Transformation capability model for automotive suppliers

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***Abstract* — The automotive industry's transition to electromobility, marked by the replacement of traditional combustion engines with electric drives, significantly disrupts the existing product range of many companies. This transition is especially impactful in Germany, a major automotive hub employing about 786,000 people in 2021, where it's projected that around 21 percent of these jobs could be at risk by 2030. Therefore, there is an urgent need for German automotive suppliers to adapt to the evolving electromobility landscape, further intensified by concurrent trends like digitalization, work changes and sustainability. A notable gap in the current literature is the absence of a comprehensive capability model for these suppliers to manage this transformation effectively. This research aims to close this gap by identifying the essential transformation capabilities and developing a capability model, emphasizing 30 key capabilities clustered into superordinate dimensions and structured along the fields of action of human, technology and organization, the MTO approach.**

Keywords – transformation capabilities, automotive suppliers, electromobility, digitalization, sustainability, disruptive innovation

I. Introduction

The automotive sector is experiencing a transformation influenced by multiple simultaneous trends, necessitating substantial adaptations. The transition towards electrification, notably towards fully electric vehicles, is decreasing the demand for traditional combustion engines and transmissions, impacting manufacturers of these components significantly. In Germany, the automotive sector represents a pivotal industry, having contributed to the employment of approximately 786,000 individuals in 2021 [1]. The transition to electric vehicles is expected to jeopardize about 21 percent of jobs in the German automotive sector by 2030 [2]. This is particularly impactful for German automotive suppliers, 80 percent of whom are small and medium-sized businesses, most of which lack the know-how, financial means, and human resources to manage the transformation quickly and independently [3]. While the European Union is intensifying sustainability regulations and requiring companies to invest in renewable energy and eco-friendly materials in manufacturing processes [4], the digitalization of production and products also requires considerable investment and the development of new skills among the workforce [5], particularly evident in the evolving human-machine interface in robotics [6]. As a result, automotive suppliers are under considerable pressure to adapt their existing business models and are challenged to develop relevant organizational, technical, and human competencies to maintain long-term competitiveness.

The aim of this research is to identify and analyze key transformation capabilities essential for automotive suppliers to effectively manage these simultaneous trends. This study reviews existing literature on transformation capabilities using a systematic literature review approach and pinpoints the key capabilities identified. Those capabilities are then clustered into superordinate dimensions, which in turn are structured along the MTO fields of action in order to develop a model of transformation capabilities. The research is guided by the following two questions:

1. What are the key capabilities required for automotive suppliers to successfully transition in the face of electromobility, digitalization, work changes, and sustainability?
2. How can these capabilities be clustered and bundled along social, organizational and technical aspects?

II. Existing Theories & Previous Work

A. Transformation capabilities:

The concept of transformation, derived from the Latin "Transformatio," refers to the process of changing a subject from its current state to a new, predefined desired state [7]. As defined by Klasen [7], business transformation involves the strategic realignment and organizational transformation of a company or its components to sustainably secure its performance in the market.

Capabilities refer to individuals' cognitive abilities and skills for problem-solving, including the willingness and ability to adapt these skills in various situations [8]. In a corporate setting, capabilities are specific knowledge and skills that enable effective and efficient resource management [9]. Moreover, a company's "transformational capability" refers to its proficiency in initiating change and adjusting processes to align with external market changes or fluctuations in demand. They allow individuals to recognize societal challenges, devise innovative solutions, and convince others of these solutions, essential for driving transformation and staying competitive in dynamic markets [10]. When defining transformation capabilities, it is vital to consider the concept of "dynamic capabilities", as defined by Teece et al. [11]. Dynamic capabilities are the abilities of a company to integrate, build, and reconfigure internal and external capabilities and resources in response to environmental changes [11]. Subsequently, Teece [12] classifies dynamic capabilities into three categories: Sensing (identifying opportunities and threats), Seizing (capitalizing on opportunities), and Transformational (enhancing and reconfiguring resources to maintain competitiveness).

B. Transformation capability model

The 23 papers identified in the systematic literature review focus predominantly on one sub-trend; no paper examines all

trends combined with a focus on the automotive supply industry. Blumberg and Kauffeld [13] and Rost et al. [14] analyze and outline the changing nature of tasks as a result of Industry 4.0 and the associated employee skills required, such as specialist knowledge, willingness to learn and holistic thinking, while largely ignoring organizational and technical capabilities. Jerman et al. [15], on the other hand, focus on highlighting key competencies for smart factories in production processes in the automotive industry, neglecting other sub-trends, such as sustainability. Višković et al. [16] highlight the areas of technological innovation, such as big data, artificial intelligence and renewable energy, that should be focused on in order to simplify the electrification process in the automotive industry. Narkar and Naik [17], by contrast, outline strategies on how automotive suppliers can position themselves in the future in order to effectively manage various risks associated with the transition to electromobility.

While a few papers demonstrate innovation capabilities to manage change in the face of disruptive trends in the automotive industry, they mainly examine the effect of innovation capabilities on organizational performance and supplier-buyer relationship and do not focus on highlighting transformation capabilities [18–20]. Müller and Pfleger [21] focus on the sustainability trend and highlight sustainability activities for companies without mentioning required capabilities. Additional sources from a Google search include company studies and white papers from management consultancies that deal with the transition to electromobility in the German automotive industry and partly reveal technical, organizational, and human capabilities [3, 22, 2, 23]

Overall, there is a significant research gap of transformation capability models for automotive suppliers, covering and bundling capabilities needed for the electromobility, digitalization, workplace, and sustainability transformation. While most papers highlight relevant capabilities of different subtrends or thematic complexes within the automotive industry, there is a lack of models summarizing transformation capabilities to cope with dynamic market development.

The paper aims to close this gap by developing a transformation capability model for the automotive supply industry that is both practical and applicable.

III. Methods / Research Approach

A systematic literature review was employed to identify key transformation capabilities relating to people, technology, and organization. The literature review process is based on the PRISMA method (Preferred reporting items for systematic reviews and meta-analyses), which is divided into four phases: identification, pre-selection, eligibility check and final inclusion, using targeted keyword searches as well as forward and backward searches to systematically find relevant papers [24]. Key databases including Google Scholar, ScienceDirect, and IEEE Xplore were investigated using the search string: TITLE(supplier AND capabilities OR capability OR ability OR abilities AND automotive OR automobile OR electromobility OR electrification OR digitalization OR sustainability). Furthermore, German sources were considered, specifically addressing the German market, thus aligning with the paper's target audience.

After excluding pre-2018 publications and duplicates, nine papers were initially selected for detailed review. The forward and backward searches led to the discovery of five additional papers. To ensure the practical relevance and applicability of the final transformation capability model, a Google search was conducted, which revealed an additional nine sources, resulting in a total of 23 papers being included in the analysis (see figure 1).

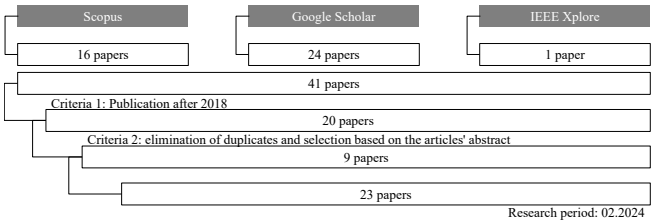

Fig. 1. Systematic literature review results (own visualization)

The MTO concept serves as a framework for clustering the relevant transformation capabilities of the model into fields of action. The MTO concept is a sociotechnical analysis method for the holistic examination and design of work processes. It aligns and interrelates aspects of human (M), technology (T), and organization (O), needed to create efficient and productive work environments and optimize employee qualifications. Furthermore, it encompasses a multifaceted perspective on the prerequisites for achieving a successful transformation. This includes the way new technologies reshape organizational processes, work tasks, and interpersonal collaboration, which in turn necessitates the development of new skills and qualifications for employees [25].

IV. Findings

A. Collected data

A total of 23 sources were analyzed as a result of the systematic literature review, including 14 scientific papers and 9 Google search business studies. The analysis of the sources resulted in a total of 30 capabilities (see table 1), which are highlighted in italic and described below. For the sake of simplicity, the capabilities were grouped into superordinate categories, which are also used to provide structure in the final transformation capability model.

B. Analysis of collected data

Management and leadership:

Leadership competencies are crucial elements in the process of transformation. Middle management has the responsibility to identify and nurture these innovation drivers at the operational level. Simultaneously, top management must exemplify a culture of change and a readiness to learn, while creating the necessary space for these activities. They need to be capable of partially relinquishing control and allowing for bottom-up innovations [26]. Therefore, the active support of the highest level of leadership, known as *top management commitment*, is acknowledged as a vital skill for the successful implementation and achievement of transformation initiatives in general.

A vital aspect of any transformation is *readiness for change and motivation*. Change readiness involves curiosity, openness to new ideas, self-initiative, and a willingness to learn, leading to updates and changes in one's behavior and knowledge [13]. Especially in the rather conservative automotive supply industry, it is crucial to encourage changes in culture and mindset at senior and management level. Several major suppliers have already initiated change programs or reinforcing actions aimed at cultivating a culture that supports ag-

ile working methods throughout the organization. Key initiatives include employee events and workshops to build a sense of community and foster collective commitment [23].

TABLE I. DESCRIPTION OF TRANSFORMATION CAPABILITIES (OWN VISUALIZATION)

Transformation capability [source]	Description of capability
Top-management commitment [26]	Determined commitment of top management to actively lead and support change.
Readiness for change and motivation [13, 23]	Willingness and drive to actively shape and implement change
Self-organization [14, 27]	Ability and initiative to structure and carry out work independently
Interdisciplinary collaboration [28]	Cooperative work among specialists from diverse disciplines to solve complex problems
Involvement of employees [23]	Active involvement of the workforce in decision-making processes and transformation projects
Personnel development [23]	Systematic promotion and further training of employees to equip them with future-oriented skills and knowledge
Technical skills [15]	Specialized knowledge and skills in handling technological equipment and processes
Soft skills [15]	Interpersonal and personal skills that promote cooperation and communication
Innovation skills and creativity [15]	The ability to generate and implement new ideas
Openness to learning [15]	Employees' willingness to acquire and accept new knowledge and skills
Product portfolio adjustment [18]	Strategic revision and optimization of the product portfolio to meet market and customer requirements
Product standardization and modularization [29]	Application of uniform standards and modular components to increase production efficiency and flexibility
Entering new markets [17]	Expansion of a company into new geographical or product-related markets
Digitalization of production [30]	Integration of digital technologies in manufacturing processes to increase efficiency and flexibility
Production automation [20, 30]	Use of technologies for the autonomous control and execution of manufacturing processes

Employees:

Without granting autonomy and opportunities for change at the operational level, ideas and concepts may remain undeveloped or unexpressed [27]. Employees must be able to act independently and organize themselves in dynamic situations [14]. For this reason, the ability of *self-organization* is included. Cross-functionality, specifically in terms of *interdisciplinary collaboration*, has been recognized as a crucial element concerning transformational maturity. Interdisciplinary teams can contribute to enhanced agility, quicker decision-making, and higher customer centricity, among various other advantages [28].

One essential action at the onset of a transformation journey is securing early *involvement of employees* and encouraging *personnel development*. Personnel development is crucial to ensuring that the existing staff possesses the necessary skills and knowledge to adapt to new technologies, processes, and market conditions. Through specific training and development programs, employees can enhance their abilities, contributing to the company's innovation and competitive edge. Investing in staff development significantly enhances readiness for change and motivation, as well as employee involvement, leading to higher productivity and job satisfaction [23]. Employee-related highly demanded and future-oriented competencies are *technical skills*, including technical knowledge related to mechanical engineering, electronics, or programming, as well as *soft skills* such as analytical thinking, linguistic skills, flexibility and openness to change. In the context of flexibility and openness to change, *innovation skills and creativity* are becoming particularly relevant as repetitive, routine, and physical tasks decrease because of digitalization. Linked to this is the ability of *openness to learning*, which will be indispensable in the context of smart manufacturing characterized by continuous digital information flow and human machine interaction [15].

TABLE I. (CONTINUED)

Transformation capability [source]	Description of capability
Process optimization [20, 30]	Systematic enhancement of manufacturing processes to increase efficiency and quality
Closed-loop circular system [17, 21]	A sustainable business model involving the reuse of resources and minimization of waste by returning products to the production cycle at the end of their life cycle
Sustainable sourcing practices [17, 21, 31]	Procurement of materials taking into account ecological, social and economic criteria in order to promote responsible consumption and production long-term
Renewable energy sources [21]	Use of natural, renewable sources of energy such as the sun and wind for a sustainable energy supply.
Decarbonization strategy [21]	Plan to systematically reduce carbon dioxide emissions in processes, products or organization in order to combat climate change
Transparent communication of strategies and objectives [22, 26]	Open and clear exchange about corporate strategies and objectives with all relevant stakeholders
Strategic target picture [33]	A clear roadmap of the desired state or result of the transformation that an organization wants to achieve within a fixed time frame
Need for transformation [23]	Recognizing the need for fundamental change in an organization's structures, processes or cultures
Securing financing [16, 22, 34]	Obtaining the necessary means or resources to support and implement transformation processes in an organization
Network of partners [16, 19, 22, 30, 34]	Collaboration between different actors who share their resources, skills and knowledge to achieve common goals
Project and resource management [35]	Strategic planning, organization and management of projects and resources in order to achieve transformation objectives efficiently
Digitalizing internal processes [36, 37]	Transforming traditional, manual processes into automated, digital processes to increase efficiency and effectiveness
R&D [30]	Systematic analysis of internal and external environments to gain new knowledge and use it to develop new products, processes or services
Digital assistance systems [14, 38]	Technological applications that support users in their daily tasks and decisions and in familiarizing themselves with new processes through automated functions and information
Documenting internal knowlege [18, 39]	Capturing, storing and sharing company-specific, employee-related know-how and information for future use and long-term retention

Products and markets:

Automotive suppliers, particularly those with product portfolios vulnerable to industry disruptions, such as internal combustion engine powertrain components, are increasingly required to *adjust their product portfolio* in order to respond to customer needs and retain existing as well as add new customers to remain competitive long-term [18]. Moreover, *product standardization and modularization* will play a more crucial role in managing the increased product complexity, as highlighted by Nicoletti et al. [29].

Vulnerable suppliers should also consider *entering new markets*. The transition to electrification is progressing more slowly in developing Arabic and Asian countries compared to Western nations, largely due to the reliance on abundant coal and oil reserves for electricity generation and the slow development of e-mobility infrastructure. These markets present a significant opportunity for powertrain players to establish

their existing products and expand their market share elsewhere [17].

Production:

The *digitalization of production* is a crucial future capability for generating long-term competitiveness through flexibility and resilience. The trend is even moving towards the development of smart factories, in which the production steps are simulated virtually. In these factories, generative artificial intelligence enables machines to autonomously learn from data, identify when maintenance is needed, and create innovative solutions. This advancement necessitates the flawless integration of diverse technologies, ensuring that machines, tools, and products are interconnected and communicate via computer chips and sensors [30]. Concurrently, enhancing *production automation* and *process optimization*, which includes adopting LEAN principles, smart inventory management and arranging machinery for optimal process flow, further refines production workflows. These capabilities not only optimize production processes but also reduce downtime and boost efficiency [30]. In view of sustainability challenges, modern digital technologies and processes in production, such as pollution prevention technologies, further contribute to the elimination or avoidance of environmental damage [20].

Sustainability:

There is a growing demand from both legislation and consumers for sustainable products, especially those that contribute to CO2 emission reductions in the industry. To meet the challenges posed by stricter environmental regulations, traditional automotive suppliers must focus on creating efficient and circular products in the coming years [17]. Hence, another key capability is the retention of resources within *closed-loop circular systems*, significantly contributing to the conservation of resources. This also involves adopting *sustainable sourcing practices*, which includes choosing renewable or environmentally friendly materials and partnering with suppliers who are committed to fair labor conditions and ecological sustainability [21]. The Supply Chain Due Diligence Act in Germany further mandates that companies take responsibility for upholding human rights in global supply chains [31].

In the context of anthropogenic climate change, the imperative for sustainable practices is increasingly critical, particularly within the manufacturing sector characterized by substantial resource and energy demands. This sector contributed approximately 20 percent to global carbon dioxide emissions in 2021 when accounting for energy consumption [32]. Consequently, the adoption of a *decarbonization strategy*, coupled with the integration of *renewable energy sources* in manufacturing processes, emerges as pivotal sustainability interventions for automotive suppliers [21].

Transformation readiness:

Another important measure at the beginning of a transformation journey is fostering trust by *transparently communicating strategies and objectives* to both decision-making bodies and the workforce. Effective communication can help overcome negative attitudes and doubts, thereby smoothing the path for the transformation process [26]. It is recommended to openly frame the upcoming changes as a shared challenge, and to actively seek, from the very beginning of the transformation, a common approach to address or lessen the adverse effects on employees affected by the organizational change [22].

Accordingly, it is essential to establish a *strategic target picture* first. Crafting an effective target picture necessitates a comprehensive evaluation of both internal and external factors: To fulfill the target objectives, an organization must ensure its internal flexibility and capacity in terms of employee availability and expertise, as well as resource availability and financial health. Internally, the strategy might focus on leveraging digital technology to refine core business processes, guarantee resource availability, and boost efficiency [33]. Externally, the transformation strategy needs to address the various disruptions in the automotive sector, such as autonomy, connectivity, electrification, shared mobility, and sustainability concerns. This involves anticipating market trends, understanding shifts in customer needs and behaviors, and exploring new methods of customer engagement. Traditionally, suppliers have engaged in B2B sales with OEMs, but now there is an opportunity to directly engage with end-users. This could involve offering extended warranties for components made by the supplier or engaging in service solutions [23]. Thus, the ability to define a target picture is preceded by the ability to recognize the *need for transformation*.

However, essential for any successful transformation is the availability of financial resources. Small and medium-sized automotive suppliers, in particular, largely depend on bank loans for financing [16], making the ability to access external capital a key capability, identified as *securing financing.* In case financial resources are constrained and internal R&D capabilities are insufficient, establishing close academic and business collaborations becomes particularly advantageous [16]. Engaging in project collaborations, mergers and acquisitions, joint ventures, or strategic alliances proves effective in pooling the necessary expertise for component development, decarbonization, or market entry, while also facilitating cost reductions [22, 34]. It is essential to have a robust *network of partners,* equipped with skills and technologies that enhance and complement one's own offerings, to create and propel new business models [30]. Partnerships are a valuable part of a transformation as they can supplement missing resources to develop new products or enter new markets, promote a trend- and market-oriented corporate culture and innovation capabilities, and expand access to knowledge and resources. Such partnerships strengthen collective performance and support an ecosystem that encourages sustainability and innovation [19].

A successful transformation also requires established *project and resource management*, which means that resources, such as time, personnel, and budget, are dedicated to executing transformation projects, with project management being a central coordination function within these projects [35]. *Digitalizing internal processes* is essential nowadays in order to minimize the use of resources in everyday operations, enhance efficiency in workflows, and facilitate company-wide communication and collaboration [36]. As the number of interconnected consumers, factories, vehicles, and supply chains grows, so does the generation of vast amounts of data. Automotive suppliers are tasked with harnessing this data to enhance company-wide transparency and utility. To achieve this, they must implement a range of technological solutions aimed at supporting business operations [37]. By gathering and analyzing this data, suppliers can mitigate business risks and increase their adaptability.

Knowledge management:

Embedding *research and development (R&D)* deeply within the organization is crucial to ensure that investments in research and continuous innovation are given the priority they require [30]. In addition, *digital assistance systems* are becoming increasingly significant when it comes to introducing new processes and creating a learning-friendly working environment. These systems empower staff by providing quick access to pertinent information, enabling them to adapt to new processes and workflows more rapidly and effectively [14]. They not only assist in managing daily tasks but also enhance decision-making through provided analyses and recommendations. Such systems play a crucial role in simplifying the transformation experience for employees and enhancing the acceptance of new technologies within the organization [38]. In this context, systematically capturing and *documenting internal knowledge* to ensure continuous learning and development is vital [18]. This ensures that valuable corporate knowledge, established processes, and best practices are retained and made accessible to others. It acts as a reference for employees, reducing uncertainties and easing the integration of new team members [39].

C. Discussion

In the first step, the identified capabilities were categorized into thematic main categories in order to bundle them and thus provide a better overview. The main categories formed were "management and leadership", "employees", "products and markets "production", "sustainability", "transformation readiness"and "knowledge management". The categorization of the skills into main categories is shown in table 2.

TABLE II. CATEGORIZED TRANSFORMATION CAPABILITIES (OWN VISUALIZATION)

Top category	Transformation capabilities
Management and leadership	1.) top-management commitment 2.) readiness for change and motivation
Employees	3.) self-organization 4.) interdisciplinary collaboration 5.) involvement of employees 6.) personnel development 7.) technical skills 8.) soft skills 9.) innovation skills and creativity 10.) openness to learning
Products and markets	11.) product portfolio adjustment 12.) product standardization and modularization 13.) Entering new markets
Production	14.) digitalization of production 15.) production automation 16.) process optimization
Sustainability	17.) closed-loop circular system 18.) sustainable sourcing practices 19.) renewable energy sources 20.) decarbonization strategy
Transformation readiness	21.) transparent communication of strategies and objectives 22.) strategic target picture 23.) need for transformation 24.) securing financing 25.) network of partners 26.) project and resource management 27.) digitalizing internal processes
Knowledge management	28.) R&D 29.) digital assistance systems 30.) documenting internal knowlege

Subsequently, the categorized transformation capabilities were further structured along the action fields of human, technology, and organization according to the MTO concept. All capabilities that directly relate to human collaboration, the behaviors of employees and leadership dynamics, were assigned to the human action field. Capabilities related to production, encompassing the modification of processes and workflows, as well as the development of new components, were categorized under the technology domain. Finally, capabilities that are organization-centric, influencing strategic direction, financial management, and operational processes, were allocated to the organization domain. The final transformation capability model, comprising 30 transformation capabilities, 7 top categories, and 3 action fields, is now established. This final model is depicted in table 3.

TABLE III. FINAL TRANSFORMATION CAPABILITY MODEL (OWN VISUALIZATION)

Action field	Top category	Transformation capabilities
Human	**Management and leadership**	1.) top-management commitment 2.) readiness for change and motivation
	Employees	3.) self-organization 4.) interdisciplinary collaboration 5.) involvement of employees 6.) personnel development 7.) technical skills 8.) soft skills 9.) innovation skills and creativity 10.) openness to learning
Technology	**Products and markets**	11.) product portfolio adjustment 12.) product standardization and modularization 13.) Entering new markets
	Production	14.) digitalization of production 15.) production automation 16.) process optimization
Organization	**Sustainability**	17.) closed-loop circular system 18.) sustainable sourcing practices 19.) renewable energy sources 20.) decarbonization strategy
	Transformation readiness	21.) transparent communication of strategies and objectives 22.) strategic target picture 23.) need for transformation 24.) securing financing 25.) network of partners 26.) project and resource management 27.) digitalizing internal processes
	Knowledge management	28.) R&D 29.) digital assistance systems 30.) documenting internal knowlege

The next phase involves evolving the capability model into a maturity model, which is not included in the scope of this paper. The finished transformation capability model aggregates the most essential skills that automotive suppliers must possess in response to current disruptions in areas such as electromobility, digitalization, work changes, and sustainability, to successfully manage the transformation.

V. CONCLUSION

A. Limitations

This research paper has certain limitations. Notably, the literature review, due to a scarcity of relevant scholarly sources on this contemporary topic, includes sources that focus on individual trends like digital transformation. To maintain practical relevance and applicability, it also drew upon non-academic business studies, which compromises the paper's academic rigor. In addition, the model is currently being validated with stakeholders in the automotive supply industry in order to test and validate its practical relevance.

Furthermore, this transformation capability model tackles numerous concurrent trends associated with the transition to electric mobility, thereby covering more general capabilities that cater to the needs of these various trends, without providing an in-depth coverage of each individual trend.

B. Concluding remarks

In conclusion, the transformation process in the automotive supply industry is complex and demands a holistic approach that integrates a variety of capabilities and strategies. Leadership skills are essential for promoting a culture of innovation and change. This involves fostering innovation at the operational level, embodying a culture of change, and encouraging bottom-up innovations. Key capabilities for successful transformation include readiness for change, employee motivation, and organizational preparedness. These are particularly crucial in the traditionally conservative automotive supply industry, where changes in culture and mindset are imperative. Early involvement of employees and transparent communication of strategies are vital for tackling the challenges of organizational change among all levels. Establishing a clear strategic target picture that accounts for both internal and external factors is essential for steering the transformation process. For automotive suppliers, particularly those vulnerable to industry disruptions, it is critical to adapt product portfolios and venture into new markets. Securing funding and forming innovation partnerships are the assisting components for successful transformation implementation. Moreover, personnel development initiatives are crucial to ensure that existing employees are equipped with the necessary skills and knowledge. Digitalizing internal processes and operations are needed to enhance adaptability and efficiency. Utilizing data for company-wide transparency and effectiveness, implementing assistance systems for employees, and preserving internal knowledge are also imperative in times of digitalization. Moreover, adopting sustainable manufacturing practices and decarbonization strategies are vital in response to anthropogenic climate change, ensuring long-term industrial competitiveness in a rapidly changing global market.

This paper highlights the relevant capabilities collectively for the German automotive supply industry, thereby making a significant contribution to the research on transformation capabilities relevant to the electromobility transformation and the concurrent trends of digitalization, work changes and sustainability.

C. Future work

Future work should validate the transformation capability model with experts from the automotive supplier industry both qualitatively and quantitatively to ensure its broad relevance. It may also be worth examining whether the model is applicable to other industries in the manufacturing sector and whether a specific target group, such as small and medium-sized enterprises, can be particularly identified.

Furthermore, this transformation capability model addresses several concurrent trends, covering electromobility, digitalization, work changes and sustainability. Future research could develop capability models specific to individual sub-trends, for example related to sustainability, thereby gaining more specific capabilities and greater model depth. In this way, it can also be examined whether further relevant capabilities need to be added to this existing transformation capability model. In addition, the existing capability model can be expanded into a maturity model that provides companies with recommendations for closing discrepancies and further developing the relevant capabilities. It is planned to convert the transformation capability model into a web-based transformation maturity self-assessment. This tool will enable companies to assess their transformational maturity in terms of capabilities and receive valuable guidance for their enhancement. In this manner, the transformation capability model will find wide reach and practical application, enabling continuous validation and optimization.

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