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# An Experiment for Measuring Business Process Maturity with Different Maturity Models

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# AN EXPERIMENT FOR MEASURING BUSINESS PROCESS MATURITY WITH DIFFERENT MATURITY MODELS

*Complete Research*

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## Abstract

*Since the 2000s, Business Process Management (BPM) has evolved into a comprehensively studied discipline that goes beyond the boundaries of particular business processes. By also affecting enterprise-wide capabilities (such as an organisational culture and structure that support a process-oriented way of working), BPM can now correctly be called Business Process Orientation (BPO). Meanwhile, various maturity models have been developed to help organisations adopt a process-oriented way of working based on step-by-step best practices. The present article reports on a case study in which the process portfolio of an organisation is assessed by different maturity models that each cover a different set of process-oriented capabilities. The purpose is to reflect on how business process maturity is currently measured, and to explore relevant considerations for practitioners, scholars and maturity model designers. Therefore, we investigate a possible difference in maturity scores that are obtained based on model-related characteristics (e.g. capabilities, scale and calculation technique) and respondent-related characteristics (e.g. organisational function). For instance, based on an experimental design, the original maturity scores are recalculated for different maturity scales and different calculation techniques. Follow-up research can broaden our experiment from multiple maturity models in a single case to multiple maturity models in multiple cases.*

*Keywords: Maturity model, Business process management (BPM), Business process orientation (BPO), BPM adoption and governance, Experiment.*

## 1 Introduction

Business Process Management (BPM) has evolved into a comprehensively studied discipline that goes beyond the boundaries of a particular business process. Therefore, it requires more than process-specific capabilities that deal with the traditional process lifecycle (i.e. capabilities related to process modelling, deployment, optimisation and management) (Weske, 2010). BPM can now correctly be called Business Process Orientation (McCormack and Johnson, 2001), as it also impacts on the organisation-wide culture and structure. Examples of possible capabilities in the domain of BPM/BPO are strategic alignment, governance, methods, IT, people and culture (de Bruin and Rosemann, 2007). For instance, a more detailed analysis of the values that typify a process-oriented culture is performed by Schmiedel *et al.* (2013), resulting in 'customer orientation', 'excellence', 'responsibility', and 'teamwork'.

Nowadays, many maturity models exist that help organisations obtain a more process-oriented way of working based on a roadmap with step-by-step best practices. Maturity models consider business process capabilities as critical success factors for business processes to perform well. On the other hand, maturity is defined as an aggregate of business process capabilities to indicate the expected performance of a business process or a set of business processes (Van Looy *et al.*, 2011).

The literature distinguishes different types of business process maturity. A first distinction is based on the number of business processes considered in the model:

- Maturity of particular business processes, in line with the CMMI tradition (e.g. OMG, 2008);
- Maturity of the whole process portfolio in an organisation (e.g. de Bruin and Rosemann, 2007).

In addition to the number of business processes, maturity types can be defined based on the capabilities that are considered in the maturity model (Van Looy *et al.*, 2014):

- BPM maturity, limited to capabilities related to the traditional process lifecycle (i.e. process modelling, deployment, optimisation and management);
- Intermediate BPO maturity, i.e. BPM maturity plus a process-oriented culture;
- BPO maturity, i.e. BPM maturity plus a process-oriented culture and a process-oriented structure.

The concept of 'business process maturity' thus refers to an umbrella term with various maturity types. For instance, a maturity model can measure the BPM maturity of a single business process or of all business processes in an organisation. Similarly, BPO maturity can be measured from the perspective of a single business process as well as for the process portfolio in an organisation.

Although maturity models are frequently criticised for oversimplifying reality, several studies have shown a positive correlation between business process maturity and actual business (process) performance (McCormack, 2007; Skrinjar *et al.*, 2008). Moreover, given the presence of numerous (mostly non-academic) maturity models and their increasing uptake by organisations (Harmon, 2013), it is worthwhile to scientifically examine business process maturity in more detail. This article intends to explore the degree to which business process maturity depends on characteristics related to (1) the maturity model that measures business process maturity (e.g. capabilities, maturity scale, calculation technique), and (2) the respondents who fill out the maturity questionnaire (e.g. their organisational function). The corresponding research questions are:

- RQ1. To which extent do different business process maturity models assess a similar situation with a similar maturity score?
- RQ2. To which extent do different respondents assess a similar situation with a similar business process maturity score?

The purpose of the present article is to reflect on how business process maturity is currently measured, and to explore relevant considerations for practitioners, scholars and maturity model designers. For instance, by explaining a possible difference between maturity scores, recommendations can be derived on who to involve in a maturity assessment and how to transform responses into a maturity score. As such, our study supplements the current literature by presenting a novel perspective on maturity models. In particular, contemporary articles on maturity models are mainly situated in the design-science paradigm by investigating how maturity models should be designed (e.g. Becker *et al.*, 2009), and academic articles that design a particular maturity model (e.g. de Bruin and Rosemann, 2007). Additionally, the selection criteria have been studied to properly choose one maturity model over another (e.g. Van Looy *et al.*, 2013). Nonetheless, the current literature still requires extensions of our understanding of the effects associated with the persons who assess maturity and how their responses are processed into a maturity score. Our study thus looks into the realm of business process maturity from a unique perspective (i.e. behavioural rather than design-science), and investigates a problem of academic value. Better insight into the effects of measuring business process maturity is also relevant for practical reasons, among others to distil benchmarking opportunities or limitations. Hence, this study intends to provide insightful conclusions on the design, selection, application and interpretation of business process maturity, which may result in recommendations or guidelines for both researchers and practitioners.

The remainder of the paper elaborates on our methodology in section 2. Afterwards, the results of the study are presented (section 3) and discussed (section 4). Section 5 concludes with a summary of the main findings so far and future research.

# 2 Methodology

To respond to the research questions, a case study was conducted in which an organisation was assessed by different respondents (RQ2) who filled out the maturity questionnaires of different maturity models (RQ1). A single case study was chosen as the emphasis is rather on a multitude of maturity models and of respondents than on multiple organisations. The case was used in an experimental design, which allowed us to measure differences in maturity scores. The resulting maturity scores were not only compared among maturity models and among respondents, but also manipulated by adapting some model-related characteristics (i.e. recalculations were made for different maturity scales and calculation techniques).

In particular, it concerns a quasi-experimental empirical strategy which aimed at measuring the effects of model-related and respondent-related characteristics in maturity outcomes. The research strategy was similar to an experimental observational study or a natural experiment (Dunning, 2012; Rosenzweig and Wolpin, 2000). In this type of research, simple comparisons (i.e. across maturity models and respondents) exposed to the presence or absence of conditions or variables are typically used to strengthen causal inference. Control over these conditions or variables was primarily based on research-design choices. For instance, in this study, we considered the causal effects associated with model-related characteristics (e.g. capabilities, scale and calculation technique) and respondent-related characteristics (e.g. organisational function). The randomness criterion is typically satisfied by change or variation in rules governing behaviour (i.e. rules on how to assess and calculate maturity). The original maturity scores (i.e. measured by the original scale and calculation technique per maturity model) may act as control group.

The subsequent methodology sections describe the selection of different maturity models and the case setting in which the experiment was conducted.

## 2.1 Selection of different maturity models

We used the BPMM Smart-Selector to choose maturity models for our study (http://smart-selector.amyvanlooy.eu/). This decision tool offers a large sample of business process maturity models (BPMMs), both for specific business processes and for the whole process portfolio in an organisation. The user can choose maturity models from this sample based on a guided questionnaire. In particular, when the user fills out the questionnaire, the BPMM Smart-Selector refines its sample to those maturity models that best fit the respondent's needs. The questionnaire is based on 14 selection criteria derived from an international Delphi study (Van Looy *et al.*, 2013), from which the user can choose. The most important selection criteria for the purpose of our study are as follows. We particularly looked for validated maturity models that can be used without much restrictions.

- **Process type.** We looked for maturity models that cope with generic business processes, instead of domain-specific maturity models that are limited to specific process types (e.g. supply chains or collaboration processes).
- **Number of business processes.** We looked for maturity models that deal with the whole process portfolio in an organisation, as the study involves respondents who operate in different business processes and in different departments of the same organisation.
- **Validation.** We looked for maturity models that explicitly give empirical evidence for (1) their application in organisations, and/or (2) the performance outcomes of their application.
- **Assessment availability.** We looked for maturity models with a fully available assessment questionnaire and details on how maturity scores are calculated.
- **Direct costs.** We looked for maturity models that are free to access and use.

The BPMM Smart-Selector indicated that six maturity models correspond to the selection criteria above. Additionally, we searched for maturity models that take different business process capabilities into account in order to examine a possible impact on the resulting maturity scores.

- **Capabilities.** We looked for one model that measures BPM maturity, one model that measures intermediate BPO maturity, and one model that measures BPO maturity.

From the six remaining maturity models, the BPMM Smart-Selector indicated that four models measure BPM maturity, while one model was found for each of the other two maturity types. Hence, we decided to include the last two models in our study, i.e. respectively (Rummler-Brache Group, 2004) and (Hammer, 2007). In order to make a decision on the four maturity models that measure BPM maturity, we decided to restrict one of our previous selection criteria.

- **Validation.** We then looked for a maturity model that explicitly gives empirical evidence for both (1) their application in organisations and (2) the performance outcomes of their application.

The BPMM Smart-Selector indicated that two of the four models have a better proof of validity. Moreover, it appeared that one of the two models is based on the other model by re-using a similar maturity questionnaire in other countries. Hence, we decided to include the latter in our study, i.e. (McCormack, 2007). The three selected maturity models are summarised in Table 1.

| **Maturity model** | **McCormack (MCC)** | **Rummler-Brache Group (RUM)** | **Hammer (HAM-Org)** |
|---|---|---|---|
| **Capability coverage** | BPM maturity | Intermediate BPO maturity | BPO maturity |
| **Number of business processes** | Process portfolio | Process portfolio | Process portfolio |
| **Number of maturity levels** | 5 | 5 | 5 |
| **Maturity scale** | 1-5 | 1-5 | 0-4 |
| **Maturity level names** | Ad hoc (score =<2);<br>Defined (2<score<3);<br>Linked (3<score<4);<br>Integrated (>=4) | Numbers only<br>(10-50) | Numbers only<br>(E-1, E-2, E-3, E-4) |
| **Number of maturity assessment items** | 11 | 10 | 13 |
| **Maturity questionnaire** | Per item:<br>sentence + 5-point Likert scale (from strongly disagree to strongly agree) | Per item:<br>sentence + 5-point Likert scale (from strongly disagree to strongly agree) | Per item:<br>description for levels 1 to 4 + colour code per description (green, yellow, red) |
| **Maturity calculation (per employee)** | Aggregating and averaging the scores | Aggregating the scores | Minimum score for the green colour code among all items |
| **Maturity calculation (all employees)** | Average score | Average score | Average score |
| **Advice to progress** | First improve the modelling capability (i.e. process view), then the other capabilities | Improve any score | Improve the minimum score(s) |

*Table 1. A comparison of the maturity models under study, based on (Hammer, 2007; McCormack, 2007; Rummler-Brache Group, 2004).*

For reasons of conciseness, the remainder of the paper will refer to each maturity model by means of an abbreviation, i.e. MCC for (McCormack, 2007), RUM for (Rummler-Brache Group, 2004), and HAM-Org for (Hammer, 2007). We must note that we explicitly refer to HAM-Org instead of HAM, since the model of Hammer (2007) also offers another maturity questionnaire for specific business processes (which will not be included in the present study).

## 2.2 Case description

The questionnaires in the selected maturity models were filled out by multiple respondents of diverse organisational functions in the same organisation (Table 2). The respondents first received a half-day training in business process orientation.

| | | | |
|---|---|---|---|
| **Details of the organisation** | **Sector** | | Public domain |
| **Details of the respondents** | **Total number** | | 25 |
| | **Per function** | **Top management** | 5 |
| | | **Middle management** | 7 |
| | | **Low management** | 5 |
| | | **Operational staff** | 8 |

*Table 2. Details of the organisation under study and its respondents.*

The organisation under study is a medium-sized organisation in the public domain. It wishes to invest more in business process orientation, particularly for reasons of internal control and audit. Therefore, the role of a project manager was introduced a few years ago. This person is not only responsible for the process improvements in the organisation, but also for many other tasks. Due to a work overload of the project manager, only a few business processes have been modelled in a graphical design so far. In order to progress more in terms of business process orientation, the management team has now decided that each department should graphically model at least three business processes in the BPMN notation by the end of the year. The management team is also considering to switch from a traditional organogram with vertical departments to a more process-oriented organisation chart. Given this context, the organisation is interested in assessing its current situation.

# 3 Results

We now describe the systematic assessment of different business process maturity models for the case.

## 3.1 Maturity results with original scale and calculation technique (RQ1)

The direct results after using the three maturity models are shown in Table 3. In particular, the results were obtained by applying the original scale and calculation technique, as presented in the respective models. Additionally, in order to facilitate a comparison between the values, the resulting maturity scores were transformed into a percentage. Finally, an overall maturity score was calculated by averaging the maturity scores of all three models. As such, each maturity model has an equal or neutral weight. The number of respondents per maturity model also appears in Table 3, i.e. 25 respondents for MCC and RUM, and 24 respondents for HAM-Org. Given the rather small standard errors for the different maturity scores (i.e. between 1.64% and 3.00%), we did not expunge data or respondents from the sample and considered the data collection as valid.

| **Maturity model** | **McCormack (MCC)** | **Rummler-Brache Group (RUM)** | **Hammer (HAM-Org)** |
|---|---|---|---|
| **Number of respondents** | 25 | 25 | 24 |
| **Maturity (all employees, original scale)** | 2.45 out of 5 (standard error: 0.08) | 24.32 out of 50 (standard error: 0.92) | 0.50 out of 4 (standard error: 0.12) |
| **Maturity (all employees, %)** | 48.95% (standard error: 1.64) | 48.64% (standard error: 1.85) | 12.50% (standard error: 3.00) |
| **Average maturity (all models, %)** | 36.70% | | |

*Table 3. Original maturity results.*

Despite the fact that the same respondents filled out all maturity questionnaires, it turned out that the maturity scores for MCC and RUM are similar (i.e. almost 49%), while the maturity score for HAM-Org is significantly lower (i.e. 12.50%). At first sight, this difference can be explained to some degree by the scale and calculation technique used per model. Particularly, MCC and RUM apply a similar scale (i.e. 1-5) and a similar calculation technique (i.e. with a mean calculation), whereas HAM-Org uses a lower scale (i.e. 0-4) with another calculation technique (i.e. with a minimum calculation). The subsequent section investigates this proposed effect in more detail.

## 3.2 Maturity results with adapted scale and calculation technique (RQ1)

We reused the same maturity questionnaires and responses for those different scales and calculation techniques presented in the maturity models under study. In particular, the score per maturity model was recalculated for the possible combinations of scales (0-4 versus 0-5) and calculation techniques (minimum calculation versus mean calculation). As this article merely reports on a quasi-experiment limited to a combination of original scales and calculation techniques in the selected models, future work could explore other options (e.g. weighted mean, mode, etc., see http://smart-selector.amyvanlooy.eu/).

Table 4 shows the alternative maturity scores for the adapted scales and calculation techniques, and this in percentages in order to facilitate a comparison between the values.

| **Scale / calculation technique** | **0-4 scale (%)** | **Original scale (%)** | **1-5 scale (%)** |
|---|---|---|---|
| **Minimum calculation (%)** | MCC: 7.00%<br>RUM: 11.00%<br>HAM-Org: 12.50% | MCC: 25.60%<br>RUM: 28.80%<br>HAM-Org: 12.50% | MCC: 25.60%<br>RUM: 28.80%<br>HAM-Org: 30.00% |
| | ***Average: 10.17%*** | ***Average: 22.30%*** | ***Average: 28.13%*** |
| **Original calculation (%)** | MCC: 36.18%<br>RUM: 35.80%<br>HAM-Org: 12.50% | MCC: 48.95%<br>RUM: 48.64%<br>HAM-Org: 12.50% | MCC: 48.95%<br>RUM: 48.64%<br>HAM-Org: 30.00% |
| | ***Average: 28.16%*** | ***Average: 36.70%*** | ***Average: 42.53%*** |
| **Mean calculation (%)** | MCC: 36.18%<br>RUM: 35.80%<br>HAM-Org: 35.66% | MCC: 48.95%<br>RUM: 48.64%<br>HAM-Org: 35.66% | MCC: 48.95%<br>RUM: 48.64%<br>HAM-Org: 48.53% |
| | ***Average: 35.88%*** | ***Average: 44.42%*** | ***Average: 48.71%*** |

*Table 4. Maturity results for different scales and calculation techniques.*

Table 4 confirms that the maturity scores are generally lower for a 0-4 scale than a 1-5 scale, and also generally lower for a minimum calculation technique than for a mean calculation technique. For instance, the overall maturity score is the lowest (i.e. 10.17%) for a 0-4 scale combined with a minimum calculation technique, whereas the highest overall maturity score (i.e. 48.71%) is for a 0-5 scale with a mean calculation technique. The original overall maturity score lies in between (i.e. 36.70%).

When adapting all maturity scores to similar scales and calculation techniques, the differences between the three maturity models seem to decrease. For instance, all scores range from 7.00% to 12.50% for a 0-4 scale and a minimum calculation technique, and from 48.53% to 48.95% for a 0-5 scale and a mean calculation technique. This finding confirms that the designer's choice for one or another scale and calculation technique strongly influences the final maturity score for a specific maturity model.

Furthermore, the methodology section indicated that the three maturity models under study were chosen based on their different capability coverage (i.e. MCC measures BPM maturity, RUM measures intermediate BPO maturity, and HAM-Org measures BPO maturity). Nonetheless, Table 4 shows that the differences between maturity scores decrease when controlling for the scale and the calculation technique. Hence, the present results do not show significant differences whether or not a process-oriented culture and/or a process-oriented structure are measured. We must, however, note that the organisation under study has a relatively low business process maturity (i.e. with an overall maturity score between 10.17% and 48.71% for the different combinations). Therefore, we may conclude that the coverage in business process capabilities does not seem to matter much in case of lower maturity.

## 3.3 Maturity results per function (RQ2)

This section examines the original maturity results per organisational function, since the questionnaires of the three maturity models were answered by multiple respondents of the same organisation (Table 5).

| **Maturity model** | **McCormack (MCC)** | **Rummler-Brache Group (RUM)** | **Hammer (HAM-Org)** |
|---|---|---|---|
| **Maturity (top management, %)** | 52.73%<br>(standard error: 1.91) | 54.80%<br>(standard error: 5.95) | 18.75%<br>(standard error: 6.25) |
| **Maturity (middle management, %)** | 45.20%<br>(standard error: 3.75) | 42.00%<br>(standard error: 2.05) | 3.57%<br>(standard error: 3.57) |
| **Maturity (low management, %)** | 42.54%<br>(standard error: 3.13) | 45.20%<br>(standard error: 3.83) | 15.00%<br>(standard error: 6.12) |
| **Maturity (operational, %)** | 53.86%<br>(standard error: 1.78) | 52.75%<br>(standard error: 1.77) | 15.63%<br>(standard error: 6.58) |

*Table 5. Maturity results per function.*

Table 5 shows that for all maturity models under study, the highest maturity scores were assigned by the top managers (i.e. 52.73% for MCC, 54.80% for RUM and 18.75% for HAM-Org). The maturity scores of the middle managers and the lower managers are similar for MCC and RUM, while HAM-Org shows a significant lower score for the middle managers. Regarding the operational staff, higher maturity scores were assigned in the models of MCC and RUM (i.e. similar to the top managers), while their maturity score for HAM-Org is rather close to the score of the lower managers.

The difference in maturity scores among the organisational functions implies that a maturity score risks being under- or overestimated, depending on the respondent's function. For instance, in the present situation, Table 5 suggests an overestimation of maturity by especially the top managers and to some degree the operational staff.

## 3.4 Link between maturity results and perceived process success (RQ2)

As business process maturity is supposed to be linked to actual business (process) performance (Skrinjar *et al.*, 2008), this section investigates the degree of process success in the organisation under study. We therefore introduced the following two variables that subjectively measure the perceived process success.

- "Perceived process success by respondent" (ordinal):
  - To which extent do you think that the organisation has been successful in adopting a process-oriented way of working?
- "Perceived process success by workgroup" (ordinal):
  - To which extent does your team or workgroup think that the organisation has been successful in adopting a process-oriented way of working?

The reason why we did not opt for objective and quantitative metrics of the actual business process performance, is because we are interested in a difference in opinion among the respondents. Furthermore, a distinction is made between the respondent's own perception and the perception within his/her workgroup or team in order to obtain a more refined view on process success.

| | | |
|---|---|---|
| **Perceived process success by respondent (ordinal)** | **Low** | 17 |
| | **Medium** | 8 |
| | **High** | 0 |
| | **Missing** | 0 |
| **Perceived process success by workgroup (ordinal)** | **Low** | 14 |
| | **Medium** | 8 |
| | **High** | 1 |
| | **Missing** | 2 |

*Table 6. Perceived process success.*

Table 6 shows that the perceived process success is generally considered as 'low' in the organisation, both the perceptions of the respondents themselves and the perceptions within the workgroups. This finding corresponds with a generally low overall maturity score, as previously discussed (i.e. 36.70% in Table 3).

However, Table 6 also shows that some respondents have a higher perceived process success. Therefore, it is worthwhile to take a closer look at the variables.

| | | **Perceived process success by workgroup (ordinal)** | | | |
|---|---|---|---|---|---|
| | | Low | Medium | High | Total |
| **Perceived process success by respondent (ordinal)** | Low | 11 | 4 | 0 | 15 |
| | Medium | 3 | 4 | 1 | 8 |
| Total | | 14 | 8 | 1 | 23 |

*Table 7. Cross tabulation of Perceived process success by respondent * Perceived process success by workgroup.*

Table 7 starts by showing that most respondents gave a similar response for their own perception of process success and the perception within their workgroup (i.e. 11 respondents for 'low' and 4 respondents for 'medium'). In order to examine which respondents assessed both variables differently,

additional tables are needed that summarise each variable from the perspective of organisational functions.

| | | Function | | | | Total |
|---|---|---|---|---|---|---|
| | | Top management | Middle management | Low management | Operational staff | |
| **Perceived process success by respondent (ordinal)** | Low | 4 | 7 | 3 | 3 | 17 |
| | Medium | 1 | 0 | 2 | 5 | 8 |
| Total | | 5 | 7 | 5 | 8 | 25 |

*Table 8. Cross tabulation of Perceived process success by respondent * Function.*

The variable 'Perceived process success by respondent' is detailed in Table 8. It shows that especially the top managers and the middle managers rated their own perception of process success as 'low'. On the other hand, the lower managers and the operational staff show less unanimity, i.e. they are almost equally divided among the categories of 'low' and 'medium'.

| | | Function | | | | Total |
|---|---|---|---|---|---|---|
| | | Top management | Middle management | Low management | Operational staff | |
| **Perceived process success by workgroup (ordinal)** | Low | 5 | 2 | 4 | 3 | 14 |
| | Medium | 0 | 4 | 0 | 4 | 8 |
| | High | 0 | 0 | 0 | 1 | 1 |
| Total | | 5 | 6 | 4 | 8 | 23 |

*Table 9. Cross tabulation of Perceived process success by workgroup * Function.*

Next, the variable 'Perceived process success by workgroup' is presented in Table 9. In line with the above, top managers also tend to have a 'low' perception of process success within their workgroup. On the other hand, especially the operational staff appear to be undecided by showing respondents in the categories of 'low', 'medium', and even 'high'.

In general, an interesting finding is that the top managers rather seem to overestimate business process maturity by giving higher maturity scores (see previous section), while still having a lower perceived process success.

# 4 Discussion

In order to go beyond the comparison of different business process maturity models, this section discusses relevant considerations for practitioners, scholars and maturity model designers.

## 4.1 Discussion of model-related characteristics (RQ1)

Until now, the results suggest no difference in maturity scores for maturity models measuring different sets of business process capabilities. Nonetheless, the study should be repeated for an additional organisation that has progressed more in terms of business process maturity to better investigate the extent to which the capability coverage counts.

On the other hand, the identified effects of scale and calculation technique on business process maturity have some implications for academics and practitioners.

- For practitioners who use a maturity model, the results suggest that benchmarking between organisations is only useful if the maturity models also apply the same scale and calculation technique. Hence, benchmarking seems not necessarily limited to the same maturity model.
- Nonetheless, for practitioners who want to start with a particular maturity model, the BPMM Smart-Selector shows that the scale and the calculation technique should not be decisive for choosing one or another maturity model, as other selection criteria are more important to find a fit with the organisational needs (i.e. with benchmarking being included in another selection criterion of the BPMM Smart-Selector, called 'purpose') (Van Looy *et al.*, 2013).
- For scholars, the large difference in overall maturity scores (i.e. ranging between 10.17% and 48.71% in Table 4) may have an effect on studies that try to investigate a positive correlation between higher maturity (i.e. as being the expected business process performance) and higher actual business (process) performance. Particularly, if multiple maturity models are taken into account for reasons of generalisation, some models may propose a lower or higher maturity score for the same situation. Hence, a blind comparison between the resulting maturity scores of different maturity models seems inappropriate. In order to solve this problem, the present study calculated the average score among different models to obtain an overall maturity score.
- Maturity model designers should consider the (dis)advantages of the different scales and calculation techniques before choosing one for their own model. Hence, in line with the first implication, scale and calculation technique are thus important design criteria for a maturity model (rather than selection criteria for practitioners).
    - For instance, a 0-4 scale expresses that business process maturity can actually be non-existent in an organisation (i.e. with a minimum level of zero), while the lowest level on a 1-5 scale provides an organisation with a slightly more positive perception to start from as all organisations may have a specific way of working (even if business processes are still in the head of individual employees).
    - Regarding a calculation technique, the minimum calculation techniques relies on the Theory of Constraints (i.e. an improvement technique for business processes, which states that an organisation as a chain of multiple business processes is only as strong as its weakest link) (Dettmer, 1997). Other calculation techniques (e.g. the mean or a weighted mean) consider more the different assessment items, and thus the different business process capabilities covered in the maturity model.

## 4.2 Discussion of respondent-related characteristics (RQ2)

The study also revealed an effect of organisational function on business process maturity. In this case, a difference in opinion was found between top management and operational staff on the one hand, and middle management and low management on the other hand. Moreover, a contrast between the attitudes towards business process maturity and those of perceived process success was especially clear for top management. One explanation is that top managers may have a detailed view on how their business is running in terms of performance, while their responses to maturity questionnaires may be based on aspirations or global policies rather than facts. Similarly, operational staff members may respond more with socially accepted answers or possibly based on ignorance of global business. If the latter is true, then middle managers and lower managers tend to be a critical mass for BPM/BPO. The reflections above are in line with the process literature, in which top management commitment and empowerment-related values such as 'responsibility' and 'teamwork' are both described as critical success factors (see section 1, de Bruin and Rosemann, 2007; Schmiedel *et al.*, 2013).

In sum, we present some actionable guidelines regarding respondent-related characteristics.

- For practitioners who use a maturity model, the results suggest that a maturity model gives more accurate results if over- and underestimations are balanced. For this purpose, it seems better to involve different organisational functions in a maturity questionnaire instead of merely questioning top managers.
- For scholars, more research can be conducted on measuring response styles based on variables such as demographics, culture, personality, etc. Response styles may shed light on possible under- or overestimations regarding attitudes towards maturity, and thus on the quality of maturity assessments. Research on response styles may also investigate how and to which degree a response bias might be corrected.
- We encourage maturity model designers to advise on the targeted group of users for their maturity questionnaire, and to provide details on how a 360-degree feedback can be executed for their specific model. Another possibility is to include external stakeholders as well, such as customers and suppliers. Maturity model designers may also consider different maturity questionnaires to be filled out per organisational function in order to better adapt the assessment questions to the different perspectives taken by practitioners. Such customised maturity questionnaires may also contribute to more accurate results.

# 5 Conclusion

The present study has illustrated some relevant considerations for accurately measuring business process maturity.

First, if different maturity models are used to assess the same organisational situation, different maturity scores can be obtained. The reason presented in our study was not necessarily a difference in capabilities covered in the maturity models, but rather a difference in the scale and the calculation technique used by those maturity models. For instance, maturity scores are generally lower for a 0-4 scale than a 1-5 scale, and for a minimum calculation technique than for a mean calculation technique. However, when adapting the original maturity scores to similar scales and calculation techniques, similar maturity scores could be obtained for an organisation with a relatively low degree of business process maturity.

Secondly, if different organisational functions use the same maturity model, different maturity scores can be obtained. The reason why a maturity assessment could benefit from involving different organisational perspectives, is because some people tend to overestimate or underestimate a situation. For instance, the top managers in our study rather overestimated business process maturity (i.e. by giving higher maturity scores compared to the other organisational functions), but still had a low perceived process success. On the other hand, the operational staff in our study combined high maturity scores with higher perceived process success. Hence, to eliminate a possible effect of overestimation or underestimation, it seems valuable to include different organisational functions in a maturity assessment.

The findings above are based on a single case study, which aimed at experimenting with different maturity models. Follow-up research could repeat the experiment for organisations that have progressed more in terms of business process maturity in order to investigate the impact of different business process capabilities covered in the maturity models. Hence, the experiment could be broadened from multiple maturity models in a single case to multiple maturity models in multiple cases. Future work could also be strengthened by involving other scale and calculation techniques.

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