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BPM maturity and performance: The influence of knowledge on BPM

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ABSTRACT

In order to continuously improve performance, organizations need to control their processes. To do this it is assumed that organizations need a high level of business process management maturity and employees need a high level of knowledge and experience in BPM. Proof of this assumption has not been found in the literature. Therefore, the objective of this study is to determine what the influence is, of knowledge and experience of BPM, on the dependence between BPM maturity and process performance. For this study a dataset of 469 respondents from Dutch organizations was collected over the period of 2010 till 2015. Analyses of the data shows that the scores of BPM Maturity and Process performance by respondents with extensive BPM knowledge and experience are significantly higher than by respondents with limited BPM knowledge and experience. However further analyses show that BPM knowledge and experience has no influence on the strength of the relation between BPM Maturity and Process Performance. Therefore, we can conclude that BPM knowledge has no intervening effect on the relationship between BPM Maturity and Process performance. Additionally, we found that the following dimensions of BPM maturity: Process Resources, Process Tools, Process Awareness, Process Improvement and Process Measurement are the main predictors of Process performance.

Keywords: BPM Maturity, Performance, Knowledge, Quantitative research.

INTRODUCTION

Organizations continuously strive to gain competitive advantage. Therefore, new ways of quality improvement, cost reductions and lowering time to market are needed (Bruin & Freeze, 2005). The rapid innovation of technology and global collaboration are reasons why organizations often see it as a necessity to change their business models (Bogers, Hadar, Bilberg, 2016; Rayna & Striukova, 2016; Jia, Wang, Mustafee, Hao, 2016). To become as adaptable and flexible as possible, organizations should take control of their processes in order to be able to continuously improve themselves. Therefore, attention for Business Process Management (BPM) has grown

over the last decade (Ravesteyn & Versendaal, 2007; Ravesteyn, Zoet, Spekschoor, Loggen, 2012).

To assist in BPM governance, maturity models have been developed (Ravesteyn et al., 2012; Tarhan, Turetken, Reijers, 2016; Aversano, Grasso, Tortorella, 2016). Most of these models are descriptive (Röglinger, Pöppelbuß, Becker, 2012). Tarhan et al. (2016) found that only three out of the 61 selected models also measure (organizational) performance. In the study of Tarhan et al. (2016) the BPM maturity scan of Ravesteyn et al. (2012) is not included, however it is explicitly developed with the aim of measuring BPM maturity in relation to process performance. Although a positive correlation between BPM and (organizational) performance is indicated (Trkman, 2010; McCormack, Willems, Bergh, Deschoolmeester, Willaert, 2009; Skerlavaj, Indihar Stemberger, Skrinjar, Dimovski, 2007), no comprehensive and substantial benefits around the concept of BPM have been identified (Trkman, 2010).

In 2010 a study was performed to determine a possible dependence between BPM Maturity and Process Performance (Loggen, Havenith, Spekschoor, Versendaal, Ravesteyn, 2011; Ravesteyn et al., 2012). The results showed a correlation between BPM maturity and process performance. Based on these promising results subsequently every two years a benchmark study is performed (Ravesteyn et al., 2012; Janssen, Nendels, Smit, Ravesteyn, 2015; Exalto-Sijbrands, Maris, Ravesteyn, 2016). The same tool is also used to perform several case studies (Exalto-Sijbrands, et al., 2016; Maris, Exalto-Sijbrands, Ravesteyn, 2016). These papers all indicate dependence between BPM maturity and process performance, but it stays unclear what factors are influencing this relation.

Although a strong positive correlation is shown between knowledge management and organizational performance (Andreeva & Kianto, 2012, Pérez-López & Alegre, 2012; Schiuma, 2012; Sangari, Hosnavi, Zahedi, 2015), there is no proof found in the literature that knowledge and experience of BPM influences the relation between BPM maturity and Process Performance. Based on the above the following research question is formulated for this study: What is the influence of knowledge and experience of BPM on the dependence between BPM maturity and process performance over the period of 2010 till 2015 within the Netherlands?

In the next section of this paper the concepts of this research: BPM maturity, process performance and knowledge and experience are discussed and operationalized. In section 3 the research methodology is described. Section 4 describes the results of this study. Conclusions and recommendations for further research are provided in section 5.

LITERATURE

History of BPM

In the early 1880s Frederick Winslow Taylor analyzed (manufacturing) workflows with the aim to improve them (Taylor, 1911). Shewhart, Deming, and Juran continued with the focus on quality improvement (Best & Neuhauser, 2006; Johnson, 2002) and Hammer came with the concept of Business Process Redesign (Hammer, 1990; Hammer & Champy, 1993). Two streams of ‘continuous quality improvement’, better known as Total Quality Management and ‘business

process redesign' are merged into BPM (Elzinga, Horak, Chung-Yee, Bruner, 1995; Lee & Dale 1997; Zairi, 1997).

BPM is a comprehensive system for managing and transforming organizational operations (Hammer, 2010). According to Rosemann, Bruin, and Hueffner (2004) BPM is defined as a holistic organizational management practice, which is focused on the identification, definition, analysis, continuous improvement, execution, measurement, monitoring and analysis of intra and inter-organizational business processes. Davis and Brabänder (2007) define BPM as a systematic approach to managing and improving an organization's business by the active, coordinated management of all aspects of the specification, design, implementation, operation, measurement, analysis and optimization of business processes in order to effectively and efficiently deliver business objectives.

Although Information System and Information Technology (IS/IT) was seen as an important enabler to process management it took until the beginning of this century before an integrated business and IS/IT approach to process management was envisioned (Fremantle, Weerawarana, Khalaf, 2002; Aalst, Hofstede, Weske, 2003). Nowadays organizations are outsourcing their secondary processes to focus more on core competences (Boguslauskas & Kvedaraviciene, 2009). To assist organizations in BPM governance, maturity models have been developed (Ravesteyn et al., 2012; Tarhan et al., 2016; Aversano, Grasso, Tortorella, 2016). Maturity models provide organizations the possibility to evaluate organizational processes and identify opportunities for optimization. Important research in this area is done by Rosemann et al. (2004) and Rosemann and Bruin (2005) on BPM maturity models, Curtis and Alden (2006) on business process improvement guided by maturity models, and Tarhan et al. (2016) on comparison of BPM maturity models, and searching for prescriptive models.

Process Performance

In this study the focus is on the relation between BPM maturity and process performance. According to Peppard and Rowland (1995), "The success of BPM depends on the strength of the key organizational drivers which create the impetus for change." Where BPM drivers prompt organizations to focus on BPM, the benefits are the achievable results (Rudden, 2007). The maturity study of Hüffner (2007) identified that drivers and benefits can be classified by four criteria. These drivers and benefits can be either internally or externally based and quantitative or qualitative. As the benefits are related to process performance, these are discussed in more detail. Literature mentions that the quantitative benefits of BPM are, among others, reduced cost, reduced cycle time, reduced head count, and improved quality (Gulledge & Sommer, 2002; Hammer, 2001, 2010; Zairi, 1997). These benefits can be divided into three elements (Rudden, 2007): efficiency, effectiveness and agility. Quantitative internal benefits are measurable and visible and therefore provide facts. External benefits cannot be seen within the organization and therefore it is difficult to define reliable and valid measures.

Qualitative internal benefits focus on organizational and cultural aspects. A benefit that is often mentioned in literature is the improvement and change of the organizational culture (Pritchard & Armistead, 1999). External qualitative benefits can be seen as customer related benefits or can have an impact on the competitive situation. An increased customer satisfaction as a result of

process orientation is mentioned by Hammer (2001). According to Gulledge and Sommer (2002) the reduction of cycle times implies competitive advantage. McDaniel (2001) agrees, mentioning the possibility for gaining greater market share and competitive advantage as a result of cost reductions.

Knowledge and experience of BPM

Bloom et al. (1956) state that knowledge is recognizing information, ideas, and principles in the approximate form in which they were learned. Knowledge is the way to interpret information, based on own expertise, insights and intuition. Information is data (numbers and figures) with an added value, like an explanation (Vance, 1997; Bollen & Vluggen, 2012). With executing knowledge in practice comes experience and skills. So to have experience and build up skills within a particular field there is a need to perform certain tasks in that particular field.

Identifying and leveraging the collective knowledge within the organization is known as knowledge management (Von Krogh, 1998). Knowledge management consists of knowledge processes (such as knowledge creation, sharing, acquisition, transfer and application) and infrastructures or capabilities or management activities that support and enhance the knowledge processes (Andreeva & Kianto, 2012). The management of knowledge is directly related with organizational performance (Andreeva & Kianto, 2012; Pérez-López & Alegre, 2012; Schiuma, 2012; Sangari, et al., 2015; Wong & Wong, 2011). Also BPM knowledge positively effects organizational performance (Claycomb, Dröge, Germain, 2001; Gabryelczyk, 2016; Niehaves, 2010) and user participation holds a stronger positive relationship with the BPM system development and implementation success than other participatory activities (De Waal & Batenburg, 2014).

Rangiha, Comuzzi, and Karakostas (2016) developed a framework for social BPM. The idea is to help organizations with organizing/consulting the right process capabilities (knowledge, skills and experience) when performing specific BPM tasks. Eicker, Kochbeck, and Schuler (2008) analyze employee competencies in matters of the implementation of BPM in organizations. Among these competencies, experience and expertise were identified as necessary for the roles project leader, process consultant, process coordinator, process owner, process controller and process staff in BPM. In another study, Seethamraju and Marjanovic (2009) found that individual and collective process knowledge are the keys for acchieving sustained process improvements. This suggests that by increasing the knowledge and experience of BPM, also the effect of BPM maturity on process performance should increase. However, there is no evidence found in the literature for this assumption. Therefore, the following hypothesis is stated: *Knowledge and experience of BPM affects the relation between BPM maturity and Process Performance (positively).*

BPM Maturity scan

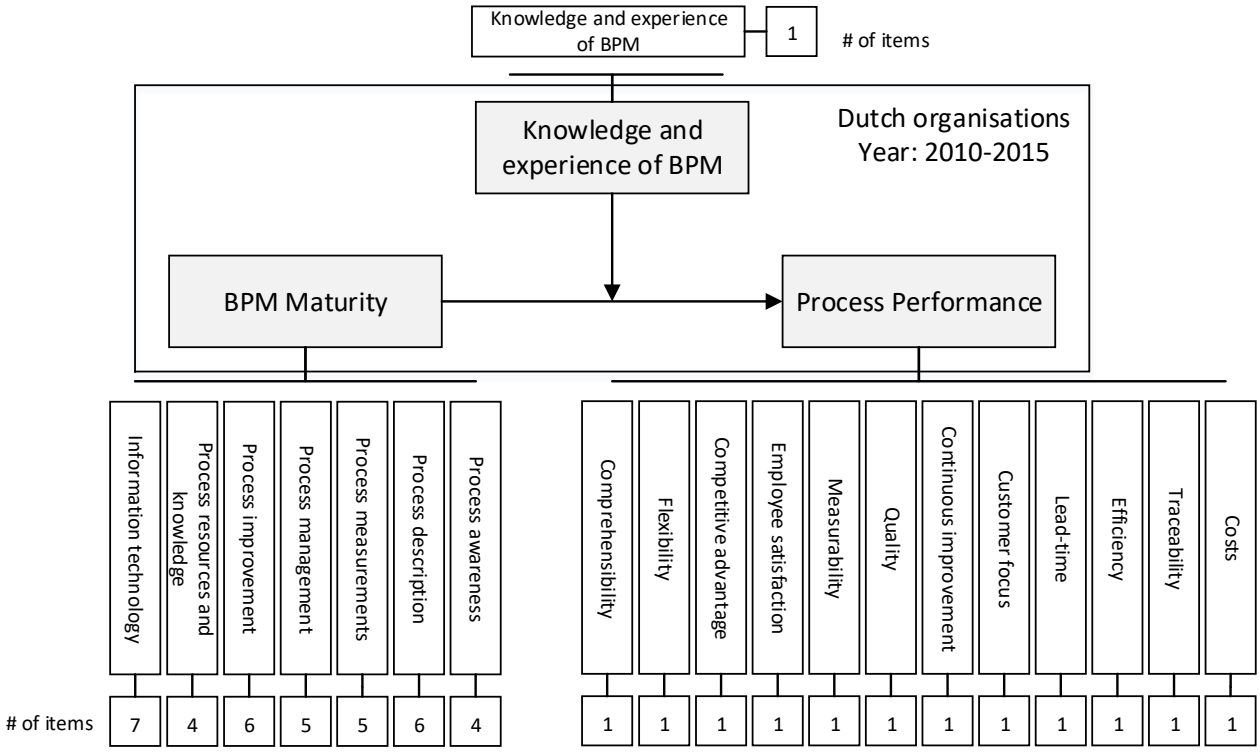
The BPM maturity scan of Ravesteyn et al. (2012) is used for this study. This scan is not included in the study by Tarhan et al. (2016), but it does measure BPM maturity and process performance. The maturity dimensions are based on the Capability Maturity Model Integrated (CMMI) and research by Rosemann et al. (2004) and Rosemann and Bruin (2005). The scan was first used in 2010 to determine the BPM maturity of organizations within the Netherlands. Subsequently every

two years a benchmark study is performed (Ravesteyn et al., (2012); Janssen et al., 2015; Exalto-Sijbrands et al., 2016). BPM maturity within an organization is operationalized in 37 BPM capabilities that are translated to questions (items) that measure 7 dimensions of process maturity (Process awareness, Process description, Measurement of processes, Management of processes, Process improvement, Process resources and knowledge and Information Technology).

The process performance construct is based on 12 elements that measure the organizational process performance. Ten elements (1-Cost, 2-Traceability, 3-Efficiency, 4-Lead-time, 5-Customer focus, 6-Quality, 7-Employee satisfaction, 8-Competitive advantage, 9-Flexibility and 10-Comprehensibility) are related to the quantitative and qualitative benefits as described in section 2.2 (process performance), while two elements 11-Continuous improvement and 12- Measurability are based on the BPM-lifecycle theory (Weske, 2007). These two elements focus on the extension on what BPM has to offer against its predecessors BPR and Work Flow Management (WFM). As the focus of traditional WFM (systems) is mainly on designing and executing processes, which according to Aalst et al. (2003) is the lower half of the BPM lifecycle, the entire BPM-lifecycle also includes measurement of processes and continuous improvement.

The construct of knowledge and experience of BPM is based on the personal knowledge and experience of the respondent. The respondents are asked to characterize their own knowledge on BPM. This question has four possible answers: 1) no knowledge and practical experience, 2) some knowledge, no practical experience, 3) some knowledge and a limited amount of practical experience, and 4) knowledge and practical experience. Because this construct is analyzed as a dummy variable the possible answers are combined into two groups: 1) with limited BPM knowledge (first and second possible answer), and 2) with extensive BPM knowledge (third and fourth possible answer). This leads into the following conceptual model (Figure 1):

Figure 1: Conceptual model.



RESEARCH METHODOLOGY

This section describes the procedure of data collection and presents the outcomes of the validation of the BPM Maturity and Process performance scales. To analyze the data, t-tests, correlation- and regression analyses were conducted.

Data Collection

During the period 2010 to 2015, data was collected from employees in different organizations in the Netherlands. The respondents were selected by the researcher's personal network through convenient sampling and as part of internships or BPM courses by bachelor's and master's students. The questionnaire was available online (e.g. via mail), but to retrieve the best (complete) data most of the bachelor's and master's students collected the data via structured interviews. The respondents were asked about their experiences with process management within their daily activities. The aim was to collect data on the seven dimensions of BPM Maturity and the dimensions of process performance. The questionnaire consisted of 53 items related to the core elements of the conceptual model namely BPM maturity (37 items) and process performance (12 items) as well as general questions to capture supporting variables such as size, sector, knowledge and experience in BPM. All items had five answer categories (1 = fully disagree, 5 = fully agree) of which the respondents selected the degree to which they agreed or disagreed with the given statements.

The total data set amounts to 469 respondents, obtained in the years 2010 (28.4%), 2013 (29.2%) and 2015 (42.4%). The respondents were mainly employed in the fields of government/semi-

public services (36.0%), services (33.7%) and production (21.3%). 22.6% of the respondents were form organizations with less than 100 employees, 22.8% from organizations with employees between 100 – 1000, 33.9% from organizations between 1000 – 5000 employees and 20.7% from organizations with more than 5000 employees. The sample consisted of business consultants, line- and staff managers, IT managers, employees and board members. Of these, 63.1% had extensive knowledge and experience with BPM; 36.9% had limited knowledge and experience with BPM.

Instrument validation

In order to validate the measurement of BPM Maturity and Process Performance dimensions, a factor analysis was performed to analyze the construct validity of the items. For all dimensions, principal component analysis (PCA) with Varimax rotation resulted in a one-factor solution. The results are presented in Table 1.

Table 1: Factor Analysis and Reliability of BPM Maturity and Process Performance Scales (N=469).

Dimension	Number of items	Eigen-value	Explained variance	Factor loading (Max.)	Factor loading (Min.)	Cronbach's alpha
BPM Maturity	**7**	**4.79**	**68,4**	**.883**	**.745**	**.923**
Process Awareness	4	2.50	62,4	.850	.702	.797
Process Description	6	3.68	61,3	.845	.627	.869
Process Measurement	5	3.21	64,2	.835	.706	.860
Process Control	5	3.19	63,8	.851	.736	.855
Process Improvement	6	3.83	63.8	.845	.788	.881
Process Resources	4	2.59	64,8	.863	.662	.812
Process IT Tools	7	3.92	55,9	.825	.565	.861
Process Performance	**12**	**6.72**	**56,0**	**.819**	**.674**	**.926**

As shown in Table 1, the eigenvalues of the dimensions were between 3.92 and 2.50, accounting for 64.8% to 55.9% of the explained variance. The factor loadings were between 0.863 and 0.825, which can be considered as being significant (Hair, Anderson, Tatham, Black, 1998). The reliability of the scales was confirmed by Cronbach's alpha value of 0.881 to 0.797 (cf. Nunnally & Bernstien, 1994). To validate the measurement of BPM Maturity and Process performance a PCA was conducted. This resulted in a one-factor solution, with an own value of 4.79 and 6.72 resp., accounting for resp. 68.4% and 56.0% of the explained variance. The Cronbach's alpha of 0.923 and 0.926 resp. confirmed the reliability of the scale.

DISCUSSION

In this section the results of the survey will be described. First, the scores of the BPM Maturity and Process performance is presented. Secondly the relationship between BPM Maturity and Process Performance in relation to the existence of BPM knowledge is discussed.

Level of BPM Maturity and Process performance

The score of BPM Maturity and Process performance of all respondents was resp. 2.91 and 2.85 (scale 1 – 5). Table 2 presents the difference of BPM Maturity (dimensions) and Process performance between respondents with limited BPM knowledge and respondents with extensive BPM knowledge. On all dimensions the scores of respondents with extensive knowledge of BPM are higher than the scores of the respondents with limited knowledge of BPM. As shown in Table 2, all differences between the two subsamples are significant.

Table 2: Differences between scores on BPM Maturity and Process performance for respondents with limited and extensive knowledge of BPM.

	Mean scores respondents with:			*Two sided t-test of equality of means*		
	Limited knowledge (N=173)	*Extensive knowledge (N=296)*	*Absolute difference*	*t-value*	*degrees of freedom*	*p-value*
BPM Maturity	**2.73**	**3.01**	**0.28**	**-4.12**	**467**	**.000**
Process Awareness	3.03	3.29	0.26	-3.36	467	.001
Process Description	2.86	3.11	0.25	-3.19	467	.002
Process Measurement	2.67	2.88	0.21	-2.54	467	.012
Process Control	2.67	3.01	0.34	-3.82	467	.000
Process Improvement	2.75	3.12	0.37	-4.43	467	.000
Process Resources	2.77	3.07	0.30	-3.61	466	.000
Process IT Tools	2.37	2.60	0.23	-2.78	466	.006
Process performance	**2.73**	**2.91**	**0.18**	**-2.51**	**463**	**.012**

Relationship between BPM Maturity and Process performance

Before showing the findings of the correlations and regression analyses between BPM Maturity and Process performance it is convenient to indicate whether both the dependent variables and the independent variables were not skewed in their distribution. The correlations between (the dimensions of) BPM Maturity and Process performance for the respondents with limited and extensive BPM knowledge subsamples are shown in Table 3.

Table 3: Correlations between BPM Maturity and Process performance for respondents with limited BPM knowledge (above the diagonal) and respondents with extensive knowledge (below the diagonal) subsamples (p<.01, 2-tailed).**

	BPM Maturity	*Process Awareness*	*Process Description*	*Process Measurement*	*Process Control*	*Process Improvement*	*Process Resources*	*Process Tools*	*Process Performance*
BPM Maturity	1	,764**	,825**	,829**	,881**	,877**	,862**	,772**	,732**
Process Awareness	,751**	1	,609**	,636**	,551**	,630**	,595**	,459**	,540**
Process Description	,844**	,610**	1	,698**	,695**	,615**	,648**	,546**	,515**
Process Measurement	,837**	,597**	,697**	1	,673**	,637**	,666**	,518**	,575**
Process Control	,879**	,563**	,705**	,689**	1	,768**	,739**	,671**	,632**
Process Improvement	,848**	,600**	,637**	,615**	,734**	1	,742**	,684**	,716**
Process Resources	,819**	,532**	,630**	,612**	,710**	,697**	1	,599**	,704**
Process Tools	,735**	,426**	,548**	,567**	,591**	,554**	,506**	1	,554**
Process Performance	,759**	,580**	,606**	,633**	,640**	,625**	,669**	,585**	1

The correlations of the respondents with limited BPM knowledge is shown above the diagonal, and the correlations of the respondents with extensive BPM knowledge below the diagonal. All correlations are significant and are between .881 and .426, which can be classified as moderate to high (Cohen, 1992). Overall, the correlations of the two subsamples are almost equal.

Two multiple regression analyses were performed (method Stepwise) for Process Performance as dependent variable, with BPM Maturity and subsequently the seven dimensions of BPM Maturity as independent variables and BPM knowledge (limited or extensive) as dummy variable. Before the two OLS regression models are applied, the potential problem of multicollinearity was investigated by computing VIF factors for each predictor in the regression model. Although in some cases correlations between independent variables were relatively high, VIF factors in none of the models exceeded 5 – a commonly applied rule of thumb (Hair, et al., 1998; Rogerson, 2001). Table 4 shows the results from the two multiple regression models.

The findings in Table 4 show that all regression coefficients as well as the regression models are significant. Based on this we can state that:

- BPM Maturity is a predictor for Process performance and explains 56.4% of the variance;
- The dimensions Process Resources, Process Tools, Process Awareness, Process Improvement and Process Measurement are the main predictors for Process performance, with 58.2% explained variance;
- BPM knowledge has no significant impact on the relation of BPM maturity with Process performance.

Table 4: Multiple regression analysis between BPM Maturity and Process performance as dependent variable with BPM knowledge as dummy variable.

Dependent variable	**Predictor**	**Beta**	**p**	**Adjusted R^2**	**F**	**df**	**p**
Process Performance	BPM Maturity	.75	.000	56,4	600,5	464	.000
Process Performance	Process Resources	.31	.000	58,2	129,7	463	.000
	Process Tools	.18	.000				

	Process Awareness	.13	.001				
	Process Improvement	.17	.001				
	Process Measurement	.14	.002				

CONCLUSIONS AND RECOMMENDATIONS

In this study, the BPM Maturity and Process performance within Dutch organizations were measured, and the relationships between the dimensions of BPM Maturity and Process performance were investigated. In particular, the research focuses on the question whether differences in BPM knowledge and experience of the respondents affect the relationship between BPM Maturity and Process performance. Data was collected with a survey in Dutch organizations over the period 2010 – 2015. For the survey, validated scales were used to measure the dimensions of BPM Maturity and Process performance. The dataset consisted of 469 respondents.

The results show that the scores of BPM Maturity (dimensions) and Process performance by respondents with extensive BPM knowledge and experience was higher than by respondents with limited BPM knowledge and experience. The differences between these two groups are significant. From these findings it can be concluded that respondents with extensive BPM knowledge and experience assess BPM maturity and Process performance higher than respondents with limited BPM knowledge and experience.

However, correlation analysis showed that the correlations between BPM Maturity and Process performance for the two groups are almost equal. Also, the two regression analyses showed that BPM knowledge and experience was no significant predictor in the regression models. Therefore, we can conclude that BPM knowledge has no intervened effect on the relationship between BPM Maturity (dimensions) and Process performance. Therefore, our hypothesis, "Knowledge and experience of BPM affects the relation between BPM maturity and Process Performance (positively)" is not confirmed. Further it was shown that Process Resources, Process Tools, Process Awareness, Process Improvement and Process Measurement are the main predictors of Process performance.

The findings are relevant for future BPM initiatives and research. Although BPM knowledge and experience of the respondents has no intervened effect on the relationship between BPM Maturity and Process performance, it has effect on the level of BPM Maturity and performance. Therefore, to succeed in BPM initiatives BPM knowledge and experience are very important. Organizations, which want to execute a process conform its goals need to provide the right people (numbers, knowledge, experience) and resources (money, facilities, and systems). To start BPM initiatives, organizations must have an environment where employees are sufficiently trained and have the competences and the awareness to execute the process. Also, a form of knowledge management in which process oriented employees (e.g. process-owners, analysts) actively share their knowledge and experiences will contribute to raising BPM initiatives.

Further research can be directed to investigate the influence of other variables (such as size or sector of the organizations) on the relationship between BPM Maturity and Process performance and subsequently the role of BPM knowledge in these cases.

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