Digital Transformation of the High-Technology Manufacturing: An Overview of Main Blockades

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ABSTRACT

Quality of life is linked to a country's or regions economic progress. Recent academic research has found that the pace of digitalization of the economy and society is similar. Despite this, there is evidence of low digital/advanced manufacturing technology adoption preparedness across economic sectors, despite government assistance and senior manager strategic orientation. The research aims to measure industry and organizational readiness for digital/advanced manufacturing technology adoption. An expert poll conducted by the author's revealed low industrial readiness for digital/advanced manufacturing technology. As a result, the research focuses on identifying organizational digital transformation hurdles. An examination of academic literature and digital maturity assessment frameworks revealed a paucity of criteria for evaluating barriers. The project seeks to establish a method for evaluating digital transformation barriers. For a manufacturing firm, a questionnaire developed using analytical research measures an overall digital-transformation barrier level and identifies issue areas. The power engineering company has a lower barrier level, which aligns with the engine construction and turbine engineering industries' higher degrees of readiness to use digital technology. This finding validates the author's method's reasonableness.

Keywords: Digitization, digital transformation, business strategy, operations management, High-Technology Manufacturing

INTRODUCTION

It is widely understood that the overall quality of life in a country, region, or other area is tied to economic progress. Various studies use Gross Domestic Product (GDP) to assess the overall quality of living, while others use novel metrics to do so. The influence of the ongoing shift to a digital economy on economic growth and the overall quality of life has recently been the subject of scholarly inquiry. Determine how the specific characteristics of the digital and cyber economy influence human living standards, evaluate the current changes in human living standards under the influence of technological transformation, and outline the conditions under which these changes will have the most positive outcomes for the overall quality of life (Adusumalli, 2016a). The digital revolution of the industrial and service industries, healthcare and education, as well as the financial industry and other economic sectors, is being accompanied by improvements in the overall quality of life for people (Pasupuleti, 2016b). People's problems with knowledge, experience, and information sharing, purchasing and selling goods are addressed through mobile applications. These applications also provide an opportunity to pay for housing and communal services, as well as fines and taxes, in the shortest amount of time, as well as speeding up the process of addressing the population's transportation issues. Addusumalli and colleagues (2016) provided a schematic diagram of data collection and processing in the start-to-finish automated production-and-marketing chain of activity in the agriculture sector (Adusumalli and colleagues, 2016b). It is expected that the achievement of these objectives will allow increasing the agricultural sector's contribution to the Russian economy in order to increase export revenue, as well as planning, scheduling, and aggregating data streams for the development of start-to-finish chains and technologies from the agricultural production stage to consumption, with a deep integration into allied industries of the digital economy. Digitalization has been shown to have a positive impact on the economies of economically developed and resource-rich regions. For less developed regions, on the other hand, this impact could result in increased digital hazards (Adusumalli, 2017a). The authors conclude that, overall, digitization of

the economy and society is progressing at a comparable speed, which is consistent with previous findings.

Digital technologies are one of the most important trends in sustainable and innovative development, and they are having a significant and frequently disruptive impact on corporate strategy and business models today. When it comes down to it, a business model is defined as the process by which an enterprise provides value to its customers, incentivizes those customers to pay for value, and transforms those payments into profit. Digital technologies are increasingly being recognized as a critical component in ensuring the worldwide competitiveness of modern products and services (Pasupuleti, 2016a). The relevance of digital technologies development and spread is emphasized in national strategic plans for creative and sustainable development, as well as in other documents. The existence of significant administrative and legislative hurdles at the federal and state levels is also acknowledged. Roadmaps for overcoming such obstacles are currently being designed and put into action. There is evidence of low digital/advanced manufacturing technologies adoption preparedness across economic sectors, despite the availability of governmental backing and the general strategic orientation of top managers, which is explored in greater depth by this study.

Literature Review

When it comes to the adoption of digital technology at the organizational level, the process is separated into three stages: digitization, digitalization, and digital transformation. The successful completion of each stage necessitates specialized organizational structure, growth and transformation plan creation, certain assets and human resources in SMEs and large organizations, as well as certain assets and human resources in large corporations (Li et al., 2018).

It is well understood that overcoming the obstacles to digital transformation is a critical component of the process (Adusumalli, 2017b). The first step in overcoming the obstacles that develop as a result of the adoption of digital technology is to identify these obstacles inside the organization. The most commonly mentioned hurdles include a lack of necessary skills, technical obstacles, individual obstacles, organizational and cultural obstacles, and environmental obstacles. However, while defining an agenda for future study, the authors did not address the issue of barrier measurement. Systems and technologies, processes, people and competence, culture, and strategy were all recognized as potential barrier groups in (Becker et al., 2010). A new barrier, the financial barrier, was discussed in the article (Ramilo and Embi, 2014), in addition to the previously discussed corresponding barrier groups (technological, financial, organizational, governmental, psychological, and process barriers), as well as the previously discussed financial barrier. The significance of this barrier was underlined in (Li et al., 2018), which demonstrated that higher perceived economic and financial obstacles do not lead to increased adoption of incentives by enterprises.

Particular metrics integrated into the digital maturity assessment model are used to assess the progress of the transformation journey and the status of the transformation. Several maturity models have been established during the last few years, both by practitioners and by academics conducting study (Pasupuleti, 2015c). They concentrated on examining assessable digital maturity models from prior research and identifying models that had not been previously investigated. Source, scope, and barrier assessment metrics analysis are included in the authors' review (if the instruments to elicit obstacles (1) are represented, (2) allow direct or indirect evaluation, (3) or are not represented) and the authors' review is divided into three sections. The review took a qualitative approach to the models that were available. The authors discovered 18 models, each with a different scope and authorship, which they categorized. The models were evaluated in terms of the availability of the barrier evaluation indicators.

Materials and Methods

Digital Manufacturing Technologies Adoption Readiness Assessment

It was decided to conduct an expert poll on advanced digital technologies in order to assess the level of preparation for the adoption of digital/advanced manufacturing technologies across various economic sectors. It was the first time that the results of the survey on digital/advanced manufacturing technologies adoption preparedness were processed for the objectives of the current investigation. A total of 135 professionals from a variety of sectors, including academics and business, participated in the survey. During the sample design process, three conditions were taken into consideration:

The first prerequisite was the requirement for the activities of the primary participants in the digital economy to be coordinated: scientific communities, corporate communities, and governmental organizations, to name a few. The specialists were tasked with assessing the readiness of manufacturing industry to embrace digital/advanced manufacturing technology. They looked at:

- Automotive;
- Aerospace;
- Engine building;
- Shipbuilding;
- Railway machine building;
- Other vehicles;
- Machine tool building;
- Other machine building;
- Agricultural engineering;
- Other specialized machine building;
- Metallurgical production; and
- Other manufacturing industries.

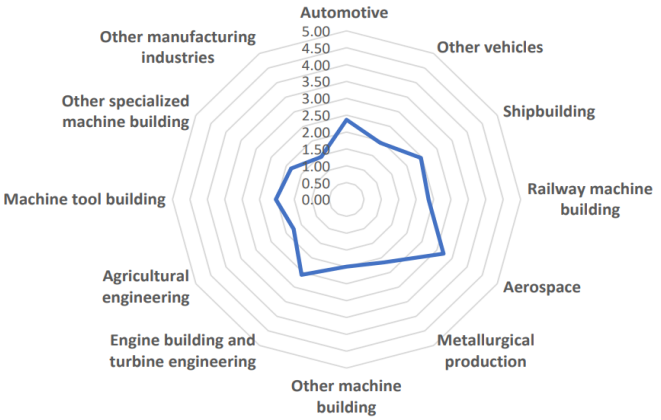

Figure 1: Assessment of the readiness for implementation of digital/advanced manufacturing technology.

The poll was constructed in the form of a questionnaire to collect information. Each expert rated each industry on a scale from 1 to 5, with 1 indicating a low readiness to adopt digital technologies and 5 indicating a strong readiness to adopt digital technologies. The average result for each industry was derived by taking the mean of all expert evaluations and dividing it by the number of experts.

The method development for identifying obstacles to digital transformation was carried out through the creation of the most prevalent key areas within the company that might potentially be considered digitalization barriers in the first place. This was accomplished by the use of an analytical approach.

- IT infrastructure;
- Existing IT systems;
- Special software requirements;
- Financial resources;
- Qualified specialists and IT personnel;
- Digital manufacturing policy;
- Limited-access information use;
- Regulatory framework; and
- Diverse IT maturity of production participants.

Representatives from the manufacturing industry validated the ten areas of manufacturing technology that had been formulated. In order to augment and add diagnostic value to any existing digital maturity assessment approach, these categories were translated into questions and presented in a questionnaire. The number of questions ascribed to a particular area was determined by the expected level of accuracy of evaluation obtained by one or more evaluation questions in that area (Pasupuleti, 2015b). The authors came to the conclusion that many significant impediments can be found in areas such as financial resources, competent professionals and information technology personnel, and regulatory framework. As a result, more than one question was prepared for each topic area in question.

RESULTS AND DISCUSSION

Digital Manufacturing Technologies Adoption Readiness Assessment

The assessment of digital/advanced manufacturing technologies adoption readiness (see Figure 1) revealed that the average readiness across all industries was poor, indicating a low level of preparedness. The most advanced and knowledge-intensive businesses, such as aerospace, engine manufacturing, and turbine engineering, demonstrate a greater willingness to adopt digital technologies than other industries.

The Findings of the Assessment

After conducting study, it was discovered that digital and advanced manufacturing technologies adoption readiness assessments were poor. Because the digital transformation of the industrial sector, services, and other economic sectors is accompanied by improvements in the overall quality of life, it should be a top priority to increase the readiness of businesses to adopt digital technologies in the first place. -(Pasupuleti, 2015a). The identification of hurdles that are impeding digital transformation at the enterprise level is the starting point for such enhancement. The enterprise level is particularly important to evaluate because many government incentives are targeted at removing barriers that exist at the regulatory and administrative levels and assisting businesses in adopting new technology by providing grants, consulting services, and other forms of assistance. Each example of transformation, on the other hand, begins with a distinct enterprise. Furthermore, each business is plagued by its own set of obstacles that must be identified and removed in order for it to be a successful enterprise. When the experts reviewed the various digital maturity assessment models, they discovered that most did not include barrier discovery tools and indicators, as the experts had expected (Adusumalli & Pasupuleti, 2017). The unique strategy proposed by the authors has been accepted by two major industrial corporations.

Overall, a power engineering company faces a 40% deterrent barrier, which is considered to be a significant amount of resistance. Eleven locations are protected by a natural barrier that is found only in that area. For a machine-building enterprise, the overall barrier equals 3/4 of the whole barrier, which is a limiting barrier. The following are some of the most serious issues:

- Manufacturing technologies that are out of date and have low levels of automation.
- The difficulty of integrating digital technologies with current IT systems in an organization.
- Availability of unique software requirements when necessary.
- This is due to a scarcity of specialists in the development and application of digital industrial technology.
- Inconsistency in the implementation of a full digital manufacturing policy.
- An insufficient amount of detail is provided on the subject of conveying restricted access information over secure access channels.
- There has been insufficient development of the regulatory framework in the sphere of information interaction.

The approval results are consistent with the expert poll results: the power engineering company has a lower barrier level, which is in line with the engine building and turbine engineering industries, which have demonstrated greater levels of readiness to adopt digital technologies than the power engineering company does. As revealed by the expert survey, the identified limiting hurdle for the machine-building organization is consistent with lower levels of readiness to use digital technology in other machine-building industries (see Figure 2).

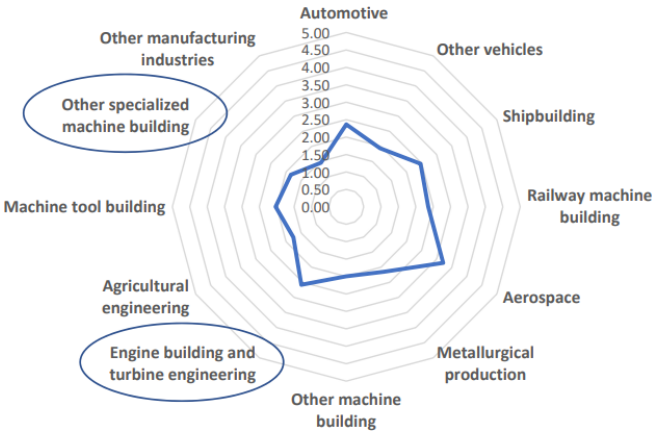

Figure 2: Assessment of the readiness for digital manufacturing technologies to be adopted.

These findings lend support to the authors' hypothesis regarding the logic of their method. The method for assessing digital transformation hurdles described in this article can be used in conjunction with the digital maturity assessment models that have been developed.

Conclusion

The purpose of this essay is to further build a system for identifying and removing roadblocks to digital transformation. The writers put out a hypothesis regarding the logic of the authors' approach of investigation. The method is tested on high-tech machine-building companies, and the results are used to establish research directions for future study. The following scientific findings were acquired and discussed in the article: In the first instance, results from the assessment of digital/advanced manufacturing technologies adoption readiness revealed that the technology was not ready for widespread implementation. In the second instance, the strategy for identifying and removing barriers to digital transformation was developed and tested in two large industrial companies before being widely adopted.

The findings are useful for both academics who are researching the adoption of new technology and practitioners in the manufacturing industry. An identified and articulated research deficit has been recognized and articulated in the academic field in relation to barrier assessment. For digital maturity assessment and barrier evaluation, theoretical results can be used to develop and propose more complicated or industry-specific approaches based on the theoretical foundation. The method that has been devised can be utilized to collect additional empirical data from other industries in order to analyze the level of obstacles in more depth. The research has some limitations, including a confined emphasis on industrial businesses and a limited approval scope for the procedure. In order to rest and revise the process, additional study might be focused on acquiring more data through recommended questionnaires in conjunction with any accessible digital maturity assessment model. In addition, a theoretical foundation for decision-making and strategy formulation phases in the context of identified barriers is an important direction to pursue.

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