A Methodology to Satisfy Key Performance Indicators for Successful ERP Implementation in Small and Medium Enterprises

Saraswati Jituri, Brian Fleck, and Rafiq Ahmad

***Abstract*—Small and Medium size industries are facing challenges in Enterprise Resource Planning (ERP) implementation. To address this issue this article proposes a methodology that focuses on the selection of most suitable ERP modules out of the available set of modules and Critical Success Factors (CSFs) identification for successful ERP implementation in small and medium enterprises (SMEs). The methodology makes use of business requirement and selects the ERP modules and CSFs, which will satisfy the business requirement. It optimizes the resources SMEs has to invest for ERP implementation. To have a better understanding on working of methodology, four examples have demonstrated at end of the article.**

***Index Terms*—Enterprise resource planning, lean manufacturing, small and medium enterprise, key performance indicators, critical success factors.**

I. Introduction

Enterprise Resource Planning (ERP) is growing business solution to keep pace with rapidly changing market demands and sustainable business growth. ERP system is the efficient information management system capable of providing the right information at right time [1] there by bringing tremendous rewards to the organization in the competitive world. However, ERP implementation is time-consuming and expensive [2], [3]. Small and medium enterprises (SMEs) are facing difficulties in ERP system implementation as there is lack of knowledge, expertise, and guidelines in this area [4], [5]. SMEs using Lean technology are not willing to use ERP system believing in the critique that Lean and ERP are opposite to each other [4], [6]. Dilemma and difficulty related to ERP implementation are keeping SMEs away from harnessing benefits of ERP system. Therefore, SMEs has to change their view on ERP system and hence article shows the ways, SMEs have to see ERP system. The basic idea is to see ERP system as modular and focus on the portion that satisfies their requirements instead of viewing it as a huge and complex system.

In the available literature on ERP system, the study has been carried out on a successful implementation of ERP and different methods have been proposed to reduce failure in implementation [3], [7]-[9]. Even though scarce publications provide ERP selection methods for selecting ERP package [10] but currently there is no modular level approach based on KPI.

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A. Implementation of Enterprise Resource Planning System in SMEs: Why it fails?

Benefits of ERP system such as reliable information access, inventory reduction, on time delivery, increased productivity, reduction in IT cost, transportation and logistics cost reduction, improved business process, improved responsiveness to customer, improved communication and integration between the functions [1], [11]-[14] are the obvious reason for ERP implementation. In some cases, SMEs go for ERP only due to peer pressure without knowing what they actually want out of the system.

ERP system is advantageous however, if not properly managed it can be seen negatively, because of increased cost of installation, extended time plan, high manpower requirement, improper integration of software with business processes, re-engineering of processes more than expected and lack of top management support [2], [3], [15], [16]. In some cases, the failure of ERP project has led to bankruptcy [13], [17]. Adding to this, SMEs weakness such as [18] local management, short-term strategy, lack of expertise, non-functional organization, limited resources and lack of method and procedure; successful ERP implementation is questionable. Therefore improper implementation planning becomes a major factor for the failure of ERP system in the organization [19]. The proposed research methodology may reduce the failure rate of ERP implementation in SMEs. Methodology explores the best & suitable ERP modules, which serve the purpose of SMEs in ERP implementation.

B. Why is it Necessary to Identify Critical Success Factors?

Critical success factors are the guiding points, following and addressing them increases the probability of a successful ERP implementation [15], [16]. When we carried out the research by studying various publications on CSFs for ERP implementation, number CSF count reached more than *fifty!!* [11], [13], [15], [16], [20], [21]. Each CSF is associated with cost, schedule, and level of achievement [13]. If SMEs focus on all the CSFs eventually, they fall into resource crisis. Hence, the research methodology focus of identification of CSFs, which are relevant to only selected ERP modules using cause and effect approach.

II. Methodology

The main purpose of this article is to provide a methodology for identification of relevant ERP modules and CSFs to satisfy identified KPIs for SME from the pool of ERP modules and CSFs. Following are the important steps of the

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proposed methodology:

- Identify the Key Performance Indicators (KPIs) from Business requirement
- Select relevant ERP modules
- Identify related Critical Success Factors (CSFs)

The proposed methodology as shown in Fig. 1, support the selection of modules and CSFs for ERP implementation as explained below.

A. Identify KPIs from the Business Requirements

The ultimate goal of any organization is to improve business performance; hence, they look for different initiatives that will enhance their performance. This is the strategic level decision. Key Performance Indicator (KPI) is one of the dimensions to represent the business performance [12], [22].There are many ways [23] to arrive at KPIs and one of the ways is Balance scorecard (BSc) [22]. The method can be used to drill down strategic level business requirement into the KPIs [22]. When ERP is the choice of organization, which satisfies their business requirement first step is to select the KPI they want to improve. For example, improve customer service may be the one of the business requirement. KPI for customer service improvement can be customer satisfaction level, on time delivery and reduction in complaints. Another example for a business requirement can be, to improve the productivity of the business process. For this requirement, KPI can be the reduction in work force and non-value added activity reduction. In a similar way for demonstration, we have selected four KPIs 'Inventory Reduction', 'Overall Cost Reduction', 'Information/Data Management' and 'Performance Improvement' from the top search in literature. These KPIs will be discussed more in section III.

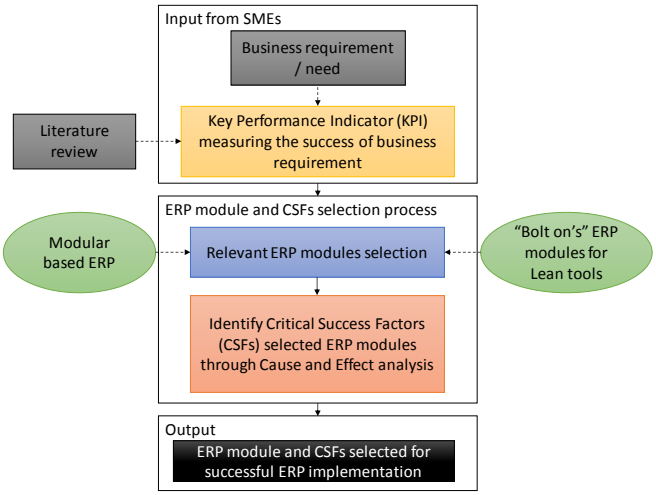

Fig. 1. Schematic representation of methodology for ERP implementation in SMEs.

In general, other KPIs can be functional level data integration, supply chain management, lead-time reduction, quality improvement etc. Once SMEs have KPIs defined, next step is to select the relevant ERP modules.

B. Select Relevant ERP Modules

All standard ERP modules in ERP software package do not serve the purpose of an organization [24]. Either ERP vendors mislead SMEs to purchase the complete software package or SMEs drop the idea of having ERP system in their organizations due to the high price of the ERP software packages and cost associated with the implementation of the complete package [25]. This is the serious concern for SMEs and drawback created around ERP systems. Therefore, before jumping into a decision of purchasing entire package, SMEs has to analyze what are the modules that will improve the KPIs identified in step one. In the methodology, the process of identifying relevant ERP modules is systematic literature studies, expert advice, and feedbacks from the ERP vendors. They should find the answer to the question "Which ERP module leads to improvement of what kind of KPI?" For example, literature studies on inventory reduction [21], [26]-[29] show that 'Inventory Management', 'Supply Chain Management', 'eKanban' and 'Customer Relation Management' are the key ERP modules for inventory reduction KPI. Therefore, "Relevant ERP modules for KPI inventory reduction are 'Inventory Management', 'Supply Chain Management', 'eKanban' and 'Customer Relation Management'. SMEs focused on cost reduction, which can be a business requirement, select inventory reduction KPI and select only relevant ERP modules (as discussed in the example). They do not need to waste their resources on purchasing the whole ERP package. Selected ERP modules can be standard modules or bolt-on modules [5] like value stream mapping, advance planning & scheduling and overall equipment efficiency management [4], [5], which supports lean manufacturing activities.

C. Identify Related CSF for Selected ERP Modules

After selection of ERP modules, SMEs has to find ways for successful implementation of these modules. As per discussion in section I.*B* of this article 'Why is it necessary to identify Critical Success Factors?' SMEs do not have resources to address all the CSF. As the result, SMEs overlook important CSF and hence fail in implementation or end up in not achieving the objectives [13]. Causes for the failure of ERP systems will become reasons for the success when these causes convert into CSF. Using this idea, the methodology proposes a fishbone cause and effect analysis tool to identify the CSFs [30]. Fish bone cause and effect analysis is the general tool, which can be applied for any kind of problem-solving. SMEs can use literature studies, brainstorming, expert advice, and ERP vendor suggestions to identify causes of failure for only selected ERP modules. From the examples demonstrated in this article in next section, one can see that any selected ERP module has a combination of generic and unique CSFs. For inventory reduction, generic CSF is 'top management support' and unique CSF is 'trust-based and synergistic alliances with supplier' identified through literature. To have more clarity, CSFs are classified under Strategic, Organizational, Operations, User and ERP software categories [13], [3].

The proposed methodology optimizes the resources SMEs have to spend on ERP implementation. Following this methodology, SMEs will successfully select relevant ERP modules and corresponding CSFs for ERP implementation but the process does not end here. SMEs should make sure that all selected CSFs addressed and they should follow a systematic ERP implementation process to gain the benefits. This will be done in future works of the proposed

methodology. The proposed method is limited to modular based ERP systems only; therefore, SMEs using this methodology should look for such ERP software vendors.

III. Demonstration with Examples

A. Selection of KPIs

To demonstrate the methodology selection of KPIs will be such that those are important to an organization and most of the SMEs would like to improve. To find those important KPIs, Hammar software is used to systematically map the selected publications [31], [32]. The generated reports consist of trends of KPIs occurrence in literature. By analyzing the trends top four KPIs inventory reduction, information/data management, overall cost reduction, and performance improvement have selected. From literature, it is clear that implementation of ERP system will definitely improve the selected KPIs. Let us assume that these KPIs have derived from the business requirements of SMEs, as they represent the top ranked KPIs in the literature.

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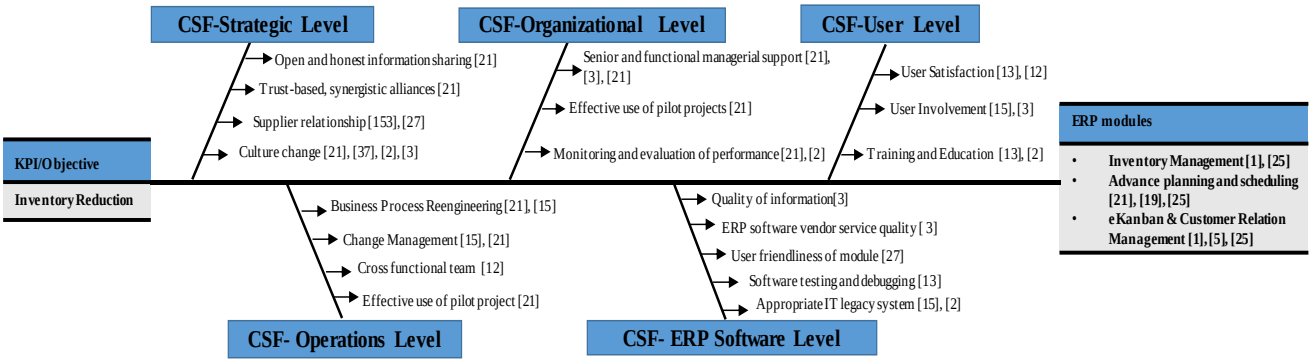

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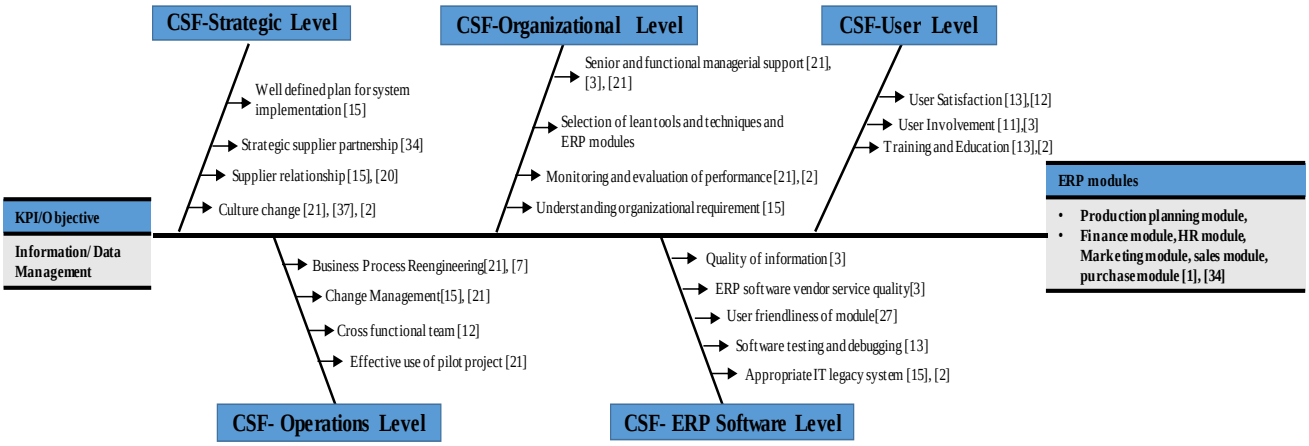

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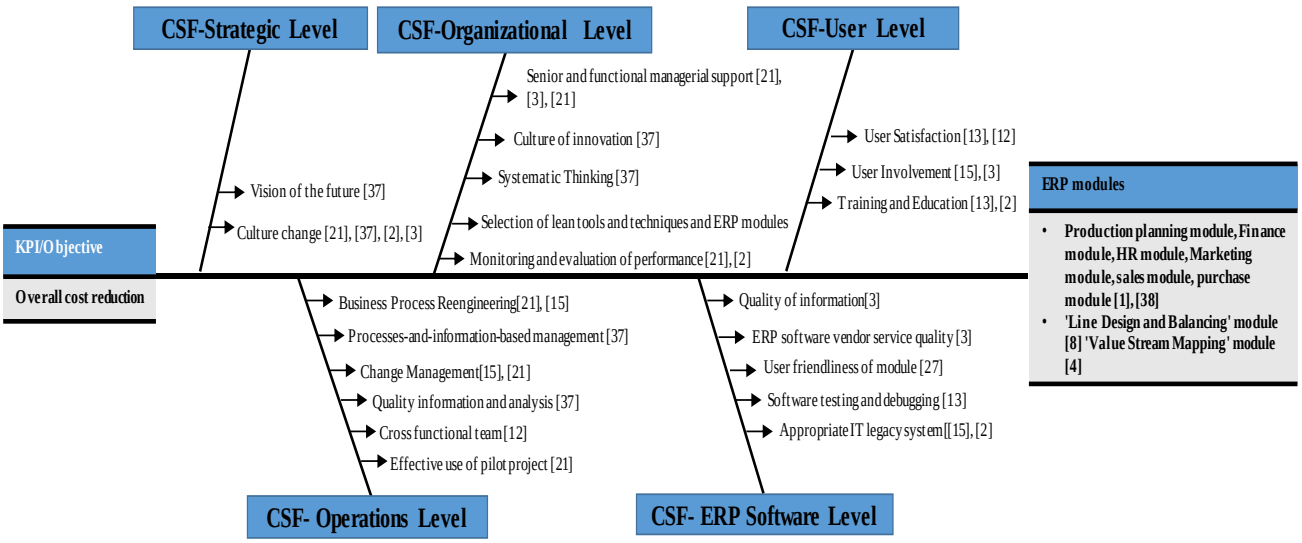

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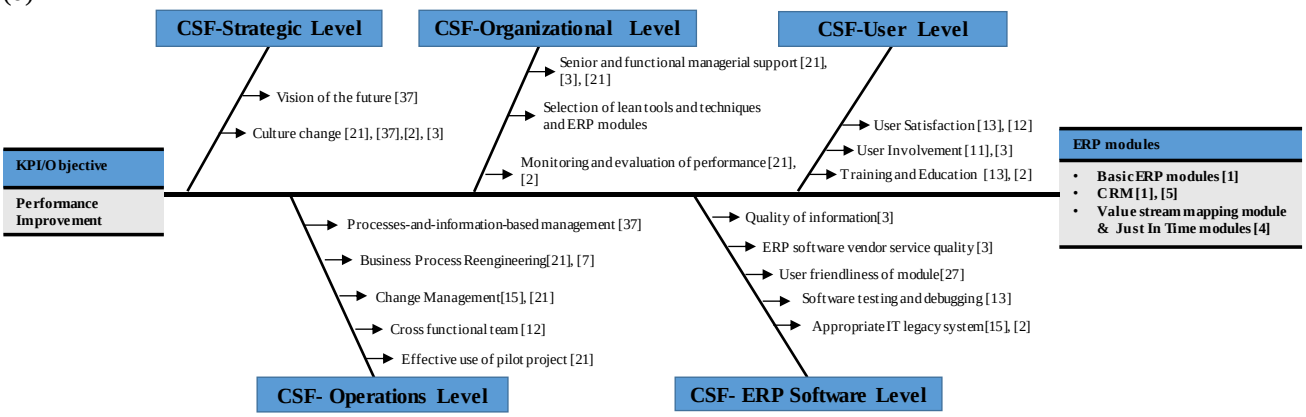

Fig. 2. Cause and effect analysis for KPI
a. Inventory reduction b. Information/Data management c. Overall cost reduction d. Performance improvement.

A. ERP Modules Selection

Each KPI has been studied individually to recognize the aspects of ERP modules that suites in improving the corresponding KPI and recommend those modules only. For Inventory reduction (KPI), the required aspects identified in the literature are:

- *Automated information flow between buyer and supplier* [21], [28]
- *Support demand leveling, JIT procurement and production leveling* [5], [26], [33].

ERP modules suitable to these aspects are Inventory Management [1], [25], Advance planning and scheduling [19], [21] eKanban and Customer Relation Management [1], [5], [21], [26]. If KPI requires Lean tools, ERP modules specially built for lean (called as Add on or Bolt on) are the recommendations.

In case of KPI Information/Data Management, important features required are:

- *Shared data and visibility across all the areas of the company* [19],
- *Affords one to manage all departments from production to distribution and accounting in one integrated system* [34]
- *Abundant information availability including supplier, customers, and alliances* [19].

The basic ERP modules such as Production planning module, Finance module, HR module, Marketing module, Sales module, Purchase module [1], [34] are suitable modules. SMEs has to select these modules for Information/Data management in their organization.

For KPI Overall Cost Reduction required aspects are:

- *Reduction of personnel, increased productivity, increase of 'on-time' deliveries, reduction in IT and procurement costs, reduction of business operating and administrative expenses* [12]
- *Lean initiatives envisage to achieve the highest quality at a lowest cost* [35].

Therefore recommended modules are more related lean tools which are, 'Line Design and Balancing' module [8] 'Value Stream Mapping' module [4] along with basic ERP modules.

Similarly for KPI Performance improvement recommended modules are Basic ERP modules [1], Customer Relationship Management [1], [5], Value stream mapping module and Just In Time modules [4]. Important aspects of modules for these KPIs are:

- *Improved customer services, flexibility, and integration of functions enhance performance* [27],
- *Lean tools for Elimination of waste leads to performance improvement* [36].

Now relevant ERP-modules have identified for selected KPIs, next step is the identification of CSFs.

B. CSF Identification Using Cause and Effect Analysis

Using literature research with help of cause and effect analysis, main reasons for failure in implementation of ERP modules have recognized. In case of KPI inventory reduction, reasons for the increase in inventory are improper communication of organization with supplier and customers regarding requirements and delivery of parts or products, fear of losing data confidentiality by sharing data with suppliers and improper production planning [21], [27]-[29]. In addition to these reasons, lack of managers' support, ERP module training deficiencies and resistance due to organizations culture are general reasons for failure. If these cause the failure in implementation, SMEs have to consider these as CSFs and address them during implementation. Fig. 2 shows the complete Cause and Effect analysis of selected four KPIs. For Information/Data management KPI, important CSFs are user involvement, user friendliness of interface of the software, quality of information and ERP vendor service [3], [11]-[13]. CSFs for the KPI Overall cost reduction are systematic thinking, performance measurement, and selection lean tools supporting ERP modules [37], [38]. For productivity improvement KPI, important CSFs are process and information based management, the vision of the future and business process reengineering [4], [37].

IV. Conclusion

SMEs can make use of the proposed methodology to make the process of ERP implementation easier and profitable. The proposed approach optimizes the resources SMEs has to spend on ERP system through selection and purchase of just right ERP modules and addressing only key CSFs. This paper is limited to only four KPIs to identify the key ERP modules and corresponding CSF. However, KPIs, which SMEs would like to improve, are many and need extensive research.

Therefore, future directions will consider those KPIs and develop them under the proposed methodology. Experimentation of practicality of proposed methodology in SMEs is another scope of future research.

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