

A proposed framework for ERP system implementation in SMEs

Danang Setiawan ^{a,1}, Muhammad Fahrezha ^{a,2}, Nur Abdillah Bagus Prakoso ^{a,3}, Qurtubi ^{a,4*}

^a Department of Industrial Engineering, Faculty of Industrial Technology, Kaliurang Street Km 14.5 Sleman, Yogyakarta, Indonesia

¹ danang.setiawan@uii.ac.id; ² muhammad.fahrezha@alumni.uii.ac.id; ³ nur.prakoso@alumni.uii.ac.id; ⁴ qurtubi@uii.ac.id*

* corresponding author

ARTICLE INFO

Article history

Received 12 Oct 2023

Revised 21 Nov 2023

Accepted 03 Dec 2023

Keywords

Enterprise resource planning

ERP implementation

Small and medium enterprises

Implementation framework

ABSTRACT

SMEs face numerous challenges and opportunities due to their pivotal roles in the economic development of a country. Adopting an ERP system is believed to be the catalyst to cope with the challenges and grab the opportunities faced by SMEs. However, implementing ERP led to potential risks caused by implementation failure, even for big companies. SMEs have a unique characteristic due to being receptive to adopting new technologies but having limited resources. Most previous research related to designing frameworks for ERP implementation was focused on big companies, although the fact that SMEs have distinct characteristics compared to big companies. Therefore, this study aims to design a framework for SMEs' ERP implementation. The framework phase consists of (1) measuring the business maturity, information communication and technology (ICT) maturity, proposed business process improvement, and (2) implementing an ERP system. The author has also provided a case study of ERP adoption in an SME in this paper by compiling both steps. This research will contribute to research on ERP in SMEs and practice as guidance for ERP implementors and SMEs in adopting the ERP system.

This is an open access article under the [CC-BY-SA](#) license.



1. Introduction

Small and medium-sized enterprises (SMEs) have substantially impacted the global economy [1]. In Indonesia, the SME sector accounts for 97% of the workforce and contributes 57% to the Gross Domestic Product (GDP) [2]. Despite experiencing rapid growth, SMEs encounter significant problems and opportunities due to intensifying competition and the expansion of the information technology [3].

To tackle the aforementioned issues and take advantage of the opportunities, the use of information technology, such as an Enterprise Resource Planning (ERP) system, has the potential to enhance the competitiveness of the SMEs [4]. ERP systems have experienced significant progress since their development in 1990 and have transformed into complex integrated enterprise systems [5]. It has been projected that by 2024, 60% of information system implementation projects will be carried out in SMEs [6]. ERP adoption in SMEs can contribute to reducing inventory expenses, strengthening customer service performance, improving inter-process communication [7] [8], reducing data input errors, increasing cost efficiency, and evaluating up-to-date data to facilitate decision-making [3].

While deploying ERP systems may lead to substantial growth, companies must be vigilant about the potential risks associated with implementation failures. Ulrich & Newcomb found that only 10% of ERP adoption programs succeeded, while 35% were discontinued and 55% were postponed [9]. This number illustrates the significant risk associated with implementing an ERP system for both the implementor and the users.

Wong et al. identified fourteen factors that can lead to the failure of ERP systems deployment [10]. These factors include complex business process re-engineering, ineffective project management, insufficient infrastructure, and reluctance to change. In addition, Hasan et al. conducted a study that categorized the factors contributing to the failure of ERP adoption into internal, external, and overlapping variables [11]. Top management and human resources are internal factors, while system vendors and consultants are external entities. Furthermore, the interaction between the user and the team responsible for executing the project results in the convergence of several aspects.

Aside from the above factors that can hinder the implementation of ERP, SMEs have unique characteristics that can contribute to implementation failure. Zach *et al.* revealed that the type of ownership and limited resources were the biggest obstacles to adopting ERP in the SME [12]. Previous research, such as [13] and [3], has also highlighted limited resources. SMEs may encounter constraints regarding financial resources, workforce availability, and access to information technology assistance [3].

Therefore, based on the description above, this paper aims to design a proposed framework for adopting an ERP system within SMEs. Designing a framework for ERP implementation in SMEs has been conducted by previous research [3]. However, all proposed frameworks directly jump into the implementation phase. As stated by Christofi *et al.* [13], evaluating the business process before the ERP adoption is a crucial step in determining the success of ERP implementation. Therefore, this study proposed integrating assessment business process maturity and ERP implementation steps. In addition, most research focuses on designing implementation frameworks for big companies [14]. Therefore, this study will focus on designing a framework for ERP implementation in SMEs.

2. Method

Numerous studies have been conducted to develop a framework for ERP implementation. However, most developed frameworks are dedicated to large companies. Therefore, this study aims to design a framework for ERP implementation within an SME, as SMEs have different characteristics than big companies. SMEs face an enormous challenge in ERP adoption due to the limited availability of finance, human resources, and information technology [3] and the type of ownership of SMEs [12].

Chofreh *et al.* [15] developed a sustainable ERP (S-ERP) implementation framework combining sustainable and decisional paradigms. This study proposed two components in ERP implementation: the sustainability paradigm (society, environment, and economy) and the decisional paradigm (strategic, tactical, and operational level).

Sahran *et al.* [16] provided a framework for ERP implementation in SMEs. The framework combines the critical success factor of ERP implementation and the ERP implementation step, starting from management direction and ending with post-implementation support.

Carmela and P. Perez [8] studied ERP framework design on garment SMEs, focusing on identifying the model and the suitable role for a garment manufacturing company. This study utilized a human-centered design methodology that consists of three phases: inspire, ideate, and implement. The “Inspire” phase aims to collect data through in-depth interviews with the management and system’s users. In the “Ideate” phase, the data collected are analyzed and translated into a solution. Moreover, in the “Implementation,” the framework obtained from the second phase is used to design the ERP system.

Alaskari et al. [3] proposed a framework for selecting ERP systems. The framework consists of three steps : (1) define and assess the current company process, (2) evaluate the ERP system, (3) select the appropriate. In step 1, business process mapping and in-depth interviews were performed.

Alaskari et al. [14] studied the ERP implementation framework in SMEs, complete with a case study. The framework consists of 9 steps: (1) phase 1: process analysis, (2) phase 2: preparing the scope of work (SOW), (3) phase 3: creating a project plan, (4) phase 4: build the system, (5) phase 5: preparing the standard operating procedures (SOP), (6) phase 6: creating a data migration plan, and (7) phase 7: user acceptance tests, (8) phase 8: user training, and (9) phase 9: go-live.

Christofi *et al.* [13] found that conducting a business process review before implementation is critical to ERP implementation success. However, most previous frameworks have jumped into the implementation step and taken minor considerations into the business process review. Alaskari et al. [14] considers business process review as the first step in the implementation, but this research only

maps the current business process. Therefore, this study will use a business process review as the first step before the implementation step.

The business process assessment will be conducted in the business process review step based on the business process maturity questionnaire Skrinjar and Trkman [17]. The questionnaire assesses 9 variables: strategic view (*sv*), process definition and documentation (*ddp*), process management and measurement (*mmp*), organizational process structure (*pos*), people management (*uk*), process organizational culture (*pok*), market orientation (*tu*), supplier perspective (*vd*), and IT support (*pip*). This questionnaire has been used by various researchers, such as [18], [19], [20], [21], and [22]. By utilizing this comprehensive assessment, the current level of SME's business process can be identified, and improvement can be proposed. Dolganova [23] stated that effective information system adoption requires Level 3 (Linked) business process maturity.

Information and communication technology (ICT) maturity will also be conducted in the pre-implementation step. This assessment is motivated by the fact that most SMEs experience a challenge with limited resource capability, one of which is information technology. In this research, the ICT maturity questionnaire is derived from Pham's [24] research. This questionnaire assesses three variables: ICT Infrastructure, ICT Application, ICT Human Resources, and ICT Policy. This questionnaire has been used in research by Manggaran *et al.* [22].

Most ERP implementations have three main steps: problem formulation, design, and testing. This research utilized the action design research (ADR) framework in the implementation step. ADR consists of three stages: problem formulation, building, intervention and evaluation (BIE), and reflection and learning [25]. In the problem formulation phase, problem formulation is carried out, determining the needs and scope of the project, as well as literature studies related to the problem. In the BIE phase, the ERP system implementation is carried out, which consists of module selection, system configuration, and data input. The activities carried out in this phase are analyzing the as-is and to-be conditions. Finally, system testing and user feedback were conducted in the reflection and learning phase.

3. Results and Discussion

3.1. Developing a Proposed Framework

The proposed framework was developed by conducting a literature review and assessing the obstacles faced by SMEs obtained from direct observation. A review found that most of the proposed framework only focused on the implementation step. As stated by Christofi *et al.* [13], evaluating the business process before the ERP adoption is a crucial step in determining the success of ERP implementation. Therefore, in this study, the proposed framework consists of two main steps: Step 1: business process assessment and Step 2: ERP implementation step. The proposed framework is depicted in Figure 1.

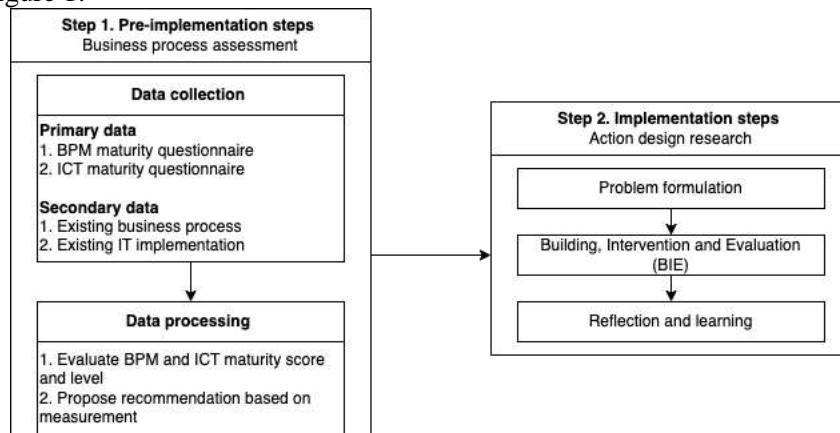


Fig.1. Proposed ERP implementation framework within SME

As depicted in Figure 1, the proposed framework consists of pre-implementation and implementation steps. In the pre-implementation step, business process maturity and ICT maturity are measured, and the proposed recommendation is given based on the assessment result. As stated by

Dolganova [23], effective information system adoption requires Level 3 (Linked) business process maturity. Three steps in the implementation are conducted: problem formulation, building, intervention and evaluation, and reflection and learning.

3.2. Utilizing the Proposed Framework in an SME: A Case Study

This subchapter presents a case study utilizing the proposed framework within an SME. The proposed framework is divided into two steps: (1) business process maturity assessment and (2) system implementation.

3.2.1 Business Process Maturity (BPM) Assessment as Pre-Implementation Step

BPM assessment is a tool for assessing organizations, providing insights into improving business process management. Lee *et al.* [26] stated that maturity assessment helps organizations set goals for improving and developing business strategies. According to Gandhi [18], BPMM measurement comprises four levels: *Ad Hoc*, *Defined*, *Linked*, and *Integrated*. Dolganova [23] advised that effective information system adoption requires Level 3 (Linked) business process maturity. The description of the four levels of BPMM are as follows:

1. *Ad Hoc*: Business processes are unstructured and undefined.
2. *Defined*: The company possesses basic documented business processes available in flowchart form.
3. *Linked*: Business processes are at a more advanced stage and are interconnected.
4. *Integrated*: Business processes reach the highest level, with complete integration among the company's processes, vendors, and customers.

The business maturity assessment of the observed SME showed an average score of 3.35, indicating that the observed SME was at the *ad hoc level*. At the *ad hoc level*, a business process needs to be structured, and most functions are still traditional. As seen in Figure 1, SME requires an improvement in all variables, especially the IT support variable (*pip*). This finding indicated that the observed SME should improve the availability of IT infrastructure supported by policies and qualified IT resources.

On the other hand, ICT maturity measured using Pham's [24] obtained that the ICT maturity level of the SME is 0.477 (substantial). The detailed score of the four criteria is depicted in Figure 2 (b). The measurement results show that the observed SMEs already have a proper infrastructure technology infrastructure and are supported by qualified human resources. However, the weakness lies in policies not meeting business and technology standards.

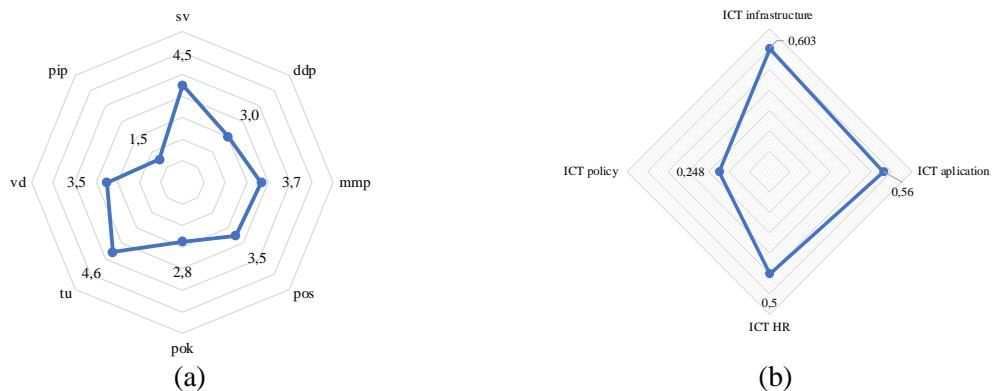


Fig.2. (a) BPM assessment, (b) ICT maturity

3.2.2 The Implementation Steps of ERP in an SME

The preceding section demonstrates the evaluation of business process maturity by utilizing a BPM questionnaire. The assessment sought to comprehend the present condition and can be utilized to suggest enhancements. Conversely, this sub-chapter will present a case study that examines the process of implementing an ERP system in an SME. This paper presents a case study of ERP implementation, employing an action design research (ADR) approach. ADR consists of three stages:

problem formulation, building, intervention and evaluation (BIE), and reflection and learning [25]. The description of each phase is as follows:

1 Problem formulation

The problem was formulated by identifying the requirements and scope of the project, as well as conducting a review of the literature on adopting ERP systems in SMEs. The SMEs under observation employ a make-to-order strategy, wherein a customer's order triggers the business process. Currently, all business procedures are documented through manual means. The problem formulation delineated the observed SME's existing (*as-is*) and projected (*to-be*) business process. Figure 3 and Figure 4 illustrate the current and desired business processes of the observed SME modeled using the Business Process Model and Notation (BPMN).

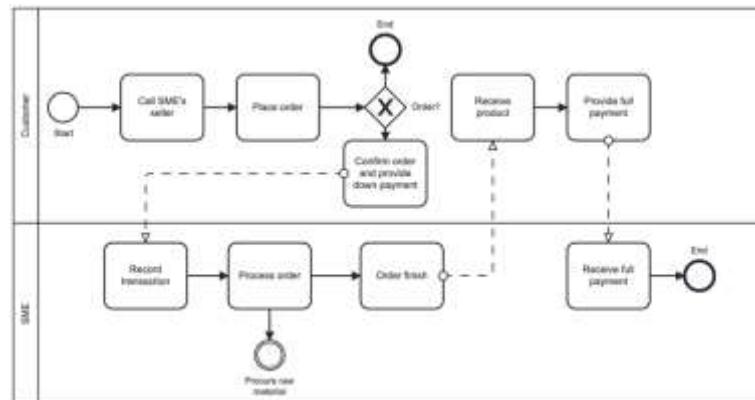


Fig. 3. As-is business process in observed SME

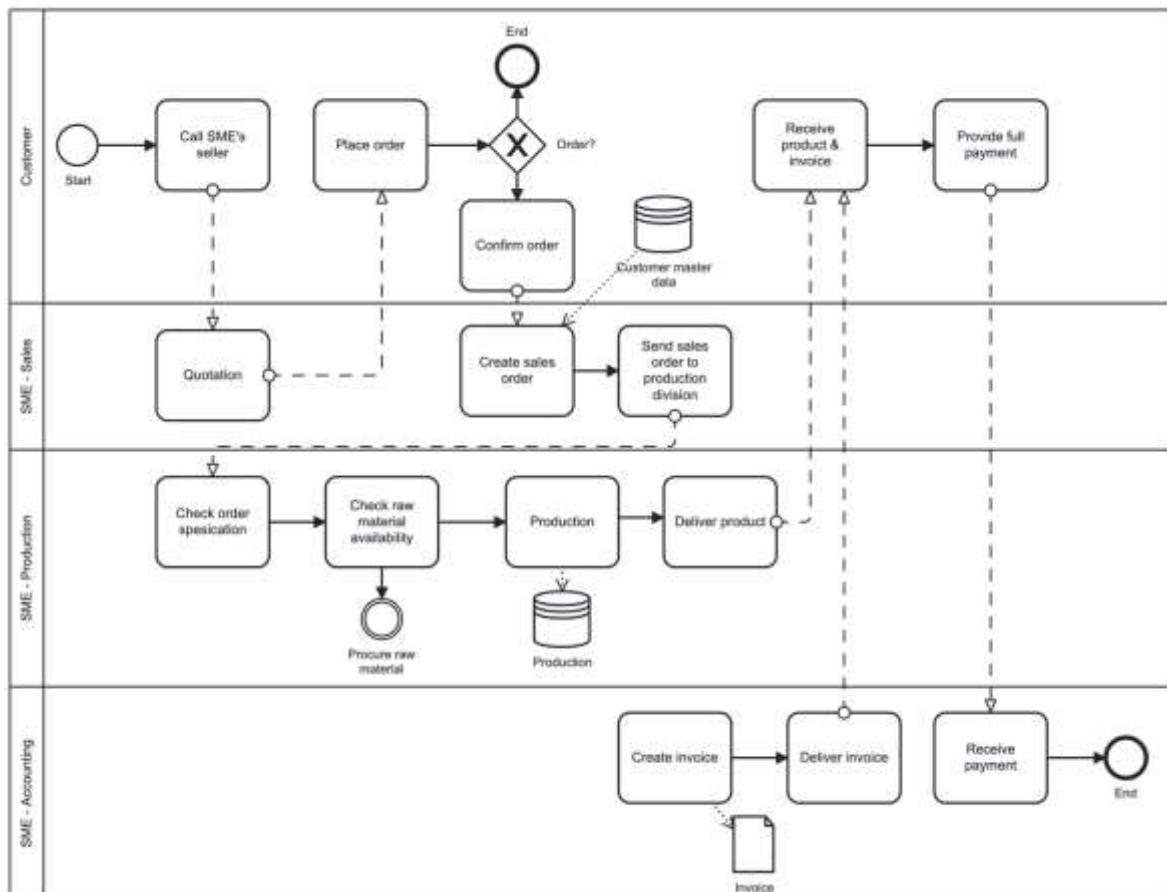


Fig. 4. To-be business process in observed SME

2 Building, Intervention, and Evaluation (BIE)

This paper describes the utilization of open-source ERP for implementing an ERP system in an SME. Configurations were conducted by identifying business processes outlined in the preceding sub-chapter. General configuration, such as company data and fundamental details about the chosen module, were inputted during this stage. This paper presents the execution of ERP implementation on a Sales module.

The Sales module was configured in the following stages: (1) initial configuration, (2) product configuration (including name, price, attributes, and variants), (3) quotation and order configuration (including name, product quantity, and discount), and (4) invoice configuration (including product name, quantity, discount, total payment, invoice date, and payment limit).

Based on the illustrated Figure 4, the observed SME provided a quotation in response to the customer's request, considering the intended business procedure. Figure 5 depicts the outcome of configuring the Quotation menu. The Quotation menu includes customer details, product name, quantity, and the date until the price is valid.

As depicted in Figure 4, a sales order document is created after the customer accepts the quotation. The process entails the subsequent steps of delivering the product to the customer, issuing an invoice, and collecting money from the customer. Figure 6 depicts the Invoice option within the open-source ERP system. The invoice menu includes the customer's name, invoice date, product name, and product price.

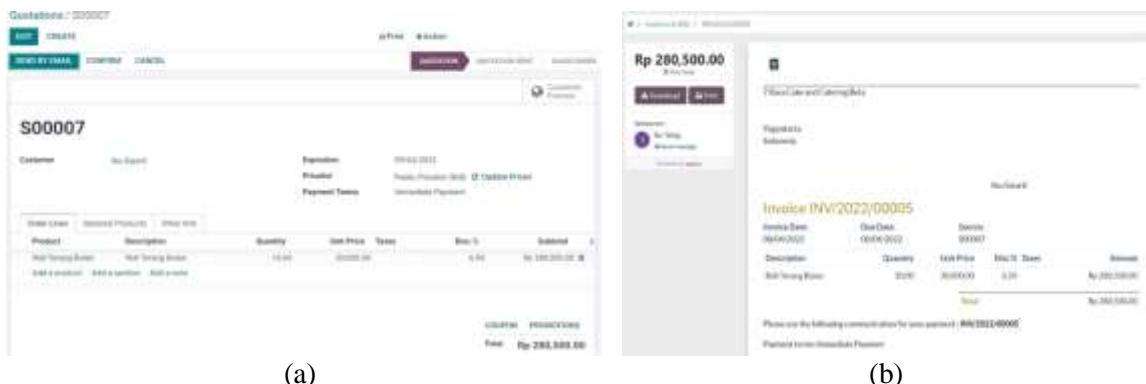


Fig.2. Configuration of (a) quotation and (b) invoice

3. Reflection and Learning

The reflection and learning stages were executed through testing and gathering user input. User Acceptance Testing (UAT) served as a technique in evaluating user performance. This stage confirmed that all functionalities were pertinent to the business processes of the observed SMEs. Table 3 depicts the many scenarios employed in UAT.

Table 2. Scenarios for User Acceptance Test (UAT)

Scenario 1	Perform sales input
Scenario 2	Perform customer input
Scenario 3	Create a quotation document
Scenario 4	Create sales order documents
Scenario 5	View product sales analysis dashboard
Scenario 6	Create customer invoice documents for sales
Scenario 7	Create payment documents for product sales

Following the UAT, interviews were conducted with the SME's owner. Interviews revealed that the system configuration was following their expectations. Furthermore, the owner of the SME also expressed a favorable response to the proposed business procedure. Adetyan *et al.* [27] identified business process reengineering as the primary determinant of ERP deployment success in small and medium-sized enterprises (SMEs). Furthermore, Silalahi *et al.* [28] discovered that non-technical obstacles were more important than technical ones. Therefore, a blueprint document was created to

guide the user when utilizing the system in this study. The blueprint paper encompasses the sales processes and their corresponding stages of implementation in Odoo software.

4. Conclusion

This paper aims to design a framework for ERP system implementation in SMEs. The proposed framework consists of two main steps: Step 1. Business process assessment and Step 2. ERP implementation. One SME was used as a case study of implementation utilizing the proposed framework. This study contributes to the literature on ERP implementation by providing a framework that combines two crucial steps to minimize the risk of ERP implementation failure. In addition, this study also has the potential to contribute to the practice of ERP implementation, especially in the SME sector.

References

- [1] B. Snider, G. J. C. Silveira, and J. Balakrishnan, “ERP implementation at SMEs: analysis of five Canadian cases,” *Int. J. Oper. Prod. Manag.*, vol. 29, pp. 4–29, 2009, doi: 10.1108/01443570910925343.
- [2] D. Bellefleur, Z. Murad, and P. Tangkau, “A Snapshot of Indonesian Entrepreneurship and Micro, Small, and Medium-Sized Enterprise Development,” 2012.
- [3] O. Alaskari, R. Pinedo-Cuenca, and M. M. Ahmad, “Framework for selection of ERP system: Case study,” *Procedia Manuf.*, vol. 38, no. Faim 2019, pp. 69–75, 2019, doi: 10.1016/j.promfg.2020.01.009.
- [4] N. Limantara and F. Jingga, “Open Source ERP: OODOO Implementation at Micro Small Medium Enterprises,” in *2017 International Conference on Information Management and Technology (ICIMTech)*, 2017, no. November, pp. 340–344.
- [5] J. Goldston, “The Evolution of ERP Systems: A Literature Review,” *Int. J. Res. Publ.*, vol. 50, no. 1, 2020.
- [6] J. Van Decker and G. Leiter, “Magic Quadrant for Cloud Core Financial Management Suites for Midsize, Large, and Global Enterprises,” 2021.
- [7] P. T. Kale, S. S. Banwait, and S. C. Laroiya, “Performance evaluation of ERP implementation in Indian SMEs,” *J. Manuf. Technol. Manag.*, vol. 21, no. 6, pp. 758–780, 2010, doi: 10.1108/17410381011064030.
- [8] C. Carmela and P. Perez, “ERP Framework Design for SME: A Solution for an Effective Management for Garments Manufacturing,” *Southeast Asian J. Sci. Technol.*, vol. 4, no. 1, pp. 137–143, 2019, [Online]. Available: <https://www.sajst.org/online/index.php/sajst/article/view/185>.
- [9] W. M. Ulrich and P. Newcomb, *Information Systems Transformation: Architecture Driven Modernization Case Studies*. Morgan Kaufmann, 2010.
- [10] A. Wong, H. Scarbrough, P. Chau, and R. Davison, “Critical Failure Factors in ERP Implementation,” *AIS Electron. Libr.*, vol. 40, no. 1, pp. 1–15, 2005.
- [11] M. S. Hasan, Z. Ebrahim, W. H. W. Mahmood, and M. N. A. Rahman, “Factors Influencing Enterprise Resource Planning System: A Review,” *J. Adv. Manuf. Technol.*, no. Spesial Issue iDECON, pp. 247–258, 2016.
- [12] O. Zach, B. E. Munkvold, and D. H. Olsen, “ERP system implementation in SMEs: exploring the influences of the SME context,” *Enterp. Inf. Syst.*, vol. 8, no. 2, pp. 309–335, 2014, doi: 10.1080/17517575.2012.702358.
- [13] M. Christofi, M. Nunes, G. C. Peng, and A. Lin, “Towards ERP success in SMEs through business process review prior to implementation,” *J. Syst. Inf. Technol.*, vol. 15, no. 4, pp. 304–323, 2013, doi: 10.1108/JSIT-06-2013-0021.
- [14] O. Alaskari, R. Pinedo-Cuenca, and M. M. Ahmad, “Framework for implementation of enterprise resource planning (ERP) systems in small and medium enterprises (SMEs): A case study,” *Procedia Manuf.*, vol. 55, no. C, pp. 424–430, 2021, doi: 10.1016/j.promfg.2021.10.058.
- [15] A. G. Chofreh, F. A. Goni, and J. J. Klemeš, “Sustainable enterprise resource planning systems

implementation: A framework development," *J. Clean. Prod.*, vol. 198, pp. 1345–1354, 2018, doi: 10.1016/j.jclepro.2018.07.096.

[16] S. Sahran, F. A. Goni, and M. Mukhtar, "ERP implementation challenges in small and medium enterprise: A framework and case study," *Adv. Mater. Res.*, vol. 139–141, no. April 2016, pp. 1636–1639, 2010, doi: 10.4028/www.scientific.net/AMR.139-141.1636.

[17] R. Skrinjar and P. Trkman, "International Journal of Information Management Increasing process orientation with business process management : Critical practices ' ', " vol. 33, pp. 48–60, 2013, doi: 10.1016/j.ijinfomgt.2012.05.011.

[18] H. N. Gandhi, "Analisis Tingkat Kematangan Proses Bisnis Perusahaan Garmen Kelas Menengah," Institut Teknologi Sepuluh Nopember, 2017.

[19] A. A. Garini, J. S. Informasi, and F. T. Informasi, "Penilaian Tingkat Kematangan Proses Bisnis Berbasis Enterprise Resource Planning : Studi," vol. 6, no. 1, 2017.

[20] P. H. G. Sibarani, "Analisis Tingkat Kematangan Proses Bisnis dan Kesiapan Teknologi Informasi Studi Kasus Usaha Makanan dan Minuman Mikro, Kecil, dan Menengah di Jawa Timur," Institut Teknologi Sepuluh Nopember, 2018.

[21] W. Utami *et al.*, "Measurement of maturity of small medium agroindustry business processes in Jember , Indonesia," in *ICCGANT*, 2019, pp. 1–11, doi: 10.1088/1742-6596/1538/1/012031.

[22] A. S. Manggabarani, M. Miftah, and Alfida, "Analysis of Business Processes and Performance of Manufacturing MSMES in Village Cileles Lebak Banten," *Ilomata Int. J. Manag.*, vol. 2, no. 2, pp. 121–132, 2021.

[23] O. Dolganova, "Multi-criteria assessment of university readiness for digital transformation," in *ICID-2019 Conference*, 2020, pp. 1–9.

[24] Q. T. Pham, "Measuring the ICT maturity of SME," *J. Knowl. Manag. Pract.*, vol. 11, no. 1, pp. 1-14., 2010.

[25] M. K. Sein, O. Henfridsson, S. Purao, M. Rossi, and R. Lindgren, "Action Design Research," *MIS Q. Manag. Inf. Syst.*, vol. 35, no. 1, pp. 37–56, 2011.

[26] J. Lee, D. Lee, and S. Kang, "An Overview of the Business Process Maturity Model (BPMM)," *An Overv. Bus. Process Matur. Model*, pp. 384–395, 2007, doi: 10.1007/s11769-001-0015-3.

[27] A. Adetyan, D. P. Putra, F. Adiana, and S. I. Wahjono, "Upaya meningkatkan keberhasilan implementasi ERP untuk membangun keunggulan bersaing pada UKM surabaya," in *Seminar Nasional Hasil Peneletian dan Pengabdian kepada Masyarakat UNIPMA*, 2012, pp. 116–124.

[28] I. P. Silalahi, Daniel, E. P. Siagian, and J. Junaidi, "Pengaruh Enterprise Resource Planning (ERP) terhadap kinerja perusahaan Usaha Kecil Menentah," *J. Syntax Adminiration*, vol. 3, no. 6, pp. 768–775, 2022.