The impact of SMART Technology on skills demand –

from Hamburg Port to the world

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1 Executive Summary

Interviews were conducted in order to assess the skill demands in the three major sections of Hamburg Port Authority (HPA). The sections are waterway, railway and road transportation. There is no demand in the railway section. Demand at road section is 45 construction workers (operational level), 15 construction specialists, e.g. engineers (planning level) and 10 managers (operational level). Waterway section conducts innovative smart port projects in small teams of 3-5 people resulting in 35 people in total with skill demand in that section.

Based on the numbers for Hamburg projections for Germany, Europe and the world were conducted. The following projections only consider port authorities and similar port infrastructure and service providers. The only other significant German port is Bremerhaven. With a strategy for ICT based evolvement of its port, half as many people would be affected as at the port of Hamburg. Not considering construction workers and focusing on planning and higher levels 50 people have skill demand in Hamburg.

Extrapolation only based on container turnaround comes to the conclusion of 300 people with skill demand in Europe. This is an upper bound estimation. Only considering ports with a future strategy involving Smart Port and ICT the number is reduced to 200 people. A worst case estimation assumes only ports with no area for expansion need to increase their efficiency by ICT rather than infrastructure projects. In this case only 75 people in total have skill demand in Europe in the port of Hamburg and Valencia where further extending the area of the port is difficult. Projections for the entire world show 1,100 up to 2,600 people affected.

Based on the results of the study from Hamburg Harbour to the world following core results can be summarized to the effect of Smart Technology on occupations:

- Non ICT-affine occupations will change and integrate modern (smart) technology
- High demand of qualification on different occupational levels
- Process oriented training and education to enable a holistic occupational competence
- **57.000 persons per year in Germany;** 35.000 persons EQF Level 4, 12.500 persons EQF Level 5-6, 5.250 persons EQF Level 7
- **30.000 contracts per year in Germany;** Sum of all apprenticeship jobs analysed
- **2.386.721 employees in total in Germany;** Study of IAB* "Berufsgruppe Verkehr und Lager" 2011
- **7.224.042 employees in the "Berufsgruppe Verkehr und Lager" in total in Europe;** Eurostat 2014 Results without France, Italy, Austria and Malta – no statistics had been found in these countries

1.1 Objective of study

The introduction and technical development of smart technology or "Internet of Everything" requires qualifications at different professional levels. Besides the education of professional engineers and skilled workers also management skills need to be identified and analyzed.

The aim of this study is an assessment of skill demands and the skill requirements of occupations and professions in Intermodal Traffic Management (ITM) at various levels in the Port of Hamburg in relation to planning, implementation and application of Smart Port / Smart City technologies. Starting from the identified skill demands at the Port of Hamburg an estimate of demands in this area for Germany, Europe and the world is projected.

1.2 Methods of study

1. Qualitative interviews with people from different sections at the Hamburg Port Authority (HPA). Interviewees: Dr. Sebastian Saxe (CIO at HPA); Sascha Westermann (intermodal, operative IT- Traffic-Management); Harald Kreft (Infrastructure Railway); Jens-Erik Wegner (Infrastructure Street); Jörg Pollmann (Infrastructure Port); Karsten Schumacher (Infrastructure IT-Technology)
2. Extrapolation of the numbers for HPA to nationwide, European and global labor market.
3. Analysis of a broad national study to identify the qualification needs in the occupational sector of logistics. The German federal institute of vocational education and training developed this study for specific occupations in the sector of logistics in order to identify future skills especially in the field of new technology.
4. Analysis of the study to assess the economic value of the Port of Hamburg in the year 2013. In this study the PLANCO institute on behalf of the HPA had analyzed the impact of the economic value to specific direct and indirect occupation of the Port of Hamburg.
5. In order to get actual employment statistics for the logistics sector TUHH placed an order with the company Textkernel to identify actual labor market needs. Textkernel has access to nationwide online and offline job advertisement. Ca. 6000 job ads were analyzed to identify actual skill qualification needs.
6. Analysis of training and education regulations for specific occupations likely to be affected by IoE and IoT. The identified occupations at the HPA were analyzed to anticipate future qualification needs
7. Analysis of the European qualification forecast data done by the CEDEFOP (European Center for Technical and Vocational Education and Training (TVET)) in order to validate our findings against other results.

2 Research Methods

2.1.1 Qualitative Interviews

Objective: Conducting qualitative interviews is important to generate subject related data on the skill demands at HPA. The heads of the different HPA department and further people were interviewed. The data analysis showed inferences both on the qualification requirements in the Port of Hamburg as well as on the overall development of careers in the logistics industry.

Method: An interview guideline was developed after inaugural discussions with HPA management and Cisco Systems. The interview guideline contained questions relating to the composition and structure of the HPA departments. The core activities and the specific qualifications and training needs were determined. The results have been summarized and listed in Chapter 3.

Description: Six different interviews had been conducted with the Management of HPA and the Head of Department: Dr. Sebastian Saxe (Chief Information Officer of the HPA); Sascha Westermann (HPA management: Intermodal and Operational IT Traffic Management); Harald Kreft (HoD, Infrastructure Railway); Jens-Erik Wegner (HoD Infrastructure Street and Maintenance); Jörg Pollmann (HoD Infrastructure Harbor); Karsten Schumacher (project manager at HPA IT-Infrastructure)

2.1.2 Extrapolation of results

Objective: The numbers for skill demands at the HPA are extrapolated to assess the demand for Germany and Europe. Further a rough estimation for global skill demand in Smart Port logistics is performed.

Description: The number of employees affected by smart technologies at the HPA is assessed as baseline. Factors on which the number of people depends are evaluated and determined for the other major German port, Bremerhaven and the largest European container ports. The factors include the container turnaround, the number of employees, the modal split and the growth and innovation strategy of the ports.

2.1.3 Analysis of a Study to Identify Skill Demand of the Logistics Sector

Objective: In the year 2006 the Federal Institute for Vocational Education and Training (BiBB) conducted a study on the competence requirements in logistics from the perspective of enterprises. This study complements the qualitative interviews in order to assess the need for new technology in logistics (Smart Technology) in the nationwide trend (Blötz und Peppinghaus 2006).

Method: Out of approximately 2 million companies, which are listed by the Federal Employment Agency, a sample of 18,500 companies was surveyed. 4,382 companies responded, 3,326 questionnaires could be evaluated. 1,606 enterprises had a logistical task profile.

Description: The study pursues following questions:

- In which industry sectors and economic functional areas logistics plays a role?
- Which professional and interdisciplinary skills are important for the practice of logistical activities?
- What training needs are requested by the companies for employees with logistical tasks (threads, type of activity)?
- How do the enterprises assess the further development of logistics activities in their field?

2.1.4 Analysis of the Report to Assess the Economic Value of the Port of Hamburg in 2013

Objective: Employees depending on the port also have a high demand for qualification with regard to interconnection of work processes and therefore new technologies.

The report prepared by the Planco Consulting GmbH on behalf of HPA determines the economic importance of the Port of Hamburg for the Hanseatic City of Hamburg and the Metropolitan Region and the Federal Republic of Germany (Planco 2014). The analysis of the report has shown the economic importance of the logistical and infrastructural work of the harbor. The amount of employees depending on the port was analyzed. Based on that results the skill demands can be estimated when it comes to the interconnection of work processes and thus to the application of new technologies.

Description: The Planco study initially considers gross value added, employment and fiscal effects. In addition, the income is determined as the sum of self-employment, entrepreneurship and wealth. The fiscal effects are limited to the port-related tax revenues. This includes the income tax, the sales tax and the business tax and corporation accounts. It will be asked, to what extent, for example, jobs or value are linked to the existence of the Port of Hamburg, or whether they would not exist without the port, or at least not at this location.

2.1.5 Analysis of German job advertisements

Objective: For the identification of skill needs in logistics sector related job advertisement were evaluated. A total of 6099 jobs were identified nationwide for a period of approximately four weeks in the month of July 2015. Conclusions can be drawn about the nationwide demand for new technologies in the logistics industry and their related occupations since a full text search was used.

Description: The company Textkernel was commissioned to analyze job advertisements for specific keywords. Textkernel offers a quality parser, semantic search engines, as well as Big Data Analyzing for job platforms. Through this service we received access to full job ads and descriptions in the German logistics sector. Popular job portals such as the federal employment agency, Monster, LinkedIn, Xing etc., were analyzed with the aim to identify the actual needs for employees in this field. Not only the short description and the title of the Job advertisements had been analyzed, the full text body of the ads shows the demands for different levels of occupation in the logistics sector.

2.1.6 Analysis of Specific Occupations at the Port of Hamburg Related to Smart Technologies

Objective: Based on the qualitative results from the HPA interviews certain professional groups and their skill demands are identified. Representative occupations were selected based on those results and their training regulations are analyzed regarding the future use of smart technologies.

Descriptions: The occupational standards and the educational standards (German "Rahmenlehrpläne") for vocational training in the specific professional groups were analyzed and presented. The main occupations for that group are located in: the construction industry sector, the IT Sector, the road and traffic engineering sector as well as the logistics sector. Based on the description of the different standards the existing competences and skills were sketched and a forecast to implement smart technology was proposed.

2.1.7 Analysis of the Cedefop Forecast Report Data for Future Employment Trends

Objective: The European Centre for the Development of Vocational Training (CEDEFOP) published an approach on a study for the quantitative survey of skill demands in Europe in 2013. While these figures provide only rough assessment of skill demands for the statistical survey, it is nevertheless interesting to compare this survey with the results from our analysis.

Description: This study is applied across all ISCO occupations in Europe, based on the results of O*net and different empirical approaches to assess an estimation of the evolution of skill demands in Europe as a whole. For this, numbers from the year 2005 will be compared to current skill demands and a prediction will be performed.

3 Hamburg Port Authority

This chapter begins with a short introduction about the actual situation and requirements at the Port of Hamburg. The link between the existing infrastructure and the logistics value chain will be displayed. The aim of this chapter is to introduce the complexity of the Port of Hamburg to identify skill demands in a relatively small sector compared to the domain of the national education policy framework. The results of this chapter are mainly based on the qualitative interviews with the HPA.

Figure 1 shows the current cargo freight and its forecast at the Port of Hamburg. Based on the forecast, analyzed by the HPA, a huge increase of containerized cargo by 2025 can be expected. The Hamburg Port is 100 km away from the coast line of the North Sea connected by the Elbe River. In Hamburg there is little potential to expand the area of the port. An increase of the cargo freight can therefore not be countered by additional space. If the Port of Hamburg continues growing at that rate cargo handling can only be achieved through an increase in efficiency of the infrastructure. That means smart technology and automated traffic management will be an asset in the future. An increase in efficiency could be achieved through automation and integration of smart technology in many areas of the Port of Hamburg.

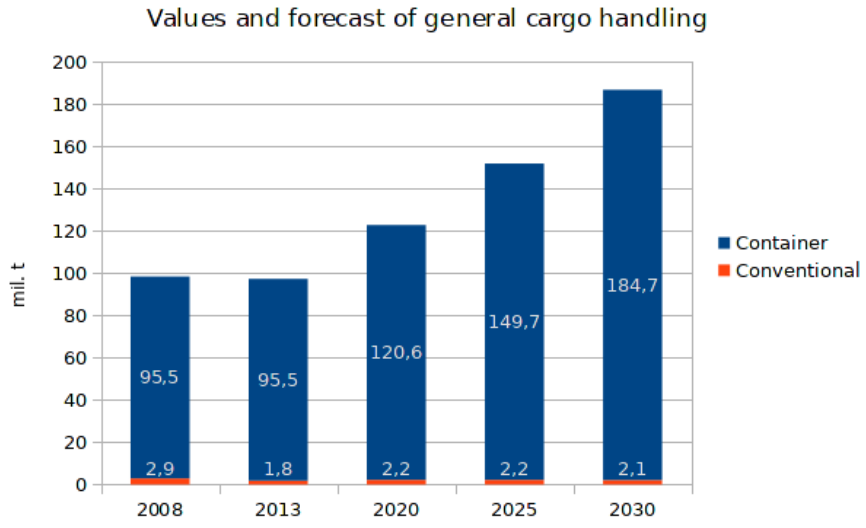

Figure 1: Values and Forecast of Total Cargo (Institute of Shipping Economics and Logistics 2015)

The increase in efficiency means greater automation and would have influence on the transportation, the traffic management and value change of the logistics sector. But shippers and shipping companies want free trade and no influence on their supply chains, especially when it is limited through the infrastructure. To ensure an intermodal traffic management the customer data needs to be visible, all log files and data must be trackable. This is mostly not in the interest of the shipping customers and often against German privacy regulations.

The increasing amount of cargo handling is a big challenge for the Port of Hamburg. Also the intermodal port hinterland traffic will rise (see. Figure 2). Especially by road and railway more cargo needs to be transported.

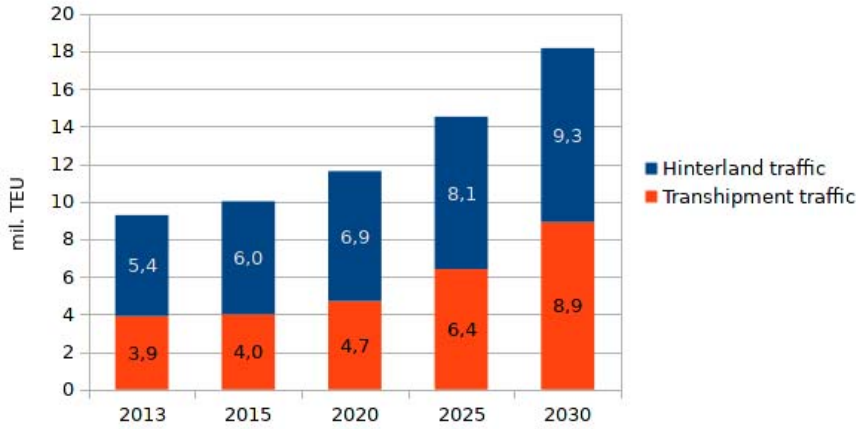

Figure 2: Intermodal Transportation Splits (Institute of Shipping Economics and Logistics 2015)

The transport logistics in the hinterland of seaports can be summarized as an intermodal transport system, with its departments (infrastructure) of transportation. The infrastructure is named after the medium carrying the associated physical cargo. The Port of Hamburg divides its infrastructure into road transportation, railways and waterways. To identify the qualification requirements and the skill demands of ITM, the different departments of the HPA are analyzed and described. In order to identify the details and the current challenges for the Port of Hamburg the Head of departments of the HPA Infrastructure were interviewed with guidelines to assess the qualification demands and the complexity.

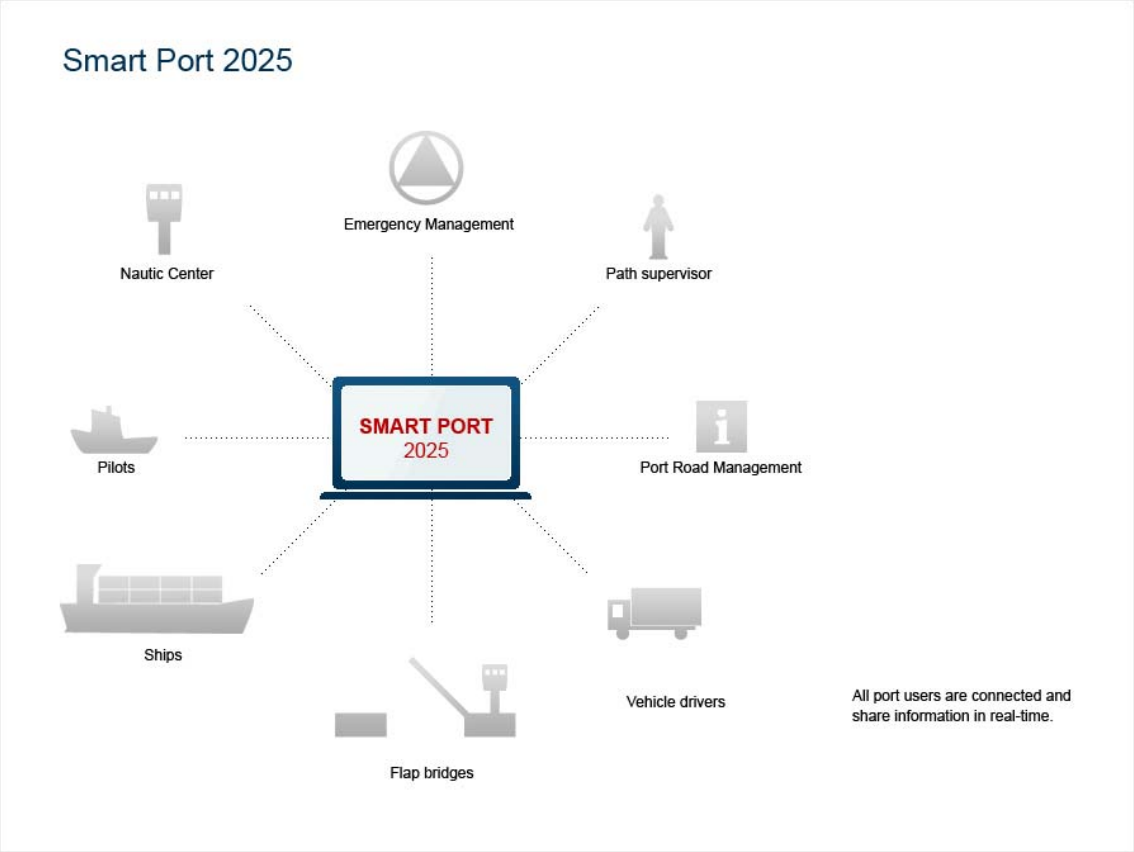

Figure 3: Vision of Smart Port 2025S (Hamburg Port Authority 2015)

Figure 3 gives a more detailed view on the vision of a smart three-part concept of intermodality and also presents a vision for the future. The infrastructure waterway is responsible for the managements of ships, pilots and the nautical center. The infrastructure road and railway is responsible for the Port Road Management, Flap bridges as well as for vehicle and train drivers. Emergency Management and the Path Supervisor have not yet been established. The infrastructure IT-Technology is responsible for a Smart Port Solution connecting all departments. In these four infrastructure sectors expert interviews were conducted with the respective department heads.

According to the department heads of the various infrastructure areas different skill demands can be identified:

- In demand for training in the railway and road infrastructure sections is present for operational as well as administrative staff. IT plays an important role in the Port of Hamburg. In IT different levels have been designated reflecting different qualification demands. An estimate of the actual skill demands is difficult to perform on these statements.
- Very dynamic working groups at the Infrastructure Waterways Section conduct projects in the field of smart technology. Owing to the interdisciplinary nature of the working groups it can be assumed that certain technical content of smart technologies will have to be trained individually.

The following rough estimate about the qualification requirements can be taken on the basis of qualitative interviews with the HPA:

Figure 4 Qualification requirements for different EQF levels at HPA

In the infrastructure road there is a skills demand in a total of 71 employees. These are made up of 46 construction specialists, 15 technicians and 10 employees in project management.

In total 22 smart port projects were carried out and are still in progress according to information from HPA. For each project groups of 5-10 people are necessary. Overall up to 35 people require training with regard to Smart Technology.

3.1 Extrapolation of the Results for Hamburg Port Authority

In [European Parliament 2015] European sea ports are compared. Especially the 24 largest ports with regard to amount of transferred goods are considered. Ports of the North Sea account for 32 % of the total amount of transferred goods in the EU. Only considering containers they account for 48 % of the total amount. Ports with largest turnover are (in this order): Rotterdam, NL (407 megatons), Antwerp, BE (172 megatons), Hamburg, DE (121 megatons), Amsterdam, NL (93 megatons) and Marseille, FR (76 megatons). According to Figure 9 those ports account for 42 % of total European turnover of goods. Still they are very different w.r.t. their specialization. The turnover classes are further divided into liquid and dry bulk cargo, roll on/roll off (RoRo) and containers. Rotterdam is able to handle all good classes equally while the other four largest ports are specialized on containers and bulk cargo. Amsterdam and Marseille focus on liquid bulk cargo (raw oil).

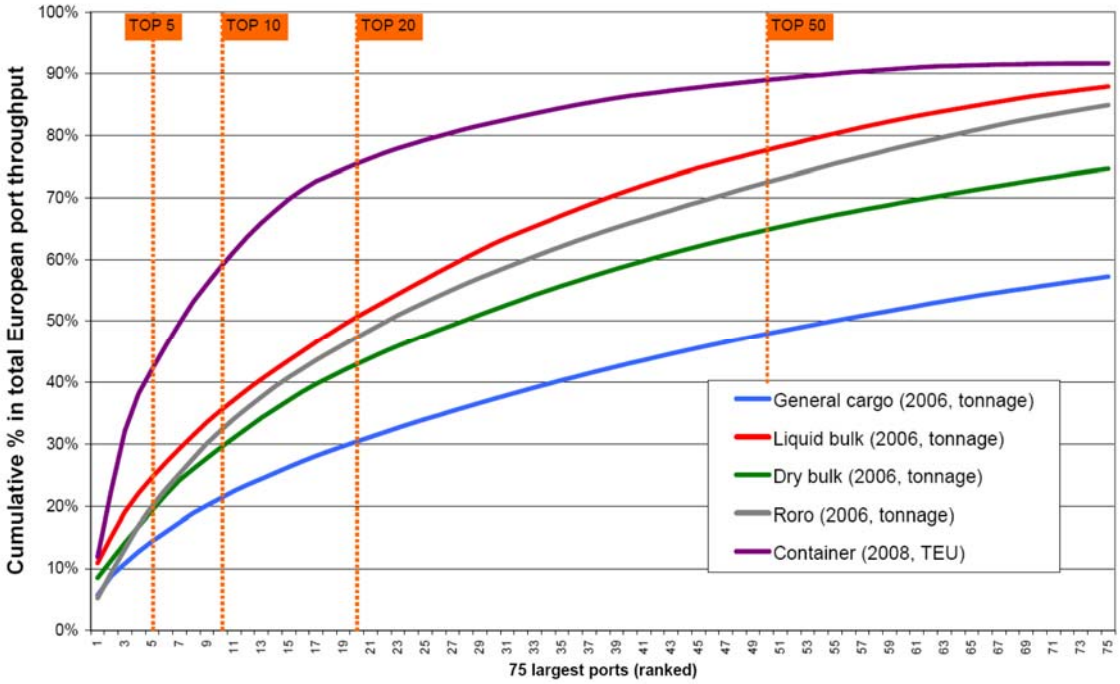

Figure 5 Share of the total European port throughput

Intermodal transport plays a minor role for bulk cargo. RoRo cargo mainly consists of vehicle ferries and has minor contribution to overall cargo turnover. That is why those cargo classes are not further considered. In the following the most important cargo class, containers, is further evaluated. The ten most important ports with regard to container cargo turnover (twenty-foot equivalent units (TEU)) are shown in Fehler! Verweisquelle konnte nicht gefunden werden..

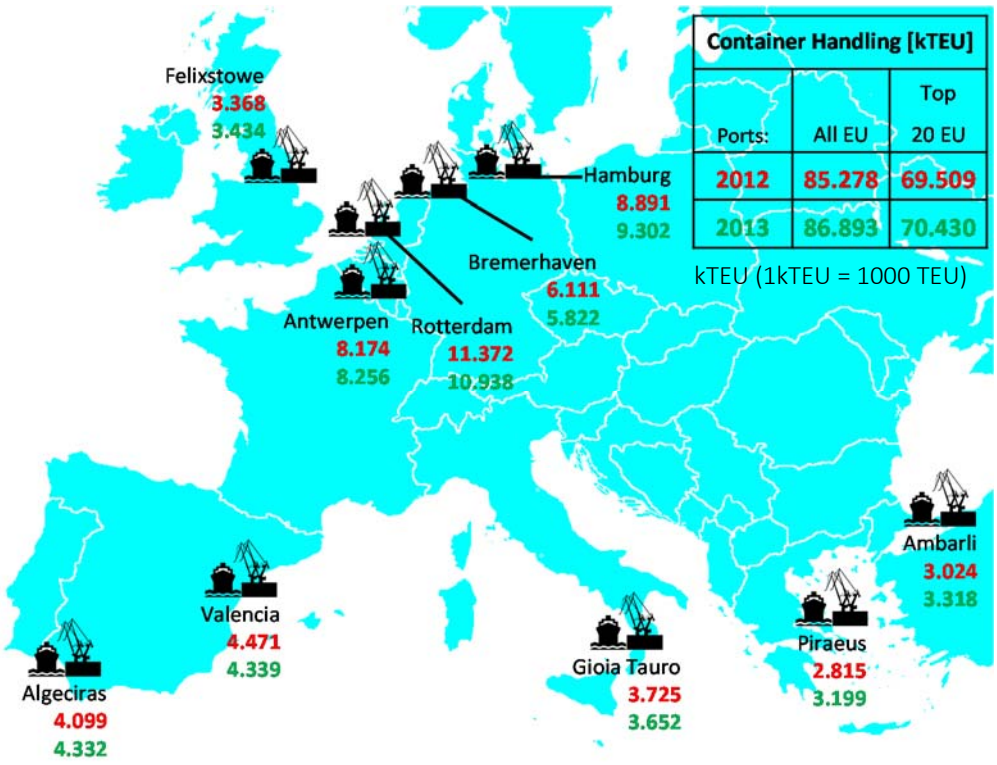

Figure 6 Container turnover of the ten largest European container ports [Eurostat 2015]

The ports of Rotterdam, Hamburg and Antwerp also belong to the top ten list when only container turnover is considered. Previously mentioned ports in Marseille and Antwerp are not within the top ten.

3.1.1 Extrapolation for Germany

15,124 TEU out of the total 15,563 TEU of German container turnover [Eurostat 2015] are handled in Hamburg and Bremerhaven. Hamburg again has double the amount of turnover than Bremerhaven. An analysis of educational demand in Hamburg was provided in the previous chapters. In the following a comparison to Bremerhaven is conducted based on the newest available data from 2012 and 2013.

In 2012 70 % and 50 % of the goods arriving in Hamburg and Bremerhaven, respectively were transported to the hinterland. Hamburg handles twice as many containers as Bremerhaven [European Parliament 2015]. Inland waterway transport plays a minor role in both ports. The model split is 50 % to 50 % between railway and street in Bremerhaven [Ferreira and Lattner 2014]. Street transport dominates in Hamburg accounting for 60 % [European Parliament 2015]. The conclusion is that hinterland transport is similar for both ports regarding the modal split.

Next the number of employees for both ports is compared. This is not determined according to agreed common standards and therefore differs significantly depending on the source. This is true for direct and indirect employment numbers [Ulatowski and Timm 2014]. According to [Ulatowski and Timm 2014] 80,000 and 60,000 people were directly employed at the Port of Hamburg and Bremerhaven, respectively.

Other studies mention different numbers but a similar proportion. Therefore 25 % less people are employed at the port of Bremerhaven than at the Port of Hamburg.

According to the modal split the situation is almost the same; according to employment it is very similar between Hamburg and Bremerhaven regarding educational demands. The current strategy for the future at Bremerhaven focusses mainly on infrastructure projects [Janssen 2014]. ICT does not play a major role. The reason is the large spare area for storing goods and expanding the Port of Bremerhaven [Lorenz 2015]. This is not possible in Hamburg since there is almost no spare area.

The Smart Port project in Hamburg was initially launched by the local government. The federal state of Hamburg and Bremen have the highest and second highest per capita income in Germany but Bremen also has highest per capita debt (31,000 EUR) in Germany being twice as high as the debt of Hamburg [Statista 2014]. The difference in local financial potential plays a minor role since most innovative projects are funded by federal- and EU money.

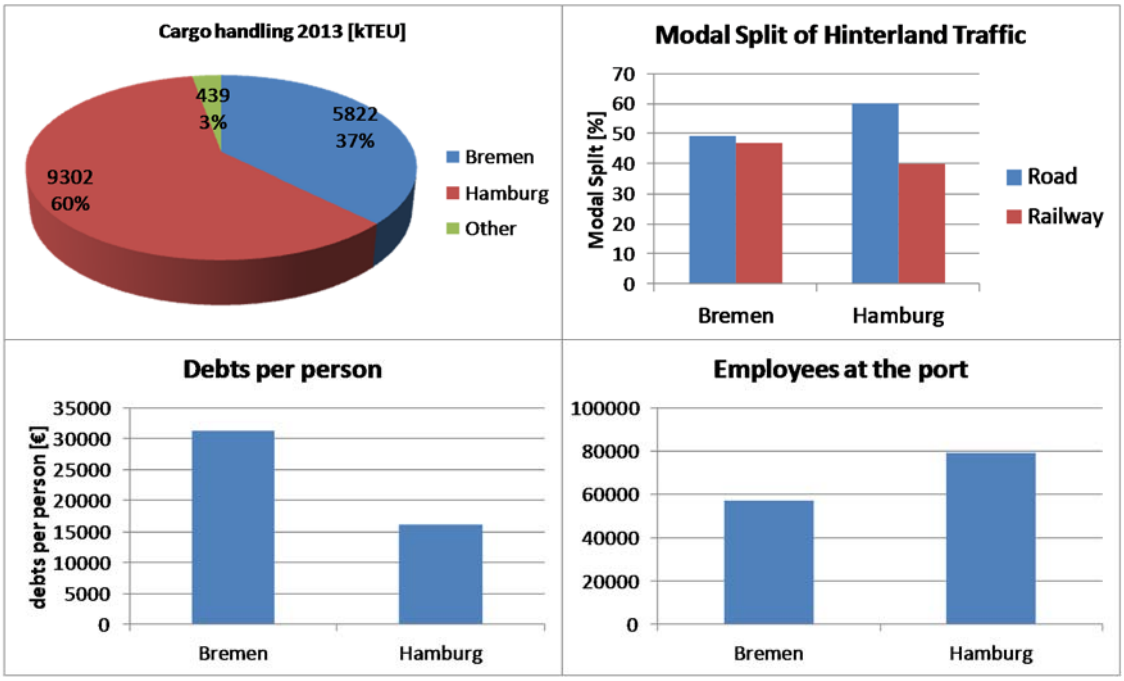

Figure 7 Comparison between Hamburg and Bremerhaven

Hamburg is twice as large as Bremerhaven with regard to container turnaround and directly employs 1/3 more people. **The educational requirement of Bremerhaven is therefore 50 % to 75 % of the one determined for Hamburg**. Practically there are currently no projects planned towards a Smart Port in Bremerhaven and therefore no educational demand in short or midterm.

The conclusion is that educational demands for Germany in the field of Smart Ports are almost only present in the Port of Hamburg.

3.1.2 Extrapolation for Europe

The comparison between Bremerhaven and Hamburg in Section 5.1 showed that indicators like container turnaround and number of employees only provide minor insight of educational demands for new technologies. The throughput of goods to the hinterland and the potential to increase it through infrastructure projects is more important. In general it is essential whether strategies for the future were developed by government and port authorities and the role of Smart Port and ICT within those.

The following table gives an overview of Smart Port strategies and projects of eight of the largest European container ports, the Ports of Bremerhaven and Hamburg were already described in detail in the previous chapters.

Rotterdam	The future strategy for Rotterdam [Port of Rotterdam Authority 2011] acknowledges ICT as a general trend and therefore aims at upgrading it. The goal is an „active ICT-driven, all-round traffic management, so that sustainable and efficient supply chains can operate through Rotterdam" [Port of Rotterdam Authority 2011].
Antwerpen	Internal project groups conduct innovative ICT projects in the Port of Antwerpen. Detailed information on the projects and amount of people involved is not publicly available.
Valencia	The Port of Valencia has announced a Smart Port strategy at the World Ports Conference in 2015 [García de la Guia 2015].
Algeciras	No information on innovative projects by the port authority could be determined for the Port of Algeciras. The terminal operators Maersk and APM Terminals have launched and completed projects to modernize and connect their ICT systems and established mixed teams with members from both companies [Churchill 2015].
Gioia Tauro	No information about future strategies for the Port of Gioia Tauro is publicly available.
Felixstowe	A project to increase intermodal container transport through railway was successfully completed and a new train terminal opened in 2013 at the Port of Felixstowe [Port of Felixstowe 2012].
Ambarli	No information about future strategies for the Port of Ambarli is publicly available.
Piraeus	It is currently planned to sell the Port of Piraeus to private investors. Therefore there are currently no plans for the future.

Table 1 Smart Port Strategies of different Ports in Europe

Ports of the Mediterranean Sea and other European ones are compared in [MED 2015] w.r.t. their Smart Port strategy. The category „Technological level" is of particular interest for this study. The presence of the following technologies is rated in the study:

- Wireless communications (PMR for voice, WiFi for data,…)
- Wireline communications (PABX, FO network, …)
- RFID (Container identification, container security, entrance system, …)

- OCR, CCTV (Container/Truck identification, security, …)
- GNSS, DGNSS (Crain guidance, container/truck positioning, …)
- TOS (Command and control integration, logistic support, …)
- Port Community System, Logistics Collaborative Systems and B2B systems.

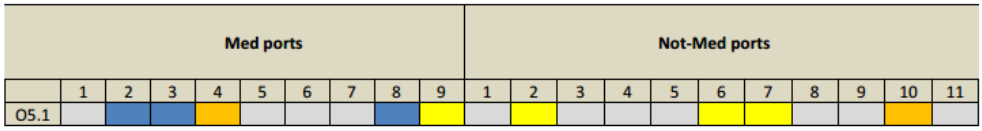

Figure 8: Relative rating of the technical level of Med. Sea and other European ports [MED 2015].

The study separates the ports into worst (orange), medium (yellow) and best (blue) ones. The information is anonymized by randomly assigning numbers to the ports. Information could only be retrieved for a small fraction of the ports. For the Non-Mediterranean Sea ports only Bremerhaven, Duisburg, Hamburg and Rotterdam provided data. Therefore the results of the study cannot be used for extrapolation. The final version of the still ongoing study could provide more information. With data currently available an extrapolation is only possible by mainly considering container turnaround and number of direct employees. Also an estimate of the available area to expand and publicly available information on future strategies is taken into account. The presence of a strategy is rated with an "o" and with "+" if the strategy includes Smart Port or ICT upgrade. Otherwise the port is rated with a "-". Based on this data different projection scenarios were calculated:

Port	kTEU (2013)	Directly Employed	Expansion Areas	Future Strategy
Rotterdam	10.938	90.000 [Port of Rotterdam 2013]	+	+
Hamburg	9.302	80.000 [Ulatowski und Timm 2014]	-	+
Antwerp	8.256	60.000 [Port of Antwerp 2014]	+	+
Bremerhaven	5.822	60.000 [Ulatowski und Timm 2014]	+	O
Valencia	4.339	10.000 [Valencia Port 2013]	O	+
Algeciras	4.332	5.000 [Coronado et.al. 2006]	+	-
Gioia Tauro	3.652		+	-
Felixstowe	3.434	2.500 [Davey 2000]	+	+
Ambarli	3.318		+	-
Piraeus	3.199		+	-

Table 2 Comparison of European Ports

The numbers on direct employees are from different years and according to different definitions. Their value for the projection is therefore limited. Hence the projection is mainly based on the container turnaround.

As a foundation it is assumed that 50 people in the Port of Hamburg have a demand for education in smart technologies in order to be able to plan, deploy and operate those.

3.1.2.1 Simple Projection: The Demand Scales According to Port Size

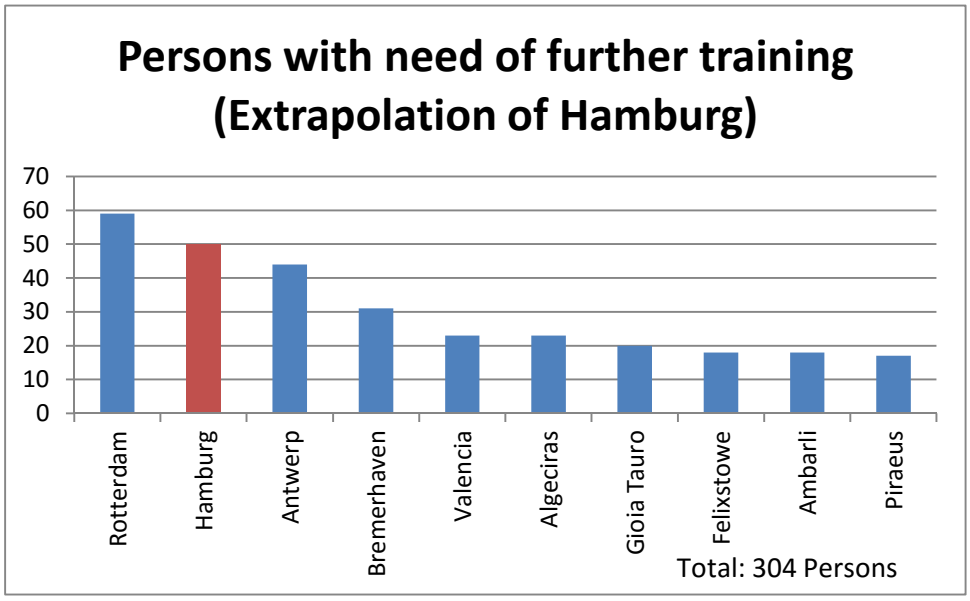

Figure 9 Number of Persons for Further training in European Ports

There is a six fold higher demand for education in entire Europe compared to Hamburg. The ten considered ports only account for 60 % of total European container turnaround, but it is unlikely that the remaining small ports have any significant demand.

3.1.2.2 Projection Considering the Future Strategy

In this scenario only ports with a Smart Port and ICT upgrade strategy are considered. Those are Hamburg, Rotterdam, Antwerp, Valencia and Felixstowe. This results in educational demand for approximately 200 people.

3.1.2.3 Projection Considering the Area for Expansion

Considering the worst case that only ports without area for expansion experience educational demands the number of people is reduced to 75 for the ports of Hamburg and Valencia.

3.1.3 Worldwide Extrapolation

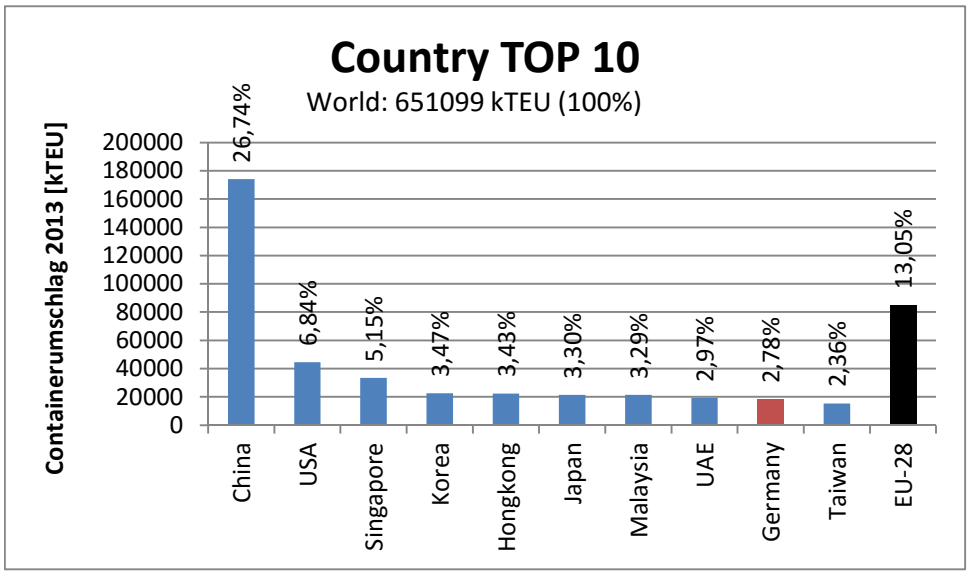

Figure 10 Worldwide container turnaround of the top ten countries [IAPH 2013], [Eurostat 2014].

Figure 16 shows the contained turnaround of the top ten countries of the world. Germany is the only European country in this list. Total turnaround for the countries is 400,000 kTEU accounting for 60 % of total worldwide turnaround. This results in factor 20 compared to Germany meaning an educational demand of 1,100 to 1,600 people. The lower number only considers Hamburg (50 people), the higher one Hamburg and Bremerhaven (80 people) as baseline. The number is increased to 1,600 to 2,600 if the remaining 40 % container turnaround of countries not in the top ten is considered.

This extrapolation based on container turnaround is only a rough estimate not considering the individual situation of each country and port.

4 Analysis of Studies and Reports

4.1 Analysis of a Study to Identify Skill Demand of the Logistics Sector

The extrapolation of the skill demands of the logistics sector by Bott and Schade 2006 showed that out of the 2,085,868 companies with 26,954,686 workers: 1,006,979 companies (48.3 %) and 14,580,080 workers nationwide are entrusted with logistical tasks (Bott and Schade 2006). In the study conducted by the Federal Institute for Vocational Training the following was analyzed:

- What development and career paths are necessary to support the target groups in the logistics sector and to what extend it is possible to support further education qualifications in the sector;
- Which logistics services are affected, how the current human resources development in the company is structured, which relevant training opportunities are currently used and to what extent new formalized training offers are requested by companies and their employees ;
- How the use of the structural approach of IT training systems is; how it is possible to integrate Non-state certificates, country legally regulated further developments in the regulated education and training. On this basis, the study shows a proposed structure and an alternative design for a regular further training, which enables the interfaces and transitions between the professions and industries by additional qualifications and credit transfer opportunities.

Although the study is already 9 years old with data from the years 2004/2005 it is nevertheless interesting to see the distribution and the importance to handle new and modern logistics technology:

Skill needs for different functional logistic activities						
	Inbound logistic	Outbound logistic	Cargo handling	Production	Wholesale	other support
Logistic basic Knowledge	76,8	84,1	85,7	76,7	76,9	81,9
Logistic special knowledge	60,3	75,9	71,1	66,4	63,3	72,4
Logistic concept knowledge	56,8	72,1	68,1	63,9	56,4	71,9
planning, controlling	72,4	78,5	80,0	74,3	80,7	86,2
wholesale knowledge	80,2	83,6	82,9	81,6	84,2	91,6
IT-Knowledge	67,2	77,1	78,0	69,0	64,5	64,0
application of logisitic technology	58,8	73,1	71,5	61,9	63,2	78,9
special technology knowledge	51,1	57,5	54,3	65,9	56,7	67,9
Safety and ecological environment	64,7	79,9	75,7	72,1	67,2	82,8
foreign language skills	46,4	56,4	51,8	53,0	51,4	62,6
social competencies	64,7	75,5	72,5	69,1	71,5	83,2
unspecified	16,6	19,3	16,3	19,6	19,7	38,8

Table 3 Skill needs for different functional logistic sectors (Bott und Schade 2006)

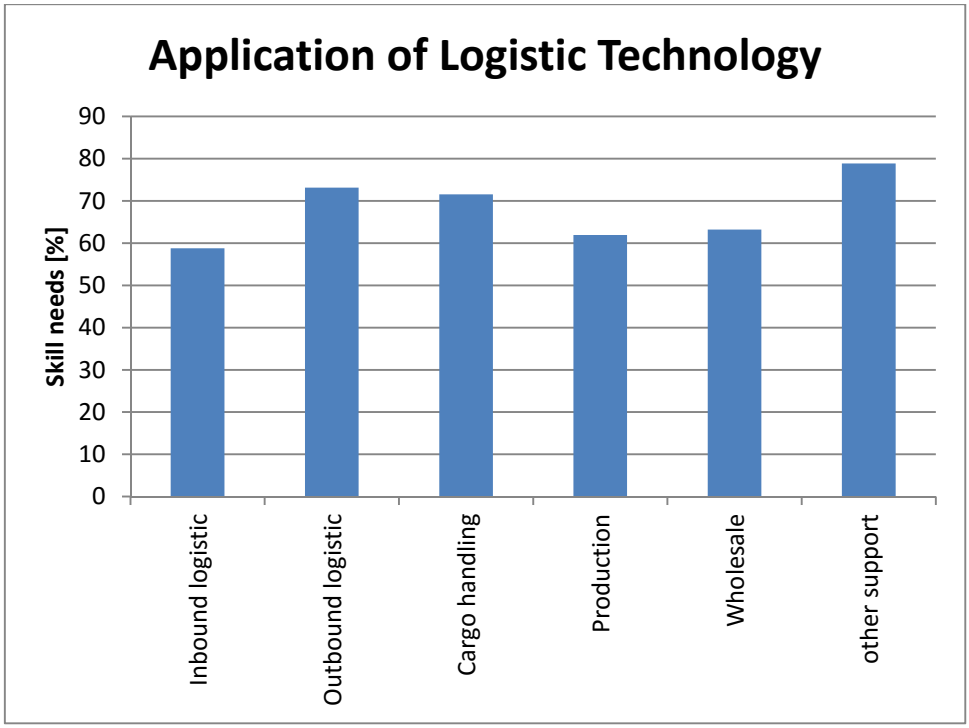

Figure 11 Skill needs for application of logistic technology

Overall, the use of logistics technology in all functional areas will be assessed quite high. In the retailing and materials management and for the application of logistic technology the need for further training is 71.5%.

When comparing this figure with the company size it can be seen that the larger the company, the greater the need for further training in dealing with logistics technology (Figure 5). It is expected that in larger companies, a higher level of automation is possible potentially requiring a greater understanding. Large enterprises are more aware of supporting further education than small ones. Maybe it is not the automation, but out of this study there is only an interpretation and the real skill needs can only be estimated from the figures of the study here.

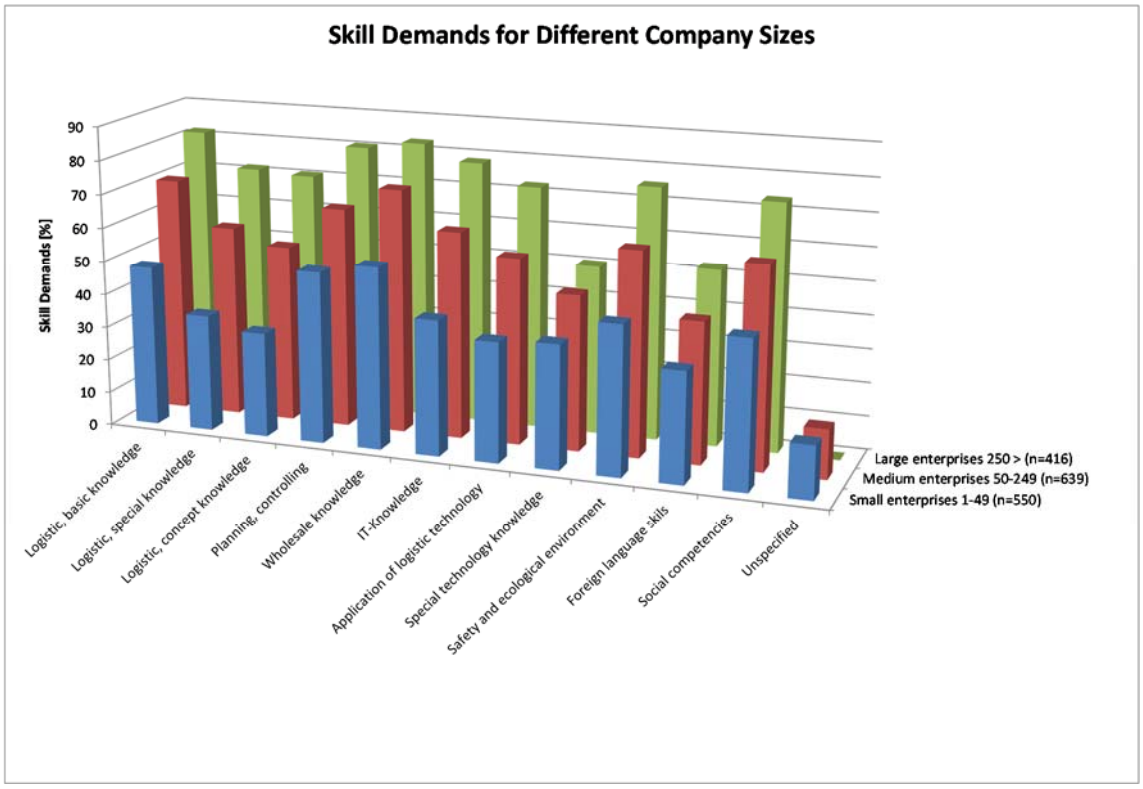

Figure 12 Skill needs for different company sizes (Bott und Schade 2006)

Another division of training demand in percent was performed over the different levels of logistics activities in trade and services. Here it is clear that exporting, business and planning activities have a need for further training to a large extent. It shows that large parts of the executive, financial and planning management need to be trained in the potential of new technologies and as part of continuous education (Figure 13).

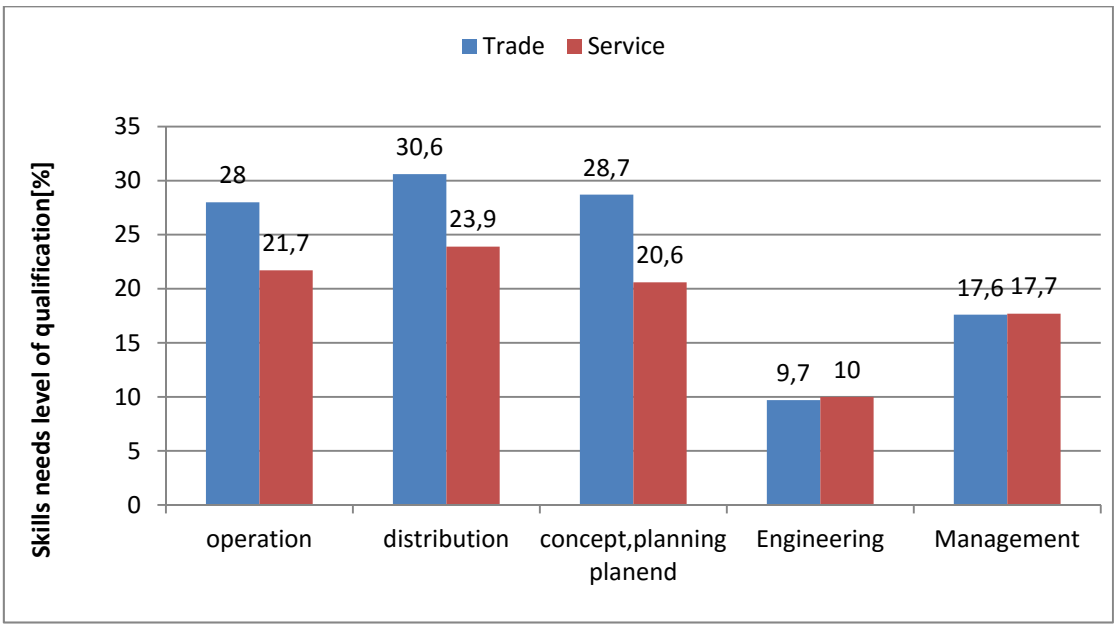

Figure 13 Skill demands of different occupational levels (Bott und Schade 2006)

4.2 Economic Value of the Hamburg Port

According to the study from the Planco institute in 2015 the Port of Hamburg is one of the most important ports in Europe and the world (Planco 2015). 2014 the port was ranked 15th in the container business in a global comparison right in front of Antwerp. It is ranked second in Europe behind Rotterdam. The Port of Hamburg was the largest German port with 146 million tons of total cargo handling in 2014.

The port-related employees were divided by the Planco study in following categories:

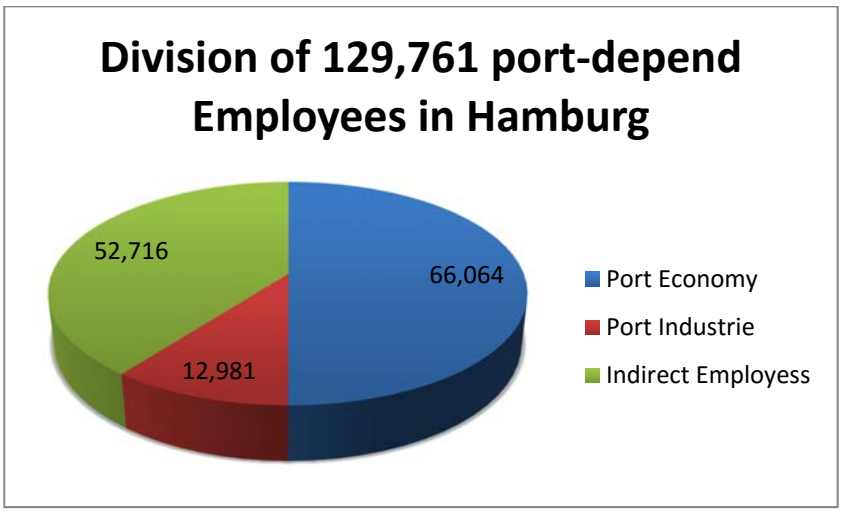

Figure 14: Division of Port dependent Employees (Planco 2015, S. 2)

All employees in these logistics sector have either direct logistic-related jobs or work partly in those areas. The Planco study further divides the port economic fields to gather more insight:

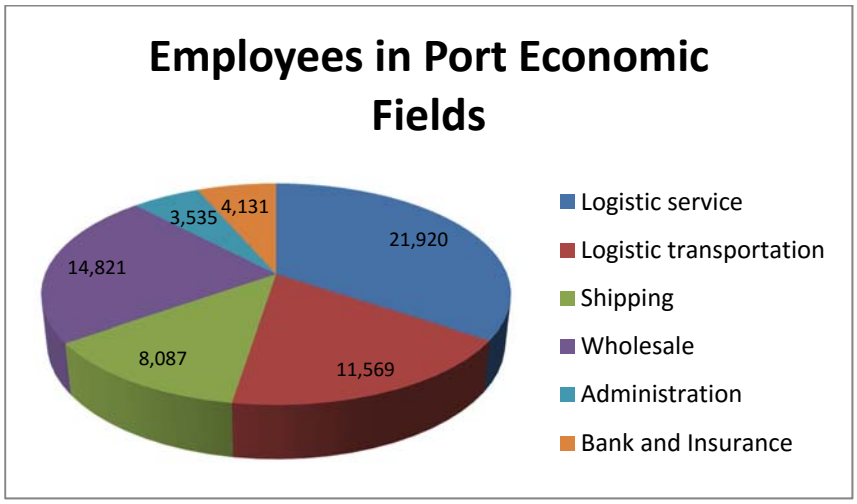

Figure 15 Employees in port economic fields (Planco 2014, S. 43)

Based on this division it is possible to identify how many individual occupational groups are represented in the Hamburg port economy. Correlating now the previously numbers in the study by the Federal Institute for Vocational Training (Bott and Schade 2006) with the analyzed training needs of 71.5% in logistical technology with the number of employees in the port industry, it is estimated that about 45.400 jobs are in potential need for further training in logistics technology. More broadly on indirect employees and the port industry the need is about twice as high. Of course these are only rough estimates, because there are no figures directly describing to which extend indirect jobs are actually entrusted with logistic tasks.

4.3 Results of the German job advertisement analysis

The analysis of the results showed about 6.000 vacancies in four weeks in Germany in the field of logistics. A distinction, at what level of occupation in the field of logistics smart technology or Intermodal Transportation will be needed and can be analyzed by evaluating the data of the full text analysis of the Job Advertisements. We have used the following keywords to search for specific occupations in the logistics sector.

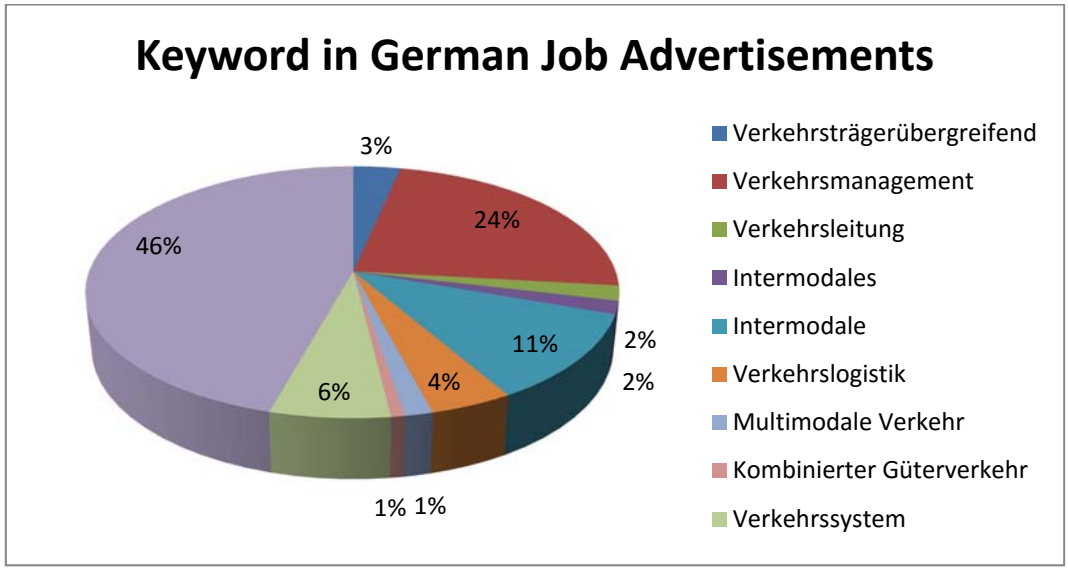

Figure 16 Keywords in German Job Advertisements

Two main results can be derived from this job advertisement survey. In total 6.000 jobs are vacant usually for a period of one month in Germany. The analysis took place in May 2015 and was only a sample, seasonal variations must be considered. Having a 20 % deviation approximately 57,000 professional jobs are annually vacant in the logistics sector in Germany.

Only a few job advertisements (13%) incorporate the keyword “intermodality”. Smart technology had not been mentioned at all. But based on these results it is not evident, if terms like that are really used now in Germany and in the logistic sector.

By looking into the division of different occupational levels the results of the job advertisements show that mainly in the operation level jobs are needed.

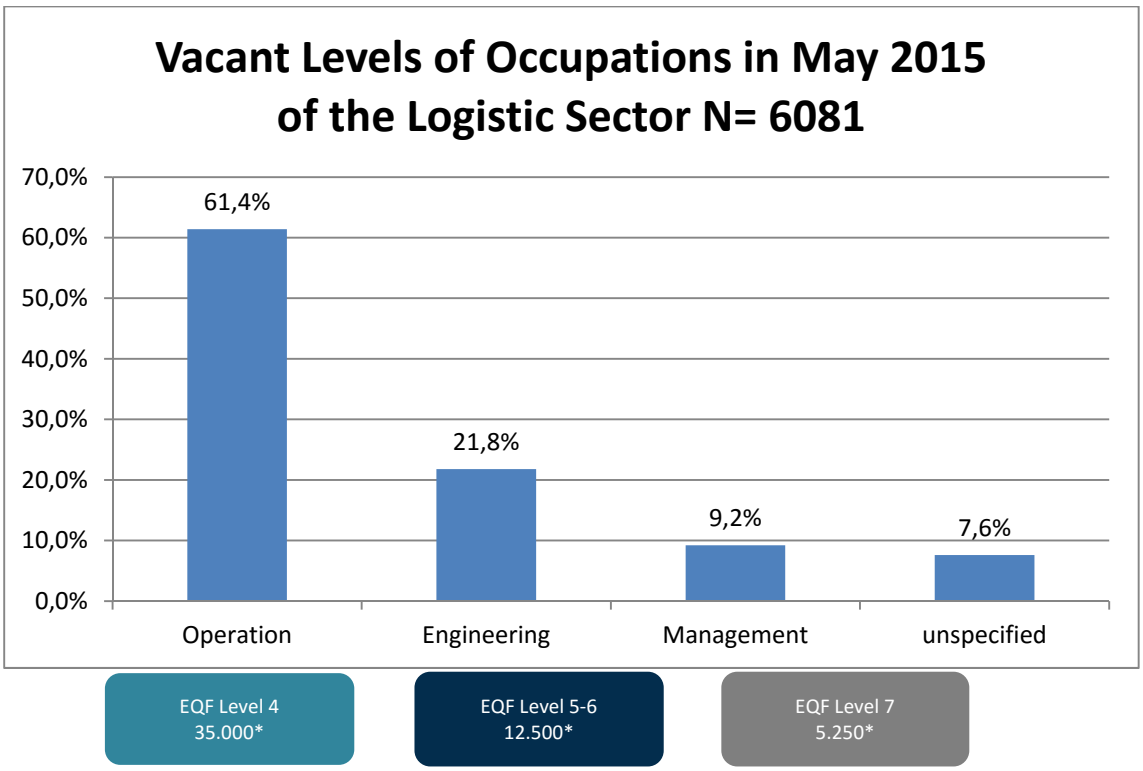

Figure 17 Vacant levels of occupations in Mai 2015 of the logistic sector

4.4 Analysis of Cedefop Forecast Data

The results from the study "Quantifying skill needs in Europe" by the European Centre for the Development of Vocational Training (Cedefop) (Cedefop 2013) suggest a fairly stable prediction of qualification requirements in the occupational groups of the transport sector. Nevertheless, a shift into higher quality educational levels can be predicted. In total the empirical data cannot be used to predicted qualification and skill needs in detail due to the broad approach of the study. But it can be seen that in the years 2005 - 2025 the level of education in the logistics sector will shift by around 6 % upwards in air, water and land transportation.

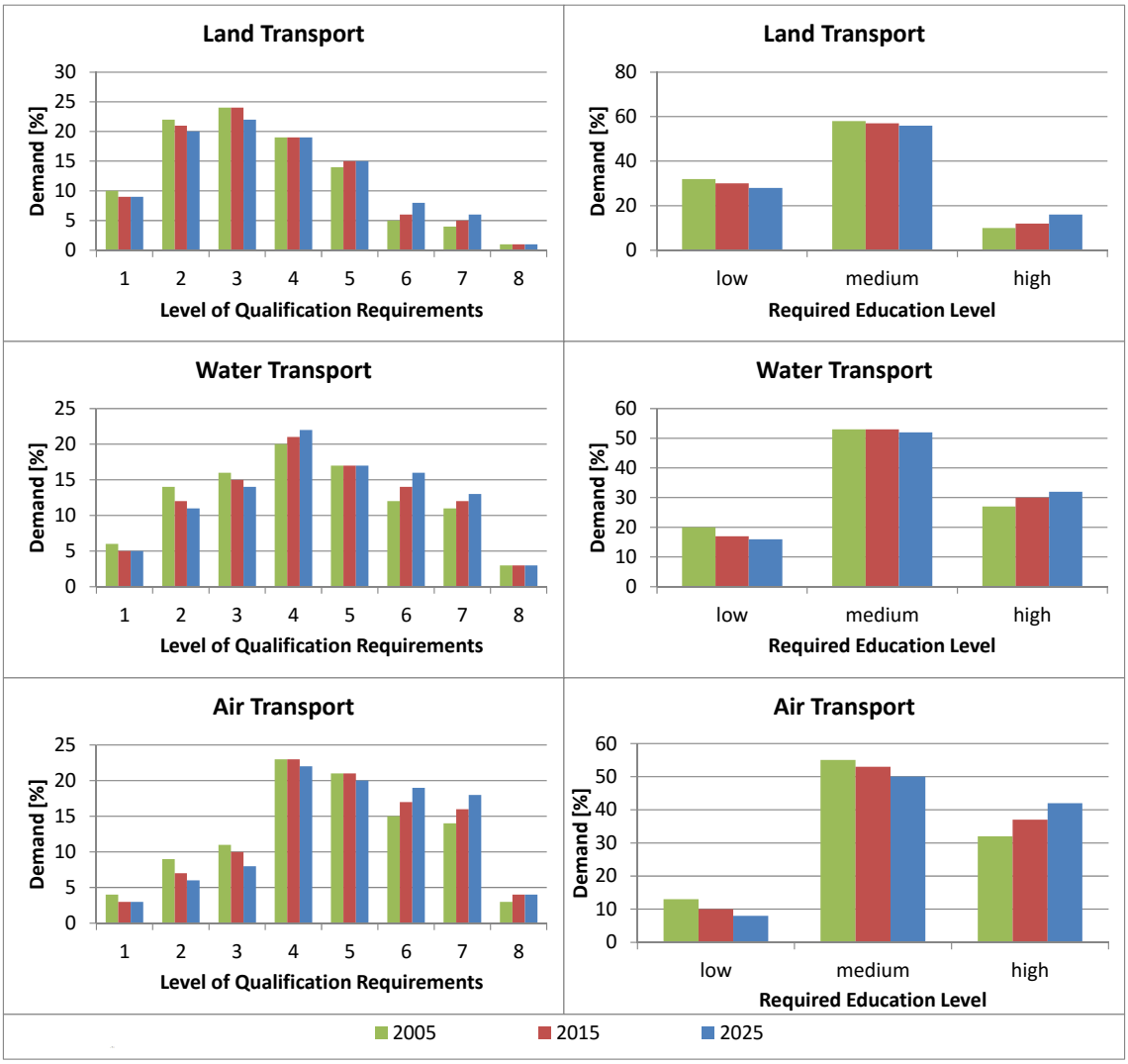

Figure 18: Qualification Trends from 2005 - 2025

4.5 Selected Occupations with Estimated Impact of Smart Technologies

In addition to the logistical professions Warehouseman, Specialist for Port Logistics and IT Specialists also professionals in road infrastructure, particularly in road construction and traffic management and traffic engineering, have significant potential for the future use of smart technologies. According to what Mr. Wegner (HPA HoD infrastructure Road) said (see Chapter**Fehler! Verweisquelle konnte nicht gefunden werden.**) about maintenance and construction work at HPA the professional specialists for road and traffic engineering and road builders have great training demands to professionally install necessary sensors and actuators.

The following list consists of aggregated current data of the Federal Institute for Vocational Education and Training. These occupations may work with smart technologies now or in the future in Hamburg. The first table shows the equivalent terms and ISCO Classification and the second table shows the nationwide training numbers and their development since of 2005.

Berufsbezeichnung	Term and ISCO Number
Fachinformatiker	Computer professionals - 2139
Fachkraft für Lagerlogistik	Warehouseman/Stock Clerks - 4131
Straßenbauer	Road construction worker - 9312
Fachkraft für Hafenlogistik	Specialist for Port Logistics - 4133
Fachkraft für Straßen- und Verkehrstechnik	Architect, Town and Traffic Planners - 2141

Berufsbezeichnung	2005	2010	2013
Fachinformatiker	20.187	23.838	27.423
Fachkraft für Lagerlogistik	10.491	22.968	25.305
Straßenbauer	4.479	4.422	3.861
Fachkraft für Hafenlogistik	84	261	249
Fachkraft für Straßen und Verkehrstechnik	165	141	99

Table 4: Nationwide Number of German Apprentices in Selected Occupations

The two occupations Computer Professionals and Stock Clerk are major German apprenticeship jobs requiring of 3 years education. In this statistic all disciplines for computer specialist have been combined,

System Integration and the Application Development. In Germany the road construction workers are specializations of professions in the construction industry, while the occupations Specialist for Port Logistics and Architect, Town and Traffic Planners are single occupations. The following table shows the number of new contracts for the selected occupations. It can be also used to see the trend of this development.

Berufsbezeichnung	2005	2010	2013
Fachinformatiker	7.461	8.730	10.356
Fachkraft für Lagerlogistik	5.838	9.885	10.110
Straßenbauer	1.746	1.821	1.650
Fachkraft für Hafenlogistik	33	81	93
Fachkraft für Straßen und Verkehrstechnik	39	39	36

Table 5 New contracts per Year (dual systems)

It is necessary to refer to the German job titles for this study. In the following chapter the core competences according to German regulation and in comparison to the ISCO 88 Classification are mentioned.

Fachinformatiker / Computer Professionals – 2139

Computer professionals work in enterprises in almost all economic sectors, especially in the IT industry. They also work for companies that create or customize the software for their business processes themselves.

Übersicht über die Lernfelder für den Ausbildungsberuf Fachinformatiker/Fachinformatikerin							
Lernfelder		**Zeitrichtwerte**					
		gesamt		1. Jahr	2. Jahr	3. Jahr	
		SI	AE			SI	AE
1	Der Betrieb und sein Umfeld	20	20	20			
2	Geschätsprozesse und betriebliche Organisation	40	40	40			
3	Informationsquellen und Arbeitsmethoden	40	40	40			
4	Einfache IT-Systeme	100	100	100			
5	Fachliches Englisch	60	60	20	20	20	20
6	Entwickeln und Bereitstellen von Anwendungssystemen	220	300	100	80	40	120
	Vernetzte IT-Systeme	140	100		100	40	
8	Markt und Kundenbeziehungen	60	60		40	20	20
9	Öffentliche Netze, Dienste	40	40		40		
10	Betreuung von IT-Systemen	120	80			120	80
11	Rechnungswesen und Controlling	40	40			40	40
Summen		880		320	280	280	

SI: Fachrichtung Systemintegration AE: Fachrichtung Anwendungsentwicklung

Table 6 Overview of the German Lernfelder (Kultusministerkonferenz 25.04.1997, S. 3)

The German occupational standard of Computer Professionals is currently being redesigned. For example in the Lernfelder 6 and 7 methods for planning of networked systems and process models for core tasks of application development are mentioned, which may include applying smart technologies.

The ISCO Description for Computer Professionals

This unit group covers Computer Professionals not classified elsewhere in Subgroup 213. For instance, it classifies those who have general knowledge of both, computer hardware and software. In such cases tasks would include:

1. Designing and implementing computer software applications, and computer operating systems,
2. Maintaining and updating computer software applications, and computer operating systems;
3. Installing computers and performing diagnostics on computer hardware;
4. Performing related tasks;
5. Supervising other workers.

Fachkraft für Lagerlogistik / Warehouseman or Stock Clerks - 4131

Stok Clerks are mainly employed in industrial, commercial and forwarding companies as well as other logistics service providers. Their work responsibilities include all activities of the warehouse logistics, they act in logistical planning and organization processes and they are responsible for identifying, picking and packing of goods. Applying enterprise storage software and logistics technology is self-evident.

Übersicht über die Lernfelder für den Ausbildungsberuf Fachkraft für Lagerlogistik				
Lernfelder		**Zeitrichtwerte in Stunden**		
Nr.		1. Jahr	2. Jahr	3. Jahr
1	Güter annehmen und kontrollieren	80		
2	Güter lagern	100		
3	Güter bearbeiten	60		
4	Güter im Betrieb transportieren	40		
5	Güter kommissionieren		80	
6	Güter verpacken		80	
7	Touren planen		40	
8	Güter verladen		80	
9	Güter versenden			80
10	Logistische Prozesse optimieren			80
11	Güter beschaffen			40
12	Kennzahlen ermitteln und auswerten			80
	Summe (insgesamt 840 Std.)	280	280	280

Table 7: Overview of the German "Lernfelder" (Kultusministerkonferenz 25.03.2004, S. 7)

The ISCO Description for Stock Clerks

Stock Clerks maintain records of goods produced and production materials received, weighed, issued, dispatched or put into stock. Tasks include:

1. Arranging and controlling receipt and dispatch of goods and keeping relevant records;

2. Maintaining stock records, verifying issue of goods, estimating needs and making requisitions of new stocks;
3. Receiving, storing and issuing tools, spare parts, or various equipment and maintaining relevant records;
4. Weighing goods received, issued, produced, or dispatched and maintaining relevant records;
5. Compiling inventories of furniture and other items received for storage;
6. Performing related tasks;
7. Supervising other workers.

Straßenbauer - Road construction worker - 9312

Road construction workers produce the substructure and the topping of roads, paths and squares and maintain them. You can find employment in construction of road, runway and sports facilities, shaft sinking and piping and civil engineering works, as well as local building authorities, infrastructure companies or road and motorway maintenance.

While in some “Lernfeldern” far more conventional technologies are displayed, for example in the construction of roads and asphalt surfaces, no traffic control systems are discussed. planning content for traffic management, traffic guidance and traffic control is already mentioned is in the “Lernfeld” 13 . Here it may be possible to integrate future smart technologies.

The ISCO Description for stock Clerks

Construction and maintenance laborers perform simple and routine tasks in connection with the building and maintenance of roads, dams and similar constructions. Tasks include:

1. Digging and filling holes and trenches, spreading gravel and related materials and performing other tasks related to the building and maintenance of railway tracks and roads;
2. Carrying bricks and mortar to bricklayer or helping in other ways in the building of dams and similar constructions;
3. Performing related tasks;
4. Supervising other workers.

Übersicht über die Lernfelder für den Ausbildungsberuf **Tiefbaufacharbeiter/-in im Schwerpunkt Straßenbauarbeiten** (1. Stufe) sowie für den Ausbildungsberuf **Straßenbauer/-in** (1. und 2. Stufe)				
	Lernfelder	**Zeitrichtwerte in Stunden**		
		1. Jahr	2. Jahr	3. Jahr
Tiefbaufacharbeiter/-in				
	Berufsfeldbreite Grundbildung (alle Berufe) *)			
1	Einrichten einer Baustelle	20		
2	Erschließen und Gründen eines Bauwerks	60		
3	Mauern eines einschaligen Baukörpers	60		
4	Herstellen einer Holzkonstruktion	60		
5	Herstellen eines Stahlbetonbauteiles	60		
6	Beschichten und Bekleiden eines Bauteiles	60		
	Tiefbaufacharbeiter/-in, Schwerpunkt Straßenbauarbeiten			
7	Bauen einer Erschließungsstraße		60	
8	Herstellen eines Erddammes		80	
9	Einbauen einer Rohrleitung		60	
10	Pflastern einer Fläche mit künstlichen Steinen		80	
Straßenbauer/-in				
11	Bauen einer Asphaltstraße			100
12	Pflastern einer Fläche mit Naturstein			100
13	Einbauen einer Fahrbahndecke aus Beton			40
14	Instandsetzen einer Straße			40
	Insgesamt 880	320	280	280

Table 8: Overview of the German Lernfelder (Kultusministerkonferenz, S. 113)

5 Conclusion Outlook

- Non ICT-affine occupations will change and integrate modern (smart) technology
- High demand of qualification on different occupational levels
- Process oriented training and education to enable a holistic occupational competence
- **57.000 persons per year in Germany;** 35.000 persons EQF Level 4, 12.500 persons EQF Level 5-6, 5.250 persons EQF Level 7
- **30.000 contracts per year in Germany;** Sum of all apprenticeship jobs analysed
- **2.386.721 employees in total in Germany;** Study of IAB* "Berufsgruppe Verkehr und Lager" 2011
- **7.224.042 employees in the "Berufsgruppe Verkehr und Lager" in total in Europe;** Eurostat 2014 Results without France, Italy, Austria and Malta – no statistics had been found in these countries

Separation of total number in EQF Level	IAB* Statistics for 2011	Approximation based on the job ad analysis 2015
EQF Level 7	--------	219.578 (9.2%)
EQF Level 5-6	2.387	520.305 (21.8%)
EQF Level 4	1.310.310	1.465.447 (61.4%)
unspecified	589.520	181.391 (7.6%)
Below Level 4	515.532	--------

Table 9 Approximation of qualification demand in EQF Level

6 Recommendations

Based on the results of the study it is necessary to differentiate the educational measurements for occupational levels. The HPA has specific needs for training at occupations at the EQF level 4 as well as level 5 and 6.

The complexity of smart port logistic process shows that it is necessary to train on different occupational levels and design adequate learning environments. Some occupations at EQF level 4, for example, needs to have skills in IT essentials and common basic knowledge of ICT technology. It is necessary to understand the sequences of the logistic process. Therefore input needed to be given and connected to the phases of the logistic process. It is expected that EQF level 4 occupations the characters of work and training are more in the operational field. Occupations at EQF level 5 and 6 are primarily in the planning and implementing tasks of smart technology,

Different methods can be used to train for the process. For example, the input can be complex projects to learn with problem-based learning concepts or the inputs can be small units of lessons just to train or to qualify for specific tasks. At the management, starting at EQF level 7, there should be more a consultancy than a training which is also connected to the process as well to smart technology.

The overview of the holistic process needs to be trained at all occupational level. It is necessary to ensure that each person working in the process is responsible for their own work tasks and should able to anticipate the consequences of their work. Hereby the people working at the management level need to know the general work tasks at the operational level are. Accordingly, the people at the operational level need to understand the importance of their work and to assess the quality of their work reflecting the needs of the planning and implementation and the management areas.

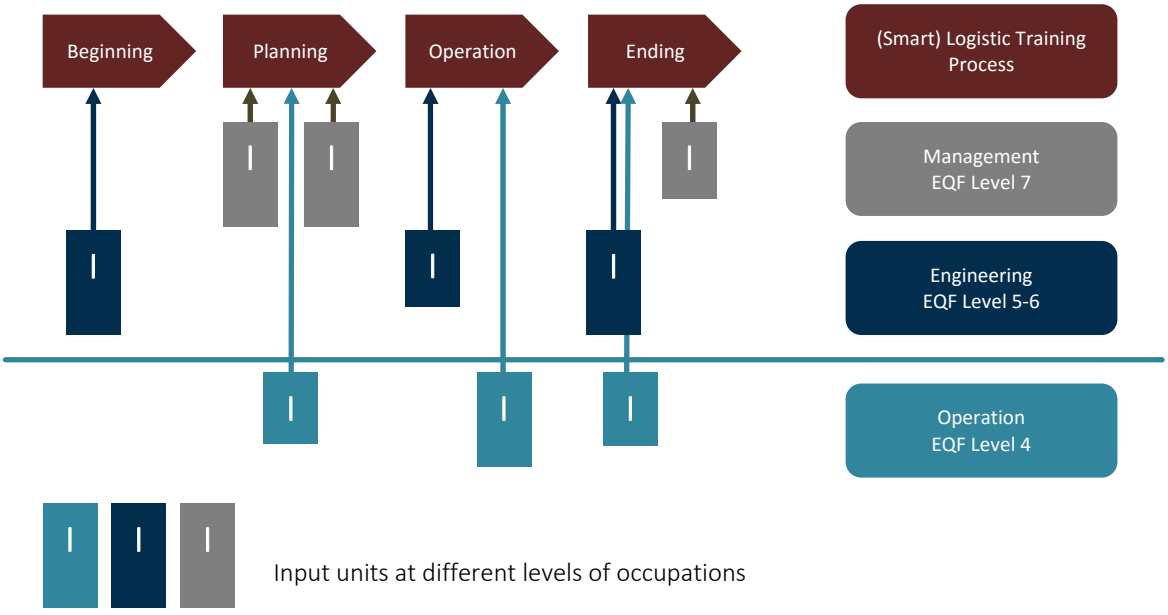

Figure 19 Inputs at different EQF Levels

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