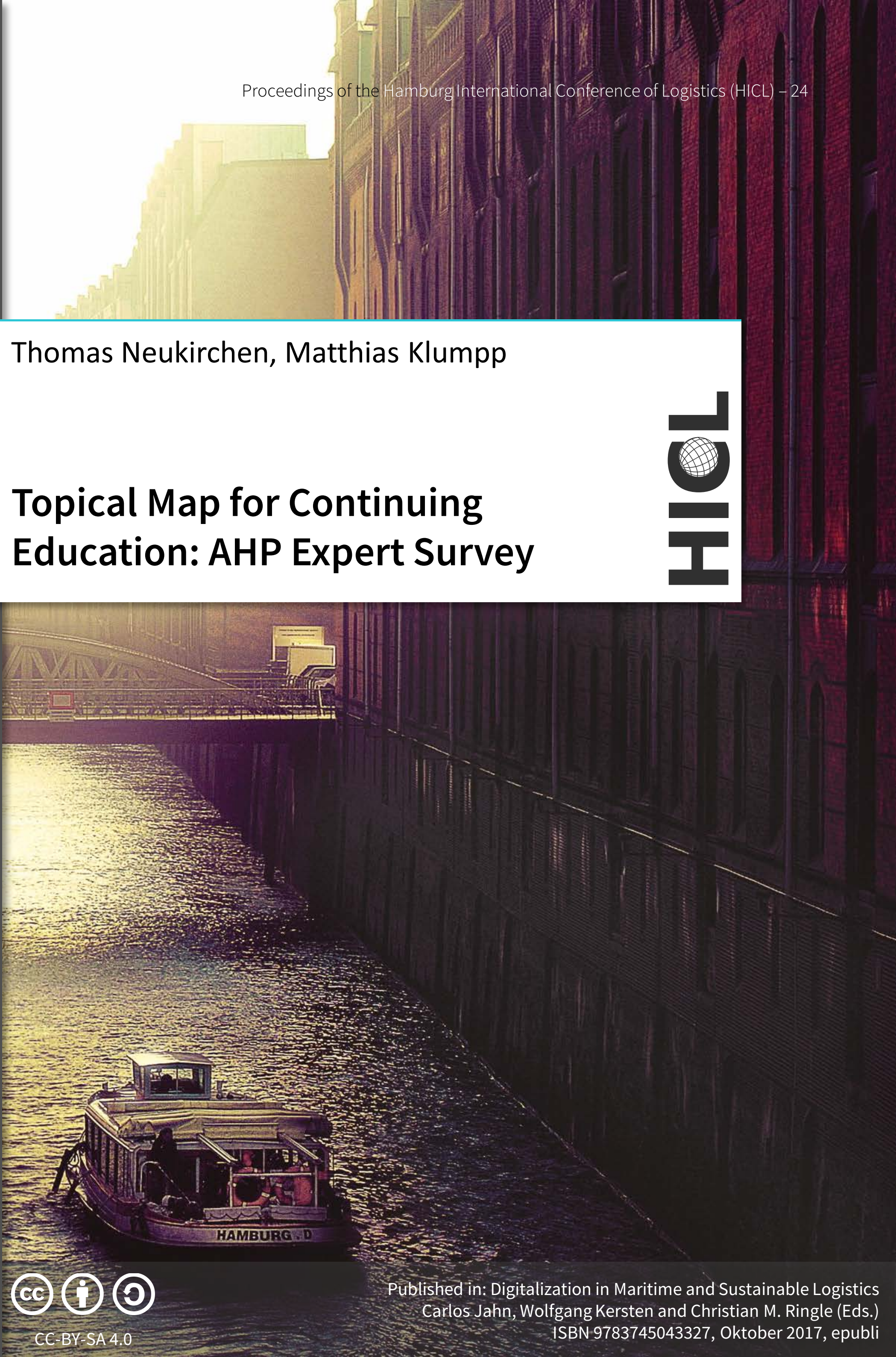

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Topical Map for Continuing Education: AHP Expert Survey

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This contribution presents an analysis of recent trend topics in logistics and supply chain management with a focus on education and training on the job, applying an Analytic Hierarchy Process (AHP).Based on a comprehensive literature survey for the identification of trends that have persisted over the ten years considered (2005-2015), expert interviews have been conducted, aggregated and evaluated with an AHP. The particular context for this contribution is the research project MARTINA, which is concerned with innovative design for logistics education and thus encompasses iterative development of education software (app for mobile training). With this in mind, a dichotomous structure according to professional areas has been chosen ('blue-collar' and 'white-collar') for the questionnaires and corresponding hierarchy.Our AHP had the goal of identifying topics for the design prototype (android-based app). Criteria included addressed the target groups 'blue collar' as well as 'white collar'; 14 alternatives were to be ranked and 45 completely answered questionnaires have been evaluated with the resultant ranking e-mobility, sharing economy, first aid training, cooperation, and diversity as the top 5 over both groups.The resultant topical ranking yields interesting results: First, we present an updated assessment of topics which will significantly shape logistics, logistics research and the related debate in the near future. Second, our results serve as guidelines for the development of new education concepts and are directly informing the design efforts taking place in the aforementioned project, thus being transformed into artifacts of the design cycle of an android-based smartphone and tablet application.

Keywords: Analytic Hierarchy Process; trend topics; education; training

1 Introduction

Intelligent logistics is based and depends on a multitude of technical, managerial and human requirements. For logistics employees in particular, this includes skill requirements for the use of new technologies and organizational paradigms. Given the situation of shortage of skilled labor in logistics two crucial competitive factors are identified: raising attractiveness of employment in the field of logistics generally as well as goal-oriented and efficient education and training for employees currently working in logistics. This contribution on current developments in logistics education and training focuses on what we call 'qualification topics' as these encompass both education and training for all professional areas (thus 'blue-collar' and 'white-collar'). Research conducted for this contribution is connected to the research and software development project MARTINA. The contribution is structured as follows: Section 2.1 presents an overview of trend topics in logistics of the past decade up until the present, which lays the groundwork for our analysis of expert interviews we conducted using the AHP-method (Section 4). Section 2.2 sketches out the research project MARTINA, which is still running until June 2018. Section 3.1 therefore gives a short outline of the AHP-method, section 3.2 describes our application of the method, section 3.3 succinctly touches upon aggregation procedures for group evaluations with AHP, section 4 presents evaluation and results, section 5 concludes.

2 Logistics Trends: Innovation and Education

Zijm, Klumpp (2017) define four areas which provide a structure for the categorization of trending topics identified in their literature survey: business process management, competitive advantage, strategic management, network structure. Related studies with focus on current trends in logistics vary the structure, for instance by providing a dual structure with social and business vs. technology trends, while yielding similar results (compare section 2.1).

2.1 Trend Topics in the Logistics Literature

Using a sample of more than 3400 articles from logistics and SCM for their literature survey, Zijm and Klumpp (2017) examined publications from the decade 2005-

2015 for the trending topics persisting through this period. The resultant ranking is organized within a fourfold structure provided by the categories business process management, competitive advantage, strategic management, and network structure. A related study by Stank et al. (2013) includes a similar structure, using strategy & performance, planning & execution, talent & information, and relationship management. Their results have their origin in interviews conducted with 160 supply chain professionals, of whom each had to give their assessment of a list of 10 trend topics (customer service to customer relationship management, adversarial relationships to collaborative relationships, incremental change to a transformational agile strategy, functional focus to process integration, absolute value for the firm to relative value for customers, forecasting to endcasting (demand management), training to knowledge-based learning, vertical integration to virtual integration, information hoarding to information sharing and visibility, managerial accounting to value-based management).

In the context of the Zijm/Klumpp study the meaning of the term business process management is 'management of activities with the goal of provision of particular outputs addressing customer demand'. Competitive advantage is to be understood as 'innovations causing competitive advantages for an organization'. Strategic management describes the 'definition and pursuit of objectives based on comprehensive internal as well as external factors conditional on efficient resource allocation'. Network structure includes flows of information and materials, and value created from vertical and horizontal cooperation. According to Zijm and Klumpp (2017), logistics faces a multitude of challenges resulting from climate change, sustainability requirements in production and services, political disruptions, mass individualization, as well as artificial intelligence and cyber-physical systems. This entails rethinking and novel concepts for organization, management of information and employee qualification. A close look on current as well as emerging technological and socio-economic innovations yields a variety of scenarios (van Breedam, 2016), representing significant requirements for education and training:

Continuing education and training on the job should qualify employees for efficient use of technology that is present at the workplace. Competitive advantage which stems from the use of technology can only be maxed out when employee qualification is adequate. For logistics, pervasive computing (Lucke and Rensing, 2014) represents the key term this changes individual learning behavior as well as the definition and evaluation of education progress and goals.

Innovations from the areas lightweight materials and engine technologies have major effects on cost efficiency and ecological footprints, with the latter being further positively affected by smart packaging, biodegradable material and additive manufacturing. Modular product design, additive manufacturing and their interrelation with mass individualization can positively affect distance to customers, stock volumes and lead times. With Automation we see that likely within the next few decades the way towards completely unmanned transport logistics is being paved, as current developments go beyond visible, established systems such as RFID and robotics toward automation of whole far-reaching decision processes. Information systems, business models, property rights and cooperation need to be regarded as one interconnected system: Given an economy where the importance of servitization and sharing economy rises, property rights and whole supply chain structures need to be re-thought. For instance, with an environment characterized by many stakeholders making decisions in parallel and on the same hierarchical level, new decision processes are mapped into novel concepts on the side of information systems (Anand, et al., 2016). Their effective use requires, in addition to vertical cooperation along the more obvious part of the value chain, horizontal cooperation: This may require single, private companies to give up their decision autonomy to some degree (while not necessarily conceding advantages) in order to achieve equilibrium solutions which are fair in the sense of allocation of gains from cooperation.

In total, we have the picture of a movement starting currently with horizontal collaboration and the alignment of socio-economic, ecological and security goals, having its endpoint in the conceptual vision known as the ‘Physical Internet’ (Montreuil, 2011). A vital step in that is of course digitial transformation, whose opportunities have been lucidly explored in a most recent study by Kersten et al. (2017).

2.2 Innovative Continuing Education in Logistics

The research project ’MARTINA’ is aimed at the development of innovative concepts for logistics education and training. After an initial period of desk research regarding qualification trends in logistics, the main project activity has quickly and consequently turned to software development, with the rise of digitization and the high mobility of some logistics employees in mind (blue collar, e.g. truck drivers). Thus the apparent challenge: Training on the job, using mobile devices. It is this particular background which justifies to the authors of the current study to succinctly ponder their view on approaches to continuing education: Continuing education has the goal of qualifying employees for the efficient use of current technologies and organization concepts. Realization of competitive advantages in business practice can only happen if qualification levels of employees match technology requirements. Such an approach includes necessary changes in individual learning behavior depending on personal competence status and history. Ensuring efficient use of established workplace technology therefore implies: Every step ahead on technological grounds has to be met with one in user qualification and motivation due to increasing human-machine interaction. Then, by provision of potential for innovation we address that 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' (Lucke, Rensing, 2014) represents important current challenges, as it changes both methods of learning and teaching as well as individual learning behavior, factually challenging the very definition of learning. Recent developments require the understanding, competence and motivation especially of, but not limited to, the attached blue-collar personnel in order to be applied properly and efficiently. For the specific task of training and integration of blue-collar employees in logistics, research as well as management practice has provided very little in terms of innovation and new approaches in the last decade – during the rise of smartphones, gamification and edutainment applications as well as modern-day individualized training on the job and e-learning concepts in other industries. Therefore, this gap is addressed subsequently as descriptions of the efforts in the software development project 'MARTINA' are described, preceded by a section treating the process of identifying education topics to be selected for demonstrational app development purposes. This topic selection was based substantially on an Analytical hierarchy Process (AHP)-based expert survey. The method is outlined in the next chapter, while particular application for the current project and results are presented in the ensuing fourth chapter.

3 Expert Survey Using the Analytic Hierarchy Process

For topic selection, the authors used an expert survey designed, conducted and evaluated using the Analytic Hierarchy Process (AHP, Saaty, 1980). The AHP is used to transform non-material, intangible aspects (preferences, for instance) into numerical, thus measurable and comparable values. From a set of alternatives, pairs are compared with respect to some criterion from a set of criteria. From these comparisons, conducted over all alternatives, priorities result, as well as local and one global ranking. Criterion is taken as a fundamental concept, that is, no further definitions and formal descriptions of this is given in the assumptions underlying the AHP. The Construct (‘hierarchy’) ‘alternative-higher level-criterion’ is repeated in a way such that criteria for pairwise comparisons on the lowest level have the state of alternatives within the following step, with the complete hierarchy finally peaking in a singular main criterion (‘goal’). With this structure, an AHP can be used to analyze some given problem exhaustively. Structure and process are given, thus the tool like character of the procedure.

3.1 Basic Concepts and Definitions

Pairwise comparisons (in our case e.g. green logistics vs. sharing economy, or cargo securing vs. dangerous goods) are expressed as numerical values with the properties of an absolute scale. Preference for one alternative over another with respect to some criterion is thus reflected as a multiple of the value attached to the item one determines to be the alternative of lesser importance (thus if one deems dangerous goods as absolutely outweighing e-mobility in any respect, one would attach ’9’, compare below). The alternative marked as inferior thus receives the reciprocal value of the one attached to the favored one. Application of this simple procedure over all possible pairs of alternatives yields what is called ‘pairwise comparison matrix’. Here, values of the corresponding principal eigenvector are global priorities over alternatives on an absolute scale. This means, by ordering alternatives descending, according to the corresponding values of the principal eigenvector, one gets a ranking of alternatives resulting from the pairwise comparisons of the decision maker. We proceed by succinctly outlining basic definition for those pairwise comparisons, as they are given by Saaty (1986) and Saaty and Kulakowski (2016).

D1: ‘Partially ordered set’ refers to a relation $\preceq$ on a set X, if this relation has the properties reflexivity, transitivity und antisymmetry. A partially ordered set is a set X with $\preceq\ \subseteq X \times X; (X, \preceq)$ (also called ‘poset’ for ‘partially ordered set‘).

$$\begin{aligned}
\text{reflexivity:} \quad & x \preceq x \forall x \in X \\
\text{transitivity:} \quad & x \preceq y \wedge y \preceq z \Rightarrow x \preceq z \forall x, y, z \in X \\
\text{antisymmetry:} \quad & x \preceq y \wedge y \preceq x \Rightarrow x = y \forall x, y \in X
\end{aligned}$$

For shorthand we note $x \preceq y \wedge x \neq y$ also as $x \prec y$.

D2: A subset $E \subseteq (X, \preceq)$ is called 'bounded from above (below)', if an element s exists with $s \in X | x \preceq s (x \succeq s) \forall x \in E$; such an s is called 'upper (lower) bound' of E. Whenever there exists a largest lower bound for the set E, this is also called lower limit or infimum of E, thus a lower bound is either smaller or equal to the infimum. The terms maximum element, largest element, upper bound and upper limit, or supremum, respectively, are analogously defined.

D3: The $p+q+1$-tuple $R = (X, R_1, \ldots, R_p, o_1, \ldots, o_q)$,$q \geq 0, p \geq 1$ is called relational system. X is a set of objects, R_i are relations over these objects, o_i are binary operators.

D4 (homomorphism): For two relational systems $R = (X, R_1, \ldots, R_p, o_1, \ldots, o_q)$ and $Q = (X, R_1, \ldots, R_p, o_1, \ldots, o_q), q \geq 0$,$p \geq 1$ a map $f : R \rightarrow Q$ is called 'homomorphism' between R and Q, if for all $A_1, \ldots, A_x \in X$, given $(A_1, \ldots, A_x) \in R_i$ and $(f(A_1), \ldots, f(A_x)) \in R'_i$, and if it holds for two arbitrarily chosen $A, B \in X$ that $f(A_1 o_j A_2) = f(A_1) o'_j f(A_2)$, with $i \in \{1, \ldots, p\}, j \in \{1, \ldots, q\}$.

The correspondence to a numerical scale (as used in the AHP) is clearly visible, as soon as one looks at relational systems over sets of numbers: A map between a relational system and a set of numbers defines a numerical scale; any triple (R, Q, f), satisfying the definitions in D4, with $Q \in R$, ($R+$ for the AHP), is called numerical scale, per convention this often refers to f itself (a pairwise comparison in the AHP corresponds to a map of a pair of alternatives into $R+$). Using f we are able to give some meaning to the notion of intensity of preference between alternatives.

D5 (preferences): Given a numerical scale (R, Q, f_c), with c referring to the criterion with respect to which the pairwise comparison is done. Define relational systems $R = (\Omega^2, \succeq)$ and $Q = (R+, \geq)$ and an homorphism $f_c : \Omega^2 \rightarrow R+; \Omega$ being the finite set of alternatives. Then:

$$
\begin{aligned}
-\omega_i \succ c\omega_j &\iff f_c(\omega_i, \omega_j) > 1 \\
-\omega_i \sim c\omega_j &\iff f_c(\omega_i, \omega_j) = 1, \forall \omega_i, \omega_j \in \Omega.
\end{aligned}
$$

Meaning, fc maps how much an alternative is preferred over another, assuming for the AHP that $f_c(\omega_i, \omega_j) = 1/(f_c(\omega_j, \omega_i))$, enabling pairwise reciprocal comparisons and their representation as pairwise comparison matrices.

D6 (hierarchy): Further assumptions lay the foundations for the hierarchy representation of the decision problem, particularly for the differentiation of hierarchical (concepts inner dependence, outer dependence, Saaty and Kulakowski, 2016).

D7 (homogenity): Necessary to incorporate that people make mistakes while comparing inherently different things/alternatives with diverse units or orders of magnitude. This ensures comparisons are limited to alternatives which have some kind of similarity if they are located on the same layer. Analogously, the archimedian axiom is well known, for two real numbers $y > x > 0$ there is a natural number n with $nx > y$.

D8 (completeness): All criteria (here: type of occupation, goal) and alternatives (here: education topics) necessary to resolve the decision problem are included in the hierarchy used to address the decision problem. For applications, this means: participants have to ensure that all criteria and preferences are included in the procedure as to their particular status of information. While not being a rationality assumption, this means that the result of the procedure depends essentially on the way that particular AHP is constructed, meaning in turn that on a strategic level, these ‚preparations‘ may be seen as vital in applying the procedure, given the ‘rules’ can be assumed common knowledge. In addition, rankings for group decisions depend almost entirely on the particular aggregation procedure one uses (Grošelj, et al., 2015).

3.2 Methodological Procedure for an Application of the AHP

Preparation of a decision problem for the use of an AHP consist of the following four steps (Saaty, 2008):

1. Problem definition, determination of general properties of the solution such as dimension
2. Structuring of the hierarchy: top-down, staring at the goal and along subsequent criteria to the bottom layer containing the set of alternatives
3. Construction of pairwise comparison- and evaluation-matrices: elements from one layer serve as criteria for pairwise comparisons of elements from the next (lower) layer

4. Use local priorities for weighting on the corresponding layer as well as for cumulative priorities: product of pairwise comparative judgements along the path from judgements on the lowest level throughout and up to the highest level

We give a short overview of Saaty's Fundamental Scale (Saaty, 2008), as needed in the present study: For instance, indicating ”1” for intensity of importance corresponds to a definition of ”equal importance”, meaning that two choices contribute equally to the objective. ”2” is defined as ”weak or slight”, ”3” as ”moderate importance”, supposed to mean that experience and judgement favor one alternative over another. Then, at the other end of the scale, for instance ”8” is translated as ”very, very, strong”, while ”9” serves as the other ”extreme importance”, meaning evidence, rather than just judgement and experience, favoring one alternative over another is at the highest possible order of affirmation. For the reciprocals it holds that whenever i is assigned one of the above numbers in comparison with j, then j has the reciprocal value when compared with i.

As described in 3.1, comparisons are done on a “fundamental scale of absolute numbers” (Saaty, 2008, p.86). With respect to ensuing calculation of eigenvalues the following definition holds: An entry aij larger than 1 expresses a decision maker's preference for the element denoting the line, thus (D5) this is mirrored in the reciprocal value aji in column j. The scale described in the preceding paragraph is commonly used, however subject to debate at times (Fülöp, Koczkodaj, and Szarek, 2010).

From the eigenvectors of the evaluation matrix associated with the maximum eigenvalue one arbitrarily picked eigenvector is normed, whose components represent evaluation indices in the following. Considerations on consistency of the particular procedure are commonly expressed with the aid of consistency index (CI) and consistency ratio (CR), the latter being the ratio of CI and a random index (RI), which represents an ideal situation (Saaty, 2001).

3.3 Aggregation Procedure for the Group Evaluation

One AHP application is group decision procedures. Regardless of practical considerations individual to any organization, from the point of view of data evaluation the manner one choses to aggregate individual judgements into on global judgement representing a group matters. This is discussed in extenso in “comparison of some aggregation techniques using group analytic hierarchy process” (Gróselj, et al., 2015), whereas in the current study we chose one of the many procedures treated, which is the relatively simple WGMM defined as

$$\omega_{ij}^{WGMM} = \prod_{k=1}^{m} \left(\omega_{ij}^{k}\right)^{\alpha_k}, \alpha_k > 0, \sum_{k=1}^{m} \alpha_k = 1, k \in \{1, \ldots, m\} \cap \mathbb{N}$$

The actual choice may be of particular concern when inhomogeneous groups, for instance with respect to hierarchical levels or power asymmetries are concerned. We went with the procedure above, since we put efforts into selecting experts from similar professional backgrounds, thus 'speaking one language', as is further elaborated in the discussion in the following evaluation chapter 4.

4 Evaluation and Results

The decision in question for the project 'MARTINA' is depicted in the following hierarchy (figure 1). The procedure of having experts rank topics based on a list that originates from literature surveys has been used before (Stank, et al., 2013).

Our expert survey yielded 45 completed questionnaires, where completed refers to "answered all pairwise comparisons presented in random order with exactly one judgement for each". Experts had professional backgrounds in logistics, most currently employed in a logistics related position in administration or operations. We gained from this the following ranking depicted in table 1(consistency 0.07979 (blue collar, left column), 0.00665 (white collar)):

Table 1: Topics and AHP-Priorities

Topic (blue collar)	Priority	Topic (white collar)	Priority
E-mobility	0,21315	Sharing economy	0,20554
First aid	0,19992	Cooperation	0,17932
Integration/immigration	0,13479	Diversity	0,17437
Dangerous goods	0,13334	Green logistics	0,14694
Efficient driving	0,12483	Flexibility/lean	0,12877
GPS-acceptance	0,10543	Risk management	0,08668
Cargo Securing	0,08854	Integrated SC	0,07838

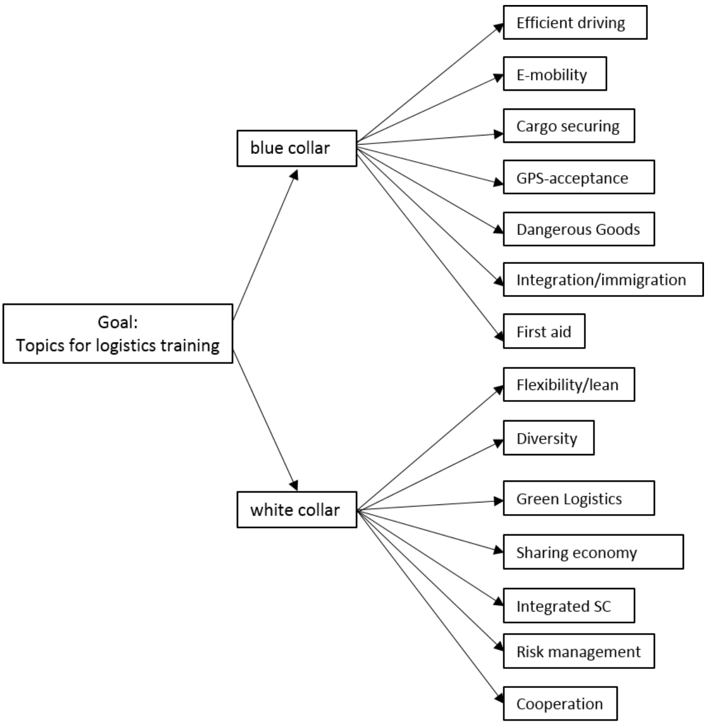

Figure 1: Decision Hierarchy for Logistics Education Topics

A discussion of this AHP-study can take place on three levels: First one can criticize the method of the AHP per se (Harker and Vargas, 1990, Dyer, 1990). Second, adequacy of the method for the given decision problem and its application in the particular context can be subject of discussion, including matters of data collection, aggregation and construction of the hierarchy. Third, context as well as interpretation of results are important: A critique of the resulting ranking happens on the premise that one knows the meaning of the terms as it was during the conduction if that particular questionnaire, thus, what exactly the terms meant to the subjects at that particular time. It is not important, however, whether subjects' understanding of terms was in accordance with a singular, common, and explicit definition, nor is it important if researchers had either assumed some explicit definition or rather, known the exact definition subjects had in their minds. Rather it should be stressed, that effort is put into having subjects with a common or similar, thus to a degree homogenous understanding of the terms amongst the group members. We achieved this by selecting subjects with quite similar professional backgrounds, thus 'speaking a common language'. This can be exemplified with a few terms from the questionnaire. However, it is not necessary to discuss all entries of our ranking. For example, a common understanding of logistics terms could suggest a rather large intersection of the topics cargo securing and dangerous goods. However, concerning legal procedure and definitions, these can be clearly separated from the standpoint of prescriptions: For dangerous goods, for instance, clear prescriptions for labelling exist (UNECE, 2015), while legal disputes with respect to cargo securing often need experts' assessments to be solved. This difference and the resulting requirements for professional training is common knowledge among our subject pool of logistics professionals.

Then given a particular context such training here, one can argue that such topics which can be related to clearly defined legal rules and by extension, clearly defined subject matters on the part of education and training, are more salient. On the other hand, one could argue that topics covered by explicit, well-tried, and formal rules do not generate as much need for additional information or training as those which leave ample room for debate. This may also explain some variation in rankings over subjects, as for the latter topics, informal rules may vary notably between employing firms. Further, an ordering criterion not made explicit can be level of abstraction of the terms presented, for instance comparing first aid and flexibility/lean. Per assumption, this may not jeopardize validity of the results (D7), as long as terms on the same layer remain sufficiently similar; however, this may hint at subjects' understanding of the term topic for training or trend themselves. This is also in reference to the assumption of a criterion in the AHP as

Figure 2: Screenshots of Cargo Securing Game and Map (v0.3)

a fundamental concept, which has been discussed in the past (Harker and Vargas, 1990).

On the one hand, this paper is an updated contribution to the ample supply of trend surveys, on the other, and this was the intended primary use of the study, findings have been used to inform a software development project ('MARTINA') with the aim of providing a mobile learning solution for logistics professionals (regarding the top-ranked topics resulting from the reported survey). For instance, applications for cargo securing (figure 2) and dangerous goods training (figure 3) are being developed. The software development project itself draws methodologically from design science research in information systems, the central part of which lies in the iterative provision of artifacts, prototypes of a piece of software, providing basic and core functionalities. These can be field-tested (with supervision) and, with feedback gained from test subjects, a new iteration including an updated artifact can be initiated. As the research project is still running until mid-2018, we can, due to this procedure, present both results and define new questions for development and research with respect to the artifact.

On an applied level, research efforts within the scope of the project encompass the development of a mobile device-based application ('artifact') as well as related efforts towards defining a topical map for ongoing qualification in logistics, thus

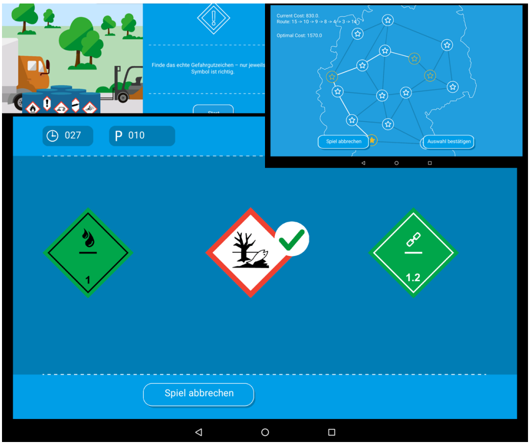

Figure 3: Screenshots of dangerous Goods and Routing Games (v0.3)

ensuring that the resulting application will be relevant and useful for blue- and white-collar employees.

Further benefits are transferability of game concepts to multiple upcoming qualification topics. Numerous theories and accounts on the psychology of motivation with special focus on game design, educational gaming and gamification (Richter, et al., 2014, Mekler, et al., 2015) testify to the importance of mechanisms which foster intrinsic motivation. In general, self-determination theory and the flow-concept are widely known (Deci and Ryan, 2004, Csikszentmihalyi, 2000), while a narrowing to gamification has been provided comprehensively by Nicholson (2015, RECIPE for gamification).

In particular, measures taken aim at strengthening competencies and the incorporation of directives into work routines:

- Development of purely digital training solutions involving a heterogeneous target group and inspiring to see the bigger picture beyond one's own role in a company,
- Strengthen and document user's competencies by each of the challenges provided through mini-games,
- Reach a broad audience by tailoring the application to hardware that is widely used.

Thus the range of in-game applications currently being prototyped/tested includes topics cargo securing, dangerous goods, first aid, route optimization, and customer service.

Currently, procedures largely correspond to agile methods as they are widely used in software development projects of similar scale. After planning, identification and architecture design, the ensuing iterative development process consists of the steps evaluation, selection, development, discussion, each cycle defined by the release of an updated prototype ready to be field-tested. Acknowledging the uncertainty inherent to software engineering, agile procedures (rather than waterfall) are the method of choice, as "it is impossible to fully specify or test an interactive system designed to respond to external inputs" (Wegner, 1997). Accordingly, full specification of the software being developed is impossible, thus it is necessary to build it in incremental steps to ensure fit to requirements. Also, full specification of the software process we use to develop is not possible, thus using administratively heavy processes like RUP or V-models is not to be

Table 2: Survey Results for Version 0.3

item	description	value
	participants	n=30
	age range	19-56
	average age	35,04
2.1	handling (1=very intuitive; 5=instructions required)	2,30
3.1	readability (1=optimal, 5=unreadable)	1,32
3.2	look, general appeal (1=very good, 5=poor)	1,61
	general impression for each game, (range as in 3.2)	
4.1	first aid	1,52
4.2	cargo securing	2,52
4.3	customer service	1,88
4.4	dangerous goods	2,39
	difficulty (1=too easy, 5=too hard)	
5.1	first aid	2,22
5.2	cargo securing	3,00
5.3	customer service	1,58
5.4	dangerous goods	3,26

recommended. Preference is given to the above process, which is designed to respond to change.

In the following we present preliminary results from a user survey gained during prototype testing of the app in its version 0.3, containing mini-games for the topics first aid, cargo securing, dangerous goods, and customer service. These test were conducted with logistics personnel from logistics companies the size of which ranged from 50 to 500 employees. 24 Questions were to be answered, most by indicating agreement/assessment on a five-level scale, some gave room for text. This prototype cycle had at its focus the balancing of difficulty, thus researchers were mainly interested in user's assessment of difficulty and handling (table 2; 1 corresponds to the best possible rating, 5 corresponds to the poorest rating). Accordingly, for next iterations, cargos securing and dangerous goods have been chosen as targets for improvement difficulty- and handling-wise, as well as with regards to a lot of quite differentiated comments received in the free-text forms and conversations.

5 Conclusions and Outlook

One obvious measure to address these effects of long-term commitment to an education measure, high upfront costs, or opportunity costs (e.g. foregone income; Abel and Deitz, 2014) lies in ongoing education, parallel and therefore synergistically to a related job that generates income. Innovative approaches have been taken in recent years, for instance with learning factory-approaches (Doch et al., 2015; Wagner et al., 2012). To effectively prepare logistics employees, especially those in blue collar occupations and of these truck drivers, for the use of new technology and organization concepts, two short propositions can be made: Efficient use of established workplace technology needs to be ensured. Every step ahead on technological grounds has to be met with one in user qualification. Further, it should provide 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. Given the issue of skilled labour shortage as a backdrop, approaches are two-fold: Either, one takes a quantitative view, focusing on the number of employees with a given set of skills, or, one treats the issue as one of quality and is thus concerned with matters of competences and ongoing education and training (Klumpp, et al., 2013). With the latter, changes in employees' set of skills are a central aim. The corresponding dual solution concept is the pair of expansive and intensive approaches: One is concerned with, e.g., raising attractiveness of a given field of work (expansive). Targeted efforts at ongoing worker education and training is an instant of the other (intensive). One example of the latter is training on the job using educational games.

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