Studying Agility during ERP lifecycle: a Conceptual Model for ERP-Implementation and Agility Assessment


Abstract—To survive and even prosper in today’s turbulent conditions, businesses have to shift their paradigm to agile manufacturing. As a direct result, they ought to provide IT infrastructure to gain response ability; hence, majority of organizations opt for an Enterprise Resource Planning (ERP) system. However, ERP lifecycle, comprising some successive phases, make organizations agility fluctuate. Therefore, this study tries to define a proper conceptual model for ERP-implementation in agile organizations. In addition, since the literature lacks a study demonstrating how ERP lifecycle phases influence organizations agility, it is also endeavored to propose a method for prioritizing these phases and effectively assess agility during ERP lifecycle.

Keywords—Agility assessment, Enterprise Resource Planning (ERP), Fuzzy-AHP, Knowledge Management (KM).

I. INTRODUCTION

Today, businesses are challenged by the present turbulent environment. In fact, unpredictable and continuously changing environment along with increased product complexities, fierce competition, globalization, and advances in information technology are the major influential forces making circumstances extremely difficult for businesses to survive. Therefore, to confront these problematic issues and even thrive, businesses have to alter their manufacturing paradigm dramatically [1, 2, 3, 4, 5, 6].

Diverse environments made businesses start deriving benefit from different manufacturing paradigms. First, they benefited from craft manufacturing. Then, they took advantage of mass manufacturing. Finally, businesses entered a new era, i.e. lean manufacturing era. To tackle today’s conditions, however, businesses need to derive benefit from agile manufacturing, a new paradigm introduced by Goldman and Nagel in 1991 [7, 8, 9, 10].

Overall, to comprehend agility, two approaches can be considered [5]. The first one embodies all practices and technologies that industry has taken advantage of in the last two decades. According to this approach, agility is totally compatible with lean manufacturing, Computer Integrated Manufacturing (CIM), Total Quality Management (TQM), Material Resource Planning (MRPII), Just In Time (JIT), and employee empowerment. However, the second approach, regards agility as a radically different manufacturing business model whereby enterprise elements, i.e. goals, objectives, technology, and organization, adapt to unforeseeable changes of environment in a “rapid” and “proactive” manner [5].

In this study the second approach is adopted. Thus, agility is considered as a twofold concept, including not only the ability to respond to unexpected changes of business environment but also the ability to act proactively with respect to those changes [1]. As stated by Sedighi et al. [11], businesses can employ Enterprise Resource Planning (ERP) systems to achieve the response ability. They have also mentioned that to act proactively, businesses should invest in knowledge management (KM) to be able to manage their intellectual assets [2, 12].

According to the literature, except the study conducted by Sedighi et al. [11], there is no other study demonstrating the impact of ERP systems on agility achievement. In their study, Sedighi et al. [11] have focused on the influence of ERP systems on agility just in the ERP post-implementation phase. It should be noted that in order to achieve a stable ERP system, organizations should go through some successive phases (i.e. ERP lifecycle) whereby each phase influences the organization performance in different manners, and consequently, influences the organization agility in different manners. This indicates that “no” study can be found in the literature discussing the overall impact of ERP implementation on agility.

Furthermore, due to the fact that each phase of ERP lifecycle makes the organization agility undergo fluctuations differently, a customized assessment method should be employed to give a real insight about the organization agility during ERP implementation.

To fill this gap, in the first place, this study aims to define a model for ERP-implementation in agile organizations. In the second place, it is tried to propose an assessment method for
evaluation of agility while ERP is being implemented.

II. THEORETICAL BACKGROUND

A. Agility

As illustrated in Table 1, a lot of agility definitions exist in the literature. All in all, as stated by the creators of agility at the Iacocca institute of Lehigh University (USA), agility is “a manufacturing system with capabilities (hard and soft technologies, human resources, educated management, information) to meet the rapidly changing needs of the marketplace (speed, flexibility, customers, competitors, suppliers, infrastructure, responsiveness)” [13].

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Author(s)</th>
<th>Definition</th>
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<tr>
<td>[13]</td>
<td>Yusuf et al.</td>
<td>“the successful application of competitive bases such as speed, flexibility, innovation, and quality by the means of the integration of reconfigurable resources and best practices of knowledge-rich environment to provide customer-driven products and services in a fast changing environment.”</td>
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<td>[14]</td>
<td>Gartner Group</td>
<td>“the ability of an organization to sense environmental changes and respond efficiently and effectively to that change.”</td>
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<td>[15]</td>
<td>Mathiyalakan et al.</td>
<td>“the ability of an (inter-connected) organization to detect changes, opportunities and threats in its business environment and to provide speedy and focused responses to customers, as well as other stakeholders, by reconfiguring resources and processes, and through strategic partnerships and alliances.”</td>
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<tr>
<td>[16]</td>
<td>Dove</td>
<td>“the ability to manage and apply knowledge effectively, so that an organization has the potential to thrive in a continuous changing and unpredicted business environment.”</td>
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In essence, the main characteristics/attributes of agility are flexibility, responsiveness, culture of change, speed, integration and low complexity, high quality and customized products, and mobilization of core competencies [5].

B. ERP systems

ERP systems, taking advantage of a central database and a common platform, are business management systems which integrate a set of modules including financial and accounting, manufacturing, sales and distribution, human resources, supply chain, and customer information [17, 18, 19, 20]. By utilizing technology to share information among diverse modules, ERP systems help businesses develop their response ability, and as a direct result, maintain their competitiveness [21, 22, 23]. ERP systems provide businesses with a wide variety of benefits like declines in inventory, working capital reduction, and sufficient information concerning customer needs. To put it simply, as Umble [24] has stated, ERP systems provide two main benefits that non-integrated systems are not capable of providing: “a unified enterprise view of the business that encompasses all functions and departments; and an enterprise database where all business transactions are entered, recorded, processed, monitored, and reported”.

For ERP lifecycle, Maheshwari et al. [25] have considered four events, i.e. first to live, technical stability, semantic stability, and decline/replacement; and three stages, i.e. technical stage, semantic stage, and effectiveness stage. In their study, each stage takes place between two events. Forslund and Jonsson [26] have offered three primary phases (i.e. selection, implementation, and use) for ERP lifecycle which every phase embodies some activities. Finally, Willis and Brown [27] have offered five stages for ERP lifecycle which are as follows: ERP implementation, go live, stabilize ERP, additional functionality/re-engineering and extend/integrate.

C. Knowledge Management

Knowledge exploitation leads organizations to innovation, and consequently, can help organizations gain competitive advantage over their competitors. Since duplication of knowledge is extremely difficult for the competitors, the resultant superiority is sustainable. Hence, it can be concluded that by means of managing knowledge, organizations can emerge successful in solving their problems as well as seizing opportunities [28]. In the literature, many authors have tried to clarify the meaning of Knowledge Management. As stated by Hibbard [29], Knowledge Management is “the process of capturing the collective expertise of the organization from different sources (i.e. databases, paper, people) and utilizing that knowledgebase to leverage the organization”. According to Davenport and Prusak [30], “Knowledge management is concerned with the exploitation and development of the knowledge assets of an organization with a view to furthering the organisation’s objectives”. As Kamara et al. [31] believed KM is “the organizational optimization of knowledge to achieve enhanced performance through the use of various methods and techniques”. Overall, KM can be considered as a systematic process consisting of numerous phases aimed at managing a combination of knowledge, information, and data with the purpose of linking people who need to know to the knowledge of right ones in a timely fashion [32, 33, 34, 35, 36]. Finally, considering KM with four major phases namely (1) Creation, (2) Retention, (3) Transfer, and (4) Application, Sedighi et al. [11] suggest that organizations can take advantage of KM to act proactively.

III. DERIVING THE CONCEPTUAL MODEL

In order to be agile, organizations need to possess dynamic
capabilities; for having such capabilities, organizations need to obtain absorptive capacity in advance [2, 3, 11]. According to Ashrafi et al. [3], absorptive capacity can be considered as “the maximum value of scientific or technological knowledge that a firm can incorporate into its business processes”. Furthermore, they believe that dynamic capabilities are “the ability of the firm to use this knowledge to exploit the technological and commercial potential of untapped knowledge in a particular domain.” Generally speaking, four dimensions can be considered for absorptive capacity: knowledge acquisition, knowledge assimilation, knowledge transformation, and knowledge exploitation.

Toward agility achievement, businesses are obliged to benefit from KM and its IT capabilities to augment absorptive capacity and knowledge quality [2, 3]. KM phases contribute greatly to all of the absorptive capacity dimensions. By means of technologies like intranets, portals, and Virtual Communities of Practice (VCoPs), KM facilitates the acquisition process of absorptive capacity [2, 34, 36, 37]. Useful acquired knowledge will be obtained after a process of gathering, selecting, analyzing, synthesizing, weighing, and evaluating the acquired data, information, and knowledge [3, 37]. Then, the obtained knowledge, whether tacit or explicit, will be converted into a standard format that is able to be codified and transferred through IT capabilities of KM [36, 37, 38]. The new valuable knowledge gained from the assimilation stage should be combined with the existing knowledge that is in the KM repositories to provide useful knowledge for solving current problems [39].

Overall, to sustain their competitive edge over their competitors, organizations ought to take step towards agile manufacturing; as a prerequisite they need to obtain absorptive capacity; and finally, they should invest in KM to be able to intensify their absorptive capacity. Therefore, KM can be considered as an inseparable part of organizations agility.

On the other hand, as McGinnis and Huang [38] proposed, ERP implementation is a continuous improvement effort encompassing an initial ERP implementation as well as some successive post-implementation projects. In order to make ERP systems boost, KM must be embedded in every single phase of this implementation process. Based on the literature on ERP implementation [34, 35, 36, 38], KM is an important tool for backing ERP systems. The empirical study conducted by Sedera and Gable [35], demonstrates the positive correlation between KM-competence and ES-success. With regard to the literature on KM phases, they suggested creation, retention, transfer, and application as the four phases constituting KM-competence. Furthermore, they considered four dimensions for ES-success: Individual-Impact, Organizational-Impact, System-Quality, and Information-Quality. Their study findings indicate that improvement in any or all of the KM-competence phases will lead organizations to improved levels of ES-success.

Therefore, as it is illustrated in Fig. 1, every phase of ERP lifecycle should be supported by the KM environment of the organization agility.

Among all the classifications of ERP lifecycle phases, the classification proposed by Willis and Brown [27] seems more sophisticated. Hence, in this study, it is tired to develop a novel model for ERP implementation in agile organizations based on the five stages (ERP implementation, go live, stabilize ERP, additional functionality/re-engineering and extend/integrate) offered by Willis and Brown [27].

In order to accomplish the cyclic phases of KM, the knowledge gained after completing each phase should be transferred to the next phase. That way, decision makers can derive benefit from the combination of the new knowledge acquired from current phase and the prior knowledge remained from the last phases to make a right decision. Highlighting the IT capabilities of KM, the dynamic conceptual model for ERP implementation in agile organizations is illustrated in Fig. 2.

**IV. AGILITY ASSESSMENT DURING ERP IMPLEMENTATION**

The literature on agility assessment lacks a study proposing a method for assessment of organizations agility during ERP lifecycle. It should be noted that every phase of ERP lifecycle influences organizations agility differently. It means that when it comes to agility evaluation, every phase should be prioritized in accordance with a set of criteria. This set of criteria should be defined and customized by the experts of the organization. However, since agility attributes and ERP lifecycle phases are specified and certain, a general method
can be proposed to set the needed criteria. Through filling out the questionnaire of Table 2 and application of Fuzzy-AHP to the gathered data, the experts can prioritize and allocate an impact factor to each phase of ERP. Then, evaluating the organization agility during each phase and using the impact factor of that phase, they can gain an insight concerning the overall level of the organization agility. That way, they can have a balanced and holistic method for assessment of agility during ERP lifecycle.

**TABLE 2**
THE QUESTIONNAIRE FOR PRIORITIZING ERP LIFECYCLE PHASES THROUGH FUZZY-AHP

<table>
<thead>
<tr>
<th>ERP lifecycle, phase No. n</th>
<th>Flexibility</th>
<th>Responsiveness</th>
<th>Culture of change</th>
<th>Speed</th>
<th>Integration and low complexity</th>
<th>High quality and customized products</th>
<th>Mobilization of core competencies</th>
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<td>Flexibility</td>
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<td>Responsiveness</td>
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<td>Culture of change</td>
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<td>Speed</td>
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<td>Integration and low complexity</td>
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**V. CONCLUSION**

Today, businesses are subject to challenge by unpredictable changes. In order to confront this problematic issue, majority of them have preferred to shift their paradigm to agile manufacturing. Generally speaking, two pillars can be considered for agility: response ability and proactive acting ability [11]. In this regard, a lot of organizations intend to implement an ERP system to gain response ability. However, it should be noted that different phases of ERP lifecycle affect organizations agility in different manners. Since the literature lacks a study depicting this point, this study tried to not only define a proper conceptual model for ERP-implementation in agile organizations, but also suggest a method for assessment of agility during ERP lifecycle.

In the first section, the problem was introduced. In the second section, the concepts of agility, ERP systems, and KM were discussed. Section three encompassed the explanations regarding the relationship between agility, ERP systems, and KM. The conceptual model was also proposed in this section. Eventually, a proper method is suggested for agility assessment during ERP lifecycle.

**REFERENCES**


