

Article

The Role of Competence Profiles in Industry 5.0-Related Vocational Education and Training: Exemplary Development of a Competence Profile for Industrial Logistics Engineering Education

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Abstract: Industry 5.0 and the associated transformation into Society 5.0 require a complete realignment of the skills required of the engineers of tomorrow. Thereby, the pre-dominant and policy-driven drivers of digitalization, and sustainability in particular, demand a complex variety of enhanced special competencies (e.g., lean thinking, data science skills) and transversal competencies from engineers working in manufacturing companies which must be systematically developed and continuously expanded. Since methodical approaches to systematic competence development in the environment of Industry 5.0-related engineering education are scarce, this article develops a competence profile for industrial logistics engineering education as an example of Industry 5.0-related vocational education and training initiatives. After elaborating on the relevant theoretical aspects of systematic competence development in adult education, an exemplary competence profile for industrial logistics engineering education is developed. Moreover, this paper presents a preliminary investigation of the impact of competencies on job performance and job satisfaction. The research results serve as a basis for the development of new teaching and learning concepts as well as for the investigation of causal relationships between competence-orientation and individual performance for industrial engineers in manufacturing enterprises.

Keywords: vocational education and training; competence profile; engineering education; industrial logistics; smart logistics



Citation: Pacher, C.; Woschank, M.; Zunk, B.M. The Role of Competence Profiles in Industry 5.0-Related Vocational Education and Training: Exemplary Development of a Competence Profile for Industrial Logistics Engineering Education. *Appl. Sci.* **2023**, *13*, 3280. <https://doi.org/10.3390/app13053280>

Academic Editors: Dimitris Mourtzis and Benoit Iung

Received: 31 December 2022

Revised: 19 February 2023

Accepted: 2 March 2023

Published: 3 March 2023



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1. Introduction

The approaches of Industry 4.0 and Industry 5.0—the production and logistics, which are based primarily on the principles of digitization, networking, and autonomization, offer a variety of opportunities to increase competitiveness for industrial companies, but also for small and medium-sized enterprises in manufacturing sectors [1,2]. Industry 4.0 and Industry 5.0 principles should be applied continually to strengthen the economy and ultimately society as well. Based on the primarily technology-oriented approaches of Industry 4.0, the focus has shifted to advanced data analytics, sustainable engineering and human integration in the course of new Industry 5.0 concepts in recent years. Therefore, the required competencies of the human workforce within smart and sustainable manufacturing enterprises will also have to change significantly. Drivers such as digitalization and sustainability are forcing a change in all competencies and thus also a complete revision of education and training, considering the usage of the latest teaching and learning methods [3,4]. The starting point for this is a precise definition of a target system by using systematic approaches like the development of empirically validated competence profiles. Since, to the best of our knowledge, methodical approaches to systematic competence development are hardly considered in Industry 5.0-related engineering education yet, this paper focuses on the conceptualization of an exemplary competence profile for industrial

logistics education. The structure of the paper is as follows: First, the relevant theories of competence development in adult education are elaborated on and the state-of-the-art in vocational education and training practices is described. Based on this, the necessary competencies in VET are discussed and possibilities for competence measurement are described. Furthermore, a competence profile for industrial logisticians is created, which is divided into special competencies, transversal competencies, intrapersonal competencies, methodological competencies, and interpersonal competencies. In addition, the authors' empirical study investigates the impact of competencies, formalized by different levels of education, on job performance and job satisfaction. The paper concludes by reflecting on the results of the literature review, the empirical study, and the conceptual framework and identifies further needs for action for practitioners, researchers, and educators.

2. Theoretical Framework

As stated in the introduction, the current development toward Industry 5.0 or Society 5.0 and the associated demands in professional and private everyday life are leading to a pluralization of individual life and educational pathways. Since, to the best of the authors' knowledge, there is no suitable theory of systematic competence development to date, the next section discusses aspects of lifelong learning and the individualization of life paths in relation to competence-oriented vocational tertiary education and training. In this regard, Schaeffter sees both opportunities and risks for the individual in our current "transformation society".

In this context, learning and education gain increasing importance. In the sense of a phenomenological or social-constructive view of learning, this can be generated by experiences in the process of dealing with oneself and the world. In this context, Husserl sees learning that takes place in the lifeworld and interprets the term lifeworld as a space of experience. A social constructivist theory of learning assumes that learning connects sensory contexts to existing experiences and thereupon creates a subjective perception of the world, which is determined by cultural, normative, and social interpretations [5]. Accordingly, learning starts with the experiences of the human being, an approach that can also be called learning world research. Learning worlds are based on the subjective life world. Learning can be helpful here intentionally or unconsciously, or by searching movements for the solution to problems; these solutions are supported again by formal and non-formal learning. All forms of learning—formal, non-formal, and informal—thus intertwine. Learning is to be seen as a process whereby, according to Buck et al. [6], new experiences can only be made based on already existing experiences. Thus, each experience also contains prior knowledge, which is shaped by expectations and anticipations. Meyer-Drawe [7] assumes learning to be relearning, which entails a change of attitudes with respect to the individual experiences. Benner sees in the learning process an in-between space with a transformational character, where knowledge and non-knowledge, ability and non-ability exist simultaneously. The process transforms the known into the unknown and vice versa [5,8]. Above all, society and the economy, including vocational training and continuing professional development, are also subject to demographic change. This results in the challenges of responding quite flexibly to changed working conditions, in some cases with several different generations of employees. This heterogeneity of generations brings with it a multitude of different life phases of the respective employees. The so-called "multigraph" of life phases" is displayed in Figure 1.

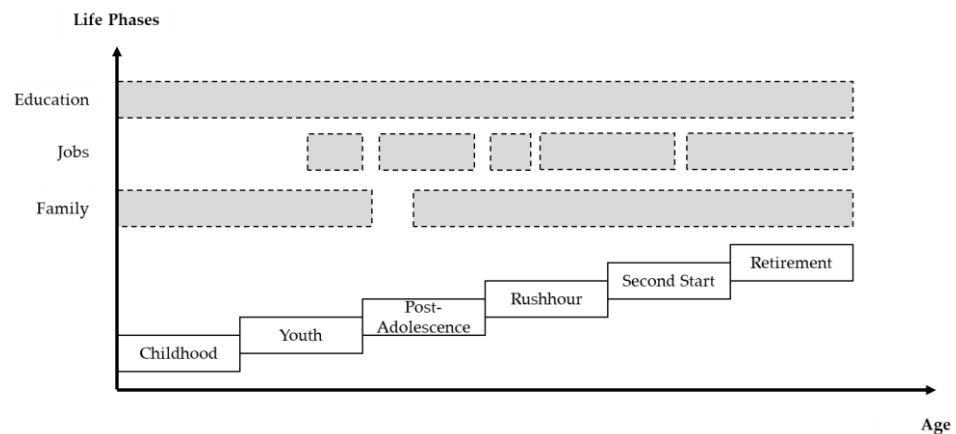


Figure 1. Multigraph of life phases according to Hasebrook et al. [9].

As illustrated in Figure 1, the life stages are becoming more diverse, volatile, and multidirectional. One reason for that is the changes in society and the economy, along with the resulting necessary adjustments in the world of work. Accordingly, the usage of dynamic and flexible competence development concepts seems to be necessary to ensure participant-oriented and life-phase-oriented (further) development [9]. Internally, this challenge could only succeed through transdisciplinary cooperation, thus making knowledge, values, and experiences accessible to all. In this context, Hasebrook et al. [9] refer to the key function of in-company competence management by stating that “only with in-service competence development that is integrated into the work process and professionally supported can employees’ ability to perform, be employed, and act, must be secured throughout their entire working lives. This requires new models of work organization, concepts for a life event-oriented personnel policy, and strategies for company-specific competence management” [9]. According to Barthel et al. [10], concerning company-internal competence development, a corresponding corporate culture is required that “systematically, specifically, and proactively pursues long-term promotion and the maintenance of performance, taking into account individual life situations, competencies, and willingness to perform (including work motivation, commitment).” Furthermore, the study clarifies the close coupling of individual and organizational development. Innovative learning and transfer concepts are of particular importance in this context. These transfer concepts can be used to support the transfer of knowledge within the company and improve the circulation of knowledge, experience, and values.

Accordingly, the development trends and changed requirements require adaptations of the previous vocational training models and concepts. Metadisciplinary and transversal forms of thinking, acting, and feeling affect professional competence [11]. The question here is to what extent modern vocational education and training must change as preparation for the labor market and occupational requirements when the future is not yet known. The demands on the human factor in the world of work are not yet known. Thus, initial vocational education and training (IVET) in particular, but also continuous vocational education and training (CVET), face the paradoxical task of adapting educational content to an unknown future.

2.1. Vocational Education and Training in Europe

Especially since the advancing technological developments (e.g., Industry 4.0, Industry 5.0) of the last decades, the world of networked and international exchange has become the norm. Thus, national and international developments and currents are intermingled in vocational education and training, which require (further) developments at the national level [12]. In this context, Busse and Frommberger [13] speak of Europeanization processes through the merger of the European Union and the resulting influences and changes within the individual European countries [14]. As the lowest common denominator of all

countries, Münk et al. [15,16] identify the qualification of Europeans in line with the labor market to be an essential function of the educational system. They further [16] attribute the modernization processes to globalization as a phenomenon of the economy which has to be considered quite critically. Thus, development processes for a “functioning qualification system” manifest themselves as a generic intersection of all (European) countries through economic competition. Triggered by this, further developments in education policy arise. As examples, Lipsmeier [17] and Clark [18] cite the discussion about maintaining or increasing competitiveness or competence orientation. Furthermore, the demand or necessity for lifelong learning and the transparency of national education systems can be seen as commonalities of international efforts regarding the conception of a “European dimension” in education (e.g., EU Commission Higher Education Area 2025, Pillar of Social rights, etc.) [15].

Vocational education and training and its possible further developments, trends, and challenges can only be considered embedded in the social and economic domains. The permanently changing social and economic innovations also influence the design of vocational education and training, as recent years have shown [19]. On the one hand, demographic change, and the associated aging of the population as well as the increasing individualization of life courses and thus also learning paths can be identified as the main factors influencing the vocational training system on the societal level. Concerning the economic sector, technological advances in digitization, as illustrated by the buzzwords “Industry 4.0” or even “Industry 5.0,” are on the rise. In addition, globalization and internationalization have significantly advanced worldwide networking [19,20].

These developments also influenced further developments concerning advancing competence orientation, modularization, and flexibilization. As early as 1999, the authors Green et al. [21] referred to an increasing focus on competencies, with the UK leading the way with comprehensive competence-based assessment. Another paradigm shift could be identified in vocational education and training since 1995. For both IVET and CVET, there was an increased focus on diversification and expansion. Green et al. also noted, “that vocational training is becoming an increasingly important component of adult education”. The modularization of VET programs led and currently leads to a flexibilization of individual educational opportunities, thus individual learning paths could be selected [22]. This modularization is currently also reflected in the recommendations of the European Commission. The introduction and future focus on so-called individual learning accounts is intended to represent the transparent presentation of individual educational measures cumulatively [23]. With the help of short educational measures—also called micro-credentials—the necessary competencies for social and economic life should be made possible, especially in vocational education and training [24].

2.2. Competencies in Vocational Education and Training

Central efforts of European education policy can be derived from the effects described above. An essential term in this context is “competence”. In literature and practice, the term “competence” is used in different ways and often quite critically and controversially. Competence is derived from the Latin “competencia” and can be interpreted as “to meet”. Weinert [25] explains the term as meaning individually available and learnable cognitive abilities and skills for successful and responsible problem-solving. For Gnahn [26] too, competence is manifested in the appropriate action when situational requirements and the individually available knowledge and skills coincide. Accordingly, competence seems to be the learnable ability to act or solve problems in a way that is appropriate to the situation [26–28]. For Siebert [29], competencies are “life-history-acquired profiles of emotion and cognition, of experience and knowledge acquisition, of thinking, willing, and acting,” which a person acquires largely throughout life. Thus, various individual endogenous factors seem to be united in the concept of competence and inextricably linked to the individual stages of a person’s life. Hasebrook et al. [9] are oriented towards life phases with individual life and development tasks in which competencies are (further)

developed. Conclusively, competence seems to become visible in the successful interplay of endogenous and exogenous factors.

This becoming visible is generally understood as “performance” [26,30]. In this regard, authors like Strauch et al. [31] and Gnahn [26] define competence as a meta-concept with differentiated types of competence. Thus, the authors distinguish subject or special competencies from generic competencies. The former refers to specific topics or subject areas, such as mathematics for statisticians [32]. Supra-disciplinary—or transversal—competencies are relevant to all situations in life [26]. The latter are discussed and researched above all in current research and are thus often summarized along with other terms (e.g., soft skills). The European Parliament summarizes generic competencies with the term key competencies [33]. The concept of competence is used seemingly “indiscriminately” in various disciplines and discourses to express the ability of persons or positions. The prolixity and vagueness of the concept of competence as just illustrated thwart the development of a unified theory of competence.

2.3. The Concept of Competence in Vocational Education and Training

In vocational education, the concept of competence is omnipresent, albeit in different forms and depths of content. In the literature, definitions of competence can be found—some of them complementary—depending on access or purpose. In this framework, the action-theoretical understanding of competence is in the foreground. Euler states that under the word competencies a plethora of reforming or modernizing efforts in (vocational) education policy discourses were in the foreground, which are currently conceptualized, implemented, and evaluated [34]. The starting point for the orientation toward competencies is the further development of company work processes and the new concepts in vocational training didactics. Vocational education and training as a complex, multi-layered and lifelong process should include the training and development of both technical and transversal competencies. Thus, the focus is again on the individual with highly personalized learning paths. This self-development is linked to the needs of the labor market. Arnold [35] speaks in this context of the model of the “reflexible man”. He has awareness of the subjective ability to learn. This potential also enables him/her to change the world if he/she changes him/herself as well. Essential here, however, are other forms of knowledge and ability. The focus is no longer on the mere acquisition of knowledge, but above all on the (further) development of methodical, social, emotional, and also reflexive abilities within the framework of practical questions or tasks [11]. Furthermore, Rolf [11] concludes that successful (vocational) education needs precise competence models and competence profiles.

2.4. Competence Assessment

Competence acquisition and its measurement are as manifold as the means of acquiring them. In the discussion about competence acquisition, the remarks of Kaufhold [36] can be referred to: “The acquisition of competence must always be considered in connection with the underlying goals and purposes as well as the associated interests” [37]. In addition to this, system theory—for example, Luhmann [38]—distinguishes the following fields of reference for competence assessment:

Person: by recording a person’s competencies, subjective competencies can be presented transparently. This in turn can lead to obtaining employment or admission to training opportunities. Further essential features are the (further) development of reflection as well as the (more conscious) perception of strengths and development potential [36,39].

Organization: In organizations, the main interest of competence assessment lies in personnel selection. In this context, the recording of competencies is relevant for the entire personnel management, from recruitment, assessment, and further development to the optimization of personnel deployment [36,39].

Society: The focus is on social and political interests concerning competency assessment [36,39].

According to Weitz [40], competence is the ability to perform a certain action. The active exercise is referred to as performance, i.e., as “the observable behavior in which the competence becomes visible”. Figure 2 displays this understanding of competence.

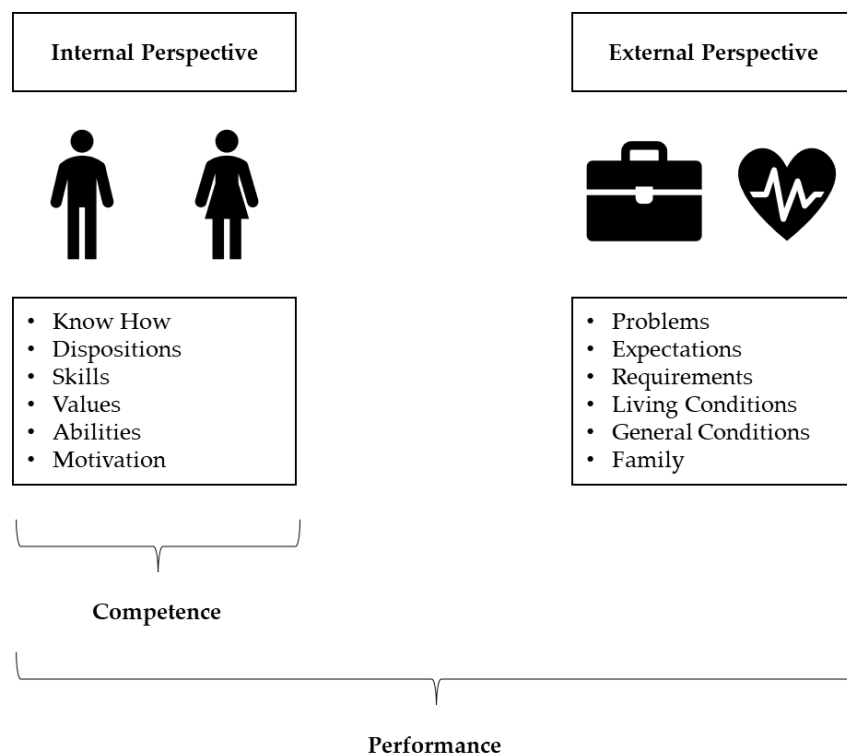


Figure 2. Competence and performance according to Gnahn (2007) [26,37].

At the same time, these explanations also imply the challenges in competence measurement. Competencies cannot be measured directly, as the chart makes clear. The individual, together with the contextual conditions, open up competence. If competencies are therefore only revealed in the interaction between the individual and the environment, the challenge lies in the use of suitable measurement methods. These measurement models must also satisfy scientific quality criteria, such as objectivity, reliability, or validity, to enable collection of representative and reliable data. In the meantime, a multitude of measurement methods exists in vocational education and training research. Depending on which competence facets are to be measured, assessment centers or case vignettes are used in addition to self-assessments and third-party assessments, but these only partially meet the scientific quality criteria [41]. For Nickolaus et al. [41], the challenge is to reliably estimate professional action competence as an overall construct. In their study, Abele et al. [42] developed partial competency items to be able to validly test competency levels and thus draw conclusions about professional action competence. According to Walker [43], the use of this approach seems promising in other domains as well. As further studies by, for example, Abele [44], Seeber [45], and Zinke et al. [46] illustrate, competence measurement methods are largely widespread in apprenticeship training in the industrial-technical sector. Findings on the differentiation of competencies and their further development in the course of further (professional) life are still lacking [41].

3. Competence Profiles in Vocational Education and Training

Especially in adult education, the term “competence profile” is omnipresent and needs a detailed discussion because the competence profile plays an essential role. A definition of competence profiles for quality improvement was demanded within the adult education sector as early as in 2011 [47]. As a definition, the explanations of Lattke and Sgier [48] can be used: “Competence profiles contain descriptions of those competencies

that are required to perform a specific professional role [. . .]. They can refer to a specific professional position in a single institution or to a professional role that is relevant across institutions". Competence profiles are also increasingly used in technical disciplines to describe requirements for necessary skills, attitudes, and knowledge. Competence profiles are used for person-related and intelligent competence analysis. Thus, various potentials can be identified to find suitable (further) training measures, according to the motto, "Strengthen strengths, weaken weaknesses". Derived from the above contents and the results of the empirical study, a competence profile for master students of industrial logistics will be presented in the concluding chapter.

3.1. Competence Profile for Master's Students of the Industrial Logistics Program

Competencies are subjective resources for solving problems, evaluating solutions, and optimizing the applied patterns of action. They are divided into four competence categories: professional competencies, methodological competencies, social competencies, and personal competencies [49]. In the following paragraphs, the classification of competencies according to importance [26], as well as the various competence areas and their sub-aspects for (prospective) purchasers in manufacturing companies are described. In addition, concrete learning outcomes for the measurable and targeted implementation of the competence profile in training practice at universities will be presented as examples.

3.1.1. Special Competencies

This is understood to mean methodical, theoretical, and, above all, practical basic knowledge based on the latest scientific findings. This area of competence also includes, among other things, the development and analysis of specialist literature. This type of competence relates to specific subject areas [32]. Examples would be:

- Supplier management
- Upon successful completion, graduates will be able to:
- understand supplier management concepts;
- perform the supplier selection process using a practical example.
- Inbound transport management
- Upon successful completion, graduates will be able to:
- understand the inbound transport management processes;
- improve inbound transport processes in a case study.
- Digitalization in inbound logistics
- Upon successful completion, graduates will be able to:
- summarize the role of digitalization in inbound logistics;
- explain key approaches to inbound logistics.
- Sustainability in inbound logistics
- Upon successful completion, graduates will be able to:
- summarize the role of sustainability in inbound logistics;
- explain key approaches to sustainability in inbound logistics.
- Lean Thinking in inbound logistics [50–52]
- Upon successful completion, graduates will be able to:
- summarize the principles of Lean Thinking in inbound logistics;
- explain key approaches of Lean Thinking in inbound logistics.

3.1.2. Transversal Competencies

The three categories of methodological, interpersonal, and intrapersonal skills are also called transversal skills. However, terms such as life skills, generic skills, essential skills, key skills, and 21st-century skills are also used [53]. According to OECD [54], transversal competencies are necessary and beneficial in several areas of life and must not only apply to one area. Thus, these transversal competencies can be useful for several fields in working life, as well as for private and political life. The designated "transversal competencies" are—as the name already reveals—relevant "in principle in all situations of

life”, not only for a certain “subject” [26]. The term “generic competence” is often equated with the term “key competence”. In addition, the European Parliament defines further so-called key competencies, which are essential for an active, self-determined lifestyle. These competencies include [33]:

- Native language competence;
- Foreign language competence;
- Mathematical competence and basic scientific and technical competence;
- Computer literacy;
- Learning competence;
- Social competence;
- Initiative and entrepreneurial competence;
- Cultural awareness.

3.1.3. Intrapersonal Competencies

Intrapersonal competencies are the dispositions of self-assessment, value attitudes, motivation, and recognizing one’s talents [32]. Purchasers must be aware of their competencies and reassess them under permanent reflection. Independence and personal responsibility are indispensable skills in manufacturing enterprises, especially for purchasers. Personal competence includes a professional ethical attitude, tolerance, commitment, a sense of responsibility, an authentic appearance, role awareness, and professional time, work, and self-management [55,56]. The following sub-aspects of personal competence are to be (further) developed in industrial logistics studies. Some examples would be:

- Time Management
- Upon successful completion, graduates will be able to:
- master time management techniques;
- manage personal time resources efficiently and effectively.
- Organizational skills
- Upon successful completion, graduates will be able to:
- summarize the principles of process organization;
- apply the principles of organization to inbound logistics processes.
- Motivation skills
- Upon successful completion, graduates will be able to:
- apply self-motivation and peer-motivation techniques;
- set achievable but challenging goals for themselves.
- Emotional intelligence
- Upon successful completion, graduates will be able to:
- put themselves in the position of the counterpart (salesperson) in the negotiation process;
- apply relationship management techniques in negotiation processes.

3.1.4. Methodological Competencies

Methodological competence refers to the ability to work in a goal-oriented manner, analyze processes, react flexibly to general conditions, and reflect on work steps [49]. Some examples would be:

- Problem-solving skills
- Upon successful completion, graduates will be able to:
- know and effectively apply problem-solving techniques;
- systematically develop solutions to problems.
- Presentation skills
- Upon successful completion, graduates will be able to:
- apply presentation techniques effectively;
- systematically create professional presentations.
- Decision-making techniques
- Upon successful completion of the course, graduates will be able to:

- apply decision-making techniques effectively;
- carry out structured decision-making in practice.
- ICT skills
- Upon successful completion of the course, graduates will be able to:
- Incorporate modern ICT tools into the work process;
- Understand the importance of ICT in inbound logistics.

3.1.5. Interpersonal Competencies

Interpersonal competencies, or social competencies, are the abilities to understand, cooperate, and act responsibly with other people. When cooperating with other people, conflict and communication skills and leadership are important [49]. Essential components of social competence in manufacturing enterprises include respect, acceptance, appreciation as well as acting professionally in and with groups. Social competence plays an essential role in all areas of interaction—language, communication, and teamwork. Purchasers must have a high level of social competence to consider the heterogeneous needs and expectations in the buyer-supplier relationship respectfully and appreciatively, to support the ability to learn and to awaken and develop the respective potentials. In addition, stimulating presentation methods must be incorporated into everyday professional life, while at the same time creating the conditions for a successful negotiation and working atmosphere [55,56]. The following sub-aspects of interpersonal competence should be (further) developed in industrial logistics studies.

- Teamwork
Upon successful completion, graduates will be able to:
 - reflect on the phases of teamwork;
 - work together in interdisciplinary teams in everyday professional life.
- Conflict Management skills
Upon successful completion, graduates will be able to:
 - apply conflict management methods and techniques effectively;
 - resolve conflicts appropriately for the situation at hand.
- Communication skills
Upon successful completion, graduates will be able to:
 - Understand and explain communication techniques;
 - Communicate appropriately in negotiations and be able to adapt to the situation.
- Negotiation skills
Upon successful completion, graduates will be able to:
 - describe negotiation techniques;
 - carry out systematic negotiation processes in everyday professional life.

4. Empirical Investigation on the Impact of Competencies on Job Performance and Job Satisfaction

As outlined in Section 2.4 of this paper, research for Industry 5.0-related vocational education and training should focus on the investigation of adequate competence profiles for engineers in modern manufacturing enterprises and their cause-effect relation to various performance measures. Since, to the best of the authors' knowledge, no studies have yet been conducted in this field, this empirical investigation aims to explore the impact of employees' competencies on job performance and job satisfaction by using secondary data from a large-scale field study. Thereby, the authors use a dataset from a field study by Woschank (2018), who focused on the investigation of decision-making processes in strategic supplier selection decisions in manufacturing enterprises in Central Europe [57,58]. Therefore, in this section, the research methodology, the hypotheses, the operationalization of the variables, and the research results will be briefly described. The overall target of this empirical investigation is to investigate the impact of competencies, operationalized based on the level of education of the key respondents on job performance, measured by a

set of economic indicators and job satisfaction, measured by a set of socio-psychological indicators, by using secondary data from a large-scale field study. Based on the theoretical analysis, the basic hypotheses of this study can be formulated as follows:

Hypothesis 1 (H1). *There is a positive relationship between competence and job performance.*

Hypothesis 2 (H2). *There is a positive relationship between competence and job satisfaction.*

According to previous studies such as that of Woschank et al., the variables will be measured as follows: (1) Competence will be measured as a result of formal education by dividing the participants into the following four groups: apprenticeship certificate, high school education, university education, and other supply management-oriented education. (2) Job performance will be measured by using a validated construct for the strategic supplier performance which measures the cost-, quality- and time performance of the selected supplier based on a 5-point Likert scale [59–62]. (3) Job satisfaction will be measured by using a validated construct for the purchaser satisfaction based on a 5-point Likert scale [63–65]. The indicators of job performance and purchaser satisfaction are displayed in Table 1 [57,58].

Table 1. Operationalization (variables and indicators).

Indicator	Measurement
Competence	Test Groups: Apprenticeship certificate, high school education, university education, and other supply management-oriented education
JP1	Job Performance: Development of total costs since the beginning of the SSP
JP2	Price stability since the beginning of the SSP
JP3	Comparison of actual costs to costs at the beginning of the SSP
JP4	Adherence to quality standards
JP5	Frequency of quality complaints
JP6	On-time delivery performance
JP7	Reliability in terms of complete deliveries
JP8	Reliability in terms of on-time deliveries
Job Performance	Mean (JP1 ... JP8)
JS1	How satisfied are you with the supplier selection decision
JS2	How do you commit to the selected supplier
JS3	How satisfied are you with the process of supplier selection
Job Satisfaction	Mean (JS1 ... JS3)

For the field study, a standardized questionnaire in the form of an online survey, based on the state-of-the-art guidelines for empirical research studies, was the selected method of data collection. The questionnaire was re-viewed and pre-tested by specialists working in the field of strategic supplier selection processes to ensure their applicability in the field study. The objectivity of the research method is ensured by the standardized research process guaranteeing the objective processing of the required procedures, a standardized method for the evaluation of the research results (including the evaluation of the descriptive results, the evaluation of both the measurement model and the structural model, the structural analysis, the hypothesis testing processes) and standardized guidelines for the interpretation of the research results. The participants were selected by using the following three membership directories: BVL (Bundesvereinigung Logistik Österreich), BMOE (Bundesverband Materialwirtschaft, Einkauf und Logistik Österreich), and MUL/IL (Montanuniversität Leoben/Lehrstuhl für Industrielogistik) for the identification of “appropriate” key informants. Content validity can be ensured by the structured research process which is based on theoretical analyses and a systematically deduced conceptual framework. The underlying indicators are objectively generated during the operationalization procedures. Most of the selected indicators were used in previous studies within a similar context, which further contributes to the enhancement of content validity. Furthermore, the

authors tested for the non-response bias as suggested by Armstrong and Overton, which evaluates the representability based on significant differences in earlier and later responses. The conducted non-parametric Kruskal-Wallis test showed no significant differences in all indicator values between “earlier”, “average”, and “later” received survey responses. This can be seen as another indication of the representability and the external validity of the research results [57,58]. The final sample includes 206 fully completed questionnaires leading to a response rate of 5.2% for the subsequent statistical analyses. The 206 participating manufacturing enterprises pertain to the following branches: 6.3% “Chemicals/Pharma”, 6.8% “Wood/Paper”, 6.8%, “Automotive”, 4.9% “Plastics/Glass”, 20.9% “Mechanical Engineering”, 17.0% “Metal”, 2.9% “Food/Clothing”, 13.1% “Optics/Electronics”; the remaining 21.4% are assigned to other product-manufacturing branches. Most of the responders (66.1%) had more than 10 years of experience in supply management-related tasks [57,58].

Table 2 shows the descriptive results of the field study.

Table 2. Descriptive results.

	Competence	Job Performance	Job Satisfaction
N (valid)	206	206	206
N (missing)	0	0	0
Mean	1.75	4.12	4.34
Std. Deviation	0.85	0.81	0.75
Minimum	0	1	1
Maximum	3	5	5

For the evaluation of the aggregated variables, the authors computed Cronbach’s alpha (CBA) values, resulting in 0.920 for job performance and 0.854 for job satisfaction. Both are above the recommended values of 0.600 and 0.700, respectively, and thus ensure internal consistency reliability [66,67].

To test the proposed hypotheses, an ANOVA was computed to investigate potential differences in the variables job performance (H1) and job satisfaction (H2) between the test groups of competence. The results of the ANOVA analysis are displayed in Tables 3 and 4.

Table 3. Descriptive of the ANOVA analysis.

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Job Performance	Apprenticeship	21	4.40	0.34	0.07	4.25	4.56	3.63	5.00
	High School	43	4.27	0.78	0.12	4.03	4.51	1.00	5.00
	University	108	4.11	0.84	0.08	3.95	4.27	1.13	5.00
	Total	172	4.18	0.79	0.06	4.07	4.30	1.00	5.00
Job Satisfaction	Apprenticeship	21	4.52	0.49	0.11	4.30	4.75	3.67	5.00
	High School	43	4.51	0.68	0.10	4.30	4.72	2.00	5.00
	University	108	4.28	0.82	0.08	4.13	4.44	1.00	5.00
	Total	172	4.37	0.76	0.06	4.26	4.48	1.00	5.00

Table 4. Detail results of the ANOVA analysis.

		Sum of Squares	Df	Mean Square	F	Sig.
Job Performance	Between Groups	1.99	2.00	1.00	1.63	0.20
	Within Groups	103.46	169.00	0.61		
	Total	105.45	171.00			
Job Satisfaction	Between Groups	2.16	2.00	1.08	1.89	0.15
	Within Groups	96.39	169.00	0.57		
	Total	98.55	171.00			

As a result, the ANOVA indicated no significant differences in job performance (H1) between the test groups of competence ($F: 1.63$; p -value: 0.20). Therefore, H1 must be rejected. Moreover, the ANOVA indicated no significant differences in job satisfaction (H2) between the test groups of competence ($F: 1.89$; p -value: 0.15). Therefore, H2 must be rejected. Surprisingly, in contrast to the theory-based assumptions, the results of this empirical study indicate that there are no significant differences in job performance and job satisfaction related to different levels of competence. This can be explained by the fact that in this explorative study, the level of competence was measured only through the four test groups (apprenticeship certificate, high school education, university education, and other supply management-oriented education); therefore, the respective competencies (abilities, skills, and knowledge) were not dealt with in more detail. Thus, according to the results of this study, the “pure” level of education does not influence job performance and job satisfaction. However, a multitude of comparable studies shows that, for example, target-oriented training measures can significantly increase job performance and job satisfaction [68–71]. Based on these results, further studies should operationalize the competence of the participants more comprehensively by, for example, recording training content in the form of a competence profile. This would also allow a deeper investigation of possible causal relationships between different performance variables.

5. Conclusions and Outlook

Currently, the implementation of competence profiles at tertiary educational institutions are still in their infancy and only gradually being completed. Therefore, the aim of this paper was the exemplary creation of a competence profile for industrial logistics engineering education. For this purpose, the theory of competencies in vocational education and training was elaborated step by step, and possibilities of competence assessment and measurement were discussed. An exemplary competence profile for industrial logistics engineering education was presented and described in detail. This is an essential step toward improving engineering education in the field of industrial logistics. For the derivation of this competence profile, in addition to consulting current literature on the topic of competence orientation in engineering education, data collection with subsequent descriptive and multivariate analysis methods was carried out to be able to create a competence profile based on statically robust data. Thereby, the preliminary empirical study showed no significant differences in job performance and job satisfaction concerning different levels of education, which underlines the importance of sharpening the training content based on competence profiles. For the further (re)orientation of the competence profile, however, further efforts are necessary, such as a primary data collection of the current competencies of alumni and their effect on individual performance for the erudition of the respective handling competence. In addition, qualitative data collection methods, such as interviews or focus groups, should be conducted with all involved stakeholders to support the static data on the one hand and to refine it on the other hand. Megatrends such as digitalization and sustainability will change the way engineers work in the manufacturing industry in the long term. To keep pace with this, professionalized training and continuing education are necessary, which is empirically founded, based on competence profiles, and that teaches the necessary training content using the latest teaching and learning methods [72]. Therefore, educational institutions are now challenged to successfully implement the trends and requirements outlined above and thus to ensure the workability, role understanding of engineers, and competitiveness of future engineering graduates. The focus on competence orientation regarding the further development of the competencies of engineering students must be implemented holistically in the respective tertiary educational institutions so that a competence expansion can take place both on the organizational level and on the individual level. To promote the implementation of competence profiles in engineering education, a first draft of a competence profile was developed. Especially in tertiary education, the cooperation of all actors—Dean of Studies, Students, Company Representatives, and

Professors—is essential for the creation and permanent reflection of competence profiles for the success of future engineers.

Author Contributions: Conceptualization: C.P., M.W. and B.M.Z.; methodology: C.P., M.W. and B.M.Z.; investigation: C.P. and M.W.; writing—original draft: C.P. and M.W.; writing—review & editing: C.P. and M.W.; supervision: B.M.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research belongs to the project “SME 5.0—A Strategic Roadmap Towards the Next Level of Intelligent, Sustainable and Human-Centred SMEs” (funded in the European Union’s Horizon MSCA 2021 programme under the Marie Skłodowska-Curie grant agreement No. 10108648).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data is available by request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Woschank, M.; Zsifkovits, H.E. Smart Logistics—Conceptualization and Empirical Evidence. *Chiang Mai Univ. J. Nat. Sci. (CMUJ)* **2021**, *20*, e2021030. [CrossRef]
2. Zsifkovits, H.E.; Woschank, M. Smart Logistics—Technologiekonzepte und Potentiale. *Berg-Hüttenmännische Mon. (BHM)* **2019**, *164*, 42–45. [CrossRef]
3. Matt, D.T.; Modrák, V.; Zsifkovits, H.E. (Eds.) Industry 4.0 for SMEs: Challenges, Opportunities and Requirements. In *Palgrave Macmillan*; Springer Nature: Cham, Switzerland, 2020.
4. Matt, D.T.; Modrák, V.; Zsifkovits, H.E. (Eds.) Industry 4.0 for SMEs: Concepts, Examples and Applications. In *Palgrave Macmillan*; Springer Nature: Cham, Switzerland, 2021.
5. Ralph, B.J.; Pacher, C.; Woschank, M. Conceptualization of the Lecture ‘Digitalization and Digital Transformation in Metal Forming’ based on Implications from Contemporary Teaching and Learning Theories. In Proceedings of the International Conference on Industrial Engineering and Operations (IEOM) Management, Harare, Zimbabwe, 20–22 October 2020; pp. 703–712.
6. Buck, H.; Dürr, R.; Fürch, C. Der Übergang von der Grundschule ins Gymnasium als Thema der Lehrerbildung. *Z. Für Sch. Und Innov. Aus Baden-Württemberg* **2016**, *52*.
7. Meyer-Drawe, K. Lernen als Erfahrung. *Z. Für Erzieh.* **2003**, *6*, 505–514. [CrossRef]
8. Felden, H.v. (Ed.) Transformationen in Lern- und Bildungsprozessen und Transitionen in Übergängen. In *Denken in Übergängen*; Springer: Wiesbaden, Germany, 2014; pp. 61–84.
9. Hasebrook, J.; Zinn, B.; Schletz, A. (Eds.) Lebensphasen und Kompetenzmanagement: Ein Berufsleben lang Kompetenzen erhalten und entwickeln, 1. Aufl. *Kompetenzmanagement in Organisationen*; Springer: Berlin/Heidelberg, Germany, 2018.
10. Barthel, E.; Hanft, A.; Hasebrook, J. (Eds.) *Integriertes Kompetenzmanagement im Spannungsfeld von Innovation und Routine*; Waxmann: Münster, Germany, 2010.
11. Rolf, A. Berufsbildung und Persönlichkeitsentwicklung in Zeiten disruptiver Innovationen. In *Handbuch Berufsbildung*; Arnold, R., Lipsmeier, A., Rohs, M., Eds.; Springer Fachmedien Wiesbaden: Wiesbaden, Germany, 2020; pp. 279–292.
12. Steiner-Khamsi, G.; Waldow, F. *World Yearbook of Education 2012*; Routledge: Abingdon-on-Thames, UK, 2012.
13. Busse, G.; Frommberger, D. Internationalisierung der Berufsausbildung als Herausforderung für Politik und Betriebe: Eine explorative Studie. In *Reihe Praxiswissen Betriebsvereinbarungen, Nr. 311*; Hans-Böckler-Stiftung: Düsseldorf, Germany, 2016.
14. Frommberger, D.; Baumann, F.-A. Internationalisierung der Berufsbildung. In *Handbuch Berufsbildung*; Arnold, R., Lipsmeier, A., Rohs, M., Eds.; Springer Fachmedien Wiesbaden: Wiesbaden, Germany, 2020; pp. 713–724.
15. Münk, D. Berufliche Bildung in Europa. In *Handbuch Berufsbildung*; Arnold, R., Lipsmeier, A., Rohs, M., Eds.; Springer Fachmedien Wiesbaden: Wiesbaden, Germany, 2020; pp. 725–736.
16. Castells, M. Der Aufstieg der Netzwerkgesellschaft, Durchges. Nachdr. der 1. Aufl. In *Das Informationszeitalter, Teil 1*; Leske + Budrich: Opladen, Germany, 2003.
17. Lipsmeier, A. Internationale Trends in der Curriculumentwicklung für die Berufsausbildung und in der Lehrerbildung in diesem Bereich. In *Gestalten statt anpassen in Arbeit, Technik und Beruf: Festschrift zum 60. Geburtstag von Felix Rauner*; Fischer, M., Ed.; Bertelsmann: Bielefeld, Germany, 2001; pp. 312–330.
18. Clark, P.J. The Curriculum Internationalization Process in Banking and Finance School-to-Work Programs: A Cross Case Study. *J. Vocat. Educ. Res.* **2002**, *27*, 293–308. [CrossRef]
19. Cedefop. Vocational Education and Training in Europe, 1995–2035: Scenarios for European Vocational Education and Training in the 21st Century. 2020. Available online: <http://data.europa.eu/doi/10.2801/794471> (accessed on 15 December 2022).

20. Cedefop. Windungen, Wandlungen, Wechsel. Die Pandemie verändert Qualifikationserfordernisse und Arbeitsplätze—und stellt unsere Sichtweise und Analyse von diesen in Frage. Kurzbericht. 2021. Available online: www.cedefop.europa.eu/EN/publications.aspx (accessed on 15 December 2022).
21. Green, A.; Leney, T.; Wolf, A. *Convergence and Divergence In European Education and Training Systems*; Institute of Education of the University of London: London, UK, 1999.
22. Cedefop. The Changing Nature and Role of Vocational Education and Training in Europe. Volume 5: Education And Labour Market Outcomes for Vocational Education and Training Graduates in Different Types of VET Systems in Europe. 2018. Available online: https://www.cedefop.europa.eu/files/5569_en.pdf (accessed on 15 December 2022).
23. European Commission. Proposal for a Council Recommendation on Micro-Credentials for Lifelong Learning and Employability. 2021. Available online: <https://op.europa.eu/en/publication-detail/-/publication/f9f9d75e-72cb-11eb-9ac9-01aa75ed71a1/language-lv> (accessed on 15 December 2022).
24. European Commission. Proposal for a Council Recommendation on Individual Learning Accounts. 2021. Available online: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021DC0773&from=EN> (accessed on 15 December 2022).
25. Weinert, F.E. (Ed.) *Leistungsmessungen in Schulen*, 2nd ed.; Beltz Pädagogik: Weinheim, Germany, 2002.
26. Gnahn, D. *Kompetenzen-Erwerb, Erfassung, Instrumente*, 2nd ed; Bertelsmann: Bielefeld, Germany, 2010.
27. North, K.; Reinhardt, K.; Sieber-Suter, B. *Kompetenzmanagement in der Praxis: Mitarbeiterkompetenzen Systematisch Identifizieren, nutzen und Entwickeln; mit Vielen Fallbeispielen*; Springer Gabler: Wiesbaden, Germany, 2013.
28. Treptow, R. Kompetenz—das große Versprechen. In *Kompetenz, Performanz, Soziale Teilhabe: Sozialpädagogische Perspektiven auf ein bildungstheoretisches Konstrukt*; Bauer, P., Treptow, R., Eds.; Springer Fachmedien: Wiesbaden, Germany, 2014; pp. 21–41.
29. Siebert, H. *Didaktisches Handeln in der Erwachsenenbildung: Didaktik aus konstruktivistischer Sicht, 4., aktualisierte und erw. Aufl. Grundlagen der Weiterbildung*; Luchterhand: Munich, Germany, 2003.
30. Tillmann, K.-J.; Meier, U. Familienstrukturen, Bildungslaufbahnen und Kompetenzerwerb. In *PISA 2000—Ein differenzierter Blick auf die Länder der Bundesrepublik Deutschland*; Baumert, J., Artelt, C., Klieme, E., Eds.; VS Verlag für Sozialwissenschaften: Wiesbaden, Germany, 2003; pp. 361–392.
31. Strauch, A.; Jütten, S.; Mania, E. *Kompetenzerfassung in der Weiterbildung: Instrumente und Methoden situativ anwenden; Perspektive Praxis*; Bertelsmann: Bielefeld, Germany, 2009.
32. Erpenbeck, J.; von Rosenstiel, L.; Grote, S.; Sauter, W. *Handbuch Kompetenzmessung: Erkennen, verstehen und bewerten von Kompetenzen in der betrieblichen, pädagogischen und psychologischen Praxis, 3. Auflage*; Schäffer-Poeschel: Stuttgart, Germany, 2017.
33. Europäisches Parlament. *Empfehlungen des europäischen Parlaments und des Rates vom 18. Dezember 2006 zu Schlüsselkompetenzen für lebensbegleitendes Lernen*; Europäisches Parlament: Brussels, Belgium, 2006.
34. Euler, D. Kompetenzorientierung in der beruflichen Bildung. In *Handbuch Berufsbildung*; Arnold, R., Lipsmeier, A., Rohs, M., Eds.; Springer Fachmedien Wiesbaden: Wiesbaden, Germany, 2020; pp. 205–217.
35. Arnold, R. *Entlehrt euch! Ausbruch aus dem Vollständigkeitswahn*, 1st ed.; Hep Verlag: Bern, Switzerland, 2017.
36. Kaufhold, M. *Kompetenz und Kompetenzerfassung*; VS Verlag für Sozialwissenschaften: Wiesbaden, Germany, 2006.
37. Pacher, C.; Woschank, M. Competencies in the Digitalized Working Environment: A Concept for Engineering Education in Higher Education Institutions. In *Proceedings of the International Conference on Industrial Engineering and Operations (IEOM) Management*, Harare, Zimbabwe, 20–22 October 2020; pp. 1203–1212.
38. Luhmann, N. *Soziale Systeme: Grundriß Einer Allgemeinen Theorie, 17. Auflage*; Suhrkamp-Taschenbuch Wissenschaft: Frankfurt am Main, Germany, 2018; Volume 666.
39. Pacher, C.; Woschank, M.; Rauch, E.; Zunk, B.M. Systematic Development of a Competence Profile for Industrial Logistics Engineering Education. *Procedia Comput. Sci.* **2022**, *200*, 758–767. [[CrossRef](#)]
40. Weitz, F. Was ist eine Kompetenz. 2017. Available online: <http://frederikweitz.blogspot.com/2017/10/was-ist-eine-kompetenz.html> (accessed on 14 February 2022).
41. Nickolaus Reinhold, W.F. Kompetenzorientierung in der beruflichen Bildung. In *Kompetenzorientierung. Berufliche Kompetenzen entwickeln, messen und anerkennen. Bundesinstitut für Berufsbildung*; Agnes, D., Reinhold, N., Beatrice, R., Reinhold, W., Eds.; Bertelsmann: Bielefeld, Germany, 2016; pp. 7–29.
42. Abele, S.; Walker, F.; Nickolaus, R. Zeitökonomische und reliable Diagnostik beruflicher Problemlösekompetenzen bei Auszubildenden zum Kfz-Mechatroniker. *Z. Für Pädagogische Psychol.* **2014**, *9*, 167–179. [[CrossRef](#)]
43. Walker, F. *Analytische Problemlösefähigkeit von ElektronikerInnen der Automatisierungstechnik und Deren Computerbasierte Erfassung*; ZeB-Forschungskolloquium, Zentrum für Empirische Bildungsforschung Universität: Tübingen, Germany, 2014.
44. Abele, S. Modellierung und Entwicklung Berufsfachlicher Kompetenz in der Gewerblich-Technischen Ausbildung. Ph.D. Thesis, Universität Stuttgart, Stuttgart, Germany, 2014.
45. Seeber, S. Ansätze zur Modellierung beruflicher Fachkompetenz in kaufmännischen Ausbildungsberufen. *Z. Für Berufs- Und Wirtsch.* **2008**, *1*, 7–97. [[CrossRef](#)]
46. Zinke, G.; Schenk, H.; Kröll, J. *Ergebnisse einer Online Befragung zur Berufsfeldanalyse der industriellen Elektroberufe*; DIE: Bonn, Germany, 2014.
47. Europäisches Parlament und Rat der Europäischen Union. *Empfehlung des Europäischen Parlaments und des Rates vom 23. April 2008 zur Einrichtung des Europäischen Qualifikationsrahmens für Lebenslanges Lernen*; Europäisches Parlament und Rat der Europäischen Union: Brussels, Belgium, 2008.

48. Sgier, I.; Lattke, S. (Eds.) *Professionalisierungsstrategien der Erwachsenenbildung in Europa: Entwicklungen und Ergebnisse aus Forschungsprojekten*; W. Bertelsmann Verlag: Bielefeld, Germany, 2012.
49. Frey, A.; Balzer, L. Einschätzungsbogen zu sozialen und methodischen Kompetenzen–smk72. In *Handbuch Kompetenzmessung*; Erpenbeck, J., Rosenstiel, L.V., Grote, S., Eds.; Schäffer-Poeschl Verlag: Stuttgart, Germany, 2017; pp. 149–160.
50. Amaro, P.; Alves, A.C.; Sousa, R.M. Lean Thinking: A Transversal and Global Management Philosophy to Achieve Sustainability Benefits. In *Lean Engineering for Global Development*; Alves, A.C., Kahlen, F.-J., Flumerfelt, S., Siriban-Manalang, A.B., Eds.; Springer International Publishing: Cham, Switzerland, 2019; pp. 1–31.
51. Alves, A.C.; Flumerfelt, S.; Moreira, F.; Leão, C.P. Effective Tools to Learn Lean Thinking and Gather Together Academic and Practice Communities. In *Proceedings of the ASME International Mechanical Engineering Congress and Exposition-2017: Presented at ASME 2017 International Mechanical Engineering Congress and Exposition, Tampa, FL, USA, 3–9 November 2017*; The American Society of Mechanical Engineers: New York, NY, USA, 2018.
52. Alves, A.C. Lean Thinking: An essential mindset. *IEEE Eng. Manag. Rev.* **2022**, *50*, 127–133. [\[CrossRef\]](#)
53. Scharnhorst, U. Transversale Kompetenzen—notwendig, erwünscht und schwierig zu erreichen. *Z. Des Bundesinstituts Für Berufsbild.* **2021**, *50*, 18–23.
54. OECD. *Definition und Auswahl von Schlüsselkompetenzen: Zusammenfassung*; OCED: Paris, France, 2005.
55. WBA. Qualifikationsprofil. Wba-Diplom. Diplomierte/r Erwachsenenbildner/in Lehren/Gruppenleitung/Training. 2019. Available online: <https://wba.or.at/media/pdf/qualifikationsprofil-wba-diplom-lehren-gruppenleitung-training.pdf?m=1562061974&> (accessed on 22 August 2019).
56. WBA. Qualifikationsprofil. Wba-Zertifikat. Zertifizierte/r Erwachsenenbildner/in. 2019. Available online: <https://wba.or.at/media/pdf/qualifikationsprofil-wba-zertifikat.pdf?m=1562061962&> (accessed on 22 August 2019).
57. Woschank, M.; Dallasega, P.; Zunk, B.M.; Pacher, C. Strategic Supplier Selection: The Importance of Process Formality in Non-Automated Supplier Selection Decisions. *Cogent Eng.* **2022**, *9*, 2094853. [\[CrossRef\]](#)
58. Woschank, M. The Impact of Decision Making Process Maturity on Decision Making Efficiency. Ph.D. Thesis, University of Latvia, Riga, Latvia, 2018.
59. Buhrmann, C. *Supplier Selection Decisions: Reducing the Vulnerability to Judgment and Decision Biases and the Implications for Supplier Performance*; European Management Publications: Vallendar, Germany, 2010.
60. Riedl, D. *Behavioral Supply Management: A Decision Theory-Based Investigation of Decision Process Decomposition in the United States and China*; European Management Publications: Vallendar, Germany, 2012.
61. Kaufmann, L.; Meschnig, G.; Reimann, F. Rational and intuitive decision-making in sourcing teams: Effects on decision outcomes. *J. Purch. Supply Manag.* **2014**, *20*, 104–112. [\[CrossRef\]](#)
62. Kaufmann, L.; Kreft, S.; Ehrgott, M.; Reimann, F. Rationality in supplier selection decisions: The effect of the buyer's national task environment. *J. Purch. Supply Manag.* **2012**, *18*, 76–91. [\[CrossRef\]](#)
63. Schröder, W. *Leistungsorientierung und Entscheidungsverhalten: Eine Experimental-Untersuchung zur Wirkung individueller Werte in Problemlöseprozessen*; Lang: Frankfurt am Main, Germany, 1986.
64. Bronner, R. *Entscheidung unter Zeitdruck: Eine Experimentaluntersuchung zur empirischen Theorie der Unternehmung*; J.C.B. Mohr: Tübingen, Germany, 1973; Volume 3.
65. Neuert, J.O. *Planungsgrade: Eine experimentelle Untersuchung zum Zusammenhang zwischen Planungsverhalten und Planungserfolg*; Wilfer: Spardorf, Germany, 1987.
66. Heath, A.; Jean, M. Why are there so few formal measuring instruments in social and political research? In *Survey Measurement and Process Quality*; Lyberg, L., Biemer, P., Collins, M., Eds.; John Wiley & Sons: New York, NY, USA, 1997; pp. 71–86.
67. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariate Data Analysis*, 7th ed.; Pearson: Harlow, UK, 2014.
68. Kaynak, H.; Hartley, J.L. A replication and extension of quality management into the supply chain. *J. Oper. Manag.* **2008**, *26*, 468–489. [\[CrossRef\]](#)
69. Ahire, S.L.; Golhar, D.Y.; Waller, M.A. Development and validation of TQM implementation constructs. *Decis. Sci.* **1996**, *27*, 23–56. [\[CrossRef\]](#)
70. Park, D.; Krishnan, H.A. Supplier selection practices among small firms in the United States: Testing three models. *J. Small Bus. Manag.* **2001**, *39*, 259–271. [\[CrossRef\]](#)
71. Mentzer, J.T.; Cox, J.E.J. A Model of the determinants of achieved forecast accuracy. *J. Bus. Logist.* **1984**, *5*, 143–155.
72. Ramirez-Mendoza, R.A.; Morales-Menendez, R.; Iqbal, H.; Parra-Saldivar, R. Engineering Education 4.0: —Proposal for a new Curricula. In *Proceedings of the Global Engineering Education Conference (EDUCON)*, Santa Cruz de Tenerife, Spain, 17–20 April 2018; pp. 1273–1282.

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