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The Impact of SAP on the Utilisation of Business Process Management (BPM) Maturity Models in ERP projects

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Abstract – The SAP Enterprise Resource Planning (ERP) system is a leading software solution for corporate business functions and processes. Business Process Management (BPM) is a management approach designed to create and manage organizations’ business processes. Both promise an improvement of business processes in companies and can be used together in organizations. In conjunction with the SAP ERP system and BPM approach, BPM maturity models can be used as diagnostic tools that allow an organization to assess and monitor the maturity of its business processes. This research analyses the complex relationships between SAP, BPM and BPM maturity models. The aim is to investigate and analyse the interaction between the use of the SAP ERP software package and the deployment of BPM maturity models. The research adopts a multiple case study approach, based on semi-structured expert interviews, and provides an in-depth insight into how a small number of organizations use SAP, BPM and BPM maturity models.

Keywords – SAP; ERP; BPM; Business Process Management; Maturity Models; BPM Maturity Models.

I. INTRODUCTION

SAP (Systeme, Anwendungen und Produkte) is a German company created in 1972 and the world’s largest provider of enterprise software that, in 2017, had more than 345,000 customers in over 190 countries [1]. The SAP ERP package provides software solutions for the full range of business functions in companies – from the processing of a leave request for employees in the human resource management function, to materials requirements planning in production and support for the full sales order processing cycle and commodity management [2]. SAP ERP is usually installed on a database platform that handles several different business functions within their respective modules, such as manufacturing, sales, finance and human resources. The implementation of an ERP system can often be seen as a form of technology innovation, and contributes to the technology maturity of a company. The capabilities of a company can often be improved by the implementation of an ERP system [3].

BPM is an approach to defining and operating company business processes, and can be used without any information technology (IT) systems or infrastructure [4]. In practice, companies often use IT software tools to administer the BPM of an organisation. Additionally, software such as SAP ERP can assist a company in standardizing and automating processes to make them as efficient as possible [5]. The basic idea of BPM is to think in terms of processes and to deal with the questions: “who does what, when, how and whereby?” [5]. BPM will usually start with a process analysis of the actual business processes [6] by the application of specific methods, techniques and tools [7].

A maturity model is described by Saco [8] as a diagnostic tool for an organization, which provides a framework to test, analyse and improve business quality [9]. For example, a maturity model analyses the quality of processes and classifies them as being at different levels of maturity. There are different maturity models for specific purposes – for example, for software development, for product manufacturing or for the business process management of a company [10] [11]. This latter type of maturity model offers a step-by-step guide, with goals and best practices, to support a more advanced use of BPM [12].

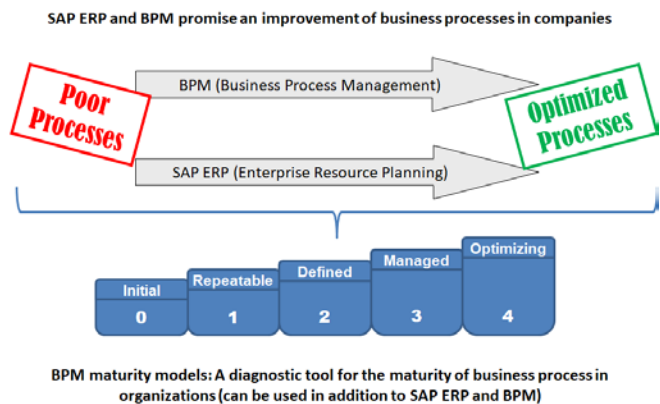


Figure 1. SAP ERP, BPM and BPM maturity models: overview

Figure 1 illustrates the various concepts that are shared by the SAP ERP system, BPM and BPM maturity models. On the one hand, the SAP ERP system includes its own business process models; on the other hand, BPM has the objective of improving business processes in an organisation; both have the same aim of optimizing an organisation's processes.

Then, there are BPM maturity models which have diagnostic tools to measure the effectiveness of processes in organisations. These tools can be used alongside SAP ERP and BPM. Van Looy [13] states that most BPM maturity models favour the use of an IT system (such as SAP ERP) to improve the BPM approach of an organisation [14]. Generally, a BPM maturity model analyses, through a set of tools and methods, the growth of BPM in an organisation. This study considers the relationship of these concepts and how these are used in practice.

Following this introductory section, Section 2 discusses relevant literature and puts forward three research questions. In Section 3, the research methodology is outlined, and this is followed in Section 4 by a summary of findings, in which the three research questions are addressed. Section 5 presents a further analysis of findings leading to the development of a number of principles to support the use of BPM maturity models within an SAP systems environment. Finally, in Section 6, the main themes of the paper are drawn together to provide overall conclusions regarding the research project.

II. LITERATURE REVIEW

BPM and process integration have been discussed for over 25 years [15], but existing literature is largely confined to general findings about the relationship between IT and the use of business processes, or about the relationship between ERP systems and business processes. For example, vom Brocke et al. [16] explain that the selection, acceptance and use of IT are a fundamental part of BPM. Business and IT need to connect with each other in order to realize better business value. Neubauer [17] also notes that ERP systems generally influence a company's business processes.

Saco [8] explains that a maturity model is a diagnostic tool for an organisation to improve its processes. This measuring tool can be used in conjunction with SAP ERP and BPM. Most authors view the use of an ERP system as a means of integrating business processes within one system which is used company-wide [17]. For example, an ERP system can hold all documents in relation to an invoice number or purchase order, and can show the document flow or action log for data changes that directly belong to a business transaction. Through the use of ERP systems, companies are expected to reduce costs by improving efficiencies and widening the availability of accurate and up to date business information, thereby enhancing overall company performance [18]. Antonucci et al. [19] indicate that ERP systems produce the data and information that are the basis for business decisions and strategies.

Overall the extant literature demonstrates that an IT application like SAP ERP can enable higher process maturity [13]. But these kinds of studies focus more on the general company level and IT systems as a whole, and do not address the question of which business process maturity model could

be used if SAP is the central IT business system in the company. Van Looy et al. [20] suggest that further research could investigate the question of whether maturity models could be selected on the basis of IT business system alignment, or investigate the relationship between BPM maturity models and IT business systems on strategic, tactical and operational levels. The SAP company has its own BPM maturity model, this being a specific tool to model the business processes that underpin the design of the SAP package. One aim of this research is to explore this SAP maturity model in more detail, and assess its relationship with the SAP ERP software system.

There is nothing in the existing literature that addresses the question of whether SAP impacts on the utilisation of BPM maturity models. The best analogy is provided by Van Looy [13] regarding IT deployment for business process maturity. She outlines in her conclusion that most maturity models recommend IT to improve process modelling and optimization. She emphasises that, in general, IT usage enables higher process maturity. This research explores the dependencies between the use of SAP and BPM maturity models and addresses the following research questions (RQs):

RQ1. How are BPM maturity models used in the planning and implementation of ERP software projects?

RQ2. How does SAP impact upon the use of specific maturity models?

RQ3. To what extent (and how) is it possible to develop a comprehensive mapping of different maturity models to the SAP software system, indicating the implications for maturity model utilisation?

III. RESEARCH METHODOLOGY

Figure 2 presents the main elements of the research methodology used in this project, selected from a body of methods that can be used to gather and process data [21] [22].

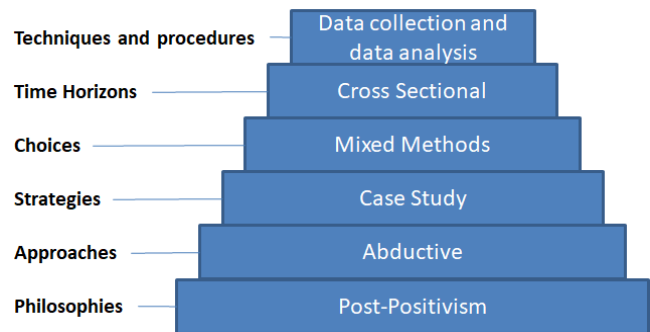


Figure 2. Research Methodology Layers [21] [22]

The research philosophy adopted here is post-positivist, based on the perspectives of Ryan [23] and Guba [24]. The goal of post-positivist research is the generation of "new knowledge that other people can learn from and even base decisions on" [25], which is relevant to this field of study where new maturity models in different specialized fields are generated with some regularity [26]. The post-positivist position supports the understanding that the world is much

more complex than when the project was embarked upon, and that it is quite possible that the inclusion of other experts in the interview process would have led to different results. This research starts with a case study on organisations which use BPM maturity models, and concludes with a generalised theory regarding the behaviour in practice of different BPM maturity models in SAP ERP projects. As described by Thomas [27], this exploration uses the abductive approach in the form of a case study to collect facts from the examined cases, followed by a judgment about the best explanation of these facts. For this purpose, four different BPM maturity models are studied as separate cases with interviews relating to each case, before a generalised output is generated.

As an explanatory study [28], this research investigates the relationship between SAP and BPM maturity models in ERP projects. With a multiple case study approach, and based on semi-structured expert interviews, a small number of organisations are examined in depth. In line with the use of documentation of BPM maturity models, a qualitative research approach is pursued. According to Saunders et al. [22], the use of a case study strategy in combination with secondary data collection techniques allows a form of triangulation to confirm the obtained data from the case study. The aim of this work is to evaluate, in multiple cases with expert interviews, whether SAP can affect BPM maturity models.

Through the use of semi-structured interviews with experts in their field, and the analysis of secondary literature such as user manuals of BPM maturity models, this research uses mixed-methods to address the research questions, thereby providing greater depth in a complex environment [29]. The RQs were developed into a range of secondary questions for the first semi-structured expert interviews. The time horizon for this research is a cross-sectional snapshot study [22]. The research analyses the current SAP impact on BPM maturity models in practice, and evaluates the picture at the time of the study [30].

The interviewees were selected with the objective of gleaning the greatest amount of expert knowledge possible from practice. The semi-structured interviews allowed a degree of flexibility that engendered an understanding and explanation of the experts' opinions regarding important issues, events and patterns in the complex interaction of SAP and BPM maturity models in ERP projects [31]. The software tool MAXQDA was used for the qualitative data analysis and comparison of the interviews, and in arranging, organising and analysing all transcribed interviews, and also for analysing secondary literature sources. This allowed a special type of methodological triangulation through the use of more than one method to collect and analyse the data. A thematic analysis was used for the identification of topics. For this purpose, statements from the interviews were coded in order to recognize and interpret connections [31]. The amount and intensity with which a subject is mentioned and treated generally reflects the importance of the subject [32].

IV. FINDINGS

The search for potential interview partners was a difficult process and resulted in many rejections. The search utilised

existing networks of business and personal contacts, resulting in 64 people in Germany, Austria and Switzerland being identified as potential experts, who were then invited for an interview. From this initial pool of 64 people, eleven people confirmed that they were willing to be interviewed for this research project. Most refusals were based on the fact that the experts did not have the necessary practical experience of the use of a BPM maturity model. Nevertheless, three of the experts interviewed are currently using no BPM maturity model, but perform some form of quality process assessment already at their company, or would like to apply a BPM maturity model in the future.

Baker and Edwards [33] explain that, within qualitative research, the attainment of a sufficient quantity of interviews cannot be set at a certain number. It is crucial to achieve saturation and try to gain new knowledge through additional interviews. In this research, there appeared to be a degree of saturation with the tenth interview, as no new knowledge surfaced.

The interviews revealed that the experts were familiar with four different BPM maturity models. These four models were already being used by the experts, and were described in more detail within the interviews. Each of these BPM maturity models was considered as a separate case. The accompanying documentation of the models was also analysed.

The models considered were:

- The eden maturity model. This model was developed by a working party called "Business Process Excellence" and has been updated and presented by the "BPM maturity model eden e.V. Association" [34] since 2009.
- Capability Maturity Model Integration (CMMI). CMMI was originally developed by the Carnegie Mellon University more than 20 years ago. Nowadays, the model is maintained and administered by the CMMI Institute [35].
- The Business Process Maturity Model (BPMM). This model was developed by the Object Management Group (OMG). Version 1.0 of the maturity model was released in June 2008 [36].
- The SAP maturity model. This model was developed directly by the SAP company. It was derived from the Process Enterprise Maturity Model (PEMM) developed by Michael Hammer and the CMMI [37].

Each expert was able to provide some key points for the implementation of BPM maturity models, when an SAP ERP system is used as the central IT system. The statements of the interviewees and the results of the documentation analysis were considered for each individual case, and then all statements were considered and reviewed as a whole. From this, generalised answers to the three research questions were developed.

A) *RQ1: How are BPM maturity models used in the planning and implementation of ERP software projects?*

In general, there are almost no prerequisites for the use of BPM maturity models. The BPM approach and BPM maturity models are usually introduced after the introduction of an ERP system. Only two experts reported an example when BPM

maturity models were established before the BPM approach was introduced in the company. All experts reported that a typical approach is that an ERP system already exists, and only afterwards is a BPM approach and the application of a BPM maturity model required. An existing ERP system usually has to adapt to the requirements arising from the BPM environment and the application of a BPM maturity model.

All sources strongly indicate that the decision to implement a BPM maturity model should be carried out by the senior management with a top-down approach. A company gets the necessary support only if the management recommends the use of BPM maturity models. A bottom-up approach is also conceivable but much more difficult to accomplish successfully. The same applies to the introduction and use of ERP systems. For many companies, the use of a certain ERP system is a strategic decision taken by senior management. According to the experts, the ERP system is then often the most important and most valuable system within the company.

Both the practical experience of the interviewees, as well as the documentation, show that usually an ERP system already exists in a company before a BPM approach is adopted. In most cases, a BPM maturity model is only introduced once the practice of BPM is already established within the company. For most companies, the application of a BPM maturity model is only an add-on that does not have to be applied, and is the final step for the use of BPM in the organisation.

B) RQ2: How does SAP impact upon the use of specific maturity models?

For most companies, the use of SAP is a strategic decision. Senior management expect a stable and long term partnership if they use the SAP ERP system, which inevitably becomes the core IT system within the company. Some experts suggested that only a very few companies in their experience do not use SAP. There are industries where no one would consider not using SAP, reported one expert, because SAP is the market leader and the *de facto* standard.

The SAP system is usually implemented company-wide, and therefore has many touch points within a company. Theoretically, process definition can be done without any kind of IT system, but at a certain point in its growth, a company becomes of a size that requires an IT system for its effective operation and support. The SAP system provides some standard processes and some companies use these default SAP processes. A good maturity model should also draw attention to such standard processes, but not all BPM maturity models analyse processes which are provided by a standard system. Every company should critically question how much of a standard process is appropriate and necessary, in order to avoid a disproportionate amount of effort to achieve full module deployment and operation.

Some companies do not have the goal of achieving the highest possible maturity level. If the highest maturity level can only be achieved by adapting the SAP system, then a company must recognize that this can lead to a larger adaptation requirement in the future, as successive upgrades of the SAP product are released. A modified standard system

means that the changed processes have to be fully tested and analysed every time the SAP system is changed, even if it is a standard system update or a simple system enhancement.

There are some other impacts and constraints that arise when an SAP ERP system is used within a BPM maturity model. The SAP system may not have the capability to display processes as a process map and how they are currently running within the SAP system. The continuous development of SAP functionalities, and the further development of a BPM approach in the company, create the risk that both will be further developed independently. The risk is that two independent process models will be developed for the same set of processes. Some experts pointed out that the application of SAP does not generally create an improved maturity level. SAP can be used without any business process orientation. If a process orientation is wanted, then a company must use its SAP system accordingly. Some experts reported that the intensive use of the SAP system will most likely lead to a higher maturity level if the system adheres to standard specifications and its underpinning process model.

A significant advantage when using the SAP system is that it has the functionality to determine key performance indicators (KPIs) for purposes of control and monitoring of business performance. Many SAP transactions already contain data like throughput times that can be used as KPIs for a more precise process analysis. These indicators can be determined directly from the financial transactions stored in the ERP database.

C) RQ 3: To what extent (and how) is it possible to develop a comprehensive mapping of different maturity models to the SAP software system, indicating the implications for maturity model utilisation?

All experts and available documentation suggested that the BPM models have no limitations and can be used in all companies. A link between the SAP modules used and the application of specific BPM maturity models was not evidenced by the experts' experiences. No correlation could be found which shows that certain SAP modules work more effectively with the investigated BPM maturity models. However, the four BPM models considered here demonstrate that quite different types of maturity model exist. Every company has to be clear regarding what it wants to achieve through the use of a maturity model and what is important, and what is not. For example, the eden maturity model with pre-defined questions behaves quite differently from the SAP maturity model which tries to establish as many standard SAP processes as possible. All of the four investigated maturity models can be used within an SAP environment, but there exist differences, and a company needs to know whether the model aligns with the company's goals, and if the analysis provided by the model matches their perceptions. The models can be broadly divided into three different categories:

- *Fixed models*

The eden model belongs to this category, and contains a questionnaire that is already fixed and does not require any adjustments to specific industry issues or interview partners. All questions are always the same. The application is

relatively simple, because anyone who applies the model answers only these questionnaires.

- *Individual models*

The application of the CMMI or BPMM models is considerably more complex. Both are similar and require much more effort. The user has to think about what is important and what is not important for an organisation. For this purpose, individual topics and possible process objectives are defined by the models as a framework, and a user has to decide what he wants to use and how. The guidelines of the model should not be viewed as a pure best practice procedure, but must be adapted accordingly to individual circumstances.

- *Special interest models*

The SAP maturity model is also based on the CMMI model, but has significant differences and therefore can be classified in a third category. In contrast to the other models, the focus of this model is the use of best practices or standard SAP processes which originate from the SAP system. Within the maturity models examined here, it is the only one that deals with SAP-specific issues and characteristics, because other models view IT much more generally.

V. ANALYSIS

Many BPM maturity models currently consider only a small range of IT applications, and do not analyse any kind of ERP system. But in many companies SAP is the dominant system, and for this reason a BPM maturity model should also consider relevant dependencies. Maturity models, such as BPMM or CMMI, are already very complex, but companies are often interested in guidelines that are less complex and require a smaller budget. Therefore, some principles have been developed in this research project to analyse the operation of the SAP ERP within a BPM application. The goal is not to develop a more complex and comprehensive maturity model; indeed the success of eden is due to the fact that the model has, in contrast to other models, less criteria and is easy to handle. The experts explained within the interviews that many companies prefer a checklist instead of a complex maturity model. For these reasons, it is not necessary to develop a separate and totally new BPM maturity model to understand and show possible dependencies.

On the basis of the three research questions, the following SAP specific principles have been developed to enable company management and all relevant stakeholders to determine and understand possible connections between an SAP system and a BPM approach. The principles can be employed to support the successful use of BPM maturity models within an SAP systems environment. These principles are not evident in any of the examined BPM maturity models in such detail.

- *Ensure that management fully support the use of SAP in the organisation to its full extent.*

The use of SAP ERP as the central IT software system within a company is usually a strategic decision. In this case, the company should decide how to integrate the system with the adopted BPM approach of the company. What does the SAP specification imply? Does that mean that only key

figures have to be generated from the SAP system? Could there be other systems besides the SAP system? Should a company use as many standard SAP processes as possible? The company must determine who decides possible solutions or any adaptations of the SAP system. The successful implementation of an SAP system is only possible if the senior management are aware of and confront these issues.

- *Establish as many SAP ERP standard processes as possible at the company in order to minimize the complexity of system upgrades or enhancements.*

If the company wants to use SAP, and the management supports this, then companies should also decide whether, and to what extent, standard SAP processes should be used. The use of standard SAP processes reduces the time, cost, resources and other operational constraints, and supports the introduction of new SAP enhancement packages or release changes. Each change makes it necessary to test customised solutions and adjust the customer-specific programming to the upgraded SAP system. But it is important to prioritize when the standard SAP processes should be used, and when it is better to use self-defined solutions. A BPM team should not accept processes as given and must analyse which approach is best suited to a specific company environment. Not all standard processes are the optimal solutions for every company, and a company should not necessarily submit to the dictates of a rule-based IT system. But the use of standard process solutions could also be very helpful and reduce the budget required to operate an IT system. Regular consideration should be given to whether IT innovations in the system could lead to process improvements. For example, mobile device applications can now operate in conjunction with SAP modules, and thus such mobile functionality is now integrated into the standard SAP system.

- *Ensure that all processes have been documented, analysed and understood, even if they are pre-defined by the SAP system.*

The use of SAP standard processes does not absolve a company from the duty to document, analyse and understand each process. It can be the case that standard processes which run in a single system like SAP run with an optimised composition, and are better coordinated than other processes; but nevertheless, each process should be analysed. Unfortunately, it is not always obvious which data is being stored and used within an SAP process. Technically, it is currently not possible to get a fast and actual process flowchart from an existing SAP system, and see how customizing settings within an SAP system may change a process flow. Therefore it is very important to understand and analyse these SAP processes in detail. This is the only way to avoid incorrect or error-prone process operations. A company should know exactly how its processes are running, and therefore a company should not be dictated to by an IT system or by the opinion of an ERP system provider. An analysis of the pre-defined process should enable a company to decide whether the standard process is usable, or whether an individual process should be developed for their specific company environment.

- *Establish a procedure that ensures that all interfaces are analysed for their BPM relevance, regardless of whether they are used between different systems or from and to the SAP system.*

Interfaces between different systems often offer opportunities for systems optimization and process improvement. Many experts recommend considering the processes from an end-to-end perspective. They have learned from their practical experience that, especially in the case of system breaks and interface connections, data is often transmitted in a format that is different to that which is required. It is important to analyse the standard interfaces provided by the software provider, which may not be the best and optimal for the user organisation.

- *Ensure that all teams within a company, especially the BPM team and the SAP team, contribute to the development of the same processes and process maps, and that only one process map exists within the organisation.*

SAP is a very powerful tool that communicates with many different sub-modules and other systems. The early versions of SAP had a functional structure but with the application of BPM, the package is now more process-oriented in design. It is important to avoid different teams working in isolation and developing different process configurations within a company. The BPM team should consist of a variety of different stakeholders, to represent different requirements and knowledge inputs.

- *Ensure that all necessary key figures are generated directly from the SAP system.*

SAP provides many instruments for the generation and monitoring of KPIs and most BPM maturity models encompass the analysis of KPIs. For many experts in this study, the SAP system was often the leading financial system in their company contexts. This offers many advantages for the analysis of KPIs. Much financial information is already stored in the SAP system, which can be used to support the BPM approach. Some companies, when trying to implement quick solutions or consultancy generated analysis, may turn to creating Excel spreadsheets rather than using the “one view of the truth” available in the SAP system. SAP provides many predefined reports, and can also employ business intelligence tools to provide customised reports from the SAP database. It may take longer to determine the required fields for an analysis within the SAP system, but for frequent use it is much faster to retrieve the numbers directly from the SAP system.

VI. CONCLUSION AND FUTURE WORK

One view evident in the existing literature is that no specific IT system should determine the use of a BPM approach, but should simply support the business transactions of a company [38]. However, the practical experience of the experts interviewed in this research provides a different perspective. Neubauer [17] asserts that ERP systems can influence a company’s business processes and this is confirmed by this research as regards the SAP ERP system.

All the interviews, which involved many practitioners, have confirmed that the SAP and BPM concepts are closely related. Theoretically, there is often no such link found in the documentation, but in practice the SAP system is the leading ERP system in many companies, and therefore there is a practical connection. An IT system such as SAP ERP can influence a company and its processes. In many companies, SAP is the dominant system, and a BPM maturity model needs to accommodate this reality.

Unfortunately, many BPM maturity models currently consider only a small range of IT applications, and do not analyse any kind of ERP system. To this end, this research has developed some principles, which can be used as management guidelines for practising managers and other relevant stakeholders. They provide practical guidance for companies using SAP, BPM and BPM maturity models, and can lead to an improvement in business performance to the benefit of many stakeholders. It is evident that many maturity models do not consider any link between an SAP system and the BPM approach. The application of the principles discussed here can help develop interrelations between these topics. Further research could also examine whether such links also exist in other ERP systems or in other standalone software packages.

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