Chapter 10
Human Resource and Knowledge Management

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Abstract Future innovations in logistics and supply chain management are driven by technological, regional, economic and social changes as well as sustainability and resource restrictions. They will not occur without sufficient attention for the *human contribution*, in particular the qualification, competence and motivation of the workforce in the logistics domain. Worldwide, about 50 million people—or the entire population of South Korea—are employed in the SCM, logistics and transportation sectors. Consequently, *human resource and knowledge management* plays an important role, more so when considering demographic developments (ageing, migration) and increasing globalization. Whereas in the past, many blue-collar jobs in logistics such as truck driving merely required a basic school education and rudimentary qualification levels, these jobs now require increased competences due to improved technology interaction, e.g., barcode and RFID systems, fleet management or toll and truck steering concepts and finally artificial intelligence applications. The same is true for many white-collar jobs in logistics, exemplified by the increasing number of university graduates employed in the sector. This is especially true for specific fields such as logistics information technology, contract logistics and supply chain innovation and design, which in turn leads to the question of how to assess qualitative and quantitative competence levels in the SCM and logistics sector. Such an analysis example is provided here with the Berufswertigkeit concept (reference framework for competence levels). This may lead to a new paradigm in HR and knowledge management for SCM and logistics: whereas past education was mainly driven by formal qualifications and therefore personnel groups (white-collar/blue-collar), future con-

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cepts may focus on an *individual analysis* of gaps and potentials based on elaborate evaluations. In addition, modern concepts like edugaming are outlined as examples for future qualification and training concepts for logistics personnel.

10.1 Introduction: Logistics Personnel and Qualification (Basic)

The supply chain, logistics and transportation industry has become a knowledge-intensive service industry, similar to other sectors such as the banking, insurance, engineering or the healthcare industries (Klumpp 2016). In the past, mainly manual labor and only basic (mostly vocational) qualifications were commonplace, both in *blue-collar* (e.g., truck drivers, warehouse personnel) as well as *white-collar* (e.g., dispatchers, managers) employment in logistics. Today, qualification requirements are different und significantly higher and they are crucial for business success in terms of being a strategic success factor (Rao et al. 1998; Lancioni et al. 2001; Mangan and Christopher 2005; Wu 2007; Esper et al. 2007, Rogers and Braziotis 2016).

Such rising qualification requirements are a consequence of technological innovations such as barcoding, RFID, GPS, and automated systems in physical logistics processes. At the same time, the overall complexity of logistics processes has risen manifold, thereby making the tasks of the planning, management and control of the logistics function even more demanding. This is because supply chains became global, with a multitude of actors and stakeholders as well as increasing demands of customers regarding quality, sustainability, price and cost-efficiency, next to flexibility and speed in delivery (Klumpp et al. 2013; Rogers and Braziotis 2016). Therefore, competence requirements for logistics personnel have grown due to the multitude of complex tasks in logistics management—to the point where innovation and growth may be hampered due to missing competences and regulations regarding process standards (Zijm and Klumpp 2016, 14–19).

In order to provide a quantitative overview of these developments some statistical data may serve as a starting point for the discussion on logistic qualification. In 2015, 2.9 million people were employed in the logistic industry for example in Germany. Comparing this with the overall GDP in Germany (3.356 trillion US $ in 2015 according to the World Bank) yields a rate of 1,157,162 US $ of GDP per logistics employee. Extrapolation of this rate to the world's GDP leads to a global estimate of logistics employees of 63.5 million persons (*high estimate*). Providing a *low estimate* with only *two thirds* of the GDP per logistics employee yields an estimate of 42.3 million persons in the sector. In this chapter, we therefore take the average of about 50 million persons employed in the SCM and logistics sector as a starting point for a global estimate for all personnel employed in the logistics sector. It is obvious that a clear-cut figure is impossible to retrieve mainly due to data gathering and definition problems (e.g. determining whether people in industrial companies, for example in the automotive sector, work with logistics tasks; we are familiar with data only for Germany) (Table 10.1).

Table 10.1 Global personnel estimate in the SCM and logistics sector

	GDP 2015 US $	Logistics employees 2015	Low estimate	High estimate
Germany	3,355,772,000,000	2,900,000	–	–
World	73,502,341,000,000	–	42,346,299	63,519,449

Sources World Bank (GDP), BVL Germany (Logistics Employees)

Many arguments could be presented in favor of or against the defined estimate range, mainly questioning the rate of logistics employees per GDP for Germany compared to other countries. Such arguments may address the question of population and population density (high for Germany), infrastructure (well developed in Germany), logistics professionalism or technology (also very high in Germany as according to the World Bank Logistics Performance Index, see http://lpi.worldbank.org, Fig. 10.1). Most arguments would have impacts in the direction of larger estimate numbers as they might allow only for a lower GDP per personnel than Germany; e.g., with lower infrastructure standards as well as technology implementation one would need more personnel for identical transportation and logistics tasks compared to Germany. This leads to the assumption that the presented estimate number is mainly on the lower safe side and the real number of logistics employees worldwide may well be larger.

The logistics industry has experienced a sector growth of about 1–2% *above* the overall average economic growth per annum. Combined with the earlier mentioned technological progress, there are sufficient arguments to pay special attention to education in the logistics industry: firms need qualified personnel in the logistics field not only because of the described technology and supply chain organizational changes; but also to cope with the above-average growth while keeping the transport chains cost-efficient as well as sustainable for the customers and society at large (Klumpp 2016; Rogers and Braziotis 2016). In order to implement this, qualified personnel is needed, in some cases very scarce which in turn may be used as an indication where actions from HR and training as well as knowledge management is required. In Fig. 10.2, the most important qualification fields with "missing personnel" are reported in a recent logistics survey from Germany. Obviously, especially specific academic qualifications in the fields of computer science (IT), management and engineering are in need, matching the "cross-discipline" nature of logistics and supply chain management.

This chapter is structured as follows: Sects. 10.2 and 10.3 further outline the *basic* concepts, terminology and requirements regarding qualification and human resource management in logistics. On an *advanced* level, Sect. 10.4 describes the tools and concepts for HR management—whereas Sect. 10.5 provides such tools and concepts for knowledge management in logistics. Addressing a *state-of-the-art* level, Sect. 10.6 is outlining the innovative Berufswertigkeit evaluation concept for competences in the logistics field; Sect. 10.7 is further describing a new research and development approach with edugaming for training and knowledge management.

Fig. 10.1 Logistics performance index—leadership 2016 (World Bank)

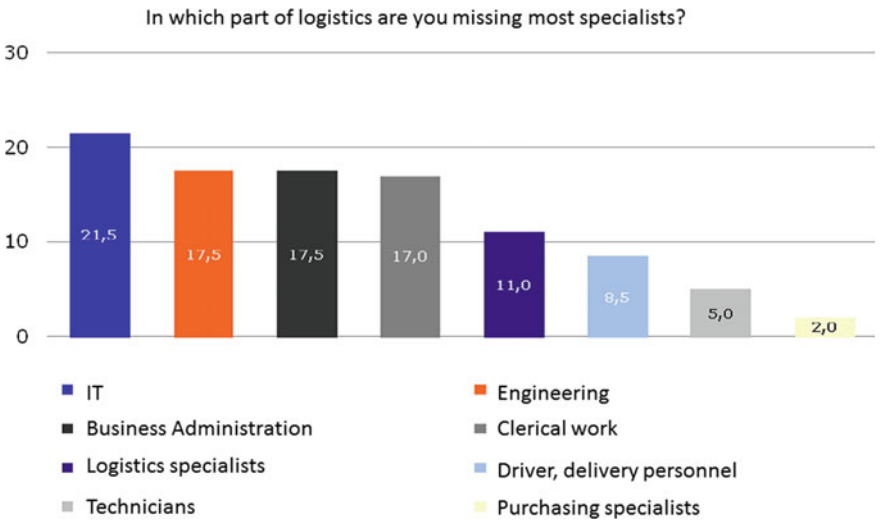

Fig. 10.2 Personnel and qualification requirements in logistics (BVL Germany)

10.2 Case Study: Bohnen Logistics

Bohnen Logistics was founded in Germany already in 1926 when Johann Bohnen started driving individual transport shipments for the local brick industry near Düsseldorf, Germany. At this time still with horses and carriage, he provided the missing transport link within the supply chain of core building corporations. Soon he realized that innovation and technology is the key to business success, especially in transportation and logistics: He was one of the first entrepreneurs to buy and use road trucks instead of horses. This enabled the business to grow in terms of employees as well as transport distance—soon he was doing business within a large part of western Germany along the river Rhine.

When his son Reiner Bohnen took over in the 1950s, the major challenge was to enlarge the service range and the geographical reach at the same time, going international within Europe. New customers and value-added services like warehousing and IT support systems were acquired and several other company locations established. Throughout the corporate history of success and growth, also the third generation CEO, Jürgen Bohnen, emphasizes the imminent importance of a "human workforce and innovation culture": Based on a very engaged, emotional but also competitive and demanding cooperation with all employees, Bohnen Logistics is convinced to provide the necessary basis for new services, technology innovation and therefore further growth.

Today, Bohnen is a valuable service brand in Germany, standing for innovation, flexibility and high-quality service and working with customers like Danone and CWS Boco. The company received the NRW.Invest Award for a top-notch new warehouse with automated services and a size of 40.000 m^2 in Duisburg, the largest inland port of Europe. The sights of the company and the employees are still onto new innovations, further automation as well as added services for customers. The bottom line of this successful corporate story within the logistics industry is the fact that qualification and competences of employees go hand in hand with innovation, including technology as well as business case innovation and services offered.

The need for innovative training and qualification concepts finds support by results of an internal survey conducted by Bohnen Logistics amongst employees. Concerning the blue collar-workforce, employees were asked about the role of logistics training. Regarding self-assessment by the interviewed, the importance of ongoing qualification was stressed with respect to changes in regulations and law.

Willingness to pursue work-related training measures was (i) given in all but those considering retirement, (ii) conditional on training happening during work hours and resulting in visible and material (monetary, status) rewards, and (iii) conditional on student-centered (as opposed to teacher-centered) learning, engagement, fun, intrinsic motivation.

Rising complexity and changes in preferences concerning ongoing qualification and training, particularly student-centeredness, intrinsic motivation and fun, and visibility of advances made can be dealt with using modern e-learning and edugaming approaches such as those outlined in Sect. 10.7 of this chapter.

It is important to recognize that qualification and training in logistics are not a "nicety" to employees but a "necessity" for strategic management in order to enable innovation and business as well as earnings growth.
(Source: Personal communications and www.bohnen-logistik.de)

10.3 Terminology and Competence Requirements

Definitions regarding qualification and competence measurement as well as continuing education and training are often fragmented or imprecise.

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 the level of student achievement in a science education context; competence is there-

fore not only skill, qualification or knowledge, but all these factors together constitute the basis for the competence of an individual person (Liu 2009; Klumpp 2016).

The term *continuing education* is also used as for example further education or training—all dedicated to the same question of on-the-job or parallel-to-the-job qualification (Cervero 1988; Mezirow 1991; Jarvis 1995; Hanft and Knust 2009). Already in 1970, the German Education Council determined continuing education in the German education structure: it can be defined as *continuation or resumption of learning after a first degree*; continuing education therefore usually might begin after entering the workforce (Bildungsrat 1970). Furthermore, continuing education includes formal, informal and non-formal learning (Marsick and Watkins 2001; Hofstein and Rosenfeld 2008; Dabbagh and Kitsantas 2012; Klumpp 2016).

Formal learning means a regulated and structured continuing training, which is organized by institutions and where students have the chance to gain acknowledged degrees and certificates. *Informal learning* indicates continuing education in project groups, networks and coaching without acknowledged degrees or certificates—but with a recognizable teaching-learning setup, whether be it personal or also electronically or virtually.

Non-formal learning is learning by doing or learning on the job without even standardized or organized learning environments and processes. Further, this can be distinguished into *general* (not practice- and profession-oriented), *vocational* (practice- and profession-oriented by deepening practical experience) and *higher* (education at research universities and universities of applied sciences).

Generally speaking, continuing education may provide advantages for all stakeholders. These advantages are defined in economic and social dimensions, with three levels each (European Centre for the Development of Vocational Training 2011):

- Macro Level: Advantages for a whole society
  - Economic profit: Economic growth and labor-market outcomes
  - Social profit: Crime reduction, social cohesion, health and intergenerational benefits
- Meso Level: Advantages for enterprises and groups
  - Economic profit: Firms performance and employees productivity
  - Social profit: Inclusion disadvantaged groups
- Micro Level: Advantages for individuals
  - Economic profit: Employment opportunities, earning and career development
  - Social profit: Life satisfaction and individual motivation

The logistics sector is also characterized by many people changing career tracks and industries, even in mid-career. Also for "newcomers" there are ample possibilities within *continuing education* facilitating the acquisition of specific logistics skills (for an example overview of professional tasks and trainings in Germany see: Berufswelt Logistik 2017). To continue education with many years of business practice experience (minimum one year) in the logistic sector there are two different ways to

Table 10.2 Differences between e-learning 1.0 and e-learning 2.0

E-learning	1.0	2.0
Learning environment	A closed area **in** the internet supporting content and tools	An open platform **to** the internet supporting tools for generating content
Teachers	Transfer all known resources into this closed area	Define boundaries and offer resources
Students	Consume the given content	Configure their personal learning environment (PLE) to generate own content

extend individual competences in Germany: through *academic* continuing education programs at universities (part-time or full-time) that offer an academic degree, or through practice-oriented continuing *professional* education (Klumpp 2016).

In order to support success in continuing education and to motivate the current generation, suitable learning tools such as *e-learning* platforms developed within the 21st century. Because information and communication technologies such as smartphones and notebooks find their way into everyday life, e-learning is an important pathway, especially for lifelong learning scenarios. The main advantage of e-learning is the possibility of receiving information anytime and anywhere. Besides e-learning scenarios without physical presence in a classroom, blended learning concepts have been realized in which traditional face-to-face learning situations are combined with e-learning elements (Klumpp 2016).

Most educational institutions offer their students e-learning platforms to support the face-to-face learning sessions with additional information. Two main software concepts are Moodle, which was developed at the University of Cologne, and Blackboard, developed by Blackboard Inc., Washington D.C. According to a definition of Web 2.0 in 2005 e-learning technologies were also developed to stimulate an active participation of the learner. Social software has been conveyed into learning environments, like wikis, podcasts or blogs. The boundary between teacher and learner disappears and collaborative learning scenarios gain in importance so that new technologies evolved (Blees and Rittberger 2009). Table 10.2 displays an overview of the differences between e-learning 1.0 and 2.0.

Competence is a major asset when measuring logistics industries' competitiveness—as also demonstrated by the *Logistics Performance Index* (LPI) published by the Worldbank, where it is one out of six indicators regarding a country-specific competence level in logistics and transportation (Worldbank 2017). Especially from the perspective of logistics practice, there are several *major trends* to be recognized and reviewed for future management concepts in relationship with competence and knowledge management (Zijm and Klumpp 2016):

- Globalization: Open Supply Chains and scattered production plants demand for reliable logistic processes.

- Digitalization: High integration of information systems such as telematics, mobile handhelds, tracking & tracing, etc.
- Knowledge management: The success of logistic service providers is often intimately connected with the employees' knowledge.
- Volatility of economic development: The logistics industry experiences a more severe impact of economic fluctuations than other industry sectors.
- Security: Examples are attacks by pirates on ship as well as disruptions due to civil wars and natural disasters.
- Sensitivity in ecological and sustainability questions: Carbon and other emissions as well as energy and resource consumption through logistics.

In addition to the main subjects identified above, most high-wage countries (i.e., in Europe and America) are affected by the *demographic change* in their population. Especially the baby-boomer generation with age cohorts from the 1950s and 1960s implicate that after 2020 many employees will withdraw from economic activity because of reaching their retirement age. When considering the identified trends and the development of the aging structure in logistics it is obvious that innovative logistics learning solutions have to be designed by offering employees *possibilities for lifelong learning*.

The number of logistics education, qualification and training programs increased in the last 20 years: today, in many European countries universities provide specific logistics programs as well as economic or technical programs with significant logistics content (Hildebrand and Roth 2008). However, 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 management in a global high-velocity supply chain environment. Therefore, flexible e-learning scenarios offer the possibility of knowledge acquisition on the job and account for the above-mentioned dependency on current trends. The 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 for a successful learning process. The cultural component can be seen as a basis of learning because the entire logistics sector and 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 strongly 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). The goal of learning is to match an employee's knowledge with the needs of the logistics industry. The needs can be displayed in the shape of a "T" (Fig. 10.3).

The horizontal level displays specific logistics know-how and the vertical level displays the understanding of other company departments with connection to logis-

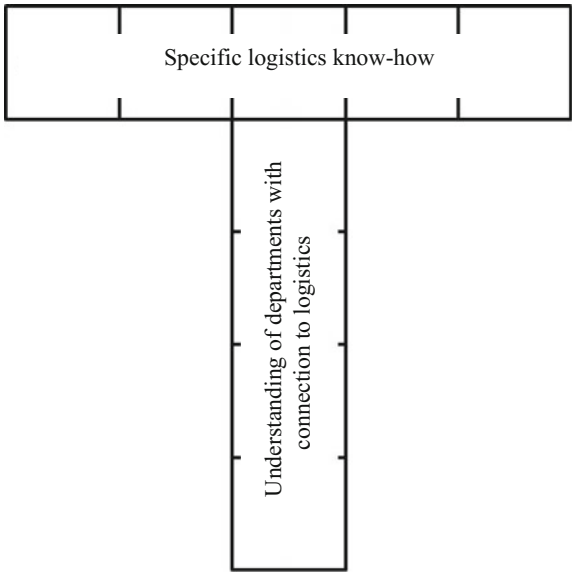

Fig. 10.3 Employee capabilities for logistics (Mangan and Christopher 2005)

tics, for example process management, engineering (R&D), production, sales or accounting departments. In a best-case scenario, operations personnel with practical experience has been equipped with management tools and competences and therefore develop into logistics managers of the future.

For designing educational courses in logistics for persons already employed, the content must be carefully designed and developed. In addition, *structural requirements* gain in importance because of the development of the sector. These aspects are relevant because the logistics industry shows several specific characteristics: high speed and flexibility of services, significant shares of small and medium-sized companies and a typically high level of personal *tacit knowledge* leads to the structural requirements listed in Fig. 10.4.

10.4 HRM Tools in Logistics (Advanced)

Innovations in logistics are often only associated with technical solutions. This restriction has implications for an area in which new concepts and solutions can raise great potential for optimization—the field of *human resources*. It is not a matter of looking at the employees as a simple production factor, but rather the organizational design of the working conditions and the work environment and thus new possibilities for the development of self-initiative and creativity to increase competitiveness.

In order to achieve this, the general HR objectives and tasks of recruiting, assessment, performance review, training as well as long-term career management and

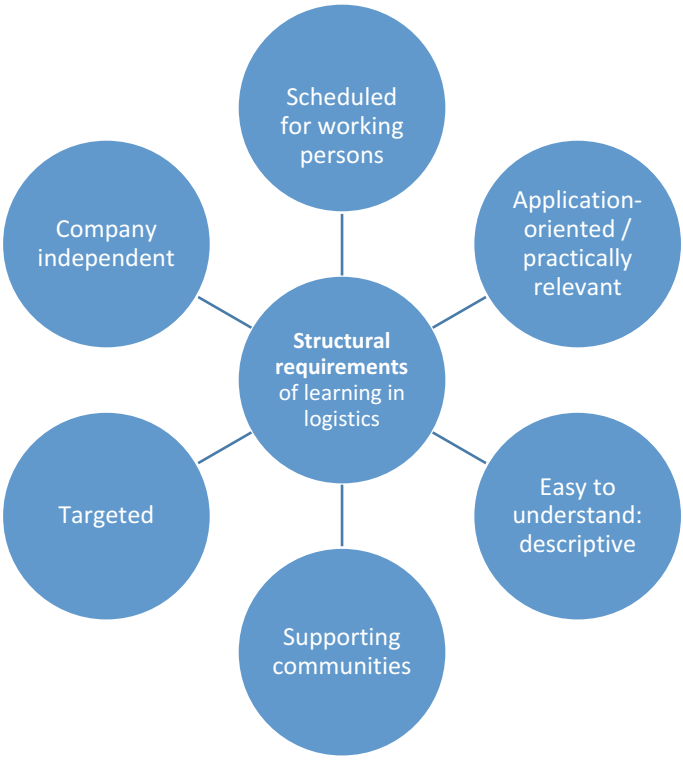

Fig. 10.4 Structural education requirements for the logistics industry

development have to be applied in general as well as specifically towards logistics employees and tasks.

Additionally, HR departments increasingly also have to focus on strategic, value-adding tasks, particularly in the SME sector. This requires appropriate HR tools. In the personnel departments of many small and medium-sized companies, Excel tables are still used to perform daily routine tasks, for example, on payroll accounting, holiday and personnel deployment planning. Due to the inefficient implementation of such administrative activities, there is often no time for strategic, value-adding initiatives. This is criticized by experts from Hamburg's consulting firm Steria Mummert as part of a comprehensive 2011 study (see https://goo.gl/LCjCGl). It concludes that SMEs neglect human resources management. Anyone who performs routine tasks in human resources efficiently can focus on more important activities, such as optimizing employee productivity, increasing employee satisfaction, or professionalizing processes in areas such as recruiting, competence and talent management—which are becoming more and more important in times of a "war for talent" (Michaels et al. 2001).

This applies to almost all industries. For logistics, some facts are aggravated though:

- Very small companies: operational logistics—in the sense of physical goods handling—is dealt with by a large number of very small companies. These tend to have only little knowledge and even fewer resources for HR topics (in most cases there is no specific HR employee/management, but the company CEO (often the owner) has to fulfill HR task "on the fly").
- Small and medium sized companies (SME): There are additional challenges in the area of logistics services and value-added services. This area of the industry is highly competitive. With low profit margins, only limited funds are invested in medium- and long-term planning.
- Large companies: This field shows a fundamental challenge for the industry, i.e. the general industry and employer attractiveness. For example, Amazon is certainly not (yet) a typical logistics company, but develops in some aspects in this direction. The company is setting up its own hubs[1] or plane and vehicle fleets, and develops alternative delivery systems (delivery by drones). The example of the personnel payment shows at this point only the problem per se. In the distribution center in Bad Hersfeld in the center of Germany, the company pays a warehouse employee 10.01 € per hour in the first, 11.59 € in the second and 11.71 € in the third year. According to the wage agreement for shipping, it would have to be 11.77 € in the first three years, and 10.93 € in the logistics sector. In Leipzig, Eastern Germany, the hourly rates are 9.55/10.47/10.99 € in the first three years. Per wage agreement, it would have to be 11.39 € in all years, and in the logistics sector 9.17 €, in the second and third year 9.61 €.[2] So, in general, payment levels are not very attractive, at least in the blue-collar section of transportation and logistics.

This is why companies try to be attractive for employees with other measures such as training support, bonus payments, company equipment or health support as shown by the following example from a German logistics HR survey (Fig. 10.5).

Personnel development is one of the key pillars in the area of company and organizational development. The effective training, coaching and further training of the employees and managers in the company combined with a goal-oriented team development is one of the most difficult tasks to be accomplished by today's Human Resources Manager. This is exemplified by Fig. 10.6, addressing the use of personnel development tools in logistics. Some instruments—at least for the case of Germany—are obviously in place such as performance review and training measures. However, others like e.g. assignments abroad or long-term career support ("high potentials" etc.) are still seldom found in the logistics sector though advancing in all other industries.

[1] Cf. https://www.bloomberg.com/news/articles/2017-01-31/amazon-plans-new-air-hub-in-kentucky-to-support-fast-deliveries.

[2] See https://goo.gl/jh8EHY.

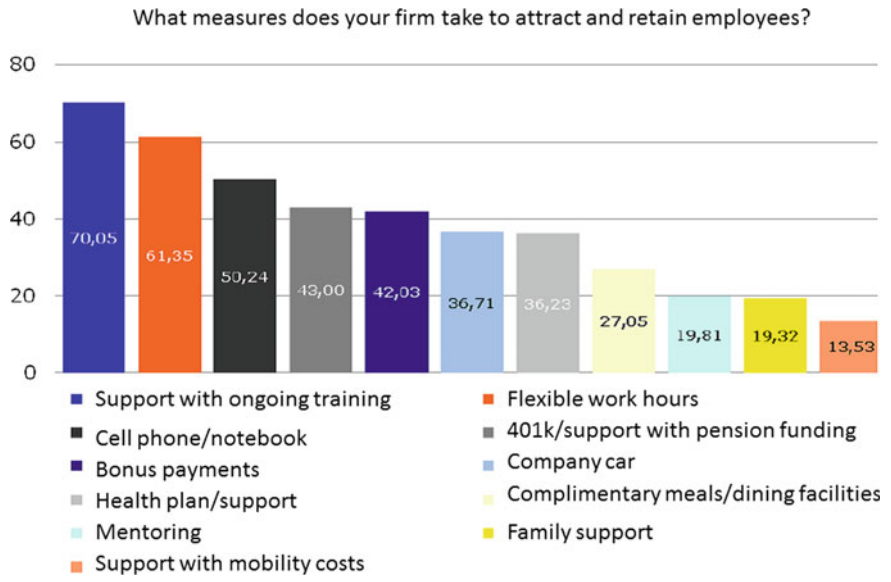

Fig. 10.5 Use of HR tools in logistics (BVL Germany)

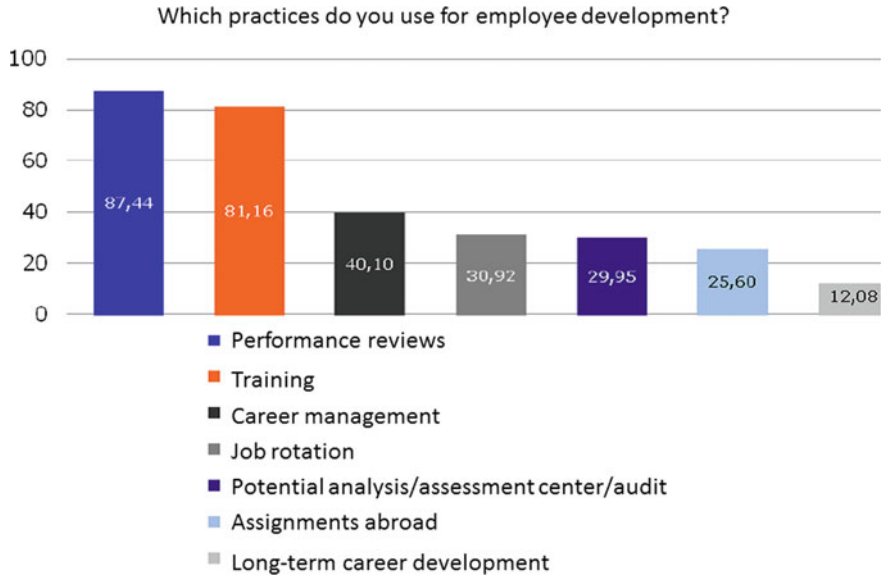

Fig. 10.6 Use of personnel development tools in logistics (BVL Germany)

This represents an often-found "gap" in HR and personnel development, causing the transportation and logistics sector to be recognized as a "latecomer" to new developments in HR management.

10.5 Knowledge Management Tools in Logistics

Knowledge management is a comprehensive term for *strategic and operational activities* that deal with the *handling of knowledge*. Contributions to this topic are often interdisciplinary, including business economics, social sciences, and computer science. As a result of today's knowledge- and innovation-oriented communication age, the knowledge capital available in the company is increasingly becoming the decisive factor in production, which is taking shape as factor of production alongside labor, land and capital (Abdih and Joutz 2005; Probst et al. 2006).

Often, information is not where you need it. Companies have recognized that efficient management as well as dealing with corporate knowledge help to increase their own competitiveness. Critical to the approach of knowledge management from a scientific point of view is, above all, an undifferentiated concept of knowledge, which is often not adequately delimited by the terms "data" and "information" (Meyer and Sugiyama 2007). In addition, knowledge can be subdivided into different categories, each of which has to be treated differently:

- *Explicit knowledge* is formulated and reproducible knowledge. It can be mediated without difficulty by a formal, systematic language, such as words and numbers. It can be logically reproduced and described and therefore it represents specific or methodological knowledge.
- *Implicit knowledge*, on the other hand, has a personal quality that makes it difficult to formalize and communicate. It is hidden knowledge that cannot be articulated. Moreover, it is strongly motivated by the related actions, obligations and co-operation within a specific context. Polanyi, in his theory of implicit knowledge, explains human knowledge with the proposition "that we know more than we know" (Polanyi 1985).

If this distinction is applied to the personal level of the competence and knowledge of one person, two specific forms can be derived:

- Individual, explicit knowledge is labelled as *embrained knowledge*. It is a conscious knowledge that depends on one's own conceptual abilities and can be activated consciously, e.g. specific knowledge. This knowledge can be transferred by rules, instructions or information and communication technologies.
- Individual, implicit knowledge is referred to as *embodied knowledge*. It is an action-oriented knowledge and results from the experiences already gained. This includes cognitive abilities such as concepts and experiences, but also skills such as the fine motor skills of a dentist or the ability to dance on a rope. The transfer of this knowledge requires intensive interaction processes and cannot be ordered by directives or controlled by the price mechanism.

However, the sum of the explicit and implicit knowledge that the individual members of the organization possesses is not yet an organizational knowledge per se. Organizational knowledge arises only from the coordinated collaboration of the organizational members. The incorporation of individual knowledge and knowledge into

Table 10.3 Knowledge dimensions (Lam 2000, 491ff.)

	Individual knowledge	Collective knowledge
Explicit knowledge	*Embrained knowledge* Conscious, verbal skills and competences	*Encoded knowledge* Knowledge depicted in rules and procedures
Implicit knowledge	*Embodied knowledge* Internalized ability	*Embedded knowledge* Organized by organizational routines and mental models

specific "organizational settings" is the prerequisite for developing organizational knowledge from the knowledge of individual organizational members (e.g., Hecker 2012; Nonaka 1994). This collective knowledge can also be explicit or implicit:

- Explicit, collective knowledge is called *encoded knowledge*. This knowledge exists in companies in the form of rules and procedural guidelines that are applied in a company. They are expressed, for example, in organizational models, organizational charts, management principles, or strategic concepts pursued by the company. This knowledge can be documented.
- Implicit, collective knowledge is called *embedded knowledge*. It is found in companies mainly in the form of organizational routines as well as "mental models" shared by the organizational members. This means the implicitly used everyday theories of action by the members of the organization.

Taking these four categories together, we arrive at a two-by-two matrix for the question of individual versus collective knowledge in the explicit or implicit form (see Table 10.3).

Nowadays implicit knowledge in companies is particularly important as a source of sustainable competitive advantages (e.g. Eisenhardt and Santos 2002). It is particularly difficult to imitate if this knowledge can be anchored organizationally in knowledge management processes. It is not enough to accumulate and store much information or to employ employees with specialist knowledge. Individual, implicit knowledge is the basis for knowledge management, but does not in itself represent a sustainable competitive advantage for companies, because individual knowledge providers can be lured away. In this case, they leave much of their explicit knowledge in the form of records. However, their implicit individual knowledge is lost to the company.

Organizational scientists Nonaka and Takeuchi developed the most familiar model of knowledge management in 1995 with the so-called "knowledge spiral". The core is that the continuous exchange between explicit and implicit knowledge is the prerequisite for the generation and transfer of organizational knowledge. In this way, *implicit knowledge* can be spread throughout the organization and can be constantly enriched at the same time. In order for organizational knowledge to be created, the individual implicit knowledge of the organizational members has to go through a dynamic transfer process. For this purpose, explicit and implicit knowledge are com-

bined into four different forms of knowledge transfer: socialization, externalization, combination and internalization (Nonaka and Takeuchi 1995).

Socialization transmits knowledge "from implicit to implicit", that is, largely without language. Instead, "learning by doing" via observation, imitation and exercise is central. Thus, children learn to cycle by practicing pedaling, steering and balance until they can. A typical example of socialization in day-to-day operations is the integration of a new team member into the group's thinking and action routines.

Externalization turns implicit knowledge into explicit. However, this conversion is always only partially possible. Prerequisite for the externalization of implicit knowledge is intensive personal communication, e.g. in quality circles or interdisciplinary teams. Using analogies and metaphors, the participants try to make their implicit experience knowledge accessible to each other.

The *combination* consolidates different explicit knowledge. Since the combination of knowledge is not linked to "face-to-face" contacts, it can be supported by information technology. Conventional information technologies deal exclusively with this form of knowledge transfer. They thus take into account only a small part of the relevant knowledge.

With *internalization*, explicit knowledge is (partially) again transformed into implicit knowledge, but in an enriched, more complex form. This is done by learning individuals or groups of action routines that were previously explicitly formulated. The safe control of routines allows complex activities to be carried out "as in sleep". They only require a reduced attention.

From a technical point of view, the use of a *knowledge management system* can be useful. The basic functions of such systems are:

- Content Management—the storage of explicit knowledge in documents, database entries, images, as a platform for the exchange of knowledge, often as an intranet form.
- Information retrieval—Find and retrieve the needed information.
- Visualization and Aggregation—The structuring of knowledge and representation of not easily explicable knowledge (graphics, pictures, drawings).
- Collaboration—Collaboration of people and groups for example with groupware.

Especially for small and medium-sized enterprises, it is a tough challenge to introduce knowledge management alongside day-to-day business. Because sustainable "deep" change requires time and effort. Knowledge management is not fundamentally new, but the use of information technology and the application of innovative organizational methods can make the handling of knowledge in the company more systematic.

In recent decades, the term *knowledge society* has become increasingly important. This term was used in 1966 by the sociologist Robert E. Lane. In 1973, Daniel Bell developed the concept further with his study "The Coming of Post-Industrial Society" (Bell 1973). While labor, raw materials and capital have a central role in industrialized societies; theoretical knowledge is the most important resource in the post-industrial era. With regard to the increasing importance of knowledge in a company, appropriate

mechanisms for maintaining and developing of this resource in companies must be successfully established (Blackler 1995).

10.6 Qualification Analysis and the Berufswertigkeit Concept (State-of-the-Art)

In the logistics industry, the access for everyone—and in particular the career changers—for continuing education should be improved. Furthermore, the logistics industry requires specialists, meaning that the access to specialized personal skills also has to be simplified. One major aspect is the demographic change in Germany, which has to be counteracted with more flexible continuing education offers in which the practical on-the-job experiences of employees should be acknowledged. All these arguments call for a *competence measurement concept*, which is precise, practical and compatible in every economic sector and in particular the logistics sector. One measurement concept, which was developed since 2007, is the German "Berufswertigkeit" concept (Klumpp 2007; Klumpp et al. 2011). It fulfills the requirements of a general competence measurement instrument as it is connected to the concept of *employability*. The main idea of "Berufswertigkeit" is a concept of competence measurement of persons with different education degrees. The criteria for an effective competence measurement regarding demands of real-world companies and work processes are *empirically evaluated and selected* from business practice (Klumpp and Schaumann 2007). With these criteria, persons with different education backgrounds and degrees can be objectively compared while the results are output-oriented (no input and curriculum analysis and comparison but competence outputs of different qualification measures). It includes *36 qualification requirement criteria* that represent the modern daily work which are used to individually measure (on a scale of 1-best to 5-worst) and calculates the aggregate "Berufswertigkeits index". The qualification criteria are (Klumpp 2016):

- Efficiency
- Independence and own initiative
- Flexibility and adaptability
- Work virtues
- Stress resistance
- Motivation and ability to lifelong learning and maintain own competence profile
- Coordinate work- and lifetimes
- Creativity
- Loyalty
- Risk-taking
- Charisma
- Ability to write and speak in German
- Knowledge of foreign language
- Ability to apply modern information- and communication technologies

- Communication and rhetoric
- Assertiveness
- International and intercultural competence
- Customer focus
- Skills in mathematics and statistics
- Preparation of cost estimates and quotations
- Planning, implementation and documentation of orders and projects
- Negotiations capacity
- Analytical problem-oriented work
- Quality management (optimization of processes and products/service quality)
- Conceptual and strategic implementation of industry-specific knowledge
- Identification with the company
- Strategic orientation
- Understanding solutions of complex technical problems
- Basic knowledge of business administration
- Perception of functions of management and organization
- Conceptual analysis and work
- Planning and control of procurement and logistics processes
- Staff requirements and staff mission planning/staff development
- Team, staff and leadership
- Improving responsible care
- Legal knowledge

The *Berufswertigkeits index* (BWI) value is calculated by a summed and unweighted index of an individual personal evaluation of all the 36 qualification requirement criteria. The value range of the index begins by 0 and ends at 100.[3] In this way, the output-oriented measuring concept "Berufswertigkeit" serves as a basic field-evaluation concept for the development of e.g. a European Qualification Framework for the logistics industry and integrates the required investigation of competences.

A field survey with 1.068 persons from the German logistics industry to be evaluated by this concept was conducted in 2012. It was executed as a telephone survey in the German states of North Rhine-Westphalia and Hessen. Both states have a significant logistics industry cluster environment, i.e. around the inland port of Duisburg (North Rhine-Westphalia) and around the airport of Frankfurt (Hessen). In that survey, existing skills and competences of persons in the logistic industry are described. Additionally, traditional formal degrees in vocational and academic education can be classified according to evaluated practical competence levels.

The following example (compare Fig. 10.7) outlines just a short example of the value and implications of a competence evaluation instrument such as the Berufswertigkeit Index. In this case, Berufswertigkeit Index results are depicted as a distribution function for different classes of achieved values in the BWI value. Alas, the first class on the left side of the graph indicates the share of people within the entire population

[3] With "0" standing for an evaluation of all criteria with "poor"; and "100" representing an evaluation of all criteria with "very good".

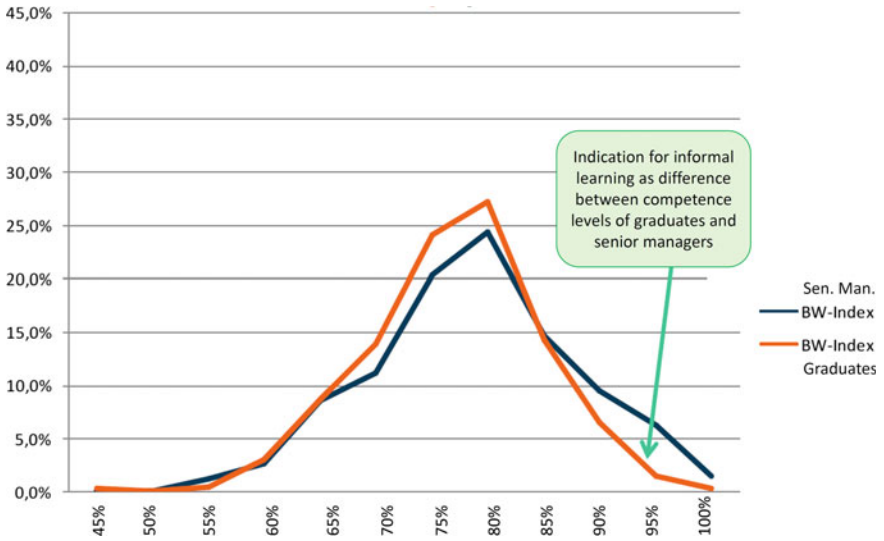

Fig. 10.7 Example evaluation with the Berufswertigkeit concept (Klumpp et al. 2011)

who have achieved a (low) BWI value of under 45%. This is followed by the second class of people who have sustained a BWI between 45 and 50% and so on. The last group contains all persons of a specific group who score a (high) BWI of between 95 and 100%. If we now take a specific group as for instance a representative group of university graduates, some sort of "normal distribution" is usually obtained like the orange line in Fig. 10.7—as competence generally is quite "normally distributed" among a given group of people. This in itself is not so much of interest (besides the possible personal and management question that pertains a single person).

However, of more interest and value is the comparison of different groups as outlined above: the group of graduates (orange) is compared to a representative group of senior managers (who usually hold a graduate degree, but are older and have additionally a long duration of practical management experience). So in-between the two groups it may be recognized that especially in the very high-level groups of BWI values, the senior management group has significantly larger shares in the high-level value group. As indicated by the arrow and the box in the figure, this indicates as difference or gap between the groups that obviously senior managers have *gained* competence during their career.[4] This would indicate a quantifiable effect

[4]Beware that this is just a "likelihood" match as in this case it was *not* a longitudinal study—therefore not the same identical persons 20 or 30 years later—and could contain *biases* such as a time-bias in academic qualification. So if, say, the senior managers *today* had their academic training about *25 years ago* and this was significantly *better* than the academic education today, the effect seen in the figure may not be valid for an effect of informal learning. Nevertheless, it may just represent the difference in academic training quality between then and today. More work is needed to further establish such research results—but the cornerstone of outlining such competence evaluation concepts as the "Berufswertigkeit" concept is laid out.

of informal learning; and this is state of the art research, as a quantifiable effect of such informal learning and competence effects has not yet been widely established. However, the effects on HR and knowledge management can be imagined: training measures will become measurable, so this is a topic for future HR research. The results and insights for the situation in Germany is readily transferable to other areas in high-level industry and service-oriented countries as competence requirements as well as education and training systems are highly uniform, at least in European and North-American countries, increasingly also in Asia.

10.7 Innovation in HR and Knowledge Management: Edugaming

Earlier, the distinction between e-learning 1.0 and 2.0 have shown the evolution, which has taken place in this field recently. However strong that progress may be, it does not clear the approach from principal difficulties concerning implementation, or rather sustainable usage. This is due to issues inherent in (corporate) e-learning as it is understood here: being used as the vehicle for mandatory instructions (e.g. for new employees), motivation to take part in such measures is strongly external and seizes as soon as material or disciplinary incentives wane. Thus, measures which foster intrinsic user motivation are called for. Given the primary requirement of ongoing qualification in logistics to prepare employees effectively for the use of new technology and organization concepts, two initial propositions can be made:

- Ongoing qualification needs to ensure efficient use of established workplace technology. Competitive advantages that result from specific technologies can only be exploited fully if qualification is made to measure—'tools are only as good as the people who use them'. As much as technological innovations are celebrated, employee qualification (insofar as interaction takes place) has to match their pace. Every step ahead on technological grounds has to be met with one in user qualification.
- Ongoing qualification provides potential for innovation. Only individuals and organizations appropriating the state of the art in relevant technology or media literacy, thus keeping close to the education innovation frontier, can be expected to generate novel ideas and concepts. Regarding logistics, the term 'Pervasive Computing' (computing happening anyplace, using any device, at any time, see e.g. Lucke and Rensing 2014) represents important current challenges, as it changes both methods of learning and teaching as well as individual learning behavior. In fact, the very definition of learning, its goals and assessment is challenged.

With a view to the issue of skilled labor shortage, again, two perspectives are distinguished. First, there is the quantitative view, having as its focus the number of employees with a given set of skills. The second treats the issue as one of quality and is thus concerned with matters of competencies and ongoing qualification, thus with changes in employees' set of skills. These views are linked to a dual solution concept,

which combines an expansive and an intensive approach: one may be concerned with, for instance, raising attractiveness of a given field of work (expansive), or with targeted efforts at ongoing worker qualification (intensive). With demographic change as a backdrop, the weight shifts continuously towards intensive approaches. Of these, one example is training on the job with educational games.

We will provide a description of the concept of edugaming based upon a case from a recent research project. Recent efforts in this direction include gamification concepts for intralogistics, being tested in a lab-setting and with a focus on employee motivation and initial training-time reduction (GameLog, Munich Technical University, MIT Beer Game, Mortgage Service Game), the latter also being the main goal of the instructive software for picking, PickNick (Fraunhofer IML), or a plethora of e-learning concepts used for instance by arvato, DHL and Dachser, some of which having been developed by specialized firms such as the TÜV Rheinland Academy Group. Similar approaches are followed with the basic' 10 Principles of Materials Handling' in the warehousing and materials handling field.

Research efforts within the scope of the project 'MARTINA' encompass the development of a smartphone-based edugaming-app as well as related efforts towards defining a topical map for ongoing qualification in logistics. This approach ensures that the resulting edugaming-app will be relevant and useful for blue- and white-collar employees. Further benefits are transferability of game concepts to multiple upcoming qualification topics. While the research subject of topic identification is important in itself, we will only look at the issue of edugaming in logistics here.

For the realization of the Edugaming concept a serious-game approach had been chosen by the developing team. The terms serious game, gamification, edutainment are often used interchangeably, while a clear definition is still debated (see e.g. Deterding et al. 2011). Nonetheless, concerning the intersection of these terms, one can state that they represent a connection of reality and game for conveying problem solving-skills and knowledge. The defining property of serious games is in a transfer of technology (development and design) from the arena of entertainment to that of education. Edutainment, then, in its original meaning, is a label for applications, which contain educational material embedded in game elements. However, the latter only function as rewards for the completion of lessons or study material.

Earlier, we stressed the importance of intrinsic motivation, especially in cases where particular educational goals are pursued. Another related concept, widely stressed within gaming contexts, is immersion—which in its ideal state means an experience of one's own physical presence in a virtual world. Intuitively, one might assume that both phenomena work hand-in-hand in an ideal educational game, with the educational content then being conveyed in passing. The suitability of this view is debated, especially with respect to the role of immersion (Hamari et al. 2016).

Even if one's ambitions in developing educational games are much more modest, these two concepts can be seen as guidelines. To develop a more comprehensive set of principles for educational games, some of the many theories of motivation provide a valid starting point. The following sketch of guiding principles for the design of educational games draws from the idea of intrinsic motivation with the aid of the widely known flow-concept (Csikszentmihalyi 1990), as well as from

self-determination-theory (Ryan and Deci 2000). Flow describes a state of 'optimal experience', resulting from intensive participation in actions valued as enjoyable. It represents a state of supreme focus, affected neither by stray thoughts or worries, nor by consciousness of time—activities conducted solely for their own sake best account for this perception. For a gaming concept, a balancing of incremental challenges and skill-development appears central. The flow-concept, as described by Csikszentmihályi, assumes that a correct balancing of these influences ensures that experience remains in a corridor 'above' boredom, simple relaxation, and 'below' worry, anxiety, or arousal. For an educational game, this translates into requirements for e.g. difficulty, role of chance events, and all kinds of reward mechanisms. With regards to this concept, we list a few first attributes an ideal educational game should have:

- Clear goals, to be achieved with reasonable effort
- Matching of difficulty of tasks and user abilities
- Causing an impression of being in control
- Requiring attention and focus to a degree that excludes simultaneous completion of other tasks
- Direct, immediate feedback
- Time perception is kept to the sidelines.

The role of rewards and incentives (not necessarily external) for motivation, and especially for motivation to take up educational games, is crucial. While the importance of intrinsic motivation is beyond doubt, we may ask how the latter is achieved in an educational games context. In self-determination-theory, three needs have been stated as conditional to motivation (Nicholson 2015), all to be evaluated subjectively from an individual user's perspective:

- Competence, understood here as the impression of having gained knowledge or abilities to an extent that matters in applications;
- Autonomy, which is congruence of behavior and identity as perceived by a user, thus closely related to freedom of choice;
- Relatedness, a perception of involvement: this may be as part of a user community or multiplayer environment, whether its setup is competitive or not.

Approaches at most comprehensive frameworks of game design elements can be found in Nicholson (2015) and Hunicke et al. (2004). There, the central role of narratives, aesthetics and sophisticated reward mechanisms is explained, as well as the ideal type of gamification, which would represent the creation of a space within which users would be able to establish and change rules and restrictions, as well as narratives, on their own. Our understanding of edugaming necessarily encompasses a subset of that framework, nevertheless putting emphasis on the aspects of

- Intrinsic user motivation, even with the requirement of relating workplace content;
- Exposition of users to narratives which are easily related to their work environment;
- Nonlinear design and transferability of specialized content to all users.

Further, the entire application, once developed, is understood as a toolbox in the sense that its body, i.e. mechanics and aesthetics may be transferred to cover topics outside the field originally focused on (logistics). Of course, within a particular software development project, these (ideal) requirements form only part of the conditions, which encompass stakeholders, schedule, funding, specific research questions etc. Within the MARTINA project, the elements intrinsic motivation/immersion, exposition/narrative/nonlinear design, and transferability have been translated into project goals and design schemes. The educational game sets out from an individual perspective of an employee, having to accomplish tasks in cargos securing and customer care.

In succeeding stages, tasks expand to different topics (for instance, dangerous goods) while growing user experience is mirrored in advances within a career in logistics. This progress is represented in a geographically growing logistics network the user manages. Further reward mechanisms are multi-dimensional, providing incentives for users to keep up a sustainable balance of cost, quality and time while playing games from the main storyline as well as optional ones. For the game design process, motivating to 'pick up and play' is a guiding thought, as is rewarding replay of optional stages with a finely graduated score in topics requiring diligence in practice (e.g. cargo securing). As is visible in the screenshots (Fig. 10.8), as a

Fig. 10.8 MARTINA app prototype, cargo-game (l.) and in-app progress (r.)

general theme for graphical design, flat 2.0 has been chosen because its combination of reductionism and usability is well-suited to mobile devices, as the *MARTINA App* is primarily geared towards smartphones and tablets.

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