Packaged Enterprise System Customization – A Systematic Literature Review

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Abstract

A packaged enterprise system (PES) is an Enterprise System (ES) software package that is built with certain assumptions about the business processes. It is offered to the business with an implemented and predefined set of functionalities, which, however, are seldom usable immediately, but require some customization. Sometimes only minor changes to PES are made while occasionally the system, offering more possibilities, is configured significantly. This paper aims at mapping what we know about PES customization, and presents a systematic literature review to form a coherent understanding of its topics, themes, methods, publication outlets, scientific disciplines, and researchers. Our findings show that the topic is scattered across disciplines and domains, the studies mostly relying on surveys and implementation phase case studies, and giving a generic view rather than focusing on certain domain or the type of PES. We thus propose a set of potential research topics, for example on the business domain level to better understand the dynamics of customization and its influencing factor.

1. Introduction

Enterprise systems [ES] are complex software packages that offer the potential of integrating data and processes across functions in an enterprise. Examples include ERP systems (integrating back-office functions such as materials management, order entry, distribution logistics, and financials), CRM (integrating marketing, sales, and customer service interactions with customers), and SCM (integrating processes among firms in a supply chain) [1]. An enterprise system is thus a comprehensive software system designed to fulfill a broad range of essential organizational information processing needs on an organization-wide scope. ES vendors typically divide their software packages into application "modules" such as accounting and finance, production, human resources [2].

Packaged software systems are a dedicated and currently dominating type of ES [3]. The "out-of-the-box" solution of a packaged software system, as provided by the vendor, usually does not meet the organization's information processing needs immediately [4]. There is thus a need to balance the focus between adjusting and tailoring the business processes or modifying the packaged ES [5]. Yet, as the organizations make large investments in ES, they expect positive impacts especially in their business processes, management of expenditure, customer service, and more generally, competitiveness. Forrester survey data [6] consistently shows that the investments in ERP and enterprise applications remain the top IT spending priority. The ERP market is currently estimated at $38 billion.

ES make an assumption that they support the best processes, and the organization should change its practices according to PES. PES thus assume the superiority of the processes and the stability of the use environment and regulation. This results in PES not always fitting to the organizational processes in practice and the organization's varying needs. A need for customization emerges, also because a modified PES gets better accepted in the organization and by its user. This leads to PES customization, where the benefits correlate with the amount of customization [2].

Customization can be further distinguished into three types: configuration, extension (i.e., through user-exits), and modification [2]. From a cost of ownership perspective, the difference between the three types of customization is the support by the ES vendor, not technical activities associated with the customization. Technical activities, such as changing entries in tables or configuration files, are usually taken by the vendor. Most ES vendors also allow extension to their systems by supporting common interfaces for data exchange (user-exits), but do not support the functionalities behind these interfaces.

Customization is the ability and practice of providing our clients with solutions that meet the needs of their requirements. IT customization is the result of detailed information gathering, process definition and implementation of best practices [7].

HＩCSS

The small amount of customization resulted in low user satisfaction as some of the user requirement cannot be covered or fulfilled. However too many customization also cause negative implication in term of increasing the system complexity [8]. PES and its customization have been known to practice and research for a long time as, for example, ES research was on its peak in the turn of the millennium, after which PES took off [9]. However, according to our initial literature search, it seems that the research is scattered across numerous outlets, focusing is a myriad of topics and methods. We thus decided to conduct a systematic literature review in order to understand PES customization better, and to see what is studied so far on PES research. The review is exploratory as we did not use any predefined model in the analysis, but utilized inductive, data-driven approach.

This paper is organized as follows. First, an overview of PES and related literature reviews is presented. Then the review: data collection, its analysis, and the results is portrayed. The paper ends with discussion and concluding sections.

2. Background

Enterprise Systems (ES) are commercial software packages that enable the integration of transactions-oriented data and business processes throughout an organization – and perhaps eventually throughout the entire inter organizational supply chain [4]. Packaged Enterprise System (PES) is a solution that incorporates common tasks and data in companies and presumably reflect best practices in the industry. Many EA modules are implemented in close collaboration with industry partners to ensure that they provide state-of-the-art functionality. In this way, the package is applicable in most organizations, and less efficient organizations can use it to raise the standard of their internal business processes. It is not just for automating tasks, but also for streamlining or reengineering processes according to what has proven successful in other companies [10].

A common problem when adopting package ES has been the issue of "misfits," that is, the gaps between the functionality offered by the package and the requirements of the adopting organization [11] observe there are three types of misfits: data, process, and output. Data misfits arise from incompatibilities between organizational requirements and ERP package in terms of data format, or the relationships among entities as represented in the underlying data model. Functional misfits arise from incompatibilities between organizational requirements and ERP packages in terms of the processing procedures required. Output misfits arise from incompatibilities between organizational requirements and the ERP package in terms of the presentation format and the information content of the output. When a misfit occurs, organization needs to choose either adapting to the new functionality or customizing the package [12].

Modification is an alteration that is usually not supported by the vendor. This includes code changes and other more invasive alterations. Organizations implementing an ES must always make some configurations [13], There are many factors that influence the customization in PES and studies have been conducted to study the influence of factors on PES implementation [14], Influence of culture and country on adoption of PES [15], Influence of ERP on business process agility in the organization [16]. Also there is an exploratory study done on the influence factors of customization in PES [2].

The factors influencing customization can be grouped into four main categories: strategy, institution, project, and the system [2]. Strategy includes business units' strategic importance and differentiators. ES modules are customized particularly in areas supporting business units that were deemed strategically more important. Institutional factors are about the resistance to change and about the business partner involvement. If the organization fails to handle the resistance to change, then ES need to be customized more, eventually making it very costly to operate. Also tight business partner involvement leads to the need for more customization because corporate wide standards that are compatible to all business partners, are rarely found from one PES. Consequently, the system is customized to fit with all units or companies in the consortium. Project factors include project leadership, methodology and timeline, customization request and change management, user involvement, and implementation partner involvement. Apart from project leadership, all other factors significantly influence on the ES customization. The system related factors are about its maturity and complexity. Maturity largely influences customization as some PES may have a good support and implementation of the processes for example in accounting, but might lack those in the logistics or finance. Consequently, the organizations need to customize the system. Complexity refers to the consultants' easiness to evaluate the system for achieving certain needs through configuration and customization [2].

These influence factors illustrate the complexity of PES customization for its implementation and success. It also shows the need from the research community to study its' numerous

aspects and understand and support PES customization.

There are several literature reviews on ES and PES. They focus on PES implementation in large enterprises [17], multinational enterprise [18], SMEs [19], and the evolution of PES [20]. In addition, PES success factors have been studied, but no paper actually talks about customization in PES. For example, Alves et al. [21] focus on requirement engineering in the PES development, Sheppard [22] studies PES development costs, and Jørgensen [23] reviews the experts' estimation on the development efforts. Other papers, not being systematic literature reviews, evaluate the success and failure of PES implementation [24], or are case studies on ERP implementation cases [25].

This thus seem to be a gap in understanding the state-of-the-art of PES customization research. This is presented next.

3. Research method

This study follows the systematic literature review guidelines by Kitchenham [26]. It comprises of three main stages: planning, execution, and result analysis. Our research process is summarized in Figure 1. Next, each phase and our activities there are shortly presented.
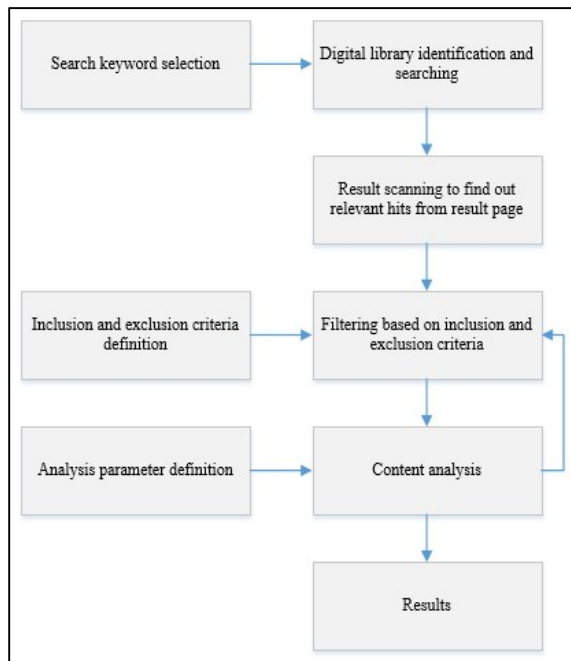

Figure 1: Research process

3.1. Literature searching and data collection

As packaged ES have been in use quite a long time, we decided to use established terms as keywords. We thus searched for "customization" in a pair with different types of packaged enterprise systems. These included "packaged enterprise system", "enterprise system", "enterprise resource planning", "supply chain management", "customer relationship management".

We used these keywords on several research databases. Online libraries provide access to a large set of studies that can be easily accessed. Different libraries are:

- EBSCO Research Database
- Ieeeexplore
- Emeraldinsight
- Springerlink
- Sciencedirect
- Scholar.google.com
- ACM Digital library
- Taylor and Francis
- Research Gate
- Wiley online library
- Semantic scholar
- Scientific literature digital library
- ProQuest
- AIS Electronic library

Searching the database returned 347 papers that were scanned for possible matches.

3.2. Data finalization

As suggested by Kitchenham and Charters (2007), we used following inclusion and exclusion criteria:

- Inclusion criteria
  - Peer reviewed studies
  - conference proceeding
  - journal articles
- Exclusion criteria
  - Papers not in English
  - Books chapters
  - Short articles
  - Commercial publications and white papers
  - PhD and Master's thesis

After applying the exclusion criteria, the result came down to 182. Then the abstracts and the results sections were analyzed to assess the relevance with our focus. The number of papers was reduced down to

67. The data set contains 65% of papers from journals, 25% papers from refereed conference proceedings and 10% from peer reviewed other sources. Papers were then inductively analyzed without any predefined framework. Various details, such as bibliographical information (author, publication year, type of publication,), focus area (evaluation, adoption, implementation of PES etc.) the type of PES, the context of study (government, private or both), industry in reference, organization size, research method, and geography were recorded. The list of included papers can be found from the ResearchGate, http://dx.doi.org/10.13140/RG.2.2.19847.01448

4. Findings

This section presents findings from the literature review.

4.1. Publication channels

Table 1 presents the distribution across different publication channels and outlets where two or more papers appeared. No particular publication channel dominates PES customization research, but the papers are widely distributed across many channels.

Table 1: Publication channel

Publication channel	Paper count
3rd Generation Enterprise Resource Planning Systems	2
AMCIS	3
ECIS	3
European Journal of Information Systems	2
ICEIS	3
ICIS	2
Industrial Management & Data Systems	2
Information System Management	2
International Journal of Operations & Production Management	2
International Journal of Production Economics	2
Journal of Information Technology Case and Application Research	2
Management Information System	4

4.2. Yearly distribution

We also looked at the articles' publication years in order to find out when the topic was trending. Most

PES papers are published in the late 2000-10. This parallels with Pekkola et al. (2013) study on the ES fashion with a delay. Nevertheless, PES research is still active and will most likely remain so in the coming years as there is no sign of decline. Figure 2 illustrate the annual distribution of articles.
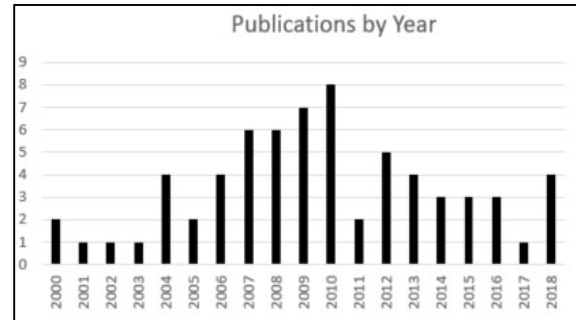

Figure 2: Yearly distribution

4.3. Geographical distribution

No ERP system can be successfully implemented without resolving misfits resulting from national differences [27]. This means mimicking others does not lead good results. We analyzed the geographical region of the research data collection and the geography of the case organization. It was found that most papers lacked clarity on this issue. For example, a survey is often distributed to different organizations, irrespective of geography. The case studies usually focus on Europe or Americas. Geographical distribution is presented in Table 2. For 20 paper, geographical distribution was marked as unknown. They either reported international surveys or case studies which could not be tagged to any particular continent, or did not disclose such information.

Table 2: Geographical distribution

Continent	Paper count
Africa	1
Asia	12
Americas	13
Europé	15
Oceania	6
Unknown	20

4.4. Distribution of research based on category

We categorized each paper according to their main themes. It looks like the most papers (27) have focused on PES implementation, which is followed by studies on Acceptance and User satisfaction (16). This

parallels with [28] who found that up to 40% of 313 ERP articles published from 2000-2006 try to explain ERP implementation. Table 3 shows how our 67 articles are distributed to different points of foci.

Table 3: Distribution according to point of foci

Research Category	Paper Count
Acceptance and User statisfaction	16
Evaluation and Selection	10
Implementation	27
Influence factor of customization	3
Maintenance and cost of operation	6
Success and failure	3
Several categories or no clarity	2

4.5. Industry distribution

Our analysis also shows that research has been largely scattered around different industries. Any particular industry does not dominate the research. Altogether, industry specific studies are few as most studies were surveys or generic interview-based studies without explicit focus on particular industries. Table 4 presents the industry distribution.

Table 4: Distribution based on industry

Industry	Paper Count
Aviation	1
Banking and Finance	1
Construction	1
Education	3
Energy	2
FMCG	1
Healthcare and education	6
Logistics	4
Manufacturing	7
Involving many industries	26
Not specific to any industry	15

4.6. Type of PES studied

The types of PES in focus in our sample clearly shows the dominance of ERP while the other types are touched only sporadically. This insight could be both positive and negative: either other PES need less customization or they have not yet been studied. Table 5 shows the dominance of ERP in PES research.

Table 5: Distribution according to PES types

PES Type	Paper Count
ERP	58
CRM	3

SCM	1
Not known or mixed cases	4

4.7. Context of study

Table 6 shows the distribution of studies across public and private sector organizations. Although there are some comparative studies where public and private sector are compared, public sector studies are largely absent.

Table 6: Distribution based on organization type

Organization Types	Paper Count
Private	15
Public	6
Both	29
Not known	17

4.8. Research method

We analyzed the research methods used. Their distribution is shown in Table 7. It looks that the majority of the studies were empirical studies, data collection being based on interviews, surveys, or case study. The scarcity of the framework building studies shows that there is an opportunity of further research to build frameworks to help customization and align PES with the strategic goals of organization.

Table 7: Distribution based on research method

Factor	Research Method	Paper Count
Theoretical	Theoretical framework building	3
	Critical literature review	2
Empirical	Interview	16
	Survey	8
	Observation	7
	Secondary data	0
	Mixed method research	7
	Comparative studies	5
	Case study	15
Descriptive	Theoretical and practice integration	1
	Practice illustration and introduction	0
	Viewpoints	3
Prescriptive	Prescriptive	0

5. Discussions and conclusions

Next, we will analyze these findings. First, it is positive that PES customizations play an important role in every phase of the PES life cycle, from procurement to implementation and further to its' acceptance. For example, 40,2% of the papers talk about PES customization in the implementation context. This is followed by a large number (23,8%) of studies on acceptance and user satisfaction. However, very little is known about the customization activities itself and their outcomes that happen *after* the system is put to production or during its use and maintenance phases.

Second, up to 80% of the lifetime costs of an IS originate from the application support and maintenance [29] [30]. However, our review shows that there is very little studied in PES customization research. For example, there is very little help for practice to decide whether they should customize the system in the first place, what are the parameters that should be considered when making this decision, or if the customization influences long term costs or benefits. Mostly the research has used surveys and interviews to understand the dynamics of PES customization while studies after the system is put to production are missing. Those studies would however help validating the usefulness and impact of customization, and align the system to the organization's strategic goals.

Third, PES customization seem to be dominated by the developed world where the acceptance of PES is significantly higher compared to the developing world. This creates problems in applying the results in practice, as the findings are not transferrable without understanding not only the context and culture of the target organization but also the business culture in each country. The lack of these studies result in a narrow scope of instructions.

Fourth, the same limitedness is apparent also with the type of PES. The research has been mainly around the ERPs and not others such as SCM or CRM. In fact, 85,9% of papers presented case studies, interviews or surveys that focused on the ERP. Very little is known about other type PES when it comes to customization.

Finally, positively speaking, PES customization research seems not to focus on any particular industry but targets many. This points to the extensive applicability of PES in different areas. However, negatively speaking, such a lack of focus does not provide in-depth understanding and instructions on the industry-specific issues on any of the fields.

Altogether, the literature review shows the scarcity of PES customization research in general, although several examples on different topics and domains have been published. Unfortunately, or fortunately, depending on the viewpoint, these papers are published on numerous outlets so that the topic is relevant in many scientific fields, but has not accumulated much knowledge in any discipline. From this perspective, our systematic literature review becomes significant as it gathers PES customization research together. Potential topics for further research will thus help the researchers to get a grasp on the topic and start the research endeavors.

5.1. Recommendation for future work

Our systematic literature review pointed out some knowledge gaps that can be used as a basis for further research. As the PES customization research focuses only on certain areas and has very few articles from each topic, basically every area need more attention and research. Our suggestions include:

- Most PES customization studies are primarily based on interviews and surveys. They thus describe certain cases or projects, being consequently quite limited in terms of generic understanding of PES customization. The surveys provide a broader scope but lack the domain-specificness and the depth of cases. This means there is a need for studies on how the customization was done and how those findings can be generalized or transferred to other context. For example multiple or comparative case studies in different domains, industries, types of PES, or countries are needed.
- PES customization research is focused on the ERP. However, SCM, CRM, and ITSM are equal obvious candidates for customization. Consequently, to study their customizations to find out if a non-ERP system is more or less likely to be customized is an evident topic. For example, what are the major factors influencing the customization in these types of systems? Are the influence factors the same or do they differ between the PES business domains?
- The studies are somewhat scattered across several industry domains. There are also some papers that talked about many industries together. These papers give a generalized view of the systems and PES

customization. Consequently, papers, in plural form, providing an industry specific point of view enhance our understanding whether PES is more mature in some industries so that they meet the business process needs better and are less likely to be customized.

- There are very few public sector specific PES customization studies. As different rules and regulations significantly affect the IS acquisitions, also PES customization is most likely different in the public sector than in the private sector. There is thus an obvious point of interest to conduct different types of PES customization studies in the public sector, and compare those findings with the private sector.

- The PES acceptance are well known in developed economies. In addition, the processes are matured. The situation is different in the developing world, so it would be interesting to study PES customization there and the extent of customization. For example, does budget constraint have any effect on the level of customization since more customization means more costs of ownership throughout the systems life cycle?

5.2. Conclusion

We aimed at understanding the state-of-the-art of PES customizations research. Our review portrays a set of studies referencing customization in different contexts, such as evaluation and adoption, implementation, application maintenance, among others.

The articles show that the PES customization research often uses empirical data from surveys, or structured or unstructured interviews of the people being involved in the implementation project. The project-focus is also evident as there is much more research on the customizations done during the PES implementation than for example during application maintenance and support. This indicates that more research is needed on actual PES customizations during whole life cycle of the product. This would then provide in-depth understanding of different kind of customization and its impacts on different phases of the PES life cycle. It would also show how the customization influence factors, such as organizational factors, market competition, technological advancements, and others, impact the project, the customized product, and the benefits.

PES refers the different systems that are offered as off-the-shelf. They include CRM, SCM and logistics solutions, maintenance management systems, ITSM systems, among others. However, more than 90% of the papers focus solely on ERP. This is a gap from the research points of view as there is limited understanding about other types of PES and how and when they should be customized, if customized at all.

These summarize our findings. We thus contribute the research by illustrating the scattered but still active research on PES customization. The activeness means it is still ongoing and worth studying. Scattered-ness means the papers are published in numerous forums and disciplines, and their topics do not provide in depth understanding on many issues.

Surely there are some limitations. Only academic articles in English were included and analyzed. Although English written research dominates, studies in other languages might provide significant insights. Similarly, practitioner oriented articles and whitepapers may be useful. In addition, the use of online databases, where the indexing algorithms influence the hits may mean that we might have missed some papers. Third, data collection ended at the end of 2019, so studies published after that are excluded.

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