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A Model for Challenges and Opportunities in the Implementation of Digitized Transforming Enablers in Manufacturing Industries

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Abstract. Every manufacturing revolution is focused around boosting productivity. Impacted by the emerging area technologies, the manufacturing sector, globally, is on the wheels of Fourth Industrial Revolution. The umbrella keyword "Digitized Transforming Enablers (DTE)", discussed in the study encompasses the digital technologies of the Fourth Industrial Revolution "I4.0". Literature has reported ample of opportunities, such as greater output capacity, production line flexibility, reduction of monotonous work, improved customer opinion of products as well as improved work-life balance for manufacturing firms, advancing towards these technological transformations. The flipside is challenges, related to lack of management commitment, employee involvement, technology standardization and financial constraints are delaying these transformations, especially in the case of small-medium enterprises (SMEs). The objective of this study was to overcome this limit by presenting a moderated mediation research model developed with the help of a theoretical background, based on descriptive and content analyses, while also describing the constructs selected and the hypotheses developed towards achieving DTE implementation. The proposed model ideates, regulatory support as a facilitator and environmental dynamism as a contextual factor, so as to explore as to how such contingency elements affects the impact of challenges and opportunities on DTE implementation.

Keywords. I4.0, DTE, Regulatory Support, Environmental Dynamism

1. Introduction

The Fourth Industrial Revolution (FIR) has a remarkable technological potential and can generate a new life-style for customers. Consumer behaviour is also changing exponentially due to the influence of emerging technologies. Therefore, manufacturing firms must rethink and reposition their strategic planning for the ever-changing behaviour. According to [1], to be future competitive, it is paramount to transform from a machine dominant approach to a digitized manufacturing one. A digital strategic planning, mapping necessary functions with ease in operability at a low cost and compatibility, is expected to help the enterprise implement appropriate technological enablers [2].

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This study introduces an umbrella keyword "Digitized Transforming Enablers (DTE)", defined as the digital technologies of FIR for transforming reporting processes, acquiring and analysing data in real time as well as applying insights to limit risk and enhance efficiency. The results of [3] indicated that the large enterprises have greater opportunities to use new technologies, as compared to small and medium enterprises (SMEs). Also, the qualitative case study from [4] highlighted that the multinational enterprises have higher driving forces and lower barriers to DTE implementation. However, in future SMEs will have good opportunities, if new technologies become more accessible and they start investing [3] [4].

The implementation of digital technologies brings opportunities, such as improvements in quality, flexibility & productivity, cost reduction and competitive advantage [5] [6], but the challenging phase is the transition from machine dominant to digitized manufacturing [1]. The transition requires support from top management [7], employee acceptance [8], investment in digital technologies [9], IT infrastructure [10], which are among the prominent challenges reported in the literature. To mitigate these challenges, regulatory support [11] [12] is a must. A contextual factor, Environmental Dynamism [13], is proposed, so as to explore how contingency elements affect the impact of challenges and opportunities on DTE. The research agenda conceptualised as part of this study is:

1) To identify whether SMEs obtain greater opportunities than the larger enterprises when implementing digital technologies of FIR.
2) To identify the challenges for DTE implementation from the extant literature.
3) To identify the opportunities for DTE implementation from the extant literature.
4) To develop a research model and research propositions for DTE implementation.

The paper is structured as follows: Section 1 covers the introduction and Section 2 offers the theoretical background along with a current review of the literature covering Digitized Transforming Enablers (DTE) for SMEs. Section 3 presents the research model, describing the constructs and hypotheses developed.

2. Theoretical Background

2.1 Why SMEs?

Flat organizational structures and short hierarchical line are favourable factors in transiting to a digital work culture. Also, the appropriate technological enablers will have competent job creation, reduce monotonous work, high product specialization, along with increased flexibility, speed and efficiency [6]. SMEs are typically less bureaucratic and have greater incentives to succeed than huge corporations [14]. The FIR prospect for SMEs will lead to the advantages [15], such as increased productivity, increased revenue, health and safety priority. Moreover, SMEs have the biggest number of employees and hence represent a significant target market for digitalization [16]. Based on the above insights, the first research agenda is addressed, that the SMEs do obtain greater opportunities than larger enterprises for DTE implementation.

2.2 Digitized Transforming Enablers

The study introduces an umbrella keyword "Digitized Transforming Enablers" (DTE), which encompasses the digital technologies of FIR. Internet of Things, Big Data, Cloud Computing, Additive Manufacturing, Tracking Tracing Technologies, Cyber-Physical

Production Systems and user friendly devices, like smart phones, watches, tablets are among the few DTE involved in this global trend of FIR. Big Data Analytics in SMEs can boost competition in markets by allowing for better decision-making, improved operational and business performance [17]. Cloud Computing has the potential to improve productivity and can give SMEs a competitive advantage in the market, by enabling SMEs to securely store, access, use and calculate data in real time [18].

3. Research Model and Hypotheses

3.1 Research Model Development

After a thorough descriptive and content analyses of the theoretical background, the study developed a moderated mediation model as shown in figure 1, proposing the relationship between the challenges and opportunities towards DTE implementation. Based on the developed conceptual framework, the study further proposes research hypotheses in the following section, covering the crux of the research agenda.

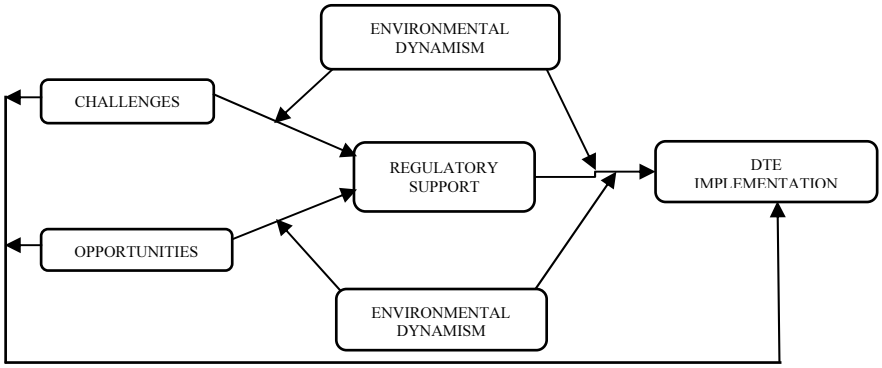

Figure 1. Research Model

3.2 Challenges, Opportunities and DTE implementation

The following section identifies key challenges, opportunities for DTE implementation from the extant literature and the conceptualization of the research propositions.

Top Management Commitment or Support is considered as an instrumental component for DTE implementation, as major decision making is done at the top. [7] analysed the challenges of SMEs in DTE application and reported that the sub-criteria, Top Management Support has the highest weightage. By DEMATEL approach, for SMEs [9], lack of top management support is among the most important challenges for DTE implementation. Top Management Support matters for SMEs in the long-term [19]. This has led to hypothesise the following: ***H1a****: Lack of Management Championship has a direct impact on DTE implementation.*

[4] [20] agreed that one of the biggest obstacles to DTE implementation is the lack of competent workers and the need to retrain employees to meet new circumstances. The study [21] revealed that the major implementation barriers of DTE in Indian SMEs are fear of unemployment and lack of IT training. Resistance [11] may come from employees, who are satisfied with the existing systems [19] and are fearful of their jobs

[4]. This has led to hypothesise the following: ***H1b****: Internal Social Capital has a direct impact on DTE implementation.*

Wide-ranging broadband infrastructure is a must for DTE realization. From the findings [22], the most serious obstacle that could derail DTE implementation is the lack of technology infrastructure. [23] revealed that the lack of IT infrastructure is preventing the DTE implementation. An ISM approach [24] confirmed that the lack of infrastructure is at the root level and a significant barrier. This leads to hypothesise the following: ***H1c****: Lack of IT infrastructure has a direct impact on DTE implementation.*

DTE requires standardization of processes within and among companies [25]. Low degrees of standardization and lack of integration knowledge are major concerns for SMEs [20] and delays DTE implementation [16]. [11] suggested that the upgradation in standards could facilitate the adoption of digital technologies. This leads to hypothesise the following: ***H1d****: Standardization has a direct impact on DTE implementation.*

Based on the above insights, the second research agenda is addressed, identifying the prominent challenges for DTE implementation.

Greater output capacity [26], lower setup and operational costs [27], improved customer opinion of products [8], improved human resources productivity [28], competitive advantage [15], fewer errors & reduced machine downtimes [8], fewer rejected products [8], increased revenue [27], improved production customization [26], opportunity for business model innovation [16] and improved work-life balance [29] are among the opportunities highlighted in literature. This has led to hypothesise the following: ***H2****: Opportunities have a direct impact on DTE implementation.*

The third research agenda of the study is hence addressed, identifying the opportunities for DTE implementation.

3.3 The mediating role of Regulatory Support

Lack of national policies on digital technologies in developing countries prevent firms from fully experiencing the FIR [11]. Government regulations make it easier to overcome obstacles, such as data security, implementation costs, human skill capabilities, organisational opposition and lack of technology standards [12]. According to the findings of [8], governments should continue to develop programmes and incentive mechanisms that support the shift to a digital work culture in overcoming obstacles, such as legal uncertainty and a lack of clear standards. This has led to hypothesise the following: ***H3a****: Regulatory support acts as a mediator to dilute the challenges for DTE implementation.* ***H3b****: Regulatory support acts as a mediator to strengthen the opportunities for DTE implementation.*

3.4 The moderating role of Environmental Dynamism

Environmental Dynamism (ED) for an enterprise refers to the environment's instability or volatility [30] [31]. [6] suggested to have future research projects, considering Environmental Uncertainty as one of the variables. A study by [13] investigated and revealed that, ED positively moderates the indirect effect of digital technologies of FIR on economic and environmental performance. Literature related to ED is seen to be fragmented and limited. Hence, further exploration is required on this moderating variable. This has led to hypothesise the following: ***H4a****: Environmental Dynamism moderates the impact of challenges on DTE implementation through Regulatory support.* ***H4b****: Environmental Dynamism moderates the impact of opportunities on DTE implementation through Regulatory support.*

The fourth research agenda of the study is proposed to be addressed, by developing a research model for DTE implementation as shown in figure 1 and by constructing the research propositions posited above.

Conclusion

The umbrella keyword DTE, discussed in the study encompasses the digital technologies of the FIR. After descriptive and content analyses, based on theoretical background, this study has aimed at exploring four research agendas, mentioned in section 1. For the first agenda, study concludes that, SMEs with digital transformation do obtain greater opportunities than larger enterprises, but the research reported in case of SMEs is limited. For the second and third agenda, study identified the challenges and opportunities from the extant literature, to enhance the understanding required for technological transformation. Challenges related to lack of management commitment, employee involvement, technology standardization and financial constraints are seen delaying the transformations. Opportunities, such as greater output capacity, reduction of monotonous work, improved customer opinion of products as well as improved work-life balance are highlighted for firms advancing towards technological transformation. In the fourth agenda, a moderated mediation model is presented, while also describing the constructs and hypotheses developed. Further, the proposed model ideates regulatory support as a mediator and ED as a contextual factor, so as to explore the impact of challenges and opportunities on DTE implementation. In all, the study presents nine propositions to the research world, guiding towards DTE implementation.

Future research work can be aimed at testing of the proposed hypotheses, which would add statistical significance. Further, due to limited work in the extant literature and demand from researchers [32] [33] [34], subsequent research investigation could be directed to find the influence of DTE implementation on sustainability dimensions and its impact on the manufacturing performance of the SMEs.

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