports area will no longer be distinct. The personnel reduction in manual sectors is inevitable, while the remaining jobs in the operative sector will be strengthened by the implementation of the new technologies.

New technologies in ports have also caused a change in qualification and educational demands. The information demands for all processes require from most workers both knowledge of I & C technologies in general and specifically in respect of highly specialised machinery. With a more decentralised organisational structure new communication and teamwork skills will be necessary.

Reduction in the number of hazardous jobs due to increased automation will lead to fewer occupational accidents and injuries. On the other hand, mental stress of the individual worker can increase together with more responsibility assigned.

Modern facilities in the port area help to reduce environmental hazards. The transshipment and storage of hazardous goods has become more secure. Fewer accidents happen, fewer substances escape into air, water and ground. Effective waste control requires that recycling companies settle down in the ports' area and offer

recycling services for all kinds of cargo and products. Finally, when new technologies help to improve the ports' performance and attract new customers, the environmental burden of the street traffic is relieved.

The effect of all the above-mentioned changes in the work environment on the employees depends on the management of the human resources. One central element in smoothing changes and motivating workers under the new conditions is the creation of a company culture based on participation. The so-called anthropocentric production system model has most of the elements that are seen today as keys to successful management of change. Teamwork, flat organisations, holistic work in decentralised structures and the importance of personal contacts among the members of the staff are the most important aspects of this approach.

The profile of customer demands has changed dramatically over the recent years. Modern customers ask for best technological performance. It is the service quality, however, that decides the attractiveness of ports. Devising specific solutions together with and for the customer becomes the most important trait for logistic service providers such as ports in a very competitive field.

Conventional piloting is an expensive, laborious, stressful and even hazardous business and the demands that the pilots understand all new navigation instruments onboard in often strange ships is an almost impossible requirement. VTS (Vessel Traffic Service) system is the standard solution to maritime traffic management and according to the different levels of information and traffic controls included, the VTS systems modifications are called for example; VTMS (Vessel Traffic and Management System) and VTMS (Vessel Traffic Managing and Information System).

VTS utilises ECDIS, ARPA and other modern predictor systems. The Automatic Ship Identification (AIS) and the transponder based data transmission between ships and / or between ships and VTS, give to the decision makers and operators of the system a much clearer and more accurate overall picture of the traffic situation. "Remote piloting", i.e. piloting ships from a shore base is theoretically possible for the first time. The traditional radar based monitoring and predictor systems e.g. ARPA is too inaccurate, especially for tight turns of vessels on the coastal waterways with plenty of interfering factors.

"Remote piloting" requires very accurate data from the ship piloted. Manoeuvring characteristics, professionalism and alertness of the officers of watch are some examples of potential problems in remote piloting. The required information is not easily obtained without a person's physical presence on the bridge. Complete route plans together with ECDIS (or some other electric map system) can minimise the potential problems.

The navigation of ships is increasingly based on the use of DGPS. However, in some circumstances the satellite signal can be totally lost or misleading. In such situations the officers of watch and the VTS operators who have only used the modern systems can have serious problems.

Traditionally, VHF-radios have been the most widely used communication equipment

in marine coastal operations. However, the newer mobile telephones like NMT and GSM are also becoming more common. Computer based systems for choosing the VHF-station according to the best reception at the moment of communication is improving remarkably the quality of VHF-messages. In the most intensive traffic situations the communication overflow can be a problem, leading to that for example ships leaving the harbour or approaching some critical point on the route may not always have the full certainty on what the traffic situation is. Another problem is the multilingual conversations and unnecessary communication. Normally NMT and GSM mobile phone systems do not allow general information to come through. This can, however, lead to a loss of some important information. Moreover, the sensitive electrical equipment on the bridge of the modern ships can in some circumstances be affected by the use of mobile phones.

Pilotnet and portnet are very useful systems but some of their advantages are easily missed. Some ships make reservations of pilots for harbour departures too early (but from the ship's point of view in the safe side of the schedule). This leads to that resources are tied up unnecessarily and, for example, the resting periods of the pilots are missed.

EDI-land, cargo cards and Tracking & Tracing (T&T)-systems are helping greatly in the handling and storing of cargoes and especially in dealing with bureaucracy and documentation. However, the transport of hazardous cargo is even today problematic. The detection, identification and storing of containers containing hazardous cargo according to the rules of the IMDG-code require that nobody along the transport system make any mistakes, intentionally or unintentionally.

4.3 The new organisational concepts

The new organizational concepts described are not necessarily new for the industry as a whole but are new in relation to the port sector. During the 1980s several new production management philosophies were introduced. Earlier concepts like TQM and JIT were accompanied by Computer Integrated Manufacturing (CIM), Kaizen, Benchmarking, Concurrent Engineering (CE) and Lean Production. The philosophies developed and implemented mainly in 1990s include Business Process Reengineering (BPR), the Virtual Company and Anthropocentric Production Systems (APS). In this chapter, a summary of the potential effects of some new organisational concepts on health and safety, the environmental control, the new technology, and the new information technology is discussed

— *In health and safety*

In many of the modern management philosophies, the control of health and safety is, to a large extent, integrated into the other strategic management activities. Especially in the originally Japanese practices, it is typical that health and safety are included in the small group activities performed predominantly at lower levels of the organisation. Other aspects typical to Japanese management philosophies include improvement of employees' skills, systematic collection of suggestions, effective communication, participative leadership style, and the use of automated systems for

hazardous work tasks. Effective and well-controlled organisational and management procedures are believed to ensure besides high productivity, also high level of health and safety.

— *In environment*

In environmental hazard protection, it can be seen that legislative and management aspects will become progressively more integrated in terms of provision and implementation. The port managers themselves see that the amount of legislation and the provisions contained therein are adequate. They also see that they have to work increasingly hard to keep themselves informed of the developments of environmental legislation. Furthermore, it seems that even the partial integration of health, safety and environmental management will have a potential impact on job profiles, responsibilities, skill base of personnel and procedural organisation. Finally, it is likely that training is going to be increasingly significant in terms of better awareness of environmental issues and specific skill areas.

There would appear to be an increasing 'team' approach to port management activity particularly in environmental areas. Training is often 'in-house' and as stated above is seen as being increasingly significant as an effective tool by which to respond to the new challenges.

Improving co-operation and information exchange between the different port operators is also a part of new organisational arrangements. Effective co-operation requires that all port operators use uniform data exchange systems. For example, information on the content of the cargo is needed and handled by the shipping agents, the port operators, the port authority and the customs office. The use of common data networks and compatible software would result in more rapid information flow, less lost data, and decreased need to retype the same information several times.

There are, of course, several ways to build up compatible information systems. The development of EDIFACT (EDI for Administration, Commerce and Transport) has been one attempt to build such an extensive communication system for ports.

— *In new technology*

In ports, there has been a shift towards flatter and leaner structures following the changes that occurred in other industries some years ago. The changes have mainly been generated by the enormous development of modern technologies, mainly computer-based. However, the consequences of this development cannot yet be accurately estimated and there is disagreement among experts about who will be affected by this, in what way and to what extent.

The use of modern I&C technologies undoubtedly simplifies some management tasks and heightens the potential organisational flexibility. Also, capacities can be better estimated and the use of infrastructure and facilities can be better planned.

I&C technology creates new aggregated functions for port employees and demands new professional classifications. Some functions can be outsourced from the

administrative area and shifted towards the operative area. For example, the gathering of information may take place directly at the transshipment facilities.

On the other hand, there is a parallel trend towards bigger organisations. The efficiency orientation of the management could lead to a stronger standardisation of jobs and a rigid task definition for employees. This could lead to a dehumanisation of work with increased routine work at some places and a few multi-task jobs elsewhere. This development can be seen in some work organisations today. If the work force is divided, it can mean, for example that the older workers who are not willing to learn new jobs or work methods have the most simple and boring tasks, while the younger people who are familiar with the new communication and data processing systems have more interesting and diversified tasks.

New information technology supports the implementation of many new organisational and management concepts. Some of the new concepts, e.g. the BPR and Kaizen, are based on the presumption that effective communication systems are available.

In ports, new work organisations can mean that cargo handling teams plan in which order the cargo is loaded into the ship or out of the ship. For this, team members must receive the information on the location of the cargo both in the port area and in the ship. In many ports the location data is already produced using information technology, e.g. GPS based systems. Besides the cargo location data, the team members may need instructions from the forwarder, from the ship or from the port authority. This requires that the necessary communication systems are in place.

The VTMISS (Vessel Traffic Management and Information System) is an example of a system that has a potential to manage all information needed in the port area. The information itself can be transferred using either mobile telephone systems or by using computer network systems.

4.4 Concluding remarks

The purpose of this chapter was to review the factors for change and the response options available. Another aim was to identify the future demands that the ports have to face, and to discuss how the new organisational forms can help the ports to meet the future challenges. These aspects are summarised and discussed in the following.

Current status in European ports

In Europe, ports are an important part of the logistic cargo transport chain. Ports have also changed from places of cargo exchange to functional elements of the total logistic chain. Also the services that ports provide for the port users have expanded. The provisions of sufficient and appropriate warehousing and storage areas are examples of the services provided today. Besides this, ports need to establish new communication systems to ensure effective loading and unloading of the ships, flexible handling of the customs activities, and safe operation with minimum environmental impacts.

Public-Private partnerships in ports

Privatisation of ports is under discussion in most of the European countries having seaports. The role that the private sector can play in ports differs but the trends show that many of activities carried out by municipal or state organisations are being transferred to private sector. The expected benefits of privatisation are the same as in all industrial sectors that have lately been privatised. These include, among others, better strategic management and long term planning of the activities. However, there are also many potential negative outcomes if privatisation is not implemented efficiently since it is a radical port reform. In many cases a public-private partnership in ports is more appropriate since it can bring similar benefits to the port and its users with fewer risks of failing to meet business and social objectives.

Organisational and management changes

The need for organisational changes in ports is due to several developments. The need for increased effectiveness is one reason, but also the rapid technological development creates needs for redefinition of work methods and practices. Often the organisational changes affect all organisational levels; the role and tasks of line-management, supervisors, and the dock workers are redefined. Typically, the changes aim at less hierarchical levels and more flexible use of the workforce. Some traditional jobs are lost due to the introduction of new technologies. Furthermore, the remaining jobs will require skilled workforce, which in turn sets demands for the training of employees. Ageing workforce is a problem, not only in port sector but in all "traditional" industrial branches. In order to keep the older employees at work, special attention has to be put in designing their work and (re)training schemes.

Safety in ports

Ports are one of the most dangerous work environments. Lost workdays due to an accident or injury can be up to 70 % higher in ports compared to other industrial sectors. There are several reasons for this situation. Firstly, ports are workplaces where a lot of potential accident sources are present everyday. Despite the increased automation, work in ports includes a lot of manual handling of loads. Work is also done in various weather conditions; in dark, in rain and in wintertime. Secondly, ports have only in the recent years started to implement systematic safety management systems. Hazard control activities that are well adapted for example in today's chemical industry, are less known in ports. The recently published safety management standards and safety audit schemes used in other industrial branches are usable also in ports.

Environmental issues in ports

Environmental issues have been high on the agenda in international forums the past 7-8 years. In recent years, several organisations have introduced environmental protection schemes and initiatives also for ports. These include the MARPOL, which provides the principal international legislative control over ship pollution within and outside ports. The OSPAR convention from 1992 is another attempt to limit environmental pollution. Besides this, much of the legislation produced by the European Union can be described as pure environmental protection legislation. As with safety management, also environmental hazard management should be a company driven activity. Systems like EMAS and the ISO 14001 are applicable starting points for developing the company's environmental management system.

The future demands

The future demands that ports have to face include external factors like new legal requirements, commercial developments and new technological innovations. In Europe, majority of the legislation will be produced within the European Union. The EU regulations and directives concern many port activities, for example, trade, safety and environmental issues. The future commercial development is more difficult to estimate. The economic growth has been high in the latter part of 1990s, but a downward trend can be seen when we approach the new millennium. Furthermore, the tendency of the trading nations to form blocs can be threat to the international trade, and also to the port industry.

Future technical environment in ports

The technical environment in ports will continue to change. The interface between land and water, transshipment of goods, interaction between the different transportation systems, services provided around goods as well as telematic and information services are the most important areas where the new technologies will be used. The technology will include both new transport systems and new information and communication systems. Often these two systems are developed hand in hand. New transport systems like Automated Guided Vehicles or Automated Stacking Cranes include a lot of information technology. Piloting is another activity that will benefit from the new information and communication technology. For example, it is probable that the VTS systems and its modifications will become standard solutions to maritime traffic management. Furthermore, the use of uniform data exchange systems between the different port operators, like shipping agents, port authority and customs office, improves effectiveness and the quality of port services.

Future organisational forms

As was stated before, many of the technological innovations require profound changes in the management and organisation of ports. This trend is going to continue, and most probably with even higher speed than before. Many European ports have started to implement new organisational forms to manage the technological development better, and to be able to meet the challenges of the world market and the national and international regulatory demands.

The originally Japanese management concepts like Lean or Kaizen (continuous improvement) have been the starting point of many organisational changes in industrial companies, also in ports. These concepts are often usable when their restrictions are understood, and when the management understands that organisational changes require a lot of time. From the point when a new organisational concept is introduced, it can take 3-5 years before most of the employees have committed themselves to the new way of working and thinking. Furthermore, new effective organisations need qualified and well trained personnel. The skills that workers have today may not be adequate in the new organisational concept. This must be remembered when, for example, training schemes are planned.

5. Identification of socio-economic impacts of the introduction of new technology and new organisational/ management concepts

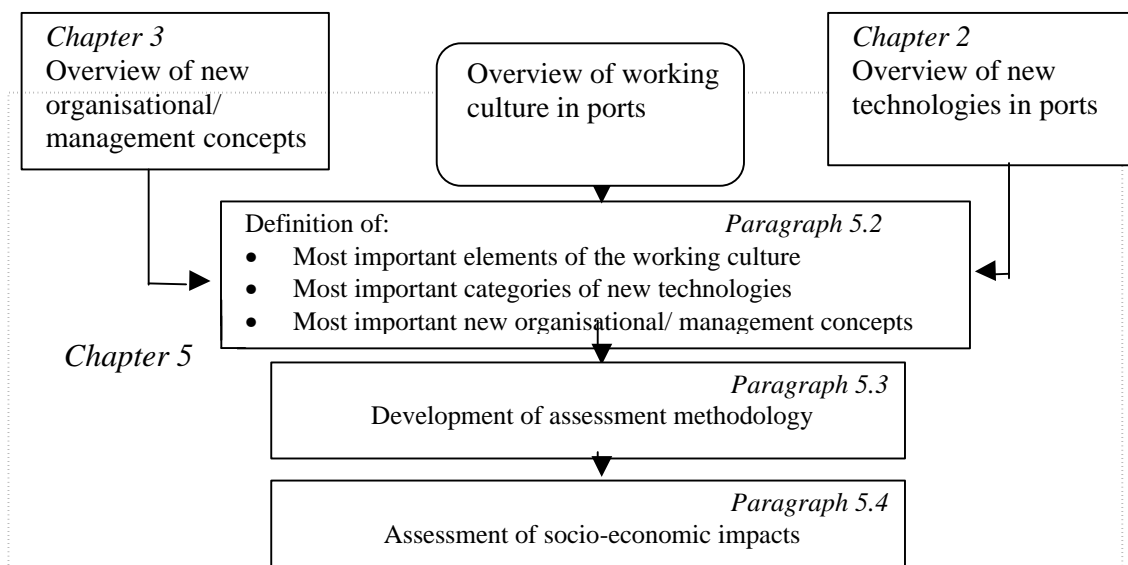
5.1 Introduction

The results of this chapter are based on the original objectives of the research which were:

- To develop an assessment methodology for socio-economic impacts resulting from the implementation of new technology and new organisational concepts in ports;
- To assess the socio-economic impacts of the introduction of new technologies and new organisational concepts in ports.
- Identify the areas where socio-economic impacts of new technologies and new organisations or management concepts can be expected

This chapter concentrates on the development and application of a methodology for a structured research into the socio-economic impact of the organisational concepts and technologies applied in ports. Socio-economic impacts were interpreted as impacts on the (port) working culture as defined in earlier EU research³. The approach used to analyse the relation between new technologies, organisational concepts and working culture in ports, and to develop and apply the assessment methodology is depicted in the next figure.

Figure 5.1 Approach to analyse socio-economic impacts in ports



In chapter 2 of this final report an overview and categorisation of new technologies in ports is given. Chapter 3 focussed on the organisational and management concepts that can be applied in ports. The information of these chapters was used as an input for the definition of the most important categories of new technologies and new organisational concepts in paragraph 5.2 that will be input for the development of an

³ WORKFRET project (1998), project funded by the European Commission under the transport RTD programme of the 4th framework programme.

assessment methodology. The definition of the most important working culture elements is based on a literature review that was made in the WORKPORT project⁴.

Paragraph 5.3 focuses on the development of an assessment methodology that allows a structured research into the socio-economic changes in ports. Finally, paragraph 5.4 contains the results of the socio-economic assessment in different European ports that took place within the WORKPORT project. Also attention has been paid to some other interesting issues that evolved during the WORKPORT research.

5.2 Definition of: working culture elements, new technologies and organisational concepts

5.2.1 Definition of working culture in ports

Based on a literature survey, an overview was made of the main developments with respect to the working culture elements from the point of view of the port worker. This overview was used to define the elements that are considered to have the most direct impact on the port working culture, and that are expected to be influenced by the implementation of new technology and new organisational concepts in ports. The working culture in ports in this project is defined as being composed of these ten working culture elements, that are mentioned below:

- **Autonomy of the port worker:** The autonomy level of the port worker defines his independence in making decisions. In some ports teams with a high autonomy have been implemented. In other ports a foreman supervises the team, so that autonomy of the port workers is less.
- **Mental work demand for the port worker:** The health of the port worker is subjected to psycho-social burdens. Increased automation is expected to result in a shift from physical work demand (carrying out operational tasks) towards passive monitoring of technological systems and an increase in mental work demand. Mental work demand is related to the perceptual-cognitive demands of monitoring the technical systems. Too much mental work demand can result in fatigue and stress for the port worker.
- **Physical conditions in the port area:** The port worker is also subject to physical burdens. Specific physical conditions are noise, working outdoors, lifting heavy goods.
- **Working time of the port job:** An element of employment conditions is the working time in ports. Most European port workers work in shifts. However, in some ports port workers work in full continuous shifts (24 hours a day) and in other ports they work in semi-continuous shifts.
- **Payments:** Another element of employment conditions is the level of payments. Traditionally payments in ports are higher than in other industries. It is expected that the pay system that is based on centralised, clearly defined, inter-administrative and cross-border job descriptions will disappear, because they do not comply with the current needed flexibility.
- **Training and education needs that are required for the port job:** The use of new technologies and the implementation of organisational/ management concepts may result in extra training needs for the people who have to work

⁴ This overview is described in Deliverable 4 of the WORKPORT project

with these new systems and within these new organisational/ management situations. This means that the port worker will be asked to take additional courses/ training.

- **Career development for the port worker:** Included in the career development of the port worker are the training possibilities that are offered within the organisation.
- **Type of contract of employment:** In a number of ports use is made of labour pools. In this case port workers don't have a fixed contract with one of the (stevedoring) companies in the ports, but may rotate over different port jobs within various organisations. Also temporary and fixed contracts are used in European ports.
- **Degree of integration of tasks in the function of the port worker:** Automation reduces the number of repetitive tasks in a job, and makes it possible to perform the same tasks with fewer people. Because of the implementation of new technologies and organisational/ management concepts within a company, different functions may be integrated. This means that port workers must be able to perform different tasks. To be able to do this, the port worker has to be multi-skilled.
- **Adherence to (safety) working procedures in the port area:** The importance of the human element in preventing accidents in ports and lessening the risk of pollution has been recognised by governments and organisations over the last years. An important cause of accidents in ports is the lack of adherence to (safety) working procedures.

Not all of the above mentioned elements are equally important to the port worker. With the help of the developed assessment methodology, these elements will be ranked according to the preference of the port worker.

5.2.2 Definition of new technologies and new organisational concepts

The port working culture is likely to be influenced by the implementation of new technologies and new organisational concepts. Since it is not possible to analyse the impact of each technology individually, the categorisation of new technologies described in chapter 2 was used to analyse the socio-economic impacts. By categorising the new technologies, it is possible to describe the socio-economic impacts of new technologies in more general terms.

In chapter 3 new organisational concepts are described that have been implemented in other industries, and that may or already have been implemented in the port environment. The following concepts are expected to have an impact on the working culture, and were defined as most important for the assessment methodology development:

- Just in Time (JIT)
- Total Quality Management (TQM)
- Outsourcing and strategic alliance
- The Virtual Company

5.3 Development of a socio-economic assessment methodology

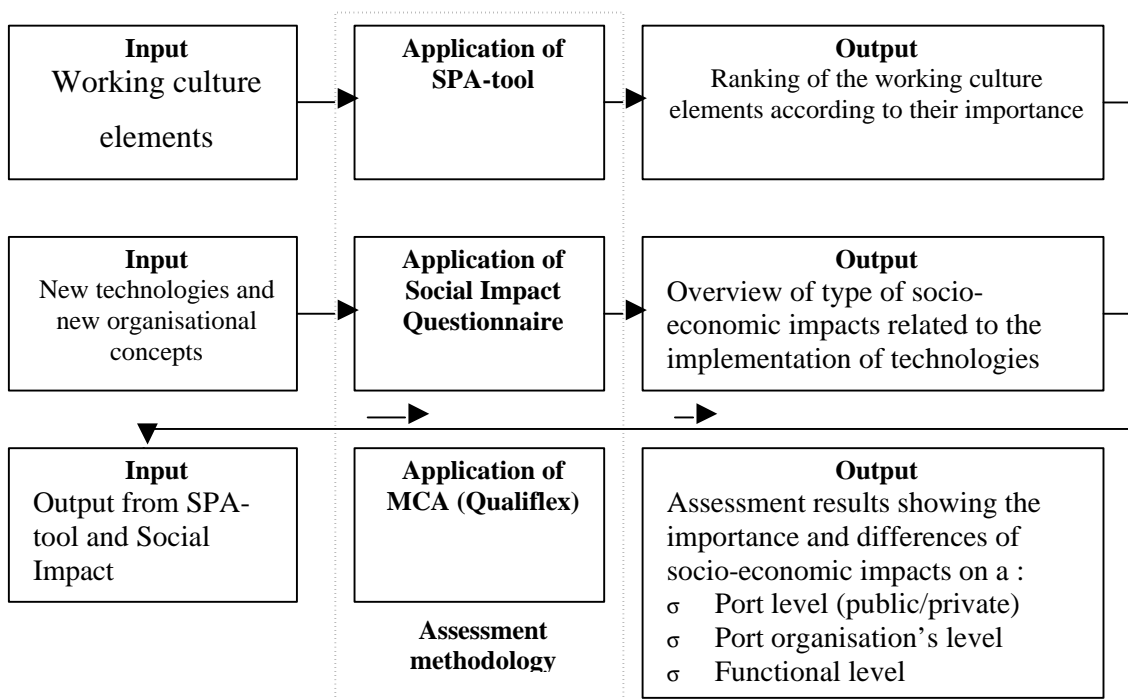
5.3.1 Introduction

A literature review was made within the WORKPORT project to identify the areas where socio-economic impacts of new technology and new organisational concepts can be expected. From the literature review only an indication of the socio-economic impacts could be given, since not much literature can be found on the subject. This information collected from the literature review needs to be verified and added to by information from people actually working in the port, and having experience with using new technologies and new organisational concepts. Therefore it is necessary to develop an assessment methodology, consisting of assessment tools, that are understandable to the different people working in the port.

The assessment methodology consists of different elements in order to find out and integrate the opinion of people working in the port about the impact of new technologies and new organisational concepts on the port working culture:

- σ Stated Preference Analysis-tool (SPA-tool)
- σ Multi Criteria Analysis (MCA)
- σ Social Impact Questionnaire

Figure 5.3 Assessment methodology for research into socio-economic impacts in ports



5.3.2 Stated Preference Analysis Tool (SPA)

The SPA-tool was chosen for the assessment because it facilitates a ranking of non-quantitative alternatives (e.g. different elements of the working culture) according to their importance, and a clarification of the elements that determine largely the port working culture. Furthermore, the SPA software tool is able to compose a next question based on the previous answer that is given by the respondent. This is a

benefit of using the SPA-tool compared to using a common direct questionnaire analysis.

First, the respondent is asked to answer questions that are related to his preference per working culture element, e.g. a low or a high autonomy, Second, the respondent is asked to answer questions that indicate the importance of each element in relation to the other elements, e.g. is (high or low) mental work demand more or less important than (high or low) autonomy. Third, the respondent is asked questions to verify the consistency of his answers.

Since the SPA can only rank 10 elements at most, a first definition of the most important elements of the port working culture was made based on a literature overview. When the assessment shows that certain elements are missing, it is easily possible to include these elements later on instead of the elements that are considered least important. There is flexibility in the use of the tool.

5.3.3 Social Impact Questionnaire

The Social Impact Questionnaire was developed to define the socio-economic impacts based on the opinions of people working in the port. With the help of the Social Impact Questionnaire, the respondents are asked how the implementation of new technologies and concepts would affect the port working culture. The respondent was first asked which new technologies or concepts he is familiar with. This enabled him to give an unprejudiced indication of the socio-economic impacts, since no technologies or concepts had to be explained to him. The results of the questionnaire are summarised in a so called Social Impact Table, in which the relation between working culture elements on the one hand and technologies and concepts on the other hand are indicated on the scale: --(highly negative), - (negative), 0 (no impact), + (positive) and ++ (highly positive). The interpretation of this scale was clearly described to the respondent.

It is possible and easy to include other technologies, organisational concepts and working culture elements in the assessment methodology than those that are currently included. This might be desirable for future research.

5.3.4 Multi Criteria Analysis (Qualiflex)

The MCA allows the comparison between various quantitative and qualitative criteria that cannot be expressed in one unity (e.g. comparison of different socio-economic impacts), and integrates the data of the individual assessments into one data set on a port level, or any other level that can be chosen (e.g. function level or company level). This makes it possible to compare the results of the assessment between different ports, different types of port organisations and different types of functions.

The Qualiflex decision technique, developed by NEI, is a computerised Multi Criteria Analysis tool. Though this tool was developed in an earlier stage and for other purposes, the application for assessing the socio-economic impact of new technologies and new organisational concepts is new. The technologies and concepts are given scores on each of the distinguished elements of the port working culture.

These elements are subsequently weighted by the Qualiflex tool according to the results of the SPA. In producing its outcome, Qualiflex looks at differences between scores. These differences are normalised to enable a fair comparison between the socio-economic impacts.

The final assessment results show whether the categories of new technologies and organisational concepts have a large or small impact on the working culture, and whether this impact is positive or negative. Also a comparison of impacts can be made between ports, between port organisations and between different functions in the port.

5.3.5 Validation and segmentation of assessment results

In order to test the practical applicability of the developed assessment methodology, the WORKPORT project partners conducted a number of interviews with the use of the Social Impact Questionnaire and the SPA. Based on this input, the WORKPORT Consortium performed a MCA with the help of Qualiflex. This trial impact assessment is based on 53 interviews with port workers and port managers in the ports of Kotka (Finland), Rotterdam (the Netherlands), Thessaloniki (Greece) and the port of Immingham (United Kingdom). In the Port of Thessaloniki the focus is on port workers, whereas in Rotterdam the focus is placed on port managers. In chapter 6 of this final report some more information on these ports can be found.

The assessment results are shown in paragraph 5.4. A segmentation in assessment results between port managers and port workers is made, showing the differences in opinion of port workers and port managers about the impact of new technologies and new organisational concepts on the port workers in different European ports. Also a segmentation between countries is made to give an indication of the differences in preferences of the port workers in different European countries. A further segmentation of type of organisation or type of function was considered not feasible because of the limited sample. As the application of the assessment methodology was predominantly meant for demonstration purposes this was acceptable.

The results of the assessment methodology indicate that the implementation of categories of new technologies and new organisational/ management concepts have direct socio-economic impacts. However, also some indirect impacts on the port working culture exist. This is because the implementation of a certain technology or organisational concept can result in the implementation of another new technology and/ or new organisational/ management concept.

For example, the increase in vessel size may lead to the implementation of new cargo handling equipment to be able to handle larger vessels in an efficient way. The direct impacts of the new cargo handling equipment can be seen as indirect impacts of the implementation of larger vessels. Based on the assessment results it was possible to give an indication of the relations between new technologies and new organisational/ management concepts in Deliverable 4 of the WORKPORT project, and the indirect impacts on the working culture. However, the aim of the assessment methodology is to concentrate on the direct socio-economic impacts. These are shown in the next paragraph.

5.4 Application of the assessment methodology

5.4.1 Main working culture elements (SPA)

Addressing the viewpoint of the port workers, the SPA approach, as developed and applied in the WORKPORT context, gives insight into the elements that determine the working culture for port workers. This serves as important input for the assessment of socio-economic impacts of new technologies and new organisational/ management concepts (by using the MCA), especially since very little attention has been paid to the elements that determine the working culture of port workers in ports up till now.

Table 5.1 shows the elements that are most important for the port working culture for port workers. Per element is shown what is on average preferred by the port workers, e.g. a high or a low autonomy. Also the ranking of the elements are shown. If each element of the working culture would be equally important to the port worker, each element would have a value of 100. It turned out that port management considers the same elements as most important for the port working culture as the port workers themselves, although the order of importance partly differs.

Table 5.1 Average importance of port working culture elements in selected European ports

Port working culture elements	SPA-Index		Ranking of importance (1 = highest importance, 10 = lowest importance)	
	According to port workers	According to port managers	According to port workers	According to port managers
The port worker has a fixed contract	151	172	1	1
Higher payments than for similar jobs outside the port	143	169	2	2
There is a high adherence to (safety) procedures	107	107	3	3
Possibilities for career development are large	106	101	4	4
High level of training/education required for the job	88	67	5	9
Autonomy on the job (high independence)	86	79	6	6
Port worker rotates over various jobs (has to be multi-skilled)	84	88	7	5
High mental work demand on the job	81	66	8	10
Low exposure to physical burdens (heat, noise, etc.)	78	77	9	7
Work only takes place during the day (no night shifts)	75	66	10	8

It can be concluded that the first four elements that are mentioned in table 5.1 clearly are considered as being of much higher importance, both by port workers and port management, than the other elements. However port managers expected that port workers would value payments and the type of contract higher than they do according to the SPA.

The SPA shows some further noticeable differences between the opinion of the port managers and the port workers for the working culture elements that are ranked lower in table 5.1. Training and education are valued higher by the port workers than is expected by the port managers. This is the same for mental work demand in the job.

Restricted by the fact that the sample size does not yet lead to results that are stable enough, the preference pattern of port workers in each of the individual ports broadly complies with the average results as shown in table 5.1. This means that in this respect one could tend to speak about a common pattern throughout the ports investigated.

However, on a more detailed level some differences appear. In contrast to other European ports, the port workers in Thessaloniki prefer a job that includes evening shifts over a situation in which the work only takes place during the day. This might be explained by the fact that extra payments are received for evening shifts. Furthermore, the port workers in Thessaloniki prefer a job in which the mental work demand is low, and not a high mental work demand as preferred by port workers in other European ports.

5.4.2 Main impacts on the working culture (Social Impact Questionnaire)

By using the Social Impact Questionnaire, the WORKPORT partners were able to find out more about the opinion of port workers and port managers with respect to the impact of the implementation of new technologies and new organisational/ management concepts on the elements of the port working culture. Thus, the tool application has clearly shown its actual applicability and usefulness in the various ports.

However, more specifically, the WORKPORT partners in the inland port of Duisburg and in the port of Thessaloniki came to the conclusion that not many new technologies and new organisational/ management concepts have been implemented so that no information could be collected for the assessment from these ports. The assessment results shown in table 5.2, are based on the information from the ports of Immingham, Kotka and Rotterdam.

The results of the tool application show that no significant impact on the identified elements of the working culture is noticed from the implementation of new technologies in the category “Port operations, connection to the hinterland”. The literature review and the assessment show that there is not much experience in ports with the implementation of new technologies in this category. Because of the growing importance of ports as an efficient link in the transport chain, and the growing importance of smooth intermodal transport, ports are expected to pay more attention to these technologies in the near future.

Furthermore, no socio-economic impacts could be identified of the implementation of JIT, Outsourcing and strategic alliance and the Virtual Company. JIT has an impact on the transport chain as a whole, of which the port is a part. JIT is not implemented by port companies themselves, but may force port companies to work more efficient resulting in the implementation of new technologies and new organisational concepts in the port. JIT will therefore not lead to direct impacts on the working culture in ports, but may have some indirect impacts. The WORKPORT assessment methodology, however, only focuses on the direct impacts. According to the interviewed port workers and port managers outsourcing and strategic alliances take place in the port, but no direct negative or positive impacts on the working culture were identified. Finally, the Virtual Company is not a well known concept in the port

area, and therefore no direct impacts on the working culture resulted from the assessment.

The socio-economic impacts of the other categories of new technologies and new organisational/ management concepts are shown in table 5.2. The elements of the port working culture that are preferred by the port workers are shown in the first column of the table. When the implementation of a new technology or new organisational concept improves the element that is preferred, this is indicated by a + (positive impact), a 0 indicates that no impact was identified and a – indicates that the implementation of a new technology or concept has a negative impact on the preferred working culture element.

Table 5.2 Socio-economic impacts of categories of new technologies and new organisational/ management concepts

Working culture elements	Organisational / management concept	Categories of new technologies				
	Total Quality Management (TQM)	Sea operations	Port operations, sea side	Port operations, transshipment sea-land	Port operations, land-side	Information technology
The port worker has a fixed contract	+	0	0	+	+	0
Higher payments than for similar jobs outside the port	+	0	0	+	+	0
There is a high adherence to (safety) procedures	+	0	+	+	+	+
Possibilities for career development are large	+	0	0	+	+	0
High level of training/education required for the job	+	0	+	+	+	+
High autonomy on the job (high independence)	+	0	+	0	0	0
Port worker rotates over various jobs (has to be multi-skilled)	+	0	0	+	+	+
High mental work demand on the job	+	+	+	+	+	+
Low exposure to physical burdens (heat, noise, etc.)	0	0	0	+	+	0
Work only takes place during the day (only day shifts)	0	-	0	0	0	0

The assessment shows that the impact of new technologies on the type of contract, the possibilities for career development and working time are not significantly high. It can further be noticed that the implementation of new technologies or new concepts hardly have a negative impact on the port working culture, except for new technologies in the category “sea operations”. It can also be noticed from table 5.2 that new technologies in the categories “port operations, transshipment sea-land” and “port operations, land side” have the same impact on the port working culture. The categories “port operations, sea side and “information technology” each have 4 positive impacts on the working culture. This does not necessarily mean that they both are equally important in relation to the port working culture. This is because each of the working culture elements is valued differently as is shown in table 5.1. The combination of the results shown in table 5.1 and 5.2 indicates the importance of each of the organisational concepts and categories of new technologies, and is shown in the next paragraph.

5.4.3 Main categories of new technologies and new organisational concepts

In the different ports, the impacts of new technologies and new organisational/ management concepts as shown in table 5.2, are valued differently by the port workers as was analysed with the help of the SPA tool. This difference is expected to have a direct relation with the acceptance and the application of new technologies and new organisational/ management concepts in the different European ports.

How the socio-economic impacts are valued in the different ports by the port workers can be analysed by using the QUALIFLEX tool, which combines the results of the Social Impact Questionnaire and the results of the SPA tool. It is shown which of the categories of new technologies and organisational/ management concepts have the most impact (either positive or negative) on the working culture in the different ports.

In figures 5.4 and 5.5, the results of the QUALIFLEX assessment are shown. It is shown whether the categories of new technologies and the new organisational/ management concepts have a positive or a negative impact on the working culture, and which of these technologies and concepts has the most impact on the working culture. The figure shows that the new technologies with the most negative impact on the working culture have an index of -14 (in Finland) , and the concept with the most positive impact has an index of 148 (in Finland). An Index > 0 indicates a positive socio-economic impact, and an Index < 0 indicates a negative socio-economic impact.

Figure 5.4

Impact of new technology and TQM on port working culture ports, according to *port workers*

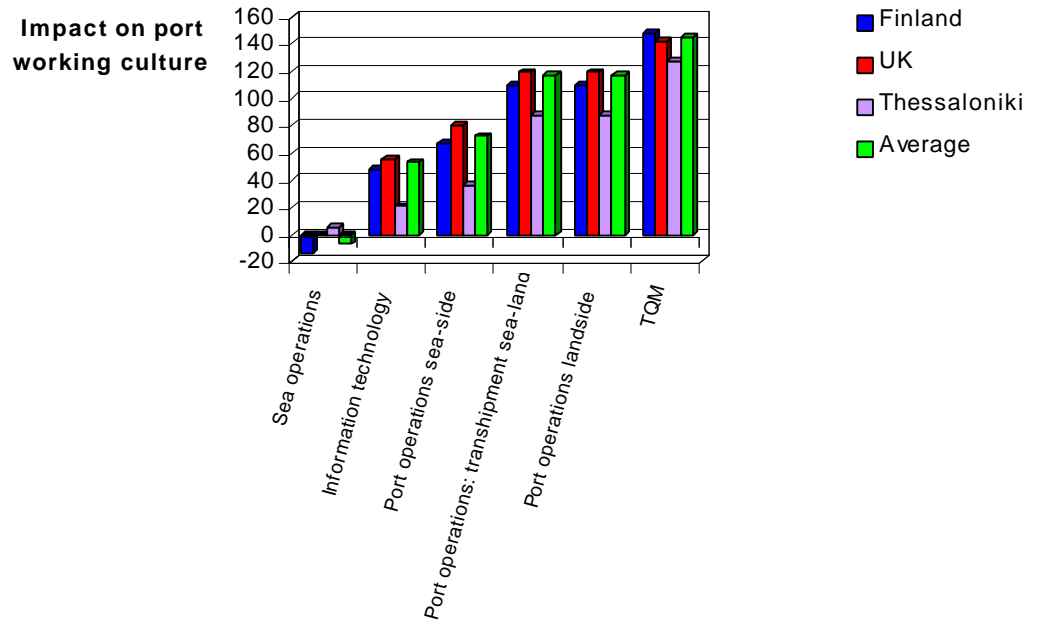
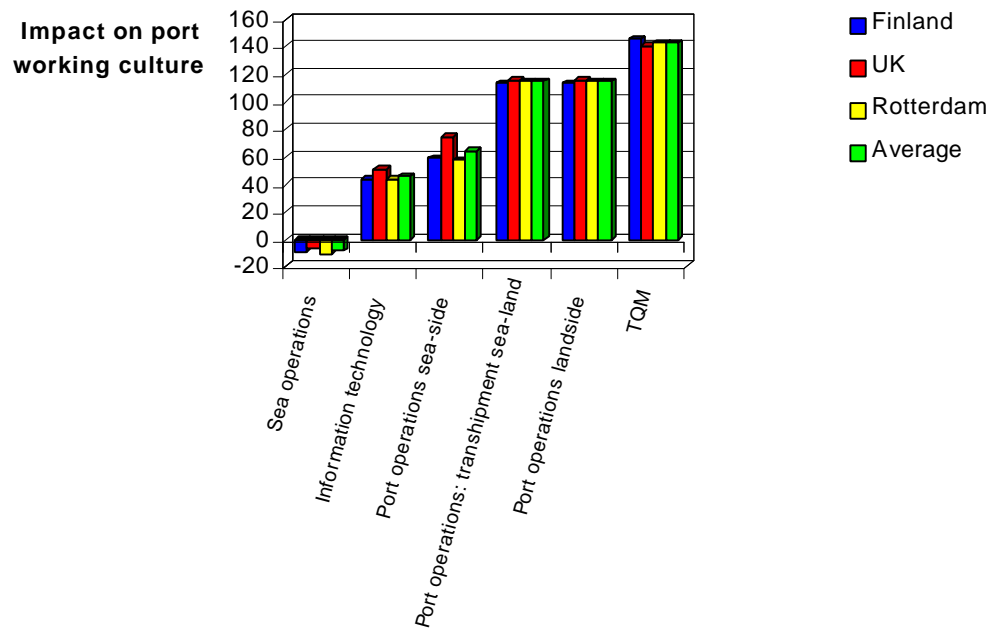


Figure 5.5

Impact of new technology and TQM on the working culture in ports, according to *port managers*



The results of the QUALIFLEX tool show that TQM has on average the most positive impact on the working culture, while new technologies in the category “sea operations” show the most negative impact on the working culture according to the port workers and port managers. The categories “port operations: transshipment sea-land” and “port operations landside” are equally important for the port working culture. It is further shown that the port workers in Greece consider the implementation of new technologies, and to a lower extent the implementation of TQM, less positive for the working culture than the port workers in other ports. The fact that Thessaloniki has not implemented many new technologies and concepts compared to other ports, might make workers more afraid of them.

5.4.4 Context factors

The assessment results showed some differences in the application of new technologies and new organisational/ management concepts and some differences in their impact on the working culture in different ports. Three issues evolved during the WORKPORT research that showed to be of particular relevance for future analysis of the relation between working culture, new technologies and new organisational concepts. These issues are: *the cultural factor, user acceptance, and port privatisation.*

The cultural factor

In earlier research the differences between reactions and behaviour of different countries due to the different national cultures was explained (Hofstede, 1991). It was described that national cultures are a product of the following four dimensions: power distance, individualism, masculinity and uncertainty avoidance. In the WORKPORT project it is shown that the differences in national culture are likely to be related to the differences in port working culture.

For example, port workers in Greece score relatively high on the masculinity index according to Hofstede, which means that they attach high value to money. This may explain why port workers in Greece prefer night work resulting in extra payments, instead of only day shifts which is preferred in other ports. Furthermore, the Netherlands and Great Britain score high on the individualism index, Finland has a medium score and Greece a low score. A high score on this index indicates that people prefer challenge in work and freedom in carrying out work. The assessment results show that the theory of Hofstede is in line with the preference of career development in the different ports: port workers in the Netherlands and Great Britain attach higher value to career development than port workers in Finland and Greece.

Port privatisation

Privatisation has become a buzzword in the last decade. Increasingly, governments plan to privatise inefficient public service and companies. The ports selected for the WORKPORT project are in different phases of the privatisation process. Earlier research has shown that privatisation may have a great impact on the working culture in ports. For example, retraining of port labour and redundancy schemes are necessary to smoothen the transfer of labour from the public to the private sector. The stage of privatisation of a port may also be an explanatory factor for the differences in

implementation of new technologies and new concepts between ports. The sample of the assessment, however, was too small to verify this.

User acceptance

From the perspective of acceptance of new technology (and management concepts) several factors were identified in earlier research that are of importance to the level of acceptance, and therefore the level of implementation of new technologies and new organisational concepts. Those are the economic situation of a country, political stability and governmental influence, general public opinions, earlier experiences with new technology and the level of complacency. In first instance the WORKPORT assessment was not aimed at identifying elements that contribute to the user acceptance, but from the WORKPORT study it could be identified that differences in the working culture between ports can influence differences in user acceptance.

ITF feels that user acceptance in ports can be improved when changes in ports, e.g. introduction of new technologies and new organisational/ management, are agreed upon by both management and the shop floor. The ITF feels that *good labour relations* between management and workers / union and mutual agreement by co-operation is indispensable when being confronted with the implementation of new technologies and new organisational/ management concepts.

Another factor to improve user acceptance is enough training and (re)skilling, because safe and efficient ports rely on qualified personnel. When any change enters the port, it should be considered whether or not employees are qualified or should be (re)skilled to work in these changed circumstances. Training programmes should adapt to the changes as well.

5.4.5 Conclusion on assessment methodology

The methodology that was developed for a structured assessment of the impacts of new technology and new organisational concepts on the port working culture has proven to be sound and suitable for this research, and can be used for further research in this area. This is important since not much research has up until now been done in the field of assessment of socio-economic impacts in the port environment. The assessment methodology has shown to be useful to receive information about this subject directly from the people working in the port area. There are, however, some recommendations to improve the assessment methodology for future use.

First, it turned out during the actual SPA tool application that it is important that the use of the tool is well explained to the respondents. This is especially useful in cases where there might be some language difficulties.

Secondly, port workers as well as port managers were asked to specify whether, in their opinion, there are elements of the working culture that are not yet included in the SPA tool. So far there turned out to be only one element that was not included in the SPA tool, which is an important element of the port working culture: social contact between port workers. An option for future research could be to include this element in the SPA tool instead of working time, as the latter one turned out to be relatively unimportant for the port working culture.

6. Case studies in six ports to identify the applicability of new organisational concepts

6.1 Introduction

In this chapter the following research objectives are worked out:

- To analyse the existing situation in the port case studies with respect to technological, organisational/ managerial changes in the ports.
- To examine the effects of these changes to the working practices and the organisational procedures, focusing on health and safety, and environment.
- To define possible barriers to application of new technological and new organisational/ management concepts.
- To define possible threats and opportunities in various application environments.

The case studies were conducted at the ports of Rotterdam (The Netherlands), Immingham (United Kingdom), Gothenburg (Sweden), Kotka (Finland), Thessaloniki (Greece) and Duisburg (Germany). For the successful fulfillment of each case study interviews with port experts, managers and workers from various departments were used based on the questionnaire developed in the WORKPORT project. This questionnaire was drawn up to analyse how the main companies in different ports deal with new technologies and new organisational/management concepts. To analyse the changes in the working culture in ports as described in chapter 5, use was made of the assessment tool that was developed in the WORKPORT project.

Before describing the results of the case studies, it is important to know something about the context factors of the ports. It has been mentioned in chapter 5, that the stage of privatisation of a port may be an explanatory factor for the differences in implementation of new technologies and new concepts in ports. The case study results showed that also the type and amount of cargo handled are likely to have an impact on the technological and organisational changes. Therefore a short description is given in this paragraph of the relevant context factors of each port.

Rotterdam

- Rotterdam is the largest port in Europe with a throughput of 310.1 million tonnes (1997).
- Focus of the case study is on container and dry bulk terminals, and the Port Authority. Rotterdam handles 5.4 million TEUs and 91.2 million tones of dry bulk cargo (1997).
- Rotterdam is a good example of a so-called landlord port, where superstructure is owned and provided by private sector companies.

Immingham

- Immingham is a major European port with a throughput of 46.5 million tones (1998).
- Focus of the case study is on the port as a whole, handling a wide range of cargoes, particularly dry and liquid bulks and Ro-Ro general cargo.
- Immingham is owned by a publicly quoted company, private sector involvement is 100 percent. Cargo operations are provided by independent stevedores, the port

authority, however, provides carnage and the crane operators.

Gothenburg

- Gothenburg is a major European port with a throughput of 30.7 million tones (1998).
- Focus of the case study is on the port as a whole, handling a wide range of cargoes mainly liquid bulks and general cargoes.
- The port authority of Gothenburg is a public sector joint stock company, whose shares are owned by the City of Gothenburg. It provides the cargo handling services as it regards stevedoring to be the port's core business.

Kotka

- Kotka is a moderately sized European port with a throughput of 7.4 million tonnes (1998).
- Focus of the case study is on the port authority and the principal port operator is a private stevedore that is owned by the wood processing industry.
- The port authority of Kotka is a joint stock company owned by the City of Kotka. Cargo handling services are provided by the private sector stevedoring company, however, crantage and crane operators are provided by the port authority.

Thessaloniki

- Thessaloniki is a moderately sized European port with a throughput of 13.7 million tonnes (1998).
- Focus of the case study is on the container terminal, with a throughput of 182,000 TEUs (1998),
- In Thessaloniki there is no private sector involvement at the moment and the port is under restructuring having become a "Societe Anonyme".

Duisburg

- Duisburg is the largest inland port in Europe, with a throughput of 49.3 million tonnes (1997).
- Focus of the case study is on the port as a whole, handling most forms of cargo including unitized and breakbulk general cargo, although bulk cargoes predominate in tonnage terms, particularly dry bulks.
- Most of the port's services, including cargo handling, are provided by private sector companies.

6.2 New technologies and organisational/ management concepts

6.2.1 New technologies

Investment in truly new technology is rare in the port industry, which is still on the whole rather labour-intensive. Technology followers in the port area are far more numerous than technology leaders. Management of the smaller port companies especially prefer to move gradually towards more efficient versions of existing equipment, typically by replacing cranes or other cargo-handling devices on a rolling basis with higher specification new models, instead of implementing whole new technological innovations.

From the case study ports, especially Duisburg, with vessel and terminal constraints, is not an innovator in new technologies. High-tech solutions are likewise not favored at Thessaloniki where replacement of labour with equipment is not seen as a priority or as socially desirable.

The most advanced technologies are seen:

- Where cargo volumes are very large, or;
- Where a new terminal has come on stream unencumbered with old design features.

Main technological changes in the ports are related to either the cargo handling systems for loading the vessels and optimizing the storage of the cargo at the terminal or the information systems. Not much new technologies have been implemented in the field of cargo transfer between the port terminal and the hinterland transport modes.

Cargo handling systems and facilities

The use of new versions of existing technologies have occurred extensively in the case study ports. The implementation of new cargo handling systems and facilities have been limited and have mainly taken place in the area of container handling. In the dry bulk sector, however, new technologies are being implemented in relation to the expansion of involvement that dry bulk handling is seeking through the development of value added activities, such as washing, screening, processing and blending.

The benefits of using new versions of cargo handling equipment are:

- The equipment is more powerful, making the task of cargo movement both faster and more efficient;
- The ergonomics of the equipment has been improved for the operators;
- Newer equipment incorporating modern health and safety considerations is easier to use;
- The improved capabilities mean that productivity has been improved. The number of employees required to operate the equipment has reduced, while at the same time the specifications of the equipment improved.

The increase in vessel size is a driving force for the investment in new cargo handling equipment at container terminals. The expectation is that the main challenge over the next ten years or so, is expected to be the accommodation of either wide vessels (up to 69m or 24 containers across) with a draught of 14m, or to plan for very deep-draught vessels (27m plus). This would potentially, completely reshape current thinking concerning container terminal design; a high level of automation could be the favored solution.

In the area of container handling, only two ports in Europe have full automation of at least part of the terminal operation, being Rotterdam and Thamesport. The main benefit of automation in the areas of quay transfer and container-stack carnage is labour cost reduction, but two main penalties are incurred:

- Very high installation and development costs and;
- Inflexibility.

Highly automated terminals require high and regular traffic volumes firstly, to justify development costs and, secondly, to keep operating costs per unit below levels seen at conventional container terminals. The problem which highly automated terminals may face is a change in working conditions outside their sphere of influence. A move towards more flexible working practices, as shown in paragraph 6.2.2, means that the cost advantages gained by terminal automation are being eroded.

Information systems

The use of IT systems was found to be an increasingly important part of the operation of all the case study ports, to varying degrees, covering a range of different activities. The following IT was observed during the course of the study; control of terminal operations, Electronic Data Interchange, Port Information Systems and VTS. The provision of high quality information regarding all aspects of the ships and cargoes being handled is important if ports are to be operated efficiently. Information is required about a vessel from the time they leave the previous port, through to their arrival, cargo storage and processing and final departure from the port.

The main findings of the WORKPORT study have been that: new information transmission methods have come on stream without old ones necessarily being dropped out, more generally, electronic means of data and information exchange have not yet penetrated the port industry deeply or consistently.

6.2.2 Managerial/organisational concepts considered in the case studies

According to Kumpe (1998), the organisational aspects of change are often underestimated. Almost all the attention is paid to technological knowledge. It has appeared that companies that have the same technological investments, have not reached the same results (Jacobs, 1998). Also according to the socio-technique (Van Amelsvoort, 1998), different elements of the organisation have to be changed in relation to each other in order to realise successful technological change.

In chapter 3 a summary was given of new management concepts that had been successfully used in other industrial sectors, in particular manufacturing. One of the objectives of the case studies was to discover the extent to which these concepts had penetrated the thinking in the port industry.

While port managers and workers may not, generally, be familiar with the concepts by name, apart from JIT and perhaps TQM, there is clear evidence to be found in the case studies that some of these concepts, in particular, Lean Thinking, JIT, BPR and TQM, have been applied in ports to increase efficiency and improve the quality of performance.

Lean Thinking

Lean Thinking does not only apply to material inputs in the production process but also to other inputs including labour. In the port industry where the demand for cargo handling services may be subject to large fluctuations and necessitate labour inventories (pools) to ensure that such demand can be met, multi-skilling of the workforce can reduce the size of the inventory required. For example, at Immingham where the port authority supplies the cranes and the operators, a core of crane operators is retained to almost meet the baseline demand for such operators. In addition, a proportion of the engineering staff is also trained to operate the cranes,

sufficient in number to meet any peaks in demand and provide for sickness cover. These multi-skilled engineering employees, are, therefore, given regular opportunities to practise their crane operating skills. A rota system has been established so that they all have equal opportunity to do so. As engineering staff who acquire this additional crane operating skill are paid more when they are operating cranes than when they are employed on maintenance work in the port which, although essential, involves tasks that can be postponed to non-peak periods without jeopardising safety, and more importantly, does not result in a loss of customer goodwill, there is an incentive for them to acquire this additional skill.

Evidence of multi-skilling, and, therefore, lean thinking was also found in the Gothenburg case study, in the Kotka case study, in the Duisburg case study and in the Rotterdam case study.

At Immingham the multi-skilling of their workforce was also a practice employed by the private stevedoring and terminal operators in the port.

Just-In-Time (JIT)

This concept is part and parcel of Lean Thinking. It has been applied by both the manufacturing industry and major retailers to meet existing orders whilst maintaining stock at a minimum level. Where ports are part of the logistics pipeline (value chain), which is the case with much short-sea Ro-Ro ferry traffic they handle nowadays, they are an integral part of this process, and terminal operators, such as Exxtor at Immingham, are fully aware of this.

The JIT concept, however, can also be applied to labour supplies; for example, where a stevedoring company maintains a core workforce that is only sufficient to meet baseline demand for the cargo handling services it provides and supplements this workforce by contract labour hired from an outside agency when required.

This employment practice is currently the one used by both Exxtor and Global at Immingham and was made possible in scheme ports in the UK by the abolition of the National Dock Labour Scheme (NDLS) in 1989. The efficiency gains resulting from this practice may, therefore, be considered as one of the benefits of abolishing the scheme.

The Gothenburg case study also mentions contracted port workers who can be called in to supplement the dock labour workforce when needed. But it is not clear whether they are hired from an outside agency or represent a labour pool which the port funds itself. Only if they are the former, can they be regarded as an example of the application of the JIT concept because otherwise they are not supplied by an outside source and the port itself bears the cost of maintaining the required labour inventory.

It is perhaps worth noting in this context that at Rotterdam where the labour pool was privatised in 1995 and is now managed by a company owned by the port stevedoring companies, this company in 1997 made a loss of 5 million EUROS. Therefore plans were made to reorganise the company to reduce its losses and make it profitable. These plans included reducing the basic wage paid to port workers from the pool

when employment cannot be found for them by a stevedoring company. But these reorganisation plans met resistance from the port workers belonging to the pool.

Business Process Re-engineering (BPR)

The reorganisation of the different harbour operations into divisions with new managers is one BPR example in the port of Gothenburg. The Thessaloniki case study discussed the possible use of BPR to resolve problems at the container terminal in the Port of Thessaloniki relating to the application of Information Technology at the terminal in order to improve the operational efficiency of the terminal. However, evidence of the actual application of this concept and its impact if successful is to be found in all the case study ports, although no mention is made of this successful application of BPR in any of the case studies. This is probably because this example, namely, the unitisation of general cargo, has become the standard way to move such cargo today, as the transition from moving general cargo in breakbulk form to moving it in some kind of unitised form began over thirty years ago. Nowadays, of course, a substantial proportion of general cargo moves as Ro-Ro cargo in short-sea trades and as Lo-Lo containerised cargo in deep sea trades.

BPR has been defined as the fundamental rethinking and radical design of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed.⁵ Unitisation of general cargo has radically changed the way such cargo is handled in ports throughout Europe and the world and has had a similar impact on port layout and terminal design. No one would dispute, moreover, that it has also achieved dramatic improvements in all the contemporary critical measures of performance, namely, costs, quality, service and speed.

Another example of BPR in ports was identified in the Gothenburg case study. This concerned the recent reorganisation of different harbour operations within the port into new divisions with newly appointed managers.

The redesign of information and communication flow is another example of BPR in the container terminal of the port of Thessaloniki implemented with the use of high technology.

Total Quality Management (TQM)

The TQM concept was implemented in the port of Immingham with very positive results in highlighting unsafe working practices before they led to an accident, making the whole system proactive than reactive. ISO 9002 and EMAS/ISO 14001 were implemented in the context of TQM. However, it is only at Immingham that a management system, which could be described as approximating to TQM, has been developed. This system was implemented by the port authority through a management led training scheme known as EXCEL, which has now been discontinued.

On the contrary, a TQM approach has not been adopted in the port of Gothenburg, although it has been discussed and quality work holds a high standard there. The whole port of Gothenburg is ISO 9002 certification accredited.

⁵ Deliverable 2, section 4.7.1.

The port of Kotka has an inclination to teamwork, which is an important element of TQM, but the privatisation procedure that is taking place is delaying the change towards team training and fully functioning teams. Nevertheless, an ISO-14001 is awarded to the port of Kotka.

In the container terminal of Thessaloniki the TQM approach is a potential development along with ISO 9002. Special attention is paid to people, meaning personnel empowerment and customer satisfaction. TQM will take some time to give positive results.

6.2.3 Change in working practices

The impact that the introduction of the new versions of cargo handling equipment has had on the operators of the equipment has been relatively minor for those capable of adapting to the use of modern computer-assisted technology. While additional training is required, provided that the operators are able to adapt to the new technology, there is no problem for them to transfer to the new machinery.

The impacts of new technologies and new organisational concepts on the working culture in ports have been summarised in chapter 5 of this final report, as well as 8 (training issues). Some general changes in the working culture of the case studies, happening in a wider context of the port, are the implementation of skill based pay in the light of multi-skilling of employees and the development of 24 hour working. This paragraph, however, will focus on the health and safety issues in the port as well as the environmental issues.

Health and safety

Minimum standards covering health and safety matters in EU ports are laid-down in legislation from Brussels. Additional legislation on points of detail has evolved over the years at a national level and ports must comply with both levels of regulation. A major factor, which has emerged, is that while all the case-study ports acknowledge the importance of maintaining a healthy and safe working environment, the level of implementation of control mechanisms differ widely from port to port. The underlying reason for this appears to be that there is a large variation in awareness on the part of management that health and safety has a direct effect on costs, and, implicitly, profits. There is a strong commercial motivation, therefore to maintain a healthy and safe port working environment, and this motivation is probably felt strongly at ports which are operating under the greatest commercial pressure. In Immingham there has been a continuing effort to reduce the incident rate and this has been enhanced by the development of a 'health and safety improvement project'. This is also true in Rotterdam where a combination of tightening legislation, better control and improved awareness has likewise brought about steady reductions in both accidents and incidents. The picture at the other case-study ports, however, has been less clear. At Gothenburg, considerable attention is paid to the ergonomic aspects of the working environment consistent with the more general/highly-focussed approach towards safety on the part of the Scandinavian countries, where accidents and injuries are seen as both extremely expensive and socially unacceptable.

Ergonomic aspects of the operation of equipment and activities undertaken in the port are a major area of concern. Examples of the type of problem that can occur include:

slipping, tripping, falling, cuts and bad backs. This problem is partly countered through legislation but with modern port handling practices there are now fewer minor accidents (cuts and bruises) and of semi-serious accidents such as broken limbs. However, when accidents do occur, they are more likely to be catastrophic in nature, but such accidents are now very infrequent.

The WORKPORT study has shown that accident rates and the degrees of success in reducing accidents, are variable from port to port. In ports where data are systematically kept, the trend in accidents and incidents is towards a safer and healthier working environment irrespective of the balance of public-private ownership.

Environment

Overall WORKPORT has highlighted the following:

- The importance of specified objectives and targets set at both operations and company levels;
- The enhanced status of environmental considerations with the business plan;
- The integration of safety, health and environmental activities at management level to meet environmental objectives and to protect the health and safety of employees;
- The importance of written policies on key issues;
- The recognition of the positive contribution of adopting an appropriate form of an Environmental Management System;
- The need to be mindful of the growing and evolving legislation and the value of training and qualifications in order to effectively respond to requirements;
- The growing sensitivity and awareness of the local and wider community to environmental issues; and
- The value of having adequate facilities and management provision for shipping and for integrating these practices with the port's environmental plan.

6.3 Implementing new concepts

For the different case-study ports an overview has been made of:

- Possible barriers to the application of new technologies and ways to overcome them;
- The most promising application methods and areas;
- Possible threats and opportunities in various application environments.

The above mentioned overview for each of the case-study ports is displayed in the pages (57-62) that follow.

Next, on pages 63-64 there is a table briefly showing the SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis for each of the case-study ports.

6.3 Main findings from each case study

Port of Thessaloniki					
Barriers to applications	Ways to overcome	Most promising changes	Threats	Port training and education	New technologies
<ul style="list-style-type: none"> • Culture • Conflicting government objectives • Financing investments • Acceptance by workforce • Bureaucratic organisation 	<ul style="list-style-type: none"> • Better education-qualification • Funding due to strategic reasons 	<ul style="list-style-type: none"> • Profit orientation • Full cost recovery • Technological breakthrough • Private sector partnership • Workforce empowerment 	<ul style="list-style-type: none"> • Inappropriate introduction of technologies • Regional instability • Lack of resources • Industrial action 	<ul style="list-style-type: none"> • Internal workshops • Localised training • Use of communication technology for training 	<ul style="list-style-type: none"> • EDP system
			Opportunities		
			<ul style="list-style-type: none"> • Willingness of government • Strategic location exploitation • Opportunities in the Balkan area • Access to Eastern Europe 		
Concluding remark					
<ul style="list-style-type: none"> • Human element is the key to change 					

Port of Immingham

Barriers to applications	Ways to overcome	Most promising changes	Threats	Port training and education	New technologies
<ul style="list-style-type: none"> • Conservatism • Commercial viability of the concept 	<ul style="list-style-type: none"> • Greater use of EXCEL type programmes • TQM 	<ul style="list-style-type: none"> • Use of contract brokers • Job training and education • Flat management structure TQM/EXCEL way of thinking 	<ul style="list-style-type: none"> • Loss of business • Loss of market share • Takeover 	<ul style="list-style-type: none"> • Encouragement of T&E • Self improvement philosophy promoted 	<ul style="list-style-type: none"> • Ergonomic designs in new equipment made work more comfortable and safer • Better working environment • ICT application to improve quality at service and management efficiency
			Opportunities		
			<ul style="list-style-type: none"> • Expansion • Profitability improvement 		
Concluding remark					
<ul style="list-style-type: none"> • Commercially driven • Management accountability • Legal awareness external due to the exposure such as the “Milfort heaven” incident 					

Port of Kotka

Barriers to applications	Ways to overcome	Most promising changes	Threats	Port training and education	New technologies
<ul style="list-style-type: none"> • Slowly changing organisational culture • Planning of the implementation of new organisational models needs more attention 	<ul style="list-style-type: none"> • Education and training of personnel and management • Co-operation between different port companies • Continuous improvement of the whole logistics chain 	<ul style="list-style-type: none"> • Development of quality and environmental-management systems • Implementation of teamwork 	<ul style="list-style-type: none"> • Rigidity of old organisational structures • International and national competition 	<ul style="list-style-type: none"> • Training for team leaders and other management • Safety awareness training • Business orientation and economics • Information technology related skills 	<ul style="list-style-type: none"> • VTS • Portnet/Kortnet • Information Technology
			Opportunities		
			<ul style="list-style-type: none"> • New container terminal is under construction • More transit traffic through the port • Wide selection of services • Development of effective EDI systems 		
Concluding remark					
Competitiveness through the implementation of team organisation and restructuring of dedicated terminals					

Port of Rotterdam

Barriers to applications	Ways to overcome	Most promising changes	Threats	Port training and education	New technologies
<ul style="list-style-type: none"> • Lack of financial means • User acceptance • Lack of flexibility in the context of technology 	<ul style="list-style-type: none"> • Harmonised approach to negotiations • Social technique 	<ul style="list-style-type: none"> • Autonomous teams • Improvement of internal communication • Adapting the social technique and social scenario approach • Non confrontational industrial relations • Adapting flexibility and innovations as key issues for future strategies 	<ul style="list-style-type: none"> • Ageing skills base • Non-flexibility of robotics 	<ul style="list-style-type: none"> • Computer based education 	<ul style="list-style-type: none"> • Robotics • Floating crane
			Opportunities		
			<ul style="list-style-type: none"> • Commercialisation of employment agency 		
Concluding remark					
Organisational change is needed for effective introduction of new technologies					

Port of Gothenburg					
Barriers to applications	Ways to overcome	Most promising changes	Threats	Port training and education	New technologies
<ul style="list-style-type: none"> • Conservatism • Preoccupation by other change projects 	<ul style="list-style-type: none"> • Education and training • Participation • Better economic resources 	<ul style="list-style-type: none"> • Further implementation of team organisation • Increased co-operation with customers • Increased co-operation with nearby ports • Implementation of adapted selection of O/M concepts 	<ul style="list-style-type: none"> • Ageing work force • Not enough society investments in infrastructure outside port area • International competition 	<ul style="list-style-type: none"> • Increased use of computer based instruction and training • Team leadership • Socio-technology 	<ul style="list-style-type: none"> • Large expansion of ro/ro terminal • Expansion and streamlining of container terminal • New and expanded infrastructure (e.g. new rail tracks and a railway station) • Deepened and widened approaches • Increased use of IT and radio communication in the operations
			Opportunities		
			<ul style="list-style-type: none"> • Benchmarking • Demanding customers 		
Concluding remark					
<ul style="list-style-type: none"> • Team organisation • Creation of willingness to change • Participation 					

Port of Duisburg					
Barriers to applications	Ways to overcome	Most promising changes	Threats	Port training and education	New technologies
<ul style="list-style-type: none"> Limited economies of scale (in relation to ICT applications) Short term investment strategy Insufficient market demand 	<ul style="list-style-type: none"> Co-operation between companies 	<ul style="list-style-type: none"> Functional diversification Public-private partnership (p.p.p.) 	<ul style="list-style-type: none"> Competing modes (esp. railways) Loss of volume 	<ul style="list-style-type: none"> Develop locally specific training programmes for container operators Develop locally a specific programme for ICT training related to port operations 	<ul style="list-style-type: none"> IT technology should be implemented The bottom-up approach seems more appropriate for the adoption of systems developed
			Opportunities		
Concluding remark					
<ul style="list-style-type: none"> the specific conditions of the whole area should be considered to explain and understand the port of Duisburg development at the same area two ports one public and the other private operate at the same time with different status 					

SWOT ANALYSIS

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
KOTKA	<ul style="list-style-type: none"> • Development of quality + environmental management systems • Implementation of team work 	<ul style="list-style-type: none"> • Slowly changing organisational culture • Planning the implementation of organisational models needs more attention 	<ul style="list-style-type: none"> • New container terminal • More transit traffic through the port • IT developments 	<ul style="list-style-type: none"> • Rigidity of old structure • International and national competition
ROTTERDAM	<ul style="list-style-type: none"> • Autonomous teams • Improving internal communication • Use of social techniques + scenarios • Non contractual industrial relations • Flexibility of ideas + Innovation 	<ul style="list-style-type: none"> • Lack of Financial means • Lack of Flexibility of technology • Resistance of users 	<ul style="list-style-type: none"> • Commercialisation of employment agency • Computer-based education • Exploitation of robotics • Floating cranes development 	<ul style="list-style-type: none"> • Ageing skills base • Inflexibility or robotics • Lack of harmony in negotiations
DUISBURG	<ul style="list-style-type: none"> • Functional diversification • Public – Private partnership 	<ul style="list-style-type: none"> • Limited economies of scale • Short term investment • Insufficient market demand 	<ul style="list-style-type: none"> • Local training programmes • Co-operation between companies 	<ul style="list-style-type: none"> • Competing modes • Loss of volume
GOTHE NBURG	<ul style="list-style-type: none"> • Team organisation. • Incr. Co-op with customers + near by ports • Implementation of ops. Management concepts 	<ul style="list-style-type: none"> • Conservatism • Pre-occupation with change issues e.g. pay • Transport infrastructure esp. rail 	<ul style="list-style-type: none"> • Expansion of RO-RO terminals • Exp. of container terminal • Increased use of IT Radio communication • Benchmarking • Demands of customers • Education + train • Increased resources 	<ul style="list-style-type: none"> • Ageing work Force • International competition • “Gap” between port and outside society • Approaches too narrow + shallow

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
THESSALONIKI	<ul style="list-style-type: none"> • Profit Orientation • Full Cost Recovery • Technological Breakthrough. • Private Sector Partnership • Work force Improvement 	<ul style="list-style-type: none"> • Culture • Conflicting Government Objectives • Problem of Financing Investments • Difficulties of Acceptance by work force • Bureaucratic organisation 	<ul style="list-style-type: none"> • Willingness of government • Strategic location • Opportunities in the Balkan Area • Access to Eastern European • EDP System • Use of Communication Technology for Training 	<ul style="list-style-type: none"> • Inappropriate Introduction of technology • Regional Instability • Lack of Resources • Industrial Action
IMMINGHAM	<ul style="list-style-type: none"> • Use of contract workers • Job training and education • Flat Management Structure • TQM / EXCEL Way of thinking • Encouragement of Training and Education • Self Improvement Philosophy Promoted 	<ul style="list-style-type: none"> • Conservatism • Questioning of commercial viability of concept / project 	<ul style="list-style-type: none"> • Expansion • Profitability Improvement • Better Working environment • Ergonomic Design • ICT Application to Improve quality of Service and management Efficiency. • Greater use of EXCEL Type Programmes 	<ul style="list-style-type: none"> • Loss of Business • Loss of Market Share • Take – Over • International Competition

6.4. Concluding remarks

For each port case study the main conclusions derived in terms of:

- Barriers to application
- Ways to overcome
- Most promising changes
- Threats
- Opportunities
- Port training and education
- New technologies

The consideration of the six case studies gives the opportunity to comprehend the following:

- ◆ The *human element* is the key to all the managerial and organisational change that is or will take place in every port. Not paying the proper attention to the employees first will lead every transition effort in ports to total disaster. On the

contrary *workforce empowerment* will involve the workforce in the decision making process and in the development of innovations

- ◆ *Team spirit* cultivation among the employees of every port will give the port management the opportunity to fully integrate all the workforce in every transition-change process and it will result in improvement of internal communication and in major developments in all aspects of every day work.
- ◆ *Education and Training* of the workforce especially in computers and information technology is a catalyst in every change process
- ◆ *Commercialisation* should be the driving force in every port that is trying to develop and compete against other powerful ports.
- ◆ The introduction of new technology in ports should be accompanied by *organisational change*. This change is possible with the use of new management concepts such as:
 - ❖ Just in time
 - ❖ Total quality management
 - ❖ Lean thinking
 - ❖ Outsourcing
 - ❖ The virtual company
 - ❖ Commercialisation and privatisation
 - ❖ Flexible working practices
 - ❖ Appropriate Pollution control and Environmental management
 - ❖ Appropriate Health and safety measures
- ◆ The *public-private partnership (p.p.p.)* is a very promising change allowing two companies, one public and the other private to operate at the same time with different status within the same port area.
- ◆ *Legal awareness* in terms of environmental, health and safety and employment legislation helps port management to avoid exposure to great risks and liabilities.
- ◆ *Management accountability* improves port management and leads to healthy and viable development.

7. The Transition Process in European Ports

7.1 The WORKPORT schematic model of the transition process in European ports

Figure 7.1 presents the WORKPORT schematic model, which describes how the European port industry has evolved since the 1960s and identifies key factors and milestones in this transition process. It also indicates a number of important continuing trends in the process and is largely based on the findings of the WORKPORT research. The WORKPORT Consortium initially considered the widely known UNCTAD 3 port generation model and tried to revise and extend it. But, following extensive discussions the Consortium finally rejected the notion contained in the UNCTAD model of port development that evolutionary process can be best described in terms of successive port generations each with its own well defined set of characteristic features. This is because of the difficulty of deciding which features determine whether a port belongs to a particular generation category, a process that is subjective and rendered virtually impossible by the fact that all ports are, to some extent, unique. The locational advantages they enjoy have largely shaped how they have developed and will, undoubtedly, influence their present development opportunities, too, and therefore their market strategy and the facilities they provide. For example, many ports may have terminals which are not the most advanced in technological terms, but they are the most appropriate for the port, since, given the volume of cargo being handled at a terminal, they provide the least cost solution for cargo handling and are, therefore, the optimal facilities. So, while it may be appropriate to describe such facilities as being, say, 3rd instead of 4th generation, based on the features of the technology being employed, it would be inappropriate to classify a port as such if the technology incorporated in its facilities is optimal for its present circumstances.

The WORKPORT model, moreover, contains operational and development port issues on the vertical axis, not considered by the UNCTAD one such as working cultures Health and Safety, Environment. Such issues have only recently become of importance and, understandably, the classification did not cover them sufficiently.

The main trends identified in Figure 7.1 by the arrows which highlight the important aspects of the transition process of European ports since the 1960s. They are the product of the search for greater efficiency and growth by port authorities and port based companies and of governmental policies, both national and local, aimed at promoting efficiency and growth in port and port related activities. They are also the product of the tighter governmental and EU regulation of such activities in order to reduce their social costs. These factors will undoubtedly continue to drive the transition process in European ports.

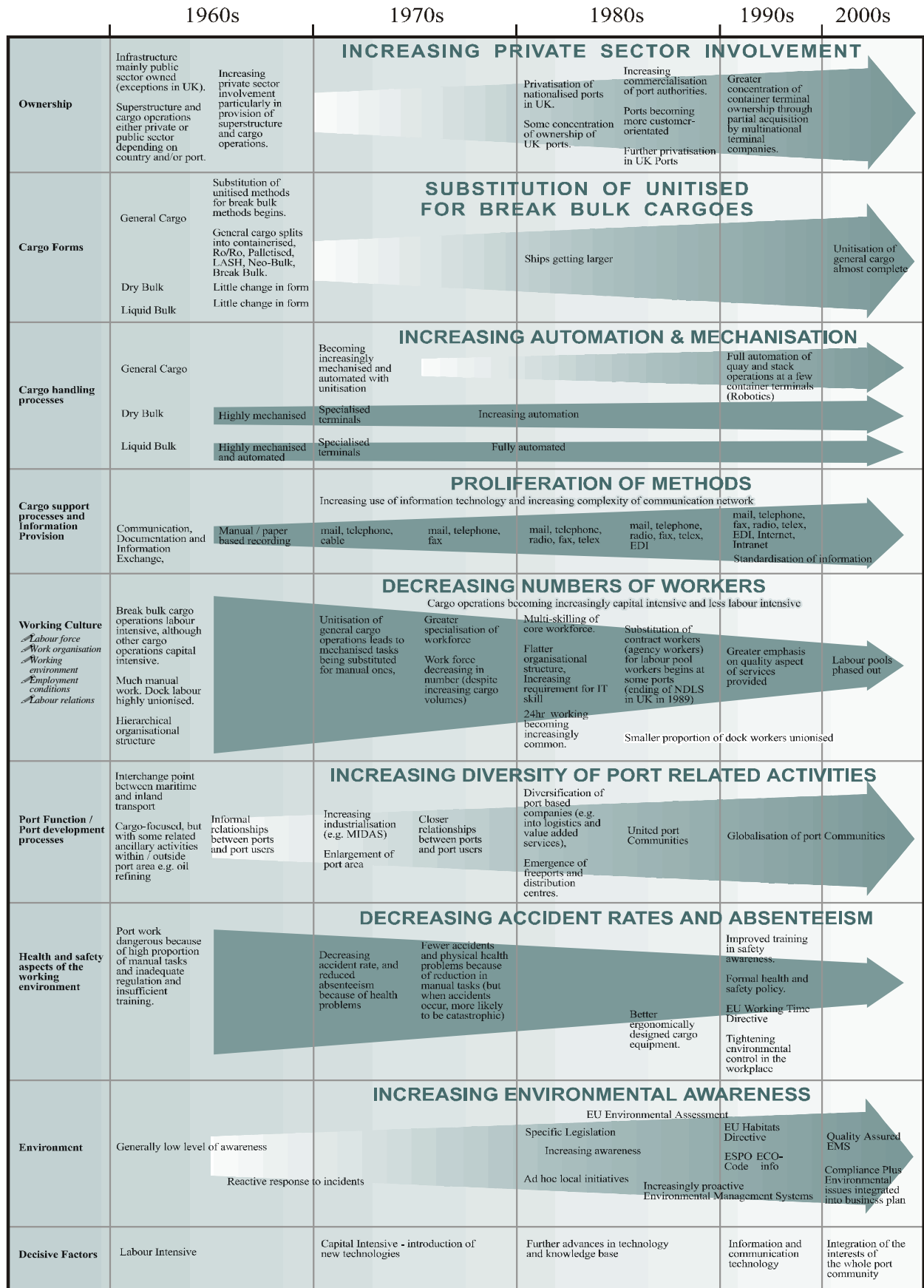
The WORKPORT model describes in detail the transition process and its main phases for European ports. However, it should be noted that not all European ports have followed these phases because they are affected by different external factors. A primary example is the case of PHARE countries' ports where it can be seen that the countries themselves are in different transition phases among them and this is also

evident in their ports.

Figure 7.1 on the whole, is rather self-explanatory but the reader can find more information on specific issues in the specific WORKPORT case study deliverables.

The port sector's policy is currently to encourage compliance to high standards through voluntary schemes of self-regulation by its members. The European Sea Ports Organisations' (ESPO) environmental code of practice (1994) and the ECO-Information project for port environmental management are port inspired initiatives.

Figure 1: WORKPORT Schematic Model of the Transition Process in European Ports



7.2 Strategies for the introduction and implementation of new organisational and management concepts to facilitate transition

Description of the model, need and scope for change

The model of the organisational change process is presented in Figure 7.2. The planning, implementation and follow-up of the change process require systematic management. The model gives structure to the change processes.

In the model, the subsequent phases build on each other. The identification of the need for change and planning of the change process influence the success of the whole process. If significant misjudgements are already made in the beginning, it affects the actions and outcomes in the end. Of course, some of the misjudgements can be corrected along the process, but in principal the former actions affect the ones following them. Often in a change process it is necessary to return to former phases to clarify the goals or to improve the implementation methods.

In all the phases of the model all economic, technological and human factors should be considered. The model can serve as a route map guiding the organisation where it wants to be. The need for change can arise from different reasons or sources. It is important that the organisation is able to recognise the need for change in advance. Organisations that are able to take precautions, actively plan ahead and shape their own future are called proactive organisations while reactive organisations just react to situations when they occur without attempting to foresee the future and identify the future demands.

Both internal and external demands for the change should be thoroughly analysed. It is essential that the need for change is recognised, understood and accepted in all organisational levels and groups.

Before actually implementing the change, organisation's weaknesses and strengths should be analysed to exploit strengths to full extent and minimise the effects of the weaknesses because they can jeopardise the success of the whole change process.

Issues to be analysed include:

- Current situation
- Weaknesses
- Strengths
- Opportunities
- Threats
- Obstacles
- Stakeholders (interested parties)
- Key issues and strategies

Possibilities to begin a change process can be assessed by conducting surveys. The personnel can respond to the existing situation and give suggestions to the change process. The willingness to change can be detected.

The analysis of the possibilities to begin a change process is often neglected. It is often seen that the analysis of current situation takes too much time and serves no important purpose although sometimes it is actually more efficient to improve some parts of the existing system rather than implementing the change at all.

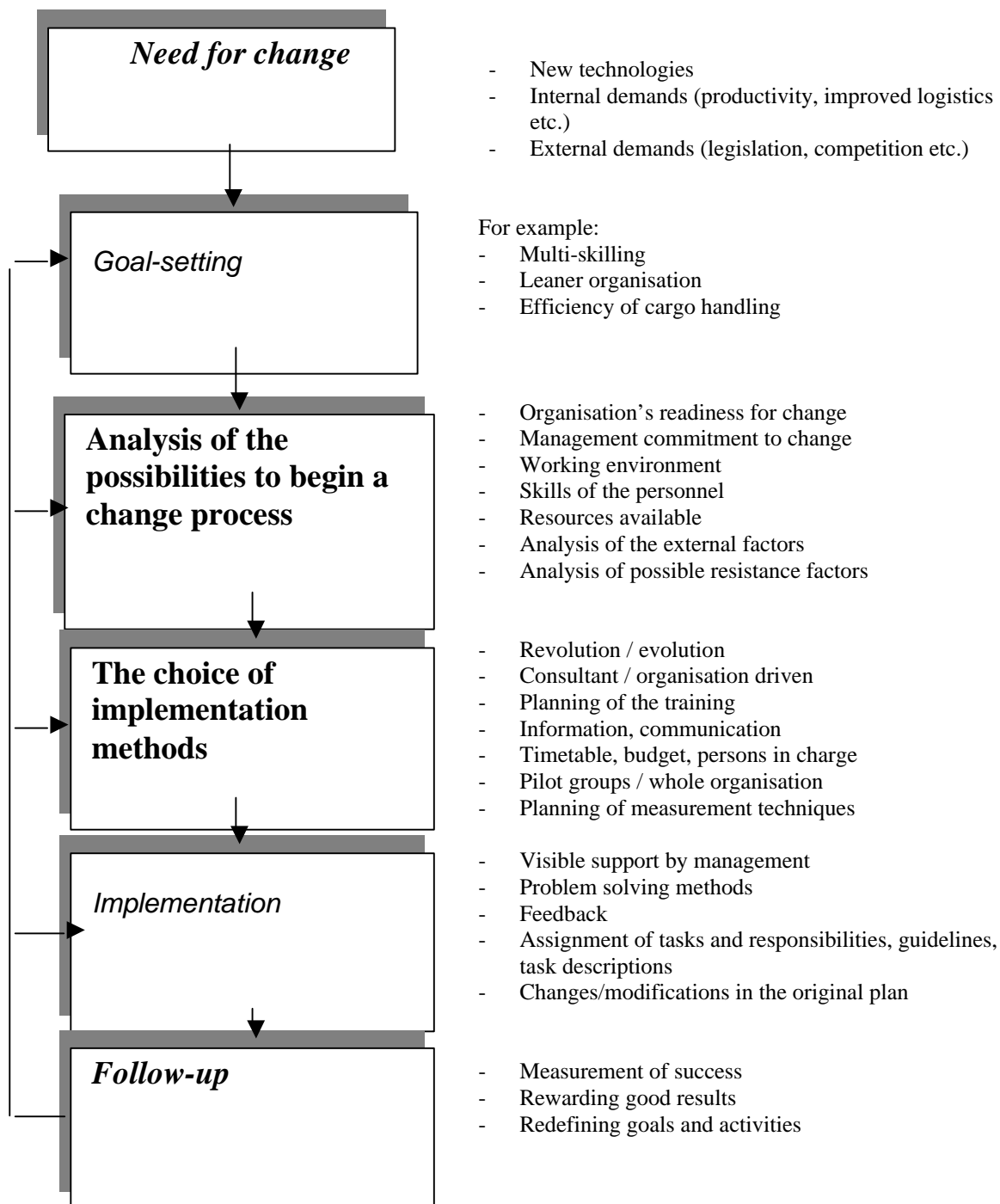


Figure 7.2. Organisational change process

Example from case study ports- Implementation of team organisation in Port of Immingham

Need for change- following the end of the National Dock Labour Scheme, working practices within UK ports were extremely inflexible with low turnaround time for ships and the workforce was not being organised in an efficient and cost effective way. The port of Immingham was already operating in a commercially competitive environment and therefore had to maintain a downward pressure on costs while at the same time improving productivity.

Goal setting- Team working allowed a number of targets to be achieved, it facilitated a more efficient use of human resources as no extra workers were required for a given task (an allocated team covered the work) and workforce absenteeism was reduced.

Analysis of the possibilities to begin a change process- an outside contractor developed the scheme for the company in conjunction with them in order to tailor the scheme as much as possible to the company's needs. The workers were required to participate in the training and were allocated to teams and the result of the implementation was that many new ideas were developed which might not otherwise have occurred.

The choice of implementation methods- The implementation of the scheme was decided at the group level rather than at the individual port level. No incentive was provided and it was a requirement that every employee undertook the formal training for the scheme.

Implementation- Once all port employees had received the formal training the team system was implemented. Team working is now the preferred system of working, replacing the gang system, which existed previously.

Follow-up- The team system of working provides an interactive system between management and workers. This creates a more responsive system for management of the port and allows for the development of ideas, which might not otherwise have been considered. Following the ending of the EXCEL system as a specific system, team working has continued, and will probably evolve further, but in a less structured way.

7.3 Overview of the process and main lessons learnt

In Figure 7.2 the organisational change process was outlined. Reality does not often follow any models or ready-made structures but creates a wider and more diverse picture of the actual practices. In the examples considered by WORKPORT (here only Immingham is presented in brief) the phases were not always clear-cut. In addition, the order of the phases varied. Each phase is now discussed with reference to the case examples.

7.3.1 Need for change

The push factors for change were quite similar in all our examples. Competition was an important factor in all our case study ports. Ports expect to increase their competitiveness by implementing new organisational and management concepts.

Flexibility is a theme that was considered in all the case change processes. This is hardly surprising because flexible structures of the organisation usually increase the competitiveness of the organisation. However, the concept of flexibility can be approached from different angles. Flexibility can apply to:

- 1) external partners and subcontractors
- 2) the number of personnel and
- 3) the working time.

All three aspects of flexibility are widely used in the port sector. Moreover, flexibility, efficiency and productivity are inextricably linked.

At Kotka and Immingham privatisation has probably affected the changes that have taken place. In Immingham port privatisation took place in 1983 but it was not until after the end of the NDLS in 1989 that major changes occurred. In Kotka the (semi) privatisation took place in 1999. Privatisation often requires changes in organisational and management concepts. When operating in the private sector the flexibility requirements are often somewhat higher than in the public sector.

At Rotterdam the introduction and implementation of new organisational and management concepts was linked to the implementation of new technologies. Organisational changes must be carried out when technological changes require them.

Some of the reasons for change were external (competition, good examples from other industries) and some internal. Human factors were not seen as a requirement contributing to the need for change. Improved working conditions were seen more as a consequence or by-product of the implemented changes.

7.3.2 Goal-setting

The goals were formulated based of the identified needs for change. The goals in the ports included, for example, multi-skilling, efficiency both in cargo handling and in the use of human resources, profitability and productivity.

Some of the goals were measurable and others were not. Similarly, some of the goals were quite specific and others were more general. It seems that little effort was put to the measurement of how well the goals have been met.

The majority of the goals were so called “hard” goals, for example productivity, cost savings and profitability. Some goals were “soft”, for example improvement of communication, better management and workforce relations, generation of ideas and shared values.

Goal-setting alone is not enough. Goals have to be communicated to the personnel. It remains unclear how the goals were communicated to the workforce and how well goals were internalised and accepted.

7.3.3 Analysis of the possibilities to begin a change process

It appears that in the examples the possibilities to begin a change process was analysed but it was not done very systematically. Often the possibilities to begin a change process are not assessed very early in the change process. For example, the analysis often takes place after deciding on the implementation methods but before the actual implementation. In some cases it could be seen that the analysis was done only after several unsuccessful change attempts.

At Rotterdam the strengths, weaknesses, opportunities and threats were analysed as part of the socio-technique approach and a group also produced a document of the internal and external demands.

The analysis can be done at different organisational levels. It seems that many analytical tools and methods are in use. However, the analysis of the working environment, the management commitment to change, and the possible resistance factors were not very thoroughly analysed in any of the examples. Probably these issues are the most difficult to assess and discuss.

7.3.4 The choice of implementation methods

Communication and access to information are important issues in every organisation. Based on the case examples, the implementation of new organisational concepts was quite well communicated to the personnel and discussed with them. The problem was that usually the information delivery and discussions were not enough. The personnel also must have time to adjust and understand the changes. Resistance is often a result of not understanding the goals and the importance of the change.

In all the examples the change processes were more evolutionary than revolutionary. This means that the planned changes were based on the organisation’s current culture, habits and values. Although the work process, the work contents, and the work shifts changed notably in some cases, the basic work still remained the same or changed very slowly. The technological developments have typically more dramatic effects on work than on organisational changes. For example, new technology has improved the safety of work by reducing the number of heavy physical work tasks, but on the other hand it has increased the need for decision making and computer skills at work.

At Rotterdam groups were used for deciding on important issues and implementation methods. A group of twenty (managers, specialists etc.) developed the firm's desired image. The document that was created in co-operation serves as a guideline in the process of the organisational design.

External consultants or experts were used in the three examples. The consultants were used for the planning of the process and training. It seems that ports do not have the expertise or resources to carry out the change process internally.

In all case examples training was one part of the implementation of the new organisational and management concepts. Introduction of new management concepts thus increase the amount of training given. Training can take the form of general training (team training, general computer skills) and/or professional training (qualification training aiming at multi-skilling and the possibility of job rotation).

7.3.5 Implementation

In our examples the implementation was to a large extent carried out as it was planned. However, implementation does not always succeed the way it was intended. For example, in the Kotka case the implementation of team organisation by the port authority was halted after it began and postponed. The management noticed that a common understanding had not been achieved among management and other personnel and moreover the time was not right for the change as another important change was taking place.

7.3.6 Follow-up

Nowadays many development projects in organisations do not have a proper end, but they tend to transform and widen, and finally nobody knows whether the project is finished or not. Proper follow-up and assessment of the project would give information on where the project is going. Thus, follow-up does not only belong to the end of a process.

Based on the change process descriptions, many ports lack systematic measures when assessing the outcome of the implementation of a new organisational concept. There are some measures used, for example the number of team meetings held. Of course, some goals are not easily measured. For example, it is more complicated to measure well-being than the use of warehouse space.

New ideas or projects do not seem to arise directly from the assessment of the success of implementation. The results and experiences could be more effectively used for future improvement activities.

It may be concluded that the follow-up and assessment stage deserves more attention in the development process of ports. Follow-up actions ensure that new ideas and concepts are not forgotten after the initial application, but continue to have a positive impact on work.

7.4 Main Conclusions

The examples of the strategies for introduction and implementation of new organisational and management concepts that were presented in this chapter differ from each other. However, they illustrate both the factors arising from the management change and the factors that are likely to lead to its successful accomplishment.

7.4.1 Possible problems

- The process is implemented too quickly so the workforce does not have enough time to adapt to the change.
- The process is implemented too slowly, so visible changes cannot be seen soon enough causing frustration.
- There is too little worker participation so employees are unable to influence the process.
- Worker participation takes place too late so employees cannot influence the planning of the change process.
- There is resistance to change. Changes are often resisted when the importance or benefits of the change are not fully understood.
- The importance of the human element is not considered or communicated when formulating the goals of the change.
- The goals of the change are communicated but not fully understood by the personnel.
- There is a decrease in work efficiency because of unclear working instructions or inadequate training.
- The change gives rise to feelings of uncertainty among employees resulting in fear of losing their jobs.
- The change induces fear of having to learn a wide range of new skills.
- There is a lack of external consultants with specialised knowledge of port work and of the port environment.
- Within the new organisational structure managers' formal or informal power is decreased so they are resistant to change.

7.4.2 Success factors

- Management is committed to the change.
- Key persons have determined that the change should succeed.
- Adequate information is delivered during the whole process.
- Adequate communication and discussion takes place.
- All personnel understand the goals and the need for change and are willing to commit to it.
- There is wide participation by all groups affected by the change at all levels within the organisation.
- Different groups and their special needs and wishes are considered.

- Improvements are made through the generation of ideas: employees' ideas are considered and if possible implemented. The reasons for not implementing are communicated.
- Unions are involved in the process.
- Appropriate measures are taken for dealing with resistance and resolving the resistance factors.
- A thorough analysis is made of the current situation and considered when deciding upon the implementation methods.
- New organisational and management concepts are tailored to meet the port company's needs
- Both qualitative and quantitative goals are set.
- There is a linking of the specific goals of the change process to the organisation's general goals.
- The introduction and implementation of new organisational concepts are integrated with the other organisational functions of the company.
- There is follow-up to assess the outcome of the process.
- Use is made of the outcomes of the process and the lessons learned when designing new changes and setting new goals.
- Training and education are seen as integral parts of the change process.
- There is implementation of the best practices from other industries.
- Use of carefully selected incentives, monetary or other incentives is made.
- There is an ability to identify the need for changes in the original plan.
- Assessment and analysis is carried out throughout the whole process.

7.4.3 Issues affecting the validity of the results

- Only five case study examples were considered. They are not however representative of all types of ports within Europe.
- There were many development projects going on in each case port but only one process from each port was chosen for close examination.
- The case study examples were quite different from each other; an implementation plan not a description (Thessaloniki); a very wide and all-inclusive socio-technique approach (Rotterdam); very few organisational or technological changes (Duisburg); and team organisation (Kotka and Immingham).

Many issues that play an important part in the introduction and implementation of organisational concepts (like the working environment, management commitment, resistance by managers and employees) are difficult to observe, raise or describe.

8. Education and training for port workers to facilitate transition

8.1 Overview of current training practices

As observed in previous chapters, the use of technology and the changing nature of general port work require a thorough practical skills and in some cases theoretical knowledge.

There is a need for an appropriate updating of port workers' education and qualifications, which has been increasingly recognised during the past 10 years in most European countries. As various port surveys interviews and personal experience have testified, the integration and co-ordination of training initiatives are of fundamental importance. Training institutions and companies must be able to detect the main development and trends in the sector at large and in the specific functional areas.

The ESPO 1998 survey on training in ports found that schools and colleges do not contribute to operational training for ports; on the contrary, a significant amount is provided in-house, in particular in countries like Finland, Norway, Spain, and the UK. In several of these countries, Spain, Norway and equally France⁶, in-house training arrangements exist in combination with courses offered by private providers. These private providers can be of various types, but in many cases, they offer a multitude of shorter courses with the aim of training the port workers for performing specific functions in the port. It has been argued that the problem with short stages is that they might be able to solve certain problems linked to lack of skills, but that they do not always provide the necessary larger perspective and deeper knowledge.

A large training institute would on the contrary be more able to provide wider perspectives and a more integrated approach to training, but so far, only in the Netherlands is the training institute (in Rotterdam) the most important provider of any type of training for all levels.

It would however seem that this kind of institution is highly regarded by the industry, and that the attempts to create similar arrangements are multiplying. The International Port Development Centre in Denmark is one such initiative of more recent date. The training centre unites a number of leading Danish vocational training establishments, which provide training to employees in ports in Denmark, Norway and several other countries.

In Belgium and Sweden, joint employer/union arrangements provide a significant amount of training. This was traditionally the case in a number of other countries as well, and, based on material collected in previous ESPO surveys, it would seem that joint employer/union arrangements have played an important part in setting up dockworker training schools in for instance Germany (Hamburg⁷) and France⁸.

⁶ In France, private provision and not in-house training is the dominant form of provision of training

⁷ ESPO (1994), p. 84

⁸ *ibid.*, p.150

8.1.1 General training requirements

The major trend in education and training today is a shift from supply-driven teaching to demand-led learning. The focus is thus now on the demand -side, meaning the individual, the company who employs him or her and their joint needs and benefits. To the company, training has become a tool of project management. Policy- and knowledge- development should take place within the organisation, in the sense that managers should aim at linking existing knowledge within the organisation with increasing participation of the workforce in the training initiatives and the specific goals they are set to reach. These goals can include everything from improving an employee's ability to operate a truck to increased awareness of health and safety issues. Job-related operational skills and safety and security procedures are important issues in port reforms, and even if they require slightly different types of training, the principle remains the same: appropriate and needs-based approach to the training of adults at work.

A significant point, which tends to be under-emphasised in a large number of surveys (which mainly focus on Northern Europe) is the lack of training culture, especially in specific countries. Interviews with employers and employees in certain ports in Southern Europe have given evidence to the fact that not everywhere is training and focus on, for instance, health and safety related matters a part of the daily operation of the business or port.

In fact, until recently, vocational training in many areas, including ports, consisted of so-called informal, on-the-job training and learning-by-doing. Port work was thus considered to be unskilled work. Today, the situation is different in that almost any job or function requires a certain amount of formal skills - skill being defined as knowledge of the means or methods to accomplish a given task. The scope for vocational training has thus been greatly extended, to include previously unskilled functions and unskilled employees in various sectors and at various levels. Historians who have observed the development of dock work in European ports remark that it is actually only during the last 3 or four decades that certain port-work activities have started to become skilled. There is a tradition for absence of both initial and continuous education for the old "blue collar" professions such as the dockers. The latter is taken to include all persons employed in handling and storing cargo in ports and on board ships⁹.

WORKPORT has studied the impact of new technologies on (manual) workers in the port, taking into account the disappearance of certain manual functions and the creation of new functions of a more administrative character.

According to a CEDEFOP's (European Centre for the Development of Vocational training) comparability study, the qualification requirements for skilled dock-workers employed in Europe's sea and inland ports have changed dramatically in the last few years.

There is a large port worker population requiring training (well over 1 million port workers according to ILO's publication: Couper, (1985) "New cargo-handling

⁹ Definition used for instance by UNCTAD, ECLAC etc. See for instance ECLAC 1996, p. 13.

techniques and their implications for employment and skills”), particularly in the unionized and general cargo trades, and with supervisors, foremen and equipment operators seen as the priority job categories.

As it has been suggested high priority should be given to health and safety training. This training should be seen in a broader perspective, where focus is on factors relating to the organization of work, the division of work and physical exposures in the workplace.

SUMMARY OF GENERAL REQUIREMENTS

- Training and education becomes the key instrument for human resource management.
- Promotion of vocational standards for port workers
- Promotion of co-operation among training institutes and other actors of the port community
- Education on the management of change
- Need for continuous training (long life training)
- Creation of real training department in port
- Apply a decentralized approach to education and training (bottom-up approach)
- Training is not worth understanding unless it is reinforced by actual practice (transferability of knowledge)
- Training should focus more on functional aspects rather than on technicalities (more process oriented than product)
- Multi - skilling training
- Communication between management and port workers where they can mix on an equal basis to discuss general and specific issues relating to port practices
- Quality assurance systems and performance related mechanisms
- The focus is on the demand-led learning
- A training culture should be activated in all port organizations in order to reinforce any training activity
- Pedagogical guidelines should be well established.

Table 8.1: New technologies in ports – training requirements emerging from their implementation.

New Technologies in Ports	Level ¹	Provision ²	Standardisation ³	Co-operation ⁴	Use of new technologies ⁵
Increase of ship size	V, T	T ¹⁰ , P	N/A	P	N/A
Mobile communications	V	O	E, N	M, C	M
Global Positioning System - GPS	V	T	E, N	P, M, C	S, M
Vessel Traffic Services	V	T	E, N	P, M	S, M
Navigation support	V, T	P	E	P, C ¹¹	S, M
Manoeuvring and collision avoidance support	T	P	E	P, M	S, M
Automatic Crane Control	T	P+M	P	P, M	S
Automated Guided Vehicles – AGV	T	P+M	P	P, M	S
Automated Stacking Crane	T	P+M	P	P, M	S
Robotic Container Handling	T	P+M	P	P, M	S
Electronic Data Interchange – EDI	V	T	E	P, M, C	M, T
Cargo Card	T	P	E	P, M, C	M
Tracking and Tracing Systems	V	T	E	P, M, C	S
Warehouse systems	V	T	N	P, C	S
Rail transshipment systems	T	P	P	C	S
Barge container transshipment systems	T	P	P	C	S
Environmental monitoring	E, T	P	E, N	P	M

¹ E: Education, V: Vocational training, T: Task specific

² P: Port, M: Equipment Manufacturer, T: Training centre, O: Other

³ E: EU level, N: National level, P: Port specific, N/A: Not applicable

⁴ P: Co-operation between ports, M: Co-operation with manufacturers, C: Co-operation with other companies

⁵ S: Simulator, M: Multimedia, T: Tele-conference, N/A: Not applicable

¹⁰ Vocational training centre

¹¹ Especially shipping companies

Table 8.1 presents the new technologies in ports and the requirements emerging from their implementation, in terms of:

1. Level of education and training required;
 2. Provision of training;
 3. Level of standardisation;
 4. Level of co-operation;
 5. Use of new technology.
-
1. The level of training required – education, vocational training, and task specific training - for each new technology implemented, is presented in the first column. For the majority of the new technologies presented, task specific training is regarded as the most appropriate method of training for their implementation (e.g. automatic crane control, robotic container handling, cargo card, rail transshipment systems). However, vocational training may be seen as necessary for some of the new technologies that require a theoretical background as well as practical knowledge (e.g. mobile communication, GPS, navigation support).
 2. Provision of training is the next issue presented. The providers of training can be either the port authorities themselves, or the equipment manufacturers, or finally training centres. Port authorities are seen to play a major role in the provision of training, however, in many cases in collaboration with the equipment manufacturers. Training centres can contribute to a greater extent in the cases where vocational training is required.
 3. Standardisation of qualifications and training in general can be achieved in three levels: European, National, or port level. European and/or National standardisation is regarded useful in reference to new technologies such as mobile communications, GPS, and Vessel Traffic Services. Moreover, European standards would facilitate implementation of technologies like navigation support systems, maneuvering and collision avoidance support systems, cargo card, Electronic Data Interchange (EDI) and tracking and tracing systems. On the other hand standardisation in port level could be appropriate for new technologies, which require more technical skills to be implemented and which, consequently, require task specific training provided by the equipment manufacturers.
 4. Co-operation could be an important factor towards facilitating the process of utilisation of the new technologies in ports. Co-operation, in terms of training, can be sought between ports, or with manufacturers or even with other companies. Most of the times, co-operation in more than one of the levels presented earlier may be beneficial. More precisely, co-operation in all three levels may be appropriate for the implementation of new technologies such as GPS, Electronic Data Interchange (EDI), cargo card, and tracking and tracing systems. For other systems of new technology, such as Vessel Traffic Services, maneuvering and collision avoidance support systems, automatic crane control, AGV, automated stacking crane, robotic container handling, co-operation with other companies may not be seen as a priority. This level of co-operation can be more substantial in cases like, rail transshipment systems or barge container transshipment systems.

5. Last column lists the appropriate training methods for each of the new technologies presented. There are many types of simulators of developing sophistication that are increasingly applied along with multimedia and teleconference.

Conclusions.

There are two main categories of new technologies in ports which require training provision.

The table below illustrates the main training provisions for the two categories.

Table 8.2: Main training provisions for the two main categories of new technologies

	Provisions for category 1	Provisions for category 2
Level of training	Task specific training	Vocational training
Provision of training	Port authorities & equipment manufacturers	Training centres
Standardisation	National and/or port specific	European and/or national
Co-operation	Between ports & manufacturers	All levels of co-operation
Training methods	Simulators	Simulators, multimedia, teleconference

Category 1. (Handling related)

Examples: Automated Crane-Control, Automated Guided Vehicles, Automated Stacking Crane-ASC, Robotic Container Handling.

- For the first category task specific training seems to be an appropriate method facilitating the implementation of these new technologies in ports.
- Provision of training, for this category seems to be best derived from port authorities with the collaboration of the equipment manufacturers.
- National and/or port specific standardisation might most suitable for this kind of new technologies.
- In terms of co-operation, co-operation might be most beneficial in the level of collaboration between ports and with manufacturers.
- Simulators seem to be the most appropriate training method for their implementation

Category 2. (ICT related)

Examples: Mobile communication, Global positioning system, Vessel Traffic Services, Navigation support.

- New technologies in this category require vocational training in a greater extent
- Provision of training mainly by training centres
- These new technologies address a need for standardisation in a European and/or national level.
- Co-operation in all levels

Table 8.3- New technologies in ports and their potential impact on requirements for training and human well-being.

Operational Areas - New technologies	Requirements for job qualification and training	Human well-being
<p>SEA OPERATIONS</p> <ul style="list-style-type: none"> • Mobile communication 	<ul style="list-style-type: none"> • User training 	<ul style="list-style-type: none"> • Increased job satisfaction by improved communication possibilities; working improvement for the planner
<ul style="list-style-type: none"> • Global positioning system 	<ul style="list-style-type: none"> • New qualifications 	<ul style="list-style-type: none"> • As a reliable navigational system increases the safety of the crew on board
<p>SEA SIDE</p> <ul style="list-style-type: none"> • Vessel Traffic Services 	<ul style="list-style-type: none"> • Changes the role of the pilot • Training of operators both ashore and on board 	<ul style="list-style-type: none"> • Improves the safety on board the ship
<ul style="list-style-type: none"> • Navigation support 	<ul style="list-style-type: none"> • New qualifications, e.g. working with electronic chart 	<ul style="list-style-type: none"> • Reduces navigational workload; increases safety on board
<ul style="list-style-type: none"> • Manoeuvring and collision avoidance support 	<ul style="list-style-type: none"> • New qualifications 	<ul style="list-style-type: none"> • Improves the safety on board
<p>TRANSHIPMENT SEA-LAND</p> <ul style="list-style-type: none"> • Automated Crane-Control 	<ul style="list-style-type: none"> • New qualifications 	<ul style="list-style-type: none"> • Improves the work conditions; enlargement of the job (a larger number of cranes to supervise)
<ul style="list-style-type: none"> • Automated Guided Vehicles 	<ul style="list-style-type: none"> • Higher qualifications to former operators (job redesign) 	<ul style="list-style-type: none"> • Improve safety and working conditions

<ul style="list-style-type: none"> Automated Stacking Crane-ASC 	<ul style="list-style-type: none"> Higher qualifications to former operators (job redesign) 	<ul style="list-style-type: none"> Improve safety and working conditions
<ul style="list-style-type: none"> Robotic Container Handling 	<ul style="list-style-type: none"> New qualifications, e.g. in the monitoring of the RCH process 	<ul style="list-style-type: none"> Improve safety and working conditions
<div style="background-color: #cccccc; padding: 2px;">LAND SIDE</div> <ul style="list-style-type: none"> Electronic Data Interchange-EDI 	<ul style="list-style-type: none"> Additional training or retraining needed 	<ul style="list-style-type: none"> Eliminates one “social” element in the work community
<ul style="list-style-type: none"> Cargo Card 	<ul style="list-style-type: none"> User training 	<ul style="list-style-type: none"> Reduces possibilities to make errors
<ul style="list-style-type: none"> Tracking and Tracing Warehouse systems 	<ul style="list-style-type: none"> New qualifications to operate the warehouse systems 	<ul style="list-style-type: none"> Improve safety (less accidents)

The range of new technologies presented in Table 8.1 are applied in the above operational areas (sea operations, sea side, transshipment sea-land, and land side operations). Their application calls for the identification of the requirements in terms of qualifications/ training, presented in the second column of Table 8.3. Moreover these requirements are also prompted by - or they are proactive for – aspects regarding human well-being (occupational safety). Thus, there is a bilateral relation between training requirements and human well-being deriving from an effect/ impact pattern.

8.2 Lessons learnt from the WORKPORT case studies and the application of the assessment framework

8.2.1 Case studies

The six case studies for workpackage 5 of the WORKPORT project, each aimed to evaluate the existing situation in the ports. The results of these case studies, as far as training and education is concerned are discussed below.

Case studies

- *The requirements for education and training that the introduction of new technology and new organizational concepts have imposed, are accepted and considered by ports*
- *Most ports have provision for training and education of newly recruited employees*
- *Most training is provided on a demand - led basis*
- *The most often used method in training is on-the-job training.*
- *The need to include safety and health issues in the education and training activities is identified and most of the times cared for.*
- *Environmental policies in most ports are acting towards rising environmental awareness of all employees.*
- *New organizational concepts, where implemented, do not address the training and education issue in a systematic way.*
- *New technology is rarely used for training.*
- *There are no standards for qualifications and minimal co-operation with other bodies (government, educational institutions, other ports, training providers)*

Stated Preference Analysis:

The assessment tool for the interviews conducted in the six case studies was the Stated Preference Analysis (SPA). The Stated Preference Analysis has proved to be a successful tool to find out more about the elements that determine the attractiveness of a port job.

Stated Preference Analysis:

- *The results presented depict, to some extent, the situation in each port*
- *Workers as well as management in the port of Kotka, for example, attach less significance in the level of education and training for port workers' job satisfaction.*
- *Port workers attach to the level of training and education required, more significance than the managers. This difference can account for the lack of training provision in new organizational plans in many ports which are designed and imposed by each port's management.*
- *There seems to be no direct link between education and training and career development and job rotation (multi-skilling). It has been stated, that education and training is a prerequisite to multi-skilling and is closely related to career advancement. However, both workers, and in a greater extend ports management have rated career development as carrying more importance to port workers job satisfaction compared to training and education.*

8.2.2 Main gaps in present port E&T schemes.

1. Lack of awareness of definitions concerning learning, training, education and self-development.
2. Lack of awareness on the modern vision of education and training
3. Lack or absence of incentive systems, training and human development policies and strategies linking and integrating career development, promotion and remuneration with training.
4. Training tends to concentrate on higher levels of staff. No systematic training and career development programs at lower and middle levels have been instituted.
5. Lack of monitoring of the effectiveness of the port E&T
6. Port management gives little or no consideration to the impact of technological changes on future requirements concerning training of port staff.
7. Lack of vision and support from both, management and trade unions.
8. Too little attention is paid by the port companies to the organisational side of technological change.
9. Absence of a working climate and conditions capable of stimulating, recognizing and recompensing training and human resources development.
10. Insufficient attention to the required quality and credibility of instructors, courses, training techniques and materials
11. Lack of European common standards on port vocational training.
12. Lack of subsidiary provisions (career and stress counseling).
13. There is a port E&T financing gap.
14. Lack of awareness of the significance of Maritime sector (including ports) for economic growth and development
15. Training was neither oriented towards increasing competencies nor conceived as a process in which port workers would acquire aptitudes, skills and knowledge required to cope with new multi-purpose functions, new handling technologies and the challenges of a restructured, competitive and commercialized port sector
16. Inadequate environmental training.
17. Inadequate safety and health training provisions.
18. Lack of life-long training provision

8.3 Utilisation of new technology and organisational aspects for port education and training

As a result of these technological advances occurring in the port industry, and in order to benefit from their implementation, ports need to make provision for relevant training at appropriate levels for their employees. The motives for facilitating programmes of training and education include both the issues of health and safety, and that of efficiency —they are not mutually exclusive. It is evident that training and education in these situations require new methods and approaches that will provide an ongoing learning culture closely linked to the new technological equipment used in the port itself. The status in Human Resource Development is reflected in the Proceedings of the International Port Training Conference held biannually since 1970 and which most recently reported in Goteborg, Sweden 1999.

New technologies that can be used for port E&T.

Teleconference
Videoconference
Audio graphics
Multimedia
Simulation
Internet
World Wide Web
Computer based training
Machine Interactive training

Factors in selection

Cost
Quality of learning
Accessibility
No. of trainees
Flexibility
User friendliness
Reliability
Obsolescence
On – line assessment
Distance learning requirement
Feedback
Essential training

Organisational aspects for Port education and training

In order to achieve goals such as operational efficiency, workforce flexibility, quality of service, improvement of health and safety, environmental protection, cost effectiveness, compliance with market demands, compliance with labour market demands, and promotion of equal opportunities, Port Organisations should review their Human Resources Management (HRM) techniques in a way that training and development of employees is seen as a priority and as the main agent of changes in all levels of the organisation. In other words, training will be a tool, which the enterprise can consider to be strategic internal resource.

Training and development should be regarded as central to anything that can be termed HRM. The case that the adoption by companies of a strategic approach towards the training and development of their workforce represents a vital component of any worthwhile or meaningful form of HRM.

Furthermore, training and development activities have implications for attempts to motivate and involve in the workforce.

One of the primary objectives of HRM is the creation of conditions whereby the latent potentials of employees will be realized and their commitment to the success of the organization secured. This latent potential is taken to include, not merely the capacity to acquire and utilize new skills and knowledge, but also a wealth of ideas about how the organization's operations might be better ordered. These motivational aspects of HRM are bound up with investment in training, which enables employers to confirm to their employees that they are being regarded as important to the company's future success. However, a failure to treat expenditure on training as a necessary investment can rapidly undermine the credibility of an organisation's attempt to adopt HRM practices.

Another factor associated with the adoption of HRM policies is the need to increase the use of formal performance and/or training needs appraisal procedures. This can

result in many changes, mainly in the introduction of training in support of greater functional flexibility.

8.4. Towards a European Perspective on standards and harmonisation

8.4.1 EU vocational standards for port workers

It is important to mention that government or academic bodies do not impose vocational standards but they are developed by the industry itself. This is also the case for ports and port workers. In terms of port workers the range of formally certified skilled port worker qualifications which can be found in the individual labour markets of the EC member States varies greatly from one country to the next.

A mutual recognition of various country arrangements, and a harmonisation of common minimum standards at the European level is the typical approach favoured by the European Commission in a relatively large number of fields, including vocational education and training for ports. However, most actors in the field do insist on the fact that the type of approach to be adopted in the field of education and training depends on factors such as: size of the organisation, type of education and training programmes offered, characteristics of customers, degree of standardisation, ancillary services provided, other activities within the scope of the quality system, etc. In addition, more research is required on the real impact of, for instance ISO 9000 standards on the improvement of the content of education and training. One of the most important questions, which need to be addressed by every institution in relation to ISO 9000 are, reasons for seeking certification and expected benefits. Moreover, there should be awareness that there are different considerations to be taken into account, depending on type of education or training organisation.

However, it may be suggested that a European perspective may contribute toward the following goals:

- Promoting competencies and access to lifelong learning
- Monitoring developments
- Serving European mobility and exchange.
- The promotion of the transparency of training qualification and training systems (recognition of qualifications)
- The forecasting of trends in occupations and qualifications
- The analysis of new occupational profiles in the light of major challenges, such as new technology, environmental issues, and increased international competition.
- Key qualifications and curricular renewal of VET (Vocational Education and Training) – identifying and encouraging the acquisition of core/key skills and qualifications.
- Identification, validation and accreditation of non-formal learning.
- Descriptions of VET systems in EU member states
- Observing innovation in VET
- Financing VET
- Quality in VET

8.4.2 Recommendations for the future

National Training Organisations

The development of National Training Organisations¹² (NTOs) for ports that can have a vital strategic role in identifying current and future skill needs, ensuring that coherent education and training arrangements are in place to meet those skill needs.

- NTOs will provide a national (and even international) perspective on how the port sector is developing, and the implication for skills, possibly on a regional basis, and help with identifying skills needs and forecasts and help with working towards alleviating shortages.
- NTOs will identify the skills that the port industry needs in order to be competitive, through NTO sector and training targets, international skills benchmarking, and Foresight activities.
- NTOs will be able to supply up-to-date labour market information, and offer a good understanding of port sector trends and labour market trends.
- Developing port sector strategies to promote and deliver NVQs (National Vocational Qualifications).
- Providing information on careers in specific sectors and the characteristics and benefits of different training initiatives, such as modern Apprenticeships and National Traineeships. Advice on how to promote and deliver such initiatives could also be provided.
- NTOs will be able to bring the view of employers and employees directly to the table, and offer an excellent understanding of the views of employers and businesses.
- NTOs will improve the current and future competitiveness of the European countries by improving the knowledge and skills of people in all port sectors.
- Between others NTOs could line training with overall career developments

Introduction of modules in the port sector

A module imparts certain capabilities and the required knowledge, practical skills and practical experience, which may be linked to assessment or certification.

Modularization of vocational training can by no means replace systematic comprehensive initial training but can supplement it. In all Member States of the European Union modules will, however, be an indispensable characteristic for continuing training in the course of its systematisation.

Justifying the need for the introduction of European modules, a number of important reasons for bringing education for the port sector chain within one single institute of education are as follows:

- The chain consists of different links which have an impact on each other and need each other;
- The activities of the different actors in the chain have considerable similarities in a number of fields of knowledge;

¹² Following the example of such centres in the U.K.

- The knowledge of business economic processes has become important for everyone working in the chain;
- Modern developments in electronic data interchange;
- Developments in product data interchange, developments at the UN of standard messages (EDIFACT), the introduction of the just-in-time concept (J.I.T.), on line –transaction-processing (O.L.T.P.), developments in broadband-I.S.D.N.: the opto-electronic infrastructure of the fibre-optics cables which will probably form the main link between major centres at the beginning of the next century etc.;
- The possibility of INMARSAT communication;
- Higher and middle management are increasingly expected to be able to function in an integrated organisational framework

Ways to promote European Port Education and Training

- EU level standardisation and certification
- European level networking and co-operation
- Utilize lessons learned from other Industrial sectors
- Promote best practice examples
- Increase cost effectiveness of Port education and training provision schemes
- Mobilisation of European funds dedicated to training

9. Main conclusions and observations

There is an increasing diversity of port related activities.

- There is a drive towards closer relationships between ports, and united port communities and probably a globalisation of port Communities;
- There is a diversification of port based companies (e.g. into logistics and value added services);
- There is an emergence of freeports and distribution centres

Among the European ports there is a preference for developing/ upgrading existing technologies rather than developing new technologies due to financial risk and/or inflexibility of the latter.

- There are a small number of technology-leaders who are found only at high volume ports
- There are a large number of technology-followers who apply or adapt existing technologies
- There is a move towards automation of port operations, but there is a risk that full automation (robotisation) and at the same time the standardisation of work activities may hamper operational flexibility

Successful technological change is supported by organisational change in the ports.

- Ports are increasingly implementing autonomous teams to move towards multiskilling and a 'lean and flexible' workforce, and increased worker participation in the work organisation. Furthermore, more attention is being paid to communication between different autonomous teams to minimise inefficiencies and uneconomical use of equipment.
- There is a spread of 'quality culture' or total quality management.
- Flatter management structures are being established to encourage good vertical communication within a port organisation.

Main barriers for the application of new technologies and organisational concepts are the acceptance on the side of the workforce, and conservatism, lack of planning (short-term investment strategies), lack of financial means and lack of education on the side of the management.

- *Main success factors for change are:*
 - Commitment from the side of the management;
 - There is a linking between the specific goals of the change process to the organisation's goals;
 - Agreement on changes between both management and the working floor;
 - Good labour relations between management and unions and mutual agreement by co-operation;
 - Training and (re-) skilling before the implementation of changes;
 - Delivery of adequate information during the whole process;

Legislation, public opinion and cost advantages are driving forces in the implementation of Environmental Management Systems in ports. The response is currently to encourage compliance to high standards through voluntary plans for self regulation.

- An increasing number of ports are developing and implementing Environmental Management Plans
- The motives for devoting resources to environmental matters include legislation, marketing opportunities, health and safety, cost awareness and local community concerns amongst others
- Environmental, improved health and safety issues might begin to interest customers more and more in the future and thus become probably important image questions.

Compliance with environmental standards is best served by partnership between legislative and self regulatory approaches because of the inherent diversity of port characteristics. EU legislation needs to be applied uniformly in order not to distort competition.

- Many ports throughout ESPO are considering voluntary implementation of a recognised form of EMS such as ISO 14001 and EMS (both accredited), or port sector based options e.g. Eco-information or METESPO;
- One port (Kotka) and one terminal (Gothenburg) already have a certified environmental management system, other ports are making preparations also.

The components of health, safety and environment are becoming increasingly integrated in terms of managing effect and impact of activities on the environment of the workspace of the worker and of the wider environment, and as elements of Environmental Risk Assessment.

- A database of common parameters is increasingly recognised as a useful tool for baseline surveys, benchmarking, monitoring and performance reporting

The type of employees that will work in the port in the near future is not expected to change radically.

- The implementation of new technologies and new organisational concepts is, however, expected to result in:
 - A demand for better educated personnel, no longer unskilled, that are able to do more process operating work
 - Port workers need less muscular strength and more technical aids
 - There is a demand for more control functions and more maintenance engineers, as well as for port workers that have a knowledge of environment and safety aspects

Further observations:

- It is not the ownership of the port that has an impact on the change in ports, it is the degree of autonomy in the decision making process of the port.

- The implementation of new cargo handling equipment has a positive impact on the job satisfaction of the dock worker;
- Equipment is upgraded for greater productivity, but safety and ergonomics are improving at the same time;
- Ageing of the port workforce may lead to labour shortages in the near future for some North European ports;
- The type of contract, payments, adherence to safety procedures and the possibilities for career development largely determine the attractiveness of the port job for European dock workers.
- Safety systems are not as effectively created as environmental management systems.
- Safety issues should be revised when implementing team organizations or their organisational and management concepts.
- Ports are often very competitive with each other and this hinders co-operation between ports. However, in health, safety and environmental issues there could and should be more co-operation.
- Implementation of quality management systems have a positive impact on health, safety and environmental issues.
- Ports are still more dangerous working places than many other industrial work places.
- Private port and terminal operators can be very safety –conscious, as accidents are recognised as a cost which affects profitability
- Many hazards of port work are due to the insufficient conditions of the vessels. Port workers’ working environment is under continuous change.
- Implementation of the organisational concepts is partly related to the size of the port companies; bigger companies have more resources
- Concepts should be tailored to port work and individual port company’s needs
- Team work
- The implementation of new technologies reduce the physically strenuous work, but increase the mental work demand.
- First the information flow on an intra-company level has to be optimised, before the communication on an inter-company level can be optimised, which is an important topic in most ports. Co-ordination between different parties in the logistic chain is needed to optimise information flows.

Further research

In the WORKPORT project a methodology has been developed for a structured assessment of the impacts of new technology and new organisational concepts on the port working culture, that has proven to be sound and suitable for further research in this area. This is important since not much research has up till now been done in the field of assessment of socio-economic impacts in the port environment.

Best practices with respect to the implementation of new technologies and new organisational concepts have been studied in six European ports in the WORKPORT project. It is recommendable also to analyse the best practices in other European ports and to set up a network for the exchange of best practices between different European ports.

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ANNEX I- WORKPORT Deliverables

The project produced the following Deliverables:

D1: New technologies in ports and shipping

D2: New organisational and management concepts successfully used in other industrial sectors for transfer to the ports' environment

D3: Survey and reviews of existing and new organisational and management concepts for ports

D4: Socio-economic impacts of the introduction of new technology and new organisational/management concepts for ports

D5: Case studies of six ports

D6: Training and education needs in European ports

D7: Synthesis of results concerning the new organisational structures and suggestions for the transitional process

Internal Reports :

A5.1: The port of IMMINGHAM case study in the UK

A5.2: The port of Duisburg case study in Germany

A5.3: The container terminal of Thessaloniki case study in Greece

A5.4: The port of GOTHENBURG case study in Sweden

A5.5: The port of Rotterdam case study in The Netherlands

A5.6: The port of Kotka case study in Finland

A7.2: The port transition process : a model of main phases

A7.5: Strategies for PHARE countries' ports

ANNEX II- WORKPORT publications

- **“Port safety in a Transition Process”** by Kuusisto Arto, Vilppola Katja, Naniopoulos Aristotelis, 1st International Conference on Occupational Risk Prevention, Tenerife-Spain, February 2000.
- **“The Port of Immingham : a case study of a port’s approach to worker safety”** by A. Beresford, B. Gardner, S. Petit, C. Wooldridge, 1st International Conference on Occupational Risk Prevention, Tenerife-Spain, February 2000.
- **“Work organization in ports in a process of change”** by Aristotelis Naniopoulos and Panos Christidis 16th International Port Logistics Conference "A New Role for the Middle East in the New Millennium in International Cargo Flows", Alexandria, Egypt, February 2000.
- **“The WORKPORT and THALASSES projects “** presentation in the “Human Element and Socio-Economic Impact” session of the Building Bridges Conference that took place on the 30th and 31st of March 1999. This Conference was hosted by the Directorate-General for Transport (DG VII) of the European Commission and the Rotterdam Municipal Port Management and held at the premises of MarineSafety International Rotterdam.
- **“WORKPORT develops work organisations in ports”**. “Steveco” magazine, April 1998 edition.
- **“Computer prägen die hafenarbeit”**. The article was published in the “Rheinische Post” on the 17th of October 1998
- **“Technik – Trend gibt Hafen neues Gesicht”**. The article was published in “WAZ” on the 9th of October 1998.
- **“Professor: Duisburg geht endlich auf Rotterdam zu”** regarding the WORKPORT meeting in Duisburg. The article was published in “Neue Ruhr Zeitung” of October 9th 1998.
- **“Hafen befinden sich im Wandel- Arbeitstreffen von europäischen Forschern in Duisburg”**. “Zeitschrift für Binnenschifffahrt- ZfB”, a magazine on inland shipping.

ANNEX III- WORKPORT project

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