

Impact Modeling of Demographic Change on the Industry Qualifications Framework (IQF) Logistics

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Abstract

The purpose of this research is to explore the demographic change in Germany on the Industry Qualifications Framework (IQF) of the logistics industry. We aim to use the Industry Qualifications Framework (IQF) Logistics as an instrument to mitigate the ensuing lack of employability in the German and European logistics industry. In order to support this with a better understanding of the impacts of demographic change on the overall competence situation in Germany, a simulation based on a competence survey from 2012 with more than 1,000 logistics employees is used. This shows the effects of aging working-age cohorts on the competence distribution in the German logistics workforce – but quite huge impacts on the total available knowledge pool mainly due to the decrease of available people within the total workforce. These results shall inspire further research and hands-on strategic management concepts to tackle questions of life-long learning as well as migration and integration in the German logistics workforce.

Keywords: IQF Logistics, demographic change, logistics industry

Introduction and Educational Background in the Logistics Industry in Germany

In 2011, 2.8 million persons were employed in the German logistics industry. 29% of them work in the transport field, 7% are responsible for administration, 47% handle the goods in warehouses and load cargo, 17% are dealing with indirect activities such as consultant or lawyer or insurance (Kille and Schwemmer, 2012, pp. 38). Totally, the logistics industry in Germany has 654,606 employees as office administration members and 1,988,322 employees are blue collar workers such as drivers or warehouse staff (Klaus, Hartmann and Kille, 2010, p. 57).

Table 1: Employees in the logistics industry (Klaus, Hartmann and Kille, 2010, p. 57)

	no.	occupation group	number SVP employees 2009	fraction logistics in percent of total employees	number SVP employees in logistics (col-)	fraction in % of all SVP employees	extrapolation to all employees (1.2 * SVP employees)	factor for extrapolation of entire logistic employees	service provider industry and trade	other economic sectors	service provider	industry and trade	other economic sectors		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	direct logistic occupations														
2	711	engine driver	35,372	20%	7,074	0.03%	8,489		8,489	89%	4%	7%	7,581	329	579
3	712	traffic controller (rail)	53,590	20%	10,718	0.04%	12,862		12,862	75%	3%	22%	9,612	400	2,850
4	713	other traffic controller	15,584	20%	3,117	0.01%	3,740		3,740	42%	17%	42%	1,560	621	1,560
5	714	motor vehicle drivers	766,378	80%	613,102	2.25%	735,723		735,723	60%	20%	19%	443,468	150,240	142,015
6	721	nautical	7,395	20%	1,479	0.01%	1,775		1,775	73%	5%	22%	1,292	92	391
7	722	technical ship's officer	5,914	20%	1,183	0.00%	1,419		1,419	51%	20%	29%	725	289	405
8	723	sailor	8,599	20%	1,720	0.01%	2,064		2,064	75%	2%	23%	1,546	38	480
9	724	inland sailor	5,939	70%	4,157	0.02%	4,989		4,989	65%	4%	30%	3,251	217	1,521
10	726	aviation occupations	26,349	15%	3,952	0.01%	4,743		4,743	85%	3%	12%	4,011	147	585
11	subtotal transport and traffic								775,803	61%	20%	19%	473,045	152,373	150,386
12	521	quality inspector	120,647	20%	24,129	0.09%	28,955		28,955	8%	77%	15%	2,285	22,263	4,408
13	522	dispatcher	228,255	80%	182,604	0.67%	219,125		219,125	7%	77%	16%	14,961	168,262	35,902
14	741	storage managers	254,634	100%	254,634	0.93%	305,561		305,561	12%	72%	16%	36,725	219,968	48,868
15	742	Forklift truck and other equipment	55,076	80%	44,061	0.16%	52,873		52,873	16%	59%	24%	8,570	31,437	12,866
16	743	furniture remover	11,241	100%	11,241	0.04%	13,489		13,489	73%	13%	14%	9,858	1,796	1,835
17	744	warehouse and transportworker	493,763	100%	493,763	1.81%	592,516		592,516	27%	49%	24%	157,177	291,250	144,089
18	subtotal storage and turnover								1,212,519	19%	61%	20%	229,576	734,974	247,968
19	681	wholesale and retail	512,790	10%	51,279	0.19%	61,535		61,535	1%	85%	14%	613	52,530	8,392
20	701	forwarding agent	101,236	100%	101,236	0.37%	121,483		121,483	78%	14%	8%	94,842	17,337	9,304
21	704	estate agent	15,102	5%	755	0.00%	906		906	5%	6%	90%	41	51	814
22	705	renters, mediators, auctioneers	28,541	5%	1,427	0.01%	1,712		1,712	5%	11%	84%	83	189	1,411
23	732	postman	115,793	10%	11,579	0.04%	13,895		13,895	95%	2%	3%	13,242	221	432
24	subtotal admin. Functions								199,532	55%	35%	10%	108,821	70,328	20,383
25	subtotal "direct activities"								2,187,864	37%	44%	19%	811,442	957,675	418,737
26	indirect logistic occupations														
27	75	enterpriser, auditor			27,348	0.10%		0,015	32,818						
28	77	purchase accounting people			45,580	0.17%		0,025	54,696				168,780	199,196	87,097
29	78	office specialists and assistants			306,300	1.12%		0,168	367,559						
30	subtotal "indirect activities"								455,074						
31	total amount								2,642,927				980,222	1,156,871	505,834

Furthermore, Kille and Schwemmer (2012) estimate for the logistics industry a turnover of 222.5 Billion Euro (2001: 160 Billion Euro) (Kille and Schwemmer, 2012, pp. 38). The experts in the logistics industry expect an economic growth of 4% to 5% per anno. This development provides every reason to consider education in the logistics industry with a special emphasis. The enterprises need qualified personnel therefore continuing education becomes very important. According to Roth and Hildebrand the logistic sector needs annually 14,000 executives (Hildebrand and Roth, 2008). In the logistics industry 30.03% of all full time employees have an 'unknown' education, 13.72% are totally without an education and only 2.78% of all full time employees possess a university degree (Roth, 2008; Roth and Klaus, 2008; Hildebrand and Roth, 2008).

The figures in table 2 result among other factors from the former bad image of the logistics industry including low wages, inconvenient working times and uncertain economy cause of a seasonal variation, uncivil conversational tone, bad career chances, few qualified personnel and high workloads. Although, in Germany there are 43 universities, 71 universities of applied sciences and 14 universities of cooperative education who offer academic training to the employees of the logistic sector (Roth, 2008; Roth and Klaus, 2008; Hildebrand and Roth, 2008). Furthermore there are continuing education facilities who also allow achieving academic degree in logistics (Roth, 2010). This personnel structure and different education overview of all logistics full time employees lead to specify and to integrate the competence measurement instrument *Berufswertigkeit* (Klumpp, 2007) which compares identified qualification profiles of personnel with differ-

ent requirements of business practice. The emphasis is to strengthen the current employees towards the presented Industry Qualification Framework (IQF) Logistics.

Table 2: Qualification of employees in the logistics industry (Federal Labour Office (Bundesagentur für Arbeit), 2011)

economic sectors 2008		number of employees covered by social insurance entire federal territory					
		a total of		thereunder			
			with vocational training	without vocational training	university of applied science degree	university degree	vocational training unknown / no allocation possible./n.s.
		1	2	3	4	5	6
a total of thereunder		27,710,487	16,042,187	3,856,768	1,075,093	1,865,276	4,871,163
sum (lines 13 to 22) thereof		1,079,759	577,251	148,217	16,088	13,904	324,299
transport of goods in railway traffic	492	17,995	12,598	3,972	491	423	511
transport of goods in road traffic, moving transport	494	199,431	91,694	19,649	706	609	86,773
transport through pipelines	495	1,570	932	79	172	280	107
transport of goods in ocean and coastal shipping	502	19,610	9,986	1,138	2,569	858	5,059
transport of goods in inland water shipping	504	2,991	1,680	300	50	40	921
transport of goods in aviation and astronautics	512	459	206	105	9	12	127
warehousing	521	71,792	38,104	16,407	1,218	1,142	14,921
provision of other services in traffic	522	558,503	308,254	80,400	9,902	9,134	150,813
postal services of universal service providers	531	154,523	97,978	19,285	668	1,077	35,515
other postal, courier and express services	532	52,885	15,819	6,882	303	329	29,552

Demographic Change in Germany

Already in the 20th century, John Maynard Keynes (1936) stated from the practical point of view that „an era of increasing population tends to promote optimism, since demand will in general tend to exceed, rather than fall short of, what was hoped for. Moreover, a mistake resulting in a particular type of capital of being in temporary over-supply, is in such conditions rapidly corrected. But in an era of declining population the opposite is true. Demand tends to be below what was expected, and a state of over-supply is less easily corrected. Thus a pessimistic atmosphere may issue; and although at long last pessimism may tend to correct itself through its effect on supply the first result to prosperity of a change-over from an increasing to a declining population may be very disastrous.” (Keynes, 1936, p. 14).

The demographic change has a high impact on economy (Klumpp et al., 2012), health care service, infrastructure, mobility as well as the pension system in Germany. The working-age population (20 to 64 years old) in Germany is currently 49.8 million. In 2030, the working-age population will probably have 6.3 million fewer persons than in 2010 (German Federal Interior Ministry (Bundesministerium des Inneren), 2011, p. 6) and in 2060 the working-age population will decline about 35% compared to 2013 (Federal Statistical Office (Statistisches Bundesamt, 2013). Not only Germany is faced with the demographic change even the “European Union is facing unprecedented demographic changes (an aging population, low birth rates, changing family structures and migration). In the light of these challenges it is important, both at EU and national level, to review and adapt existing policies” (European Commission, 2010). However, in

the future economic demand has to be adjusted due to the demographic change. Skilled and productive employees allow for economic growth. To resolve the conflict due to the impact of demographic change and to mitigate the threat of a shortage of employees we should strengthen the current employees, the underutilized population in the labour system i.e. women and disabled people and integrate the qualified immigrants in the labour system.

Impact of Demographic Change on Industry Qualification Framework Logistics

Competence Measurement in the Logistics Industry

Competence is defined as “the ability to successfully meet complex demands in a particular context. Its manifestation, competent performance (which one may equate to effective action), depends on the mobilization of knowledge, cognitive and practical skills, as well as social and behavioral components such as attitudes, emotions, values and motivations” (Hakkarainen et al., 2004). Competence demonstrates also level of student achievement in the science education context (Liu, 2009). Competence is not only skills, qualification or only knowledge but all these factors are the basic for a competence of person (Erpenbeck and von Rosenstiel 2007).

In the logistics sector the access for everyone in particular the newcomer in the logistics industry for continuing education has to be improved. Furthermore the logistics industry requires specialist and no generalists that mean that the access to specialize the skills has also to be simplified. One more aspect is to observe that the demographic change in Germany is to counteract with more flexible continuing education offers where the practice experiences of the employees have to be measured. All these reasons require a competence measurement concept and an IQF for the logistics industry which is suitable, practicable and compatible in every economic sector and in particular the logistics sector.

One measurement concept which is developed, called *Berufswertigkeit*, fulfilled the needs of a general competence measurement tool (Klumpp, 2007; Klumpp and Schaumann, 2007; Klumpp et al., 2011; Klumpp et al., 2013). The main subject of *Berufswertigkeit* is a conception of competence measurement of persons with different education degrees. The criteria for an effective competence measurement are adapted of the modern practice. The results are practice and output-oriented. Hereby the different education degree and the achieved competences could be compared. This measuring concept considers two important elements such as comparable of activities in the business practice and comparable evaluation of people’s competences and their value of company. The evaluation concept *Berufswertigkeitsindex* is already developed in previous *Berufswertigkeit* studies. This includes 36 qualification requirement criteria that represent the modern daily work which will be used to calculate the *Berufswertigkeitsindex* (Klumpp et al., 2011):

- | | | |
|--|--|---|
| 1. Efficiency | 14. Staff requirements and staff mission planning / staff development | 28. Quality management (optimization of processes and products or service quality) |
| 2. Independence and own initiative | 15. Team, staff and leadership | 29. Conceptual and strategic implementation of industry-specific knowledge and experience |
| 3. Flexibility and adaptability | 16. Improving responsible care | 30. Identification with the company |
| 4. Work virtues | 17. Legal knowledge | 31. Strategic orientation, determine / control the complete company |
| 5. Stress resistance | 18. Ability to apply modern information- and communication technologies (work place) | 32. Understanding of solutions for complex technical problems |
| 6. Motivation and ability to life-long learning and maintain to own competence profile | 19. Communication and rhetoric | 33. Basic knowledge of business administration |
| 7. Coordinate the work- and life-times | 20. Assertiveness | 34. Perception of functions of management and organization |
| 8. Creativity | 21. International and intercultural competence | 35. Conceptual working in immediate workplace |
| 9. Loyalty | 22. Customer focus | 36. Planning, control procurement and logistics processes |
| 10. Risk-taking | 23. Skills in mathematics and statistics | |
| 11. Charisma | 24. Preparation of cost estimates and quotations | |
| 12. Ability to write and speak in German | 25. Planning, implementation and documentation of orders and projects | |
| 13. Knowledge of a foreign language | 26. Negotiations capacity | |
| | 27. Analytical problem-oriented work | |

The output-oriented measuring concept *Berufswertigkeit* serves as a basic field-evaluation concept for the development of an Industry Qualifications Framework (IQF) for the logistics industry and integrates the required investigation of competences (Klumpff and Schaumann, 2007). In the field survey 809 persons in North-Rhine Westphalia (NRW) and 259 persons in Hesse with different education levels were asked. 88.6% are employed as white-collar worker in the different levels like branch manager, team leaders and office clerks in their companies and 11.4% work in warehouses or as truck drivers, namely blue-collar workers.

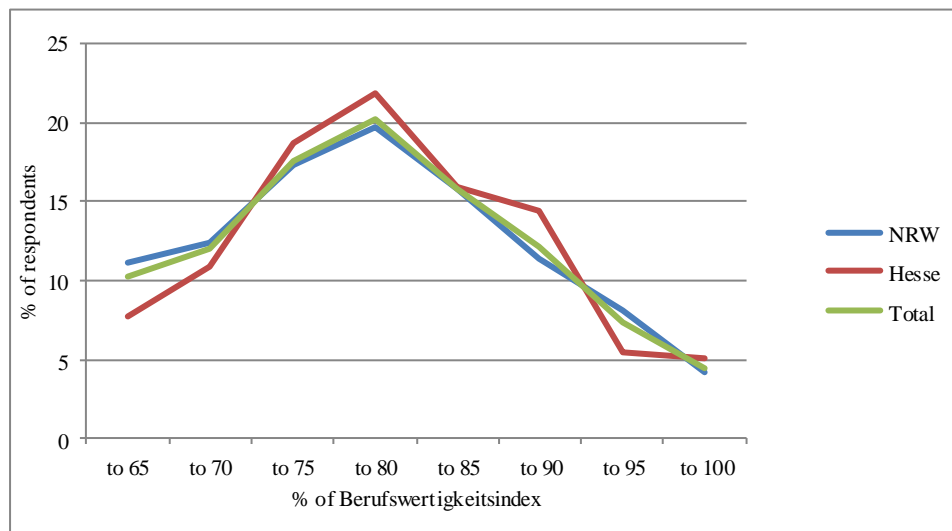


Figure 1: Berufswertigkeitsindex for the logistics industry (NRW and Hesse in 2013) (Klumpff et al., 2013)

Figure 2 presents the distribution of the Berufswertigkeitsindex (BWI) in 2013 across all age groups. The curve that presents the respondents with the age of up to 25 years indicates a high BWI with 75% to 80%. This group estimates themselves with a high BWI due to their specific logistics education and possibly their internet knowledge. In the remaining age groups the curve are flat compared to that. The BWI is equally distributed in the value of 65% to 100%. All graphs of the age groups except the age groups between 46 to 55 years old run in parallel. The remaining age groups achieve the highest BWI with 75% to 80%. The results show that 18% of respondents in the age of 46 to 55 years have a BWI of 70% to 75%. As could have been ex-

pected only 2% of the age group till 25 years achieve 95% to 100% and 8% of the age group older than 55 years old has the highest share of all age groups in the BWI of 95% to 100%.

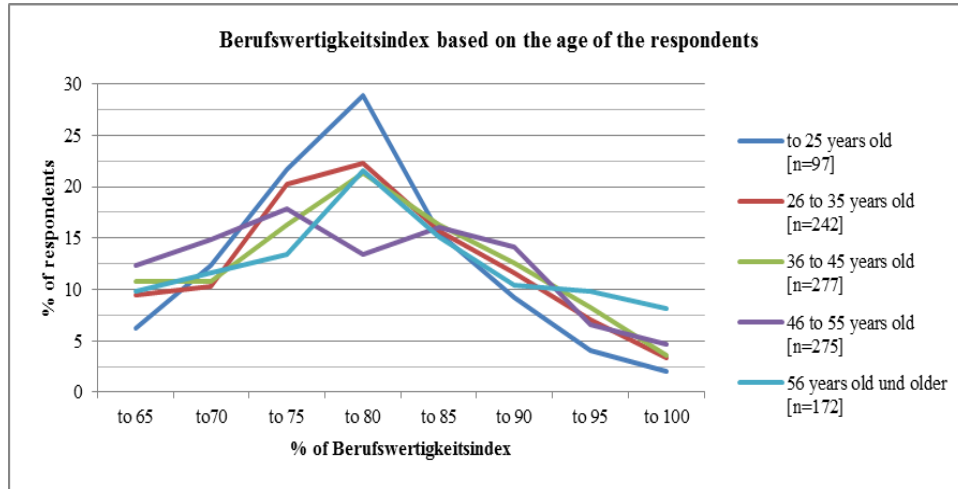


Figure 2: Berufswertigkeitsindex based on age of the respondents in 2013 (Klumpp et al., 2013)

Industry Qualifications Framework Instrument against Employability Shortage

German industry is affected by the demographic change. Especially baby-boomers in the 1950s and 1960s implicate that after 2015 many employees withdrawal from economic activity because of reaching retirement age (Bloom et al., 2011). The first impact of this phenomenon on the logistics employment situation can be seen at the development of the competence structure of German population (Figure 3). In this first case for a simulation of demographic impact we assumed the demographic development from 2013 until 2060 regarding the changing age-group distribution within total population (according to the official age cohort statistics for Germany of the German federal statistics office).

We considered the working-age population from 18 to 65 years old and the results of the *Berufswertigkeit* from figure 1. For the practical calculation the competence levels for the BWI distribution schemes were taken as a ‘given’ and multiplied with the changing age cohort shares of the total population in order to represent the changing overall competence levels of the total workforce due to the “aging effect” of demographic change.

The results are based on the following assumptions from the simulation concept and the 2012 *Berufswertigkeit* survey:

- (i) It is assumed that the average competence levels within an age group (e.g. 18-25 year-olds) is stable over the time horizon 2013 to 2060.
- (ii) It is assumed that the competence levels by age groups measured 2012 survey for the two states North-Rhine Westfalia and Hesse can be assumed to be the same for all of Germany – this is backed by the fact that also the age group distribution in 2012/2013 for the two states within the survey groups is very similar to the overall age distribution of the German workforce at this time.
- (iii) It is finally assumed, that the competence levels experienced in the survey for the logistics sector is similar for the total workforce for all of Germany – which is pos-

sibly the weakest assumption if singling out other comparative industries such as finance or automotive with probably distinctively higher overall competence levels; but still the comparison of the specific logistics industry competence level may hold true for the overall German workforce as there are arguably also industries with assumed lower competence levels like e.g. retailing, cleaning and construction.

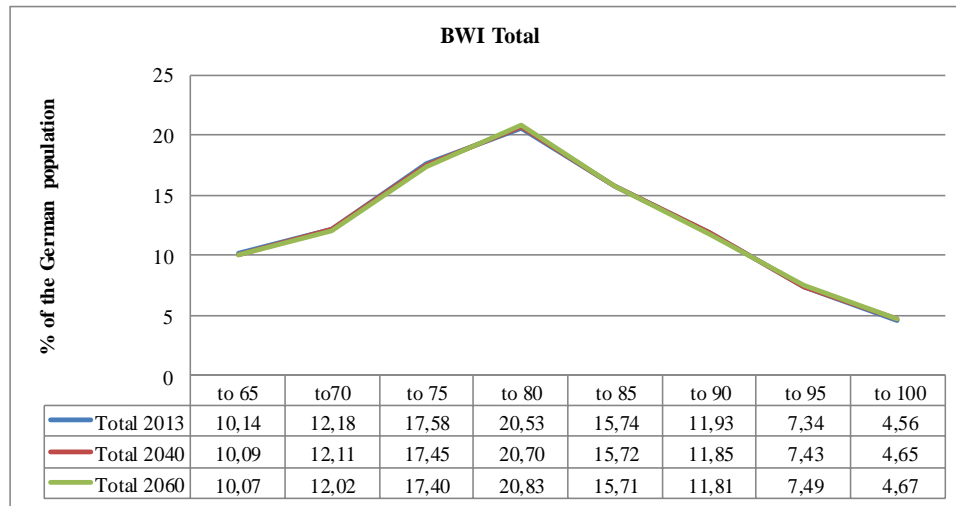


Figure 3: The impact of the demographic change on the competence of the logistics industry

The part of employees over 50 increases continuously and this effect will be enforced in the following years. The number of employees up to 25 years stagnated in the last ten years so that the withdrawal of the older workforce members cannot be balanced completely. Therefore, we elaborated the mitigation of total competence points of the German working-age population (working-age population in the age of 18 years until 65 years old) in 2013 and 2060 to simulate the effect of the declining population in Germany on the overall competence pool.

The federal statistics office states that in Germany we have 52,001 persons between the age of 18 years old and 65 years old in 2013. In 2060, we will only have 34,487 persons in the age range of 18 years to 65 years old. To determine the effect of total accumulated competence points (CP) of the German working-age population in 2013 and 2060 we multiplied average BWI levels per BWI level category group (e.g. the value of 72.5 BWI point for the category from 70.0 to 75.0 BWI points) with the total population in 2013 as well as in 2060; therefore the following figure gives a representation of the total (quantitative) competence pool in Germany for those two simulation years – depicting a sharp decline in the overall amount of competences available through the usual labor market channels due to the declining workforce. Also, this simulation is restricted to severe assumptions, mainly the assumptions that average competence levels will remain steady and there is no major migration movement pushing up the German workforce numbers.

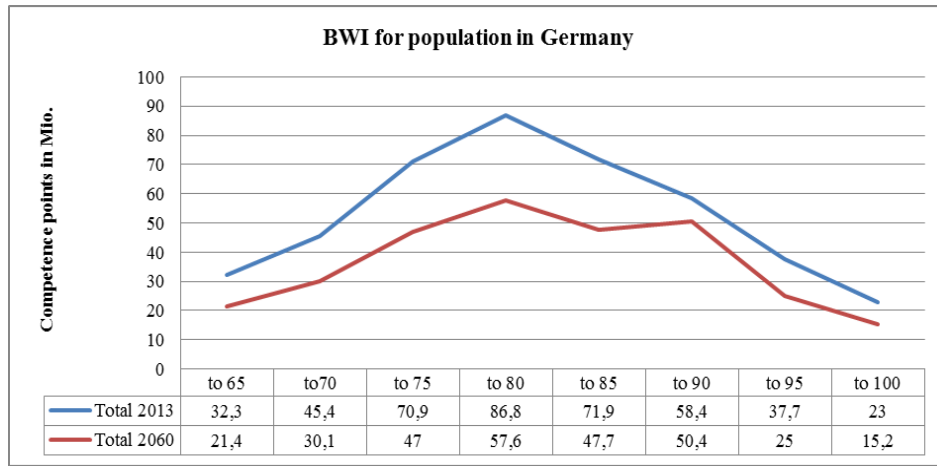


Figure 4: Competence comparison of the German population

Based on the results of the presented competence in the logistics industry, the IQF Logistics can be presented. The idea is to implement specific industry qualifications frameworks in the logistics industry based on the requirement and criteria of the logistics sector to mitigate the shortage of employability due to reduction of competences that is affected by the demographic change in Germany. An IQF logistics would especially for the logistics industry be important and could be very helpful. An example for different logistics qualifications levels connected to the current education degrees illustrates the following table. Further this structure is deployed in order to facilitate the standardization and adaption especially for SME companies in logistics – For designing education courses in logistics for working persons not only based on requirements with regard to content. A high level of education increases work productivity and employment rates and have a positive effect on production. We assigned the BWI to each level to raise the education level of the population, fight educational deficits and ensure equal educational opportunities.

Table 3: IQF for the logistics industry based on Berufswertigkeitsindex (Abidi and Klumpp, 2013)

	Competencies
Level 1 to 65% BWI	He/she has basic skills to carry out simple logistics operations under strict supervision like transport, transition handling, warehousing and picking activities in structured and stable contexts.
Level 2 to 70% BWI	He/she has basic factual and general knowledge of a field of work or study under supervision with some autonomy and to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools e.g. issuing a loading list, set a customer order, dispatching.
Level 3 to 75% BWI	He/she has knowledge of facts, principles, processes and general concepts, in a field of work or study e.g. fleet management and to accomplish tasks and solve problems by selecting and applying basic methods, tools, material and information e.g. customs clearance, procurement, transportation and inventory management.
Level 4 to 80% BWI	He/she has cognitive and practical skills required to generate solutions to specific problems by exercising self-management in contexts that are usually predictable, but changing supervise routine work of others: partial redesign of a supply chain or planning new inbound / Outbound routing destination as well as simple technology / IT tasks (with long-term logistics experience)
Level 5 to 85% BWI	He/she has comprehensive, specialized, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge e.g. developing a new logistics concept and implement it verifying which ICT innovation promotes efficiency and develop performance of self and others e.g. supervising and management of inventories, warehouse.
Level 6 to 90% BWI	He/she has advanced knowledge of a field of work or study, involving a critical understanding of theories and principles, e.g. developing and implementation of logistics education and training and demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialized field of work or study e.g. developing ICT tools, developing a last mile distribution concept or calculating Co2 emissions.
Level 7 to 95% BWI	He/she has highly specialized knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research critical awareness of knowledge issues in a field and at the interface between different fields e.g. joint sourcing, financial flows or global warehousing
Level 8 to 100% BWI	He/she has most advanced skills, including synthesis / evaluation required to solve critical problems in research / innovation and to redefine knowledge or practice in logistics allowing him/her to demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and commitment new ideas or processes at the forefront of work contexts including independent planning and supervision of large logistics companies, logistics research or consulting projects with several international networks and implications, communicating also with the industry, trade and politics

Further Development

By regarding the development of the aging structure in logistics it can be seen that innovative logistics learning solutions have to be designed for offering employees possibilities for life-long learning. The offer of logistics studies increased in the last years. Several universities provide pure logistics studies economic or technical studies with a main part of logistics content (Hildebrand and Roth, 2008; Keuschen and Klumpp, 2010). But the main challenge is to provide learning possibilities for employees without leaving their job. Employees have to increase their knowledge to tackle the tasks of logistics goods and services in a high velocity. Therefore, flexible e-learning scenarios offer the possibility of knowledge acquisition on the job and account for above mentioned dependency on trends. The high integration of technical solutions underlines the employees' capability to acquire knowledge within an e-learning scenario. The capability of logistics learning mechanisms depends on four components: temporal components, cultural components, structural components and relational components. The consideration of these four components is a major requirement of a successful learning process. The cultural component can be seen as a basis of learning because the whole logistics sector and nowadays supply chains are internationally oriented. The structural component regards the specifications of the employee's organization to realize learning activities on-the-job: flexible in time and position. Relational components assist the collaboration and communication within a strong cross-linked company structure and the temporal component supports the velocity of changes within the logistics sector and synchronizes them with the learning process (Esper et al., 2007).

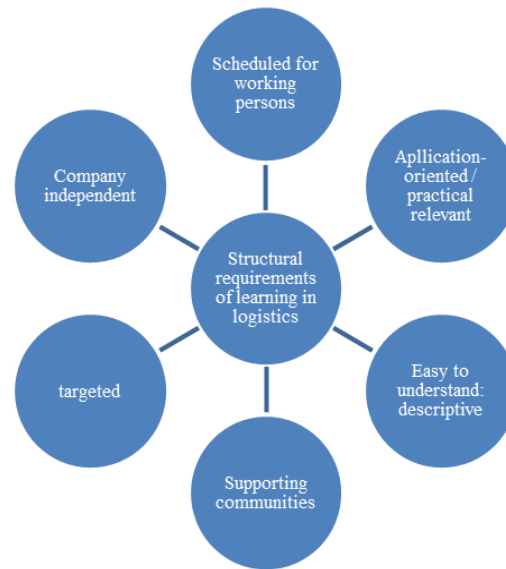


Figure 5: Structural education requirements in logistics industry

The goal of learning is to match employee's knowledge with the needs of the logistics industry i.e. logistics knowhow and as well as the understanding of other company departments with connection to logistics, for example process management, engineering or controlling. In best case, operative labor with practical experience has to be equipped with management tools and technique and developed to logistics managers of the future. For designing education courses in logistics for working persons not only requirements with regard to content has to be regarded but structural requirements gain in importance because of the development of this industry sec-

tor. These aspects are relevant because logistics industry is marked by several special peculiarities: High velocity and flexibility of services, huge part of small and medium sized companies and a huge part of tacit knowledge leads to following structural requirements.

Conclusion

The presented simulation has shown on the one hand the surprisingly minor implications of changing age group shares in the total competence distribution in the German workforce. But on the other hand, the modeled changes in total competence pool quantities (simulated as total competence points by adding up all workforce personnel with their average competence levels according to the Berufswertigkeitsindex concept) are representing a major shift in available competence quantities for the general economy and especially the logistics industry. This requires further investigation – e.g. the simulation of general as well as low-skilled and high-skilled immigration scenario impacts – as well as the preparation of dire competence management schemes. The presented IFQ Logistics scheme is such a possible instrument to improve the general education and further education impact (for example due to more problem- and person-specific education and training measures). This will also need further testing and development, as for example also acknowledge with the ESCO initiative of the European Commission, trying to connect more closely industry-specific job descriptions and systems with competence profiles and training requirements and options.

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