



"TRANSFORMING HUMAN RESOURCE MANAGEMENT: INDUSTRY 4.0'S COMPREHENSIVE APPROACH FOR THE FUTURE WORKFORCE"

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Abstract

In order for manufacturing organisations to manage the knowledge and competency difficulties associated with Industry 4.0's new technologies and processes, new strategic approaches to comprehensive human resource management are required. The number of workspaces requiring a high level of complexity will rise as a result of the ongoing automation of simple production processes, necessitating a high level of staff education. The difficulty lies in preparing workers to transfer their skills to workplaces with more complicated processes and ensuring job retention in dynamic work environments. In this work, a strategic approach to personnel qualification is discussed.

Keywords: Human Resource Management, Industry, Change in industry management

Introduction

Actuality and relevance

Companies face an increasing number of problems to overcome in a globalised environment with increasingly interconnected operations. With global competitors, innovation capability and a quick time to market become crucial. Furthermore, as a result of continually shifting customer demands for customised items on demand, the marketplaces are becoming more volatile and varied. Smart manufacturing processes are put in place to build the flexibility and capacity required to achieve those goals [1]. Simple and repetitive tasks are mechanised as other processes grow more complex and integrated. As a result, methods for qualification of the current workforce are needed. Employees must be given the ability to perform more coordinated, creative, and strategic tasks. Additionally, societal values among employees are changing, and the population is ageing more quickly, which increases the need for action [4,5].

Research question

The strategic management of competencies becomes crucial for overcoming those obstacles successfully. This article seeks to present the creation of a competence model and demonstrates a strategy for how businesses might utilise it to address new difficulties in Industry 4.0. The following research queries will be addressed as the model is developed: What general difficulties would businesses encounter in Industry 4.0? How do those difficulties affect current and upcoming jobs, as well as the associated workflows? Which fundamental skills are necessary for employees to perform their current or future jobs? How might the competency model assist a business in keeping a skilled workforce?

Methodology

The first section of this essay lays the theoretical groundwork by highlighting the importance of competence development and human resource management to a company's overall strategy. The development of the holistic competency model is discussed in the second section. First, a thorough literature research is done in order to identify the major difficulties facing Industry 4.0. A list of necessary core competences for personnel can be derived from a deeper understanding of those difficulties.

By comparing this list to the most recent and pertinent studies on future work competencies, it will be strengthened. The identified core competencies are visualised in the following stage. The pillars of the technique depicted in Figure 1 are represented by the three stages of the model creation.

The created competency model's potential applicability is highlighted in the third section. It is explained how the model may be applied to analyse an employee's preparation for Industry 4.0 and how qualification strategies can be developed.

Methodological approach

The function of human resource management and its significance for corporate strategy

The management of an organization's workforce has a significant impact on its performance and competitiveness. Human resource management is a term that encompasses all actions related to hiring and overseeing personnel in organisations; it is explained in the next portion.

The development and administration of human resources

In order to effectively employ and develop a highly motivated and competent workforce to fulfil the company's goals, human resource management is defined as an and release of personnel have been crucial components of this concept since it was originally introduced in the early 1980s. Employee development, often known as human resource development, is another crucial duty. This function has a significant impact on organisational development and, as a result, the current and future performance of any organisation by concentrating on all activities relating to the professional education, learning, and training of both individuals and teams.

Following a thorough literature review, Bob and Jim identified the following key objectives for human resource development:

1. Increasing performance and effectiveness of individuals and groups
2. Increasing performance and effectiveness within organisations
3. Creating knowledge, competencies, and skills
3. Increasing human potential and personal development

Personal development (competences), team development (collaboration), and organisational development (structure and processes) are the three primary functional areas of human resource development.

Strategic competence development

The identification of necessary competencies is a precondition for creating a workforce that will meet the demands of the present and future markets. A person needs a certain set of knowledge, abilities, attitudes, and motivations in order to execute activities and solve problems related to their area of work. This grouping is known as their competencies. Most authors divide competencies into four primary groups. Technical competencies are all knowledge and abilities that are relevant to a particular task, whereas methodological competencies are all knowledge and abilities that are related to decision-making and general issue solving. Thirdly, social competencies include all knowledge, expertise, and dispositions that support cooperation and interpersonal communication. Personal competencies also encompass a person's societal ideals, driving forces, and attitudes. On the other hand, qualification is the process of acquiring the necessary set of competencies through education and training.

In a cycle of continuous improvement, qualification and competency development work together. The goal of qualification is to close those gaps, whereas competence development strives to discover necessary competencies and subsequently helps to highlight crucial gaps. A competence model can be utilised to increase this process's transparency.

Development of an Industry 4.0 competency model

According to the technique, there are three critical processes involved in developing a competency model: identifying new difficulties, deriving the competencies necessary to address those challenges, and visualising those competencies with the aid of an appropriate tool.

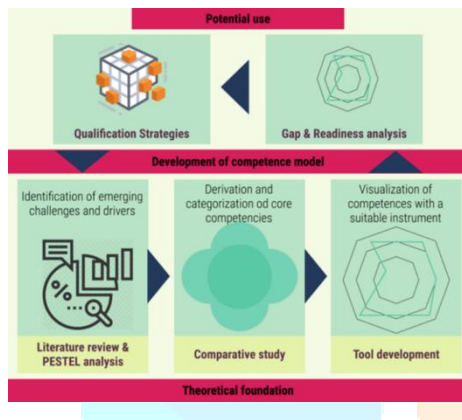
Defining Industry 4.0

The term "Industry 4.0" is frequently used interchangeably with the phrase "fourth industrial revolution" as part of the most recent high-tech plan of the Indian Government. Industry 4.0 refers to the process of digitising all aspects of

the value chain in order to connect people, things, and real-time data exchange between systems [8]. This interconnection allows for the development of artificial intelligence and the potential for products, devices, and processes to independently adapt to unforeseen environmental changes [3]. Smart items also integrate with larger systems, facilitating the development of adaptable, self-regulating industrial processes. Although there are many applications for smart systems and objects, the industrial sector continues to receive the majority of attention.

Identification of emerging challenges in Industry 4.0

Absolutely, Industry 4.0 offers businesses a wealth of new opportunities, but it also presents a number of difficulties due to the ongoing automation and digitization. The PESTEL framework is used to study macro-environmental issues in the following chapters while taking into account socioeconomic, technological, environmental, political, and legal variables.



Economic challenges:

As a result of the continuous globalisation process, businesses must contend with shorter product lifecycles, quicker time-to-market, and the need to cut costs in order to remain competitive. Companies must improve the efficiency of their innovation procedures and shift to more service-oriented business models. As traditional business models become more easily susceptible to replacements. Additionally, customers now expect a greater degree of customization and flexibility [1,2]. Markets have consequently become more turbulent and diverse. Collaboration is therefore more essential than ever before. In order to remain competitive, businesses must increasingly form strategic

partnerships with their suppliers or rivals. This ultimately results in the correlation of entire value chains, which raises the complexity of processes. [2,3,4].

Social challenges:

The demographic shift is one of the societal issues that has the biggest impact. To replace those who are retiring, fewer young people are joining the workforce. In order to retain the expertise of older employees, measures must be established to draw in young people [4]. Younger generations also reflect opposing social values, such the increased significance of a healthy work-life balance. This is related to the expanding employee flexibility brought on by changes in workplace structures. To prevent work from interfering with employees' personal lives, restrictions must be put in place on their availability at all times. New types of lifelong learning are also necessary due to the rise in virtual work and flexible work topics. Additionally, as processes become more complicated, the number of jobs requiring higher qualifications rises while the number of jobs requiring lower qualifications declines [1,3]. Therefore, businesses must prepare their staff for higher-level, more strategic, coordinated, and creative tasks.

Technical challenges:

A significant volume of data (big data) must be handled by businesses in an efficient manner due to the exponential rise of technologies. As a result, complex IT infrastructures like communication networks and internet protocols must be created and put in place. Further requirements include the development of standardised interfaces and open architectures, which enable collaborative work across various platforms, to ensure the trouble-free exchange of data between partners within a network. Large data storage on external servers creates an extra cyber security issue because Governments must assist businesses in both the creation of new technology and their assimilation into the current environment. data must be secured against unauthorised access. Employees must continue to develop the skills necessary to be ready for the rise in virtual work, such as using virtual glasses [1,4].

Environmental challenges:

The continuous climate change is a significant environmental challenge [4]. All living things within a biosphere are affected by the ongoing changes in conditions. The optimal use of natural resources is also more important because the majority of them are scarce. Companies now understand their part in advancing sustainable solutions as a result [3,4].

Political and legal challenges:

The most obvious political obstacle is the growing need for money for research initiatives.

Governments must assist businesses in both the creation of new technology and their assimilation into the current environment.

Governments also need to set up legal guidelines for the use of big data. The preservation of privacy is the main issue because, while using smart objects, data would be collected on everything. To further increase employee protection, restrictions for work hours and safety must be put in place [12,7].

Skills derived from recognised challenges

This chapter shows how to logically infer the essential core skills for employees in Industry 4.0. Accordingly, the requirements of the major emerging challenges were first determined. After that, potential competencies were deduced, and the accompanying table presents them for each challenge.

Table 1: Derivation of core competencies for identified challenges

Economic Challenges	<p>Permanent globalisation Time flexibility, process understanding, language skills, networking skills, intercultural skills</p> <p>Growing demand for innovation Process understanding, research skills, entrepreneurial thinking, problem solving, creativity, work under pressure, technical skills</p> <p>Higher service orientation is required: Networking skills, conflict solving, ability to be compromising, communication skills</p> <p>Increasing demand for collaborative and cooperative work: Ability to work in a team, ability to be compromising</p>
Social Challenges	<p>Population shifts and shifting social values: Leadership skills, ability to transfer knowledge, time and place flexibility, accepting work task rotation and work-related change</p> <p>The growth of virtual labour: Understanding IT security, motivation to learn</p> <p>Process complexity is increasing: Decision making, process understanding, technical skills</p>
Technical Challenges	<p>Exponential growth in data utilisation and technology: Compliance, analytical skills, technical skills, coding skills</p> <p>Increasing platform collaboration: Ability to be cooperative, virtual communication skills, media skills</p>
Environmental Challenges	<p>Resource shortages with climate change: Creativity to develop new sustainable solution, motivation to protect the environment, sustainable mindset</p>
Political And legal Challenges	<p>Standardization: Process understanding, coding skills, technical skills</p> <p>Personal privacy and data security: Compliance, understanding of IT security</p>

Aggregation and categorization of competencies

Leinweber contends that in order to enhance the model's clarity and transparency, it is crucial to arrange the recognised competencies into specific categories. In order to eliminate potential overlaps, an aggregation of the previously stated competence list is necessary. The grouping of competencies into the four recognised major categories of competence is the next step.

Table 2 illustrates this categorization of identified competencies. Additionally, as part of a comparative study, the studies on competencies for future employment that were most frequently cited were examined. The objective of this comparative study was to confirm the significance of the omitted abilities for Industry 4.0. Below are some literature that highlight each competency's potential importance.

Table 2: Set of aggregated competencies by their categories

Cat ego ry	Required competencies	Context
Technical Competencies	State of the art knowledge : Technical skills: Process understanding: Media skills : Coding skills : Understanding IT security :	Knowledge is becoming more crucial as a result of growing job responsibilities. To transition from operational to more strategic jobs, one needs to possess comprehensive technical skills. A broader and deeper understanding of the process is required as process complexity increases. Employees must be able to use smart media, such smart glasses, as the amount of virtual labour increases. Employees with coding skills are increasingly needed as more processes become digital. Employees that perform virtual work on servers or platforms are required to understand cyber security.
Methodological Competencies	Creativity: Entrepreneurial thinking: Problem solving: Conflict solving: Decision making: Analytical skills: Research skills: Efficiency skills:	Creativity is needed for both internal improvements and the need for more novel items. Every employee who is given more challenging and strategic tasks must act entrepreneurially. Employees must be able to determine the causes of errors and enhance procedures. Increased customer relationships result from a higher service orientation; conflicts must be resolved. Employees must make their own decisions since they will have greater process ownership. It becomes essential to organise and analyse massive amounts of data and intricate procedures. Ability to employ trustworthy sources for ongoing education in dynamic circumstances. More effective solutions must be found for complex issues, including analysing vast amounts of data.
Social Competencies	Intercultural skills: Language skills: Communication skills: Networking skills: Ability to be Compromising and cooperative : leadership skills:	When working internationally, it is important to understand various cultures, especially different work habits. being able to comprehend and communicate with international business partners and clients. While increasing virtual work demands adequate virtual communication skills, service orientation demands strong listening and presentation skills. Knowledge networks are necessary for working in a value chain that is highly globalised and linked. The participants in a value chain become equal partners; every project must produce win-win outcomes, particularly in organisations that handle an expanding volume of projects.

		Each employee is able to become a leader due to increased responsibility and flattened hierarchies.
Personal Competencies	Flexibility : Ambiguity tolerance : Motivation to learn : Sustainable mindset :	Increased virtual work allows employees to be more mobile and independent, and work-task rotation necessitates greater adaptability on the part of employees. accepting change, particularly change linked to one's job owing to rotation or reorientation of tasks. Employees must be willing to learn because changes in the workplace occur more frequently now. Employees must support sustainability projects as ambassadors of their employers.

Visualization of identified core competencies

It is only necessary to visualise the competency model if all necessary competencies have been discovered, collected, and categorised. This last phase helps the user identify competency gaps at a glance and increases transparency for understanding competence needs.

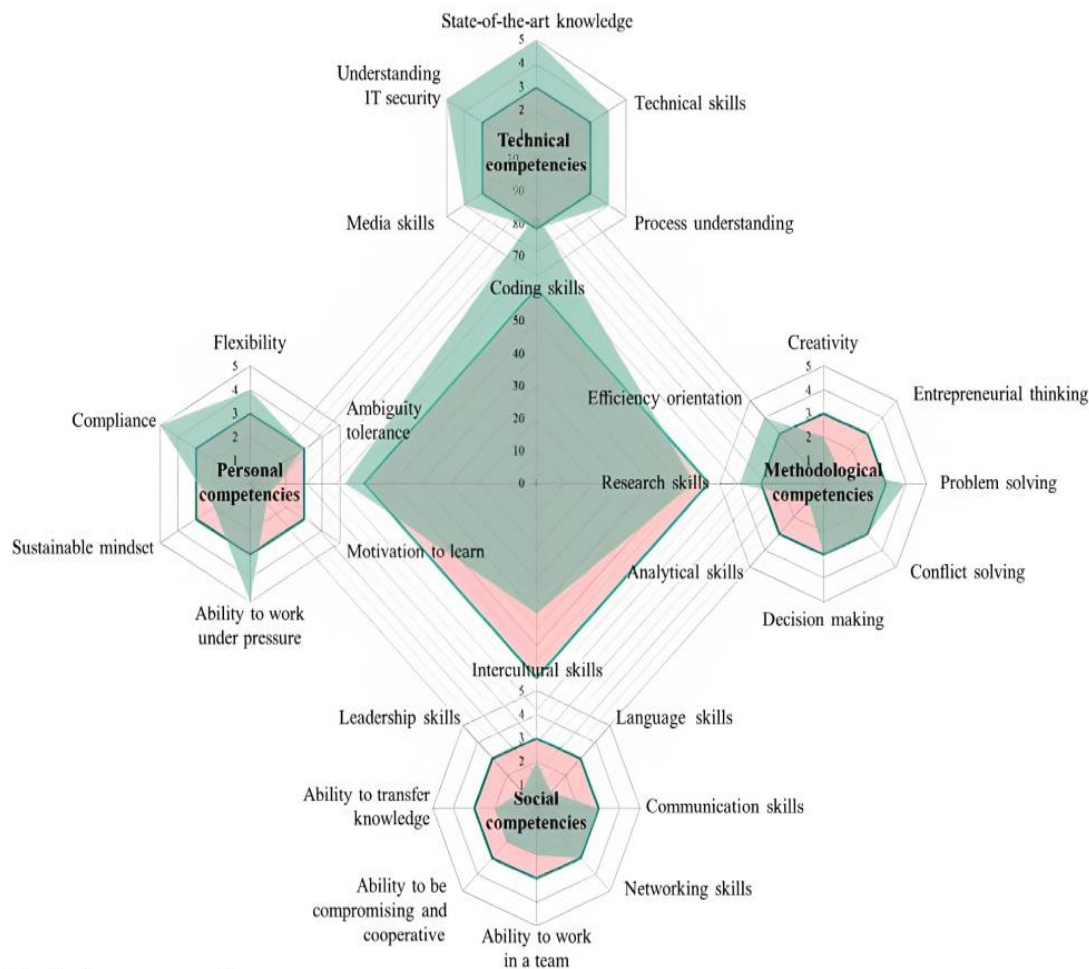
Radar charts, which are two-dimensional charts that depict multivariate data, are the conceptual foundation for the visualisation. Due to these characteristics, they are frequently used for gap studies, making them a simple tool to determine a competency model. Radar charts must include the following elements in order to visualise competence gaps: necessary competences, a scale, and a necessary scale value for each competency. The actual measured value will also be depicted in the radar chart together with those other elements. This also makes it possible to calculate the difference between the necessary and actual levels of competence.

Since the most crucial skills for Industry 4.0 have already been determined, the following step involves defining a scale. There are five levels on a regularly used scale for determining competency levels, from nonexistence to an outstanding peculiarity (one to five). Since the competency levels needed for each work role vary, this process must be followed when the model is actually used.

This competence model's visualisation is unique in that it combines multiple radar charts into a single constructed radar chart, as seen in Figure 2. As a result, one radar chart was produced for each area of competency. These individual radar plots were then integrated to create a single aggregated radar chart. This type of visualisation makes it possible for the spectator to see general gaps at the level of the skill categories and further allows for a competency-level investigation. Competency categories are scaled on the basis of percentages in the inner radar chart.

The percent figure gives an average indication of an employee's level of qualification. across all competence categories by comparing the sum of measured competence level values for a category to the sum of highest possible values. Figure 2 depicts the competency model as it is conceptualised, together with an example employee evaluation. The categories that the competencies fall under are grouped together, and the red area represents the minimal competency level for each competency. The real competency level of the evaluated employee is indicated by the green area. Therefore, if the red area is visible at any time, there is a competency gap that must be filled with the aid of an effective qualification strategy.

Figure 2: Visualized competence model



Using the model for an employee readiness analysis

In general, the established model enables businesses to carry out a competency gap analysis for essential Industry 4.0 competencies. The offered competencies are too precise to be applied to the entire workforce, hence the tool is intended to evaluate specific people. Additionally, it should be remembered that an experienced individual should conduct employee evaluations in order to reduce biases and produce reliable results.

The competencies of the model must first be weighted in accordance with the department or job profile of the employee being evaluated. The model, as mentioned previously, identifies the key abilities for Industry 4.0, but each job profile calls for a somewhat different degree of advancement in each competency. As a result, it is necessary to modify the required scale value for each unique skill.

Second, it is possible to start the employee's evaluation. The use of standardised competency assessment, such as through surveys or monitoring activities, is therefore recommended for experts. The competence model has to be updated with the results after further compilation.

The model will identify any current competency gaps once all needs have been stated and every employee's competencies have been assessed. That shows how prepared a worker is for his job in Industry 4.0. Furthermore, it is possible to identify the most significant gaps immediately. Human resource development needs to give priority to these talents. The typical visualisation of the competency model in Figure 2 demonstrates how, for instance, social competencies are not fully developed. It becomes evident that relatively few of the competencies in that category are at the required level when you look at each one in turn. The combined radar graphic also suggests that leadership and communication skills are the least developed and require quick attention.

Defining tailored qualification strategies

Qualification techniques must be created in order to close previously discovered gaps. Since those identify the biggest weak spots for an employee to deal with challenges in Industry 4.0, the focus should be placed first on the biggest competence gaps. Typically, qualification strategies include a variety of techniques and methods,

including education and training, to develop particular competencies. Because of this, a corporation must specify in advance the steps that will be taken once an employee falls short of the necessary scale level for a skill. In light of this logic, the competence model might quickly suggest to a worker the appropriate training.

Conclusion and vision

A thorough list of necessary skills for the job in a linked and digital environment was developed in the first section of this contribution. The specified competencies are becoming increasingly significant and demand attention from human resource development even though each position has varied requirements. Additionally, all identified competencies were visualised in an aggregate radar chart that made it simple for the user to comprehend the demands placed on each competency. The general application approach for the competency model was briefly covered in the second section of this study. It was shown how the model may be applied to assess and improve a worker's capacity to handle new challenges.

The creation of unique job profiles and the incorporation of various qualification processes for the competencies used in the competency model should be the main areas of future study. The model will help to increase the speed and agility of filling in competency gaps.

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