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Artificial Intelligence – Qualification and Competence Development Requirements for Executives

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Abstract

When companies increasingly use artificial intelligence (AI), this changes the world of work and, in particular, the way people and technology work together and divide up their work. Because with the help of AI systems, even cognitively demanding activities can be automated. For example, AI can support executives in their leadership tasks and partially take over administrative coordination and control tasks. Workflows and processes must be redesigned or at least adapted accordingly. This scientific article provides an overview of the necessary changes and presents suitable tools for well-structured change management that is oriented toward human-centered work design and takes AI-specific design criteria into account. Furthermore, the article presents a qualification concept, which helps executives to develop, implement and establish AI applications in a socio-technical and human-oriented manner. With the help of this concept, executives and users of AI, for example, will be able to acquire the necessary competencies. In this context, the results of the practical evaluation of the concept will also be presented.

Keywords: Artificial intelligence; change management; leadership; qualification

1. A changing world of work

The legal, economic and technological framework conditions for companies are constantly changing. In the field of organizational and economic research, the term VUCA has become established for this: Framework conditions for

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companies are volatile, uncertain, complex and ambiguous [1]. The answer to VUCA is again VUCA. Thus, companies can respond appropriately to these four factors by developing a vision, understanding the framework conditions, developing clear solutions and implementing them in an agile manner [2]. In relation to the innovation technology AI, this means that companies should learn to deal with increasingly complex software systems and ever greater volumes of data [3].

However, permanently changing framework conditions and companies adapting to them are nothing new. If we look at technological developments from the first to the fourth industrial revolution, we see that companies have always been confronted with major changes [4]. Industrial and technological change therefore appears to be a current constant that companies have to deal with [5]. Parallel to the technological developments, the world of work also changed, insofar as technology was used more and more extensively for the energetic and informational support of human work. The so-called World of Work 4.0 is currently still characterized by networked digitization as well as flexibilization of work organization [6].

The next stage of development, the World of Work 5.0, in which AI is clearly and distinctly used, is characterized by a very intensive cooperation between people and technology in the form of e.g. intelligent assistance, learning robots or user-optimized information [7].

2. Artificial intelligence in the world of work

In the course of the World of Work 4.0 and the advancing digitalization in industry as well as many other sectors, through the intelligent networking of various IT systems and through the use of networked cyber-physical systems, comprehensive data streams are accumulating that can be combined for a wide variety of "intelligent" analyses [8]. The resulting data volumes can be systematically analyzed with the aid of appropriate techniques for the purpose of process or product innovation and the development of new business models (see f.i. [9] and [10]). With the World of Work 4.0, a central prerequisite has been created, so to speak, for artificial intelligence to be used and applied in operational processes and to open up additional automation potential here [11] and [12]. AI technologies are to be understood as methods and procedures that enable technical systems to perceive their environment, to work out what they perceive, and to solve problems independently, to make decisions and to learn from the consequences of these decisions and actions. The currently very prominently discussed AI term essentially refers to machine learning, for example deep learning with artificial neural networks. AI captures, stores, processes, and interprets data, but unlike conventional software applications, it can adapt dynamically to changing data through a training phase [13].

Such AI technologies can be used in many application areas and intelligently automate processes and activities, for example:

- in material procurement, to identify potential savings [14],
- in production, to plan and carry out the maintenance and repair of machines and systems proactively and as required [15], or
- in order to carry out autonomous and dynamically adapted quality control, for example with image recognition [16],
- in marketing and sales, to analyze the usage behavior of customers [17],
- in the financial sector, to automatically recognize documents, automate payment transactions, or support loan decisions [18], and finally
- in human resources to support the selection of suitable applicants based on objective factors [19].

3. Requirements for executives

AI already has the potential to change humans work holistically and individually. This can result in new areas of responsibility as well as new forms of work. The implementation of AI has an impact on the work of executives in many respects. From a practical point of view, AI often corresponds to a leadership topic. This is shown by the study "Künstliche Intelligenz in Unternehmen" (engl. "Artificial Intelligence in companies") of the IU International University of Applied Sciences (IUBH), which surveyed more than 500 people with and without leadership responsibility. According to the results, it is primarily the middle or lower management level as well as the executive board that are concerned with AI. The middle management level achieved the highest result with 71.8 percent [20].

During the implementation of AI, executives are confronted with comprehensive requirements. They are responsible for shaping the framework conditions of the introduction process. For the implementation of AI, companies require supporting instruments.

These are being developed during the research projects humAIn work lab and en[AI]ble. A practical guide for executives as well as an AI qualification programme will be developed. They consider the practical requirements of the involved stakeholders. During the implementation of AI, executives and leadership are essential. Executives are responsible for shaping the entire change process. They are both, facilitators of the employees and multiplicators of AI. In addition, they also have the responsibility for the whole project (Figure 1).

Fig. 1. Roles of executives during the implementation and application of artificial intelligence [21].

In their functions, executives are confronted with several different requirements. Qualification and the development of competences results in comprehensive requirements for executives. In addition to executives, employees, as future users of AI, also need to have essential competencies. It is the task of executives to support this process of competence development.

4. Core competencies: Industrial engineering and change management

For most executives and employees, the focus of their extended competencies should not be on specialized technological knowledge, but on imparting AI knowledge in socio-technical contexts, sharing experiences about process and work design, and project competence. General AI knowledge in this context means that executives and employees have evaluation criteria that enable them to recognize developments related to AI, to perceive opportunities and dangers of AI, and to use AI in their operations in a way that is both humane and economical.

Guiding criteria for handling data and for process design include data sovereignty, transparency and explainability. "Data sovereignty" is understood to mean, for example, that an employee who uses and applies AI software knows what happens to the data collected and consents to its use. "Transparency" refers to the characteristic that the actions and functions of the AI software are traceable. The requirement for maximum transparency is often not fully achievable because many models are so complex that users of AI cannot see through the processes. This is precisely where the third criterion comes in, "explainability." The company needs the competence to explain regularities, processes and their backgrounds and thus to get all stakeholders "on board". Companies and individuals should be able to develop an awareness of how AI works and how data is used. This does not require in-depth IT knowledge. Mastering this skill will be an important task in dealing with AI [22].

How AI is used depends to a large extent on what knowledge executives and employees have about AI and how wisely and with foresight they use and shape the new possibilities. In doing so, it is important to maintain a balance between the requirements of technology, economic efficiency and people [22]. Here it also becomes clear how important, in addition to technological competencies, the competencies of work design and change management of the executives and employees are. This should be the focus of further training in companies.

It is important that the qualification programs include basic training to build up competencies. The basics of IT, data and AI can be developed within these programs. The basic principles of digitization and data processing must also be taught in order to understand interrelationships. This knowledge is important for both executives and employees. For example, learning platforms with short videos can help here. At the same time, executives should explore the possibility of taking excursions to the AI manufacturer together with their employees. In this way, executives and employees can come in touch with AI before it is introduced in their own company. This will increase acceptance and help to prevent fears about losing jobs. Bringing AI to life can often reduce the fears of future users. Acceptance and participation are elementary success factors here. Acceptance in particular can be achieved through appropriate qualification.

5. Qualification concept for the work design in AI

In the project en[AI]ble a qualification concept was developed (Figure 2) in an iterative process and tested and adapted with participants from various target groups (SMEs, intermediaries and works councils).

5.1. What is artificial intelligence?

The first module of the qualification concept lays the foundation for identifying and evaluating artificial intelligence. The initial aim is to provide an understanding of the special features of AI compared to conventional digitization. The key innovation in artificial intelligence lies in its ability to learn. Arthur Samuel, a U.S. computer scientist and pioneer in the field of AI, already stated in 1959: "Machine learning is the ability of a computer to learn without being explicitly programmed" [23].

In classical programming, algorithms are used that process a problem according to strictly predefined, programmed-in rules. Artificial intelligence, on the other hand, uses learning algorithms that are able to autonomously determine the most appropriate measures to achieve a given goal within the framework of a given task. Data-based training takes the place of programming fixed rules in AI. This is linked to the processing of an enormous amount of data at high speed, which is done using methods from mathematics and often on the basis of probability calculation. In this way, AI technology achieves results in the recognition of patterns as well as the identification of data-based correlations that are far beyond the reach of human capacities.

Artificial intelligence and human intelligence are very different from each other. AI has neither consciousness nor motivations and is limited in its mode of operation to the task area assigned to it by humans. Humanizing the technology is therefore not appropriate, because much work still needs to be done before a superintelligence can be achieved. The performance potential of artificial intelligence today can be soberly and succinctly characterized as follows:

- Assuming fast computers and large computing capacities, AI can evaluate the constantly growing volume of big data volumes in a way that is not possible for us humans.
- The world of AI is digital: ones and zeros. What cannot be modeled mathematically and ported to computers, an AI cannot do.
- AI is specific, i.e., related to a particular application area. AI cannot transfer what it learns from one domain to other domains.
- However, linking several specific AI applications to form AI systems opens up complex application possibilities.

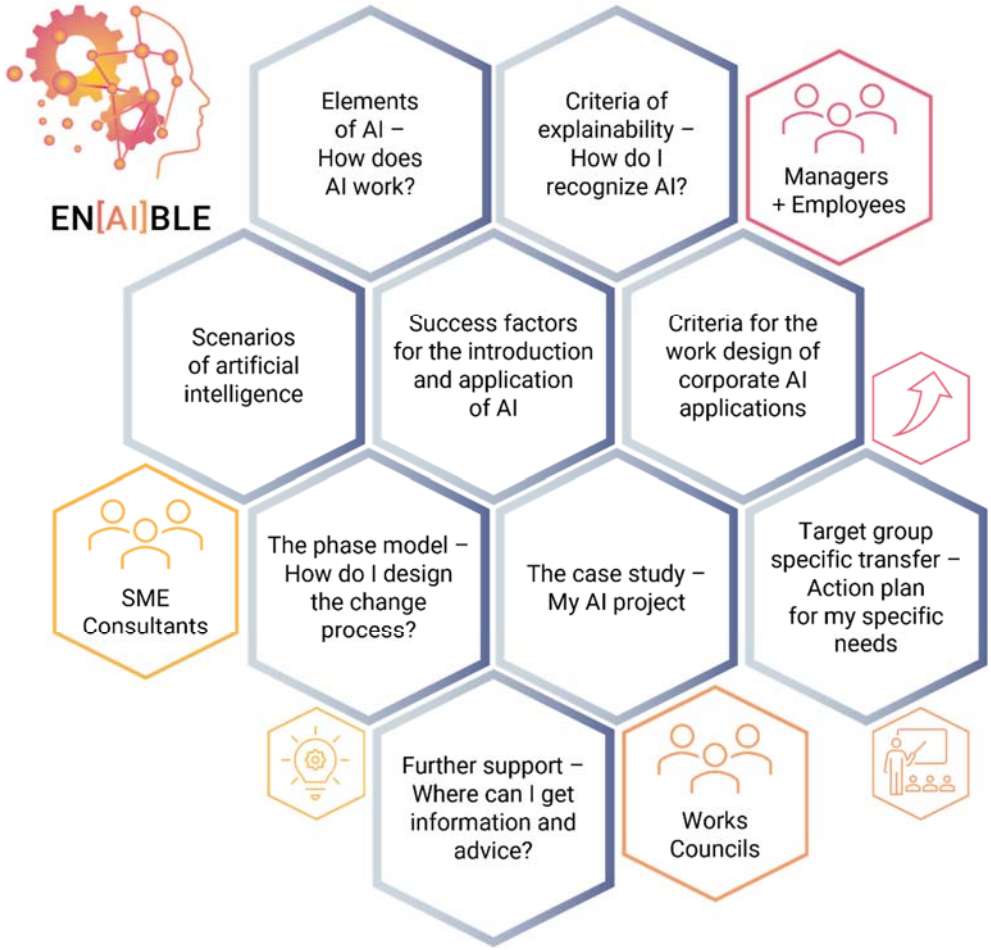

Fig. 2. Training contents and participant target groups of the training offer developed in the research project en[AI]ble.

5.2. "Explainability" – a core requirement for AI applications.

Despite the wide range of possible uses of AI, there is one fundamental requirement common to all applications for the design of all AI applications. In order for it to be controllable and to be used productively, in a way that is appropriate for people and complies with data protection requirements, its functionality must be comprehensible to the involved executives and employees. This is what the term "explainability" stands for in the technical discussion. If AI applications are used in operations, it must be clear,

- which sensors the respective AI system contains and which data is collected,
- where the data is stored,
- who has access to the data,
- how and for what purpose the collected data will be processed, and
- – this is where the specifics of AI come into play – how the AI learns.

Essentially, it is a matter of the involved executives and employees knowing on which data basis an AI functions and according to which learning methods it acts. This also creates the conditions for countering data protection risks and the dangers of third-party control.

5.3. AI solutions in medium-sized companies – participation pays off

After the module with basic information on the characteristics and functioning of AI, the second learning unit of the AI qualification course deals with how AI is applied "in the company". Using artificial intelligence successfully in a company places a wide range of demands on executives and employees. The en[AI]ble project team therefore developed guidelines and criteria that provide orientation for the introduction and application of AI.

The overall concept is socio-technically oriented. Socio-technical here means that aspects of economic efficiency, humane and healthy work, and also data protection and data security are considered holistically and form the guiding principles for the design of AI applications. In this context, as the en[AI]ble project team emphasizes, it is extremely important that executives and employees participate in the design of the technology. Particularly in small and medium-sized companies, it is expedient if all those involved, i.e. management, executives and employees, pull together. In this way, both the potential of AI can be exploited and precautions taken against the dangers posed by the technology. In the following, we will show you what this can look like in concrete terms.

Designing AI according to human-oriented manners

Like other technologies, AI holds not only opportunities to improve working conditions, but also dangers. For example, self-learning AI technology opens up new opportunities to control work and disempower those who have to work with it. For example, it may result in the devaluation of skills. As a result, many employees' worries about losing their jobs and status or their fears of being subjected to the machine in the future are not unfounded.

If you don't want to risk your company's AI projects failing at the outset, your employees must not be ignored when it comes to developing and introducing the technology. Otherwise, it could happen that an implemented AI application is not used for its intended purpose and even ends up as a disastrous investment. This risk can be avoided by informing and involving the employees at an early stage. If a works council exists in the company, its participation is required by law so that it can represent the interests of the employees. In addition to the legal aspects, there are other strong arguments in favor of employee participation in AI projects, which should be organized close to the workplace and on a departmental basis.

Because the technology is still largely uncharted territory for all company employees, executives, employees and works councils can only accept AI technology and work successfully with it if everyone understands and supports the objective of using the technology in their own company. This includes that those affected experience themselves as competent and confident in dealing with the AI application and are aware of the effects of an AI application on their working conditions and are able to help shape them.

Joining forces to get the AI solution off the ground

Continuous employee participation in the entire planning and implementation process will therefore also increase the economic benefits of AI projects. This is because a company's employees often have very concrete knowledge about their work processes and develop suggestions for improvement. This can be of great value both for the planning of AI projects and in pilot stages before the final system introduction. Employees' experiential knowledge and their ideas can be incorporated into the design of work with AI or even help to identify further fields of application for AI applications that tend not to come into view in a purely technical or economic view beyond work practice.

In order to include the views of all company employees on AI projects and the interests of employees in AI projects, it is advisable to form a project group. Its strength lies in the fact that participation takes place within the framework of a transparent and structured process that should encompass all steps in the design of the AI solution.

The composition of the project group should take into account all work areas involved in the AI project. Thus, in addition to managers, employees from the affected work and work areas in which an AI application is to be used should always be brought into the project team. They can contribute their practical knowledge from everyday work, know the work processes and are familiar with the specific interests and concerns of the employees.

In addition to the work of a project group, other concrete individual steps can be considered for the direct involvement of the employees concerned, i.e., in the planning of qualification measures, in consultation during pilot stages or in evaluation in the form of feedback on successes and problems. Depending on the occasion, it may make sense to run workshops with employees to develop needs-based design solutions for AI in the work areas.

Ultimately, three factors are essential for a successful AI introduction process: transparency, competence and participation. They form the breeding ground for acceptance of the new technology. And an active acceptance that is characterized by employees' committed involvement in innovations.

5.4. Evaluation of the qualification concept

Pre-testing with target groups

Pre-testing and test training sessions were held. Representatives of the project partner organizations participated in the pre-testing. Therefore, there was an open exchange between the course management and the participants regarding the character of the seminar, and in some cases the participants gave feedback on the form and content of the seminar. Representatives from SMEs and consulting organizations external to the project took part in the test training sessions.

The qualification concept was evaluated with the aid of a questionnaire-based quantitative survey. The participants were asked about the motivation, content and framework conditions of the training and their assessment of the successful communication of the benefits and planning and implementation process of AI. The specifics of the different target groups were taken into account in the questionnaire. The survey was conducted online following each test training session. From participants from SMEs 20 questionnaires were collected to be evaluated and from participants from consulting organizations 37 questionnaires were collected.

The company size of the participants in the test training courses is heterogeneous: 4 micro, 6 small, 3 medium, 7 large companies. Contrary to what has been shown in most studies [11], all participants, regardless of company size, attach high importance to AI and in most cases already use AI applications in the company. With the exception of two companies from the manufacturing sector, all companies are classified as belonging to the service sector.

Almost all participants from SMEs would like general training on the subject of AI in order to be able to evaluate the individual benefits and possible applications of AI for their own company. Half of the participants from SMEs would like support in dealing with AI, in establishing and implementing AI applications, and in designing concrete application fields. Only one participant wanted answers to questions relating to labor law.

Overall, the participants were satisfied with the scope and structure of the training. The general conditions (e.g., the organization and work materials) and the interactivity of the training (e.g., the form and content of the group work phases and the opportunity to share experiences with other seminar participants) were rated particularly well. Equally positive was the fact that the training took into account the level of knowledge of the participants and that seminar content and forms of presentation were adapted accordingly. This is particularly relevant because the learning success can be reduced if the participants are over- or underchallenged. Case studies and exercises based on real application examples were rated by the participants as rather useful and helpful.

The most important evaluation criterion from the project team's point of view was met during the test training sessions: Almost all participants stated that the benefits of AI for their company became clear during the training. Only two participants felt that the benefits of AI were not clear or that they would have liked more examples and practical experience. The training helped all participants to better understand the planning and implementation process of AI. In general, it is about which steps are necessary to be able to successfully implement AI in the company. Among other things, this also includes being able to weigh up how and when colleagues should be involved in the process and how this can increase acceptance of AI. After the training, about half of the participants feel fully capable of initiating the planning and implementation of an AI application in their company, or at least of providing professional support; the other half feel more capable of doing so.

Measurement of performance and success

Ideally, the success of the en[AI]ble training should also manifest itself in the everyday lives of the companies and intermediary organizations. To this end, the impact of the training was examined in a final survey. The representatives of the companies and the intermediaries were interviewed on this topic by telephone or video call. The aim was to find out whether the training was able to give a boost to the use of AI, or possibly even helped with implementation. With regard to the consultants of the intermediary organizations, it was of particular interest to find out whether the training achieved gains in knowledge about AI and whether the training could contribute to AI now playing a greater role in their consulting work.

The vast majority of participating companies and intermediaries rated the training as good to very good overall, even about half a year after their participation: The expectations of the participants were met in most cases. The training thus enabled the participants to eliminate their knowledge deficits.

Nevertheless, it is clear to both groups that attending a single training is not sufficient for successful implementation of AI-based technologies. Both the intermediaries and the companies expressed the need for further training and information materials. In addition, they wished to have contact persons for their concerns in the follow-up to the training. The topic of AI is extraordinarily complex and can only touch on a few aspects in the context of a single training course.

The consultants not only benefited in terms of content from the teaching of new AI knowledge and AI potential, but they also learned new methods that they can integrate into their consulting activities. This added value could play a role in future exploitation of the qualification concept.

The training aimed to introduce companies, intermediary organizations and works councils to the topic of AI and to highlight possible implementations. This was successful with the company representatives insofar as they were sensitized to the topic of AI. For the consultants, the measure was suitable not only for raising awareness but also for planning and implementing initial AI projects.

In view of these results, the qualification concept developed by the en[AI]ble project team can be rated as successful overall. However, they also make it clear that the training should be seen as the start of a process in which important foundations are laid and participants are enabled to deal with the topic of AI.

6. Summary and Outlook

It is clear that AI will place far-reaching demands on the work of executives. The introduction is not trivial. Companies therefore need practical support. Based on the results of the research project humAIn work lab, the ifaa is developing a tool for executives. This tool is intended to support companies in the introduction of AI systems.

AI can change work activities in the company and thus also the required competence profiles of the employees. The company management should clarify for itself the criteria according to which AI is used in the company. It should communicate how AI will be integrated and thus make the effects on scope for action or workplace design transparent and reduce fears. A corresponding continuing education concept was developed in the research project en[AI]ble and is offered by the project partners to interested companies and organizations. Through the training program, executives and employees, as well as works councils and SME consultants, are trained to design AI in their organization in a productive and human-friendly way. The training is aimed in particular at work design in AI and the transformation and change process, which is very important in AI and which is not taken into account in most of the more technology-oriented training and consulting offers.

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