# Practices of Knowledge Intensive Process Management: Quantitative Insights

## INTRODUCTION

Today's developed economies are dominated by service jobs, as the automation and offshoring of manufacturing work have been steadily increasing. Triggered by these changes, we have seen a shift from an industrial to a more knowledge-intensive economy. The pressure is rising for our service- and knowledge-centric organisations to become more competitive, especially by doing knowledge work more efficiently (Karmarkar, 2004). During the past century, we have gone through a learning process of professionalising our manufacturing processes. From Taylorism and Scientific Management through Business Process Reengineering we have evolved to an environment where manufacturing processes are being scrutinized by a range of methods and techniques such as Six Sigma and Lean, to become as efficient and effective as possible (Antonucci, 2010, Harmon, 2010). Many of these methods have been adapted and combined to improve other than manufacturing processes, and have been captured by the management discipline of Business Process Management (BPM). BPM is being implemented in numerous companies to improve the organisational efficiency and effectiveness, and has been moving away from its operational roots. As knowledge workers are the key to growth in today's organisations and as the processes they are working in are under pressure to become more efficient and effective, BPM is facing some important challenges (Davenport, 2010; Karmarkar, 2004; Reinartz and Ulaga, 2008). The question rises if this management discipline is up to the task of improving processes that are increasingly complex, human centric and variable; of improving Knowledge-intensive Business Processes (KIBPs). And if it is, how?

In order to answer this question, it is important to understand what characteristics KIBPs have and how they differ from their counterparts (which we will call non-Knowledge-intensive Business Processes (non-KIBPs) for reasons of convenience). In general terms, KIBPs rely on extensive human involvement and knowledge, whereas in non-KIBPs expert knowledge is less critical. Various research has already examined the concept of KIBPs (Eppler et al., 1999, Schymik et al., 2007, Marjanovic and Seethamraju, 2008, Marjanovic and Freeze, 2011), and methods for improving KIBPs (Eppler et al., 1999, Schymik et al., 2007, Sarnikar and Deokar, 2010, Panian, 2011, Slembek, 2003a). Despite all this valuable work and the fact that differences between KIBPs and non-KIBPs may look intuitive, there is still no commonly agreed upon model that clearly differentiates these two process types.

The first objective of this study is to shed light on the difference between KIBP and non-KIBP. In an earlier exploratory study (anonymized for blind review), we identified the differentiating characteristics that were most used in literature and evaluated these characteristics through interviews with practitioners. Six characteristics were retained as relevant discriminators between KIBPs and non-KIBPs: the level of predictability, structuredness, repeatability and complexity, the need for creativity, and the eligibility for automation. The current study will reassess and quantitatively test the discriminating value of these characteristics and based on this assessment propose a definition for KIBPs. We will also compare the effectiveness and maturity of KIBPs and non-KIBPs to have an overall understanding of the perceptions towards these processes. Secondly, the question whether and how BPM can be used to improve KIBPs will be investigated by comparing the ways in which both kinds of processes are being managed and improved by organisations today.

The following section provides the literature background on KIBPs and summarizes the most eminent characteristics as well as process management and improvement methods for these processes. Then the methodology section follows, which describes the data collection and analysis methods employed in this study. We continue with the presentation and discussion of our results. The concluding section of the paper includes contributions as well as limitations of our research.

## LITERATURE REVIEW

Research on business processes has been around for some time and it is diverse as well as multi-disciplinary in nature. Today, the focus is shifting towards process performance measurement and business process optimization (Sidorova and Isik, 2010). One of the reasons behind the greater interest in improving business processes might be the shift that is occurring from an industrial to a knowledge economy (Slembek, 2003a). This shift has also caused an increasing focus on knowledge work within the organizations (Davenport, 2010) and is posing a challenge for BPM. A recent Gartner Group research suggests that by 2013, BPM that can support unstructured, knowledge-intensive processes will be a top of the agenda item for many companies that aim to increase the efficiency of their business processes (Hill et al., 2009).

Today, most of the organizations using BPM aim to automate and streamline some of their business processes. Even though BPM is more than a process automation methodology and rather a holistic managerial approach, most of the practitioners either have focused too much on the technology component or have completely failed to address the people and culture component of BPM (Marjanovic and Seethamraju, 2008). Recently, some researchers have started to draw attention to this issue. For example, a recent study builds a case for a diversified process management approach and suggests that in some cases process standardization has already been taken one step too far (Hall and Johnson, 2009). There is an imminent danger of killing creativity and losing customer value (Seidel et al., 2010), thus harming the process rather than improving it, when there is too much focus on standardization.

With the growing importance of knowledge work and this imminent danger in the current process management and improvement methodologies, it is important to gain a better understanding of the knowledge work and the processes that are dependent on it. It is important to clarify the role and the definition of knowledge in this research. We follow Davenport's definition and refer to knowledge as a combination of experience, context, human interpretation and human participation (Davenport, 2005). Following this definition, it is not possible to separate process workers from their process actions, as process knowledge is deeply embedded in the process itself. Our analysis focuses on the knowledge that people need to be able to perform process related tasks rather than the order of these tasks (Marjanovic and Freeze, 2011).

Research on KIBPs, although steadily increasing, is still scarce. One stream of research has started to investigate improving KIBPs (Eppler et al., 1999, Dalmaris et al., 2007) whereas another focuses on modeling KIBPs (Papavassiliou and Mentzas, 2003). More recently, we observe an increase in the interest in managing KIBPs through the use of knowledge management systems and the integration of these systems with BPM (Marjanovic and Freeze, 2011, Sarnikar and Deokar, 2010), and in specific methodologies and tools for KIBPs (Rychkova and Nurcan, 2011). Process-oriented approaches for knowledge-intensive work improvement should indeed adhere to certain principles among which participation and respect for expertise in the improvement process is prominent. In fact, the preferred form of improvement for KIBP should be participative, incremental and continuous (Davenport,

2010).Yet, apart from these generic guidelines, a small number of case-based studies (e.g. Seethamraju and Marjanovic, 2009), and the common consensus that KIBPs should be treated differently, little is known about how organisations deal with KIBP improvement in practice. Which methods are they using and are these the same as the methods used for non-KIBPs? First of all, however, it is critical to understand how to identify a KIBP and differentiate it from a non-KIBP, for only then they can be compared and optimal process management methods can be identified and applied.

### *Knowledge-intensive business processes: definition*

KIBPs have been described in a number of research studies, where knowledge intensity has been regarded as a continuum of complexity (Papavassiliou and Mentzas, 2003, Eppler et al., 1999, Marjanovic and Seethamraju, 2008, Panian, 2011). Other researchers suggest that the key difference lies in the enhanced role of the knowledge worker (Richter - von Hagen et al., 2005). These one-dimensional characterisations, however, tend to ignore other important characteristics that have been suggested to constitute the knowledge intensity of processes.

Suggested characteristics of KIBPs include the higher number of stages as well as greater levels of uncertainty and ambiguity, compared to non-KIBPs (Kulkarni and Ipe, 2007, Marjanovic and Seethamraju, 2008). The level of uncertainty and risk has especially been studied in relation to creativity in business processes (Seidel et al., 2008; Seidel et al., 2010). Creative business processes can include both transactional, well-structured, repeatable parts as well as non-transactional, unstructured and non-repeatable parts (Seidel et al., 2010). Hence, one can argue that creative processes can include both knowledge intensive and non- knowledge intensive parts. Even though knowledge is an important factor for creativity in business processes, KIBP and creative processes are not synonyms, as KIBPs mainly deal with the role of knowledge and knowledge workers in processes (Seidel et al., 2008).

Other relevant characteristics are the level of decision and the role of the decision maker in the process and more specifically, the diversity of decision options, the link between process outcomes and decisions, and the required expertise of the decision maker (Kulkarni and Ipe, 2007). Marjanovic and Freeze (2011) suggest that non-KIBPs require information that is predefined and highly structured, coming from BPM, ERP or workflow systems. On the other hand, they suggest that KIBPs require both structured and unstructured information yet the source cannot be predicted beforehand. An overview of process characteristics occurring in literature can be seen in Table 1.

The most relevant and reoccurring process characteristics for KIBPs in literature are the level of predictability (Richter - von Hagen et al., 2005, Panian, 2011), required creativity (Richter - von Hagen et al., 2005, Harmon, 2007, Marjanovic and Seethamraju, 2008, Sarnikar and Deokar, 2010), structure (Richter - von Hagen et al., 2005), repeatability (Slembek, 2003b, Marjanovic and Seethamraju, 2008), eligibility for automation (Panian, 2011) and complexity (Eppler et al., 1999, Harmon, 2007, Marjanovic and Seethamraju, 2008, Davenport, 2010, Marjanovic and Freeze, 2011, Panian, 2011). An overview of these characteristics and how they are generally reported to differentiate between KIBPs and non-KIBPs can be found in Table 2.

In a preceding study, we studied the discretionary power of these characteristics through a number of interviews with process owners of KIBPs and non-KIBPs (anonymized for blind review). In the interviews, we found that KIBPs can be characterised as mostly complex, repeatable, needing lots of creativity and hard to automate. For predictability and structuredness we couldn't find a clear discretionary power. Non-KIBPs on the other hand were characterised as structured, needing less

creativity, highly predictable and repeatable, and mostly easy to automate. According to the practitioners, however, they can be either simple or complex in nature (anonymized for blind review).

The first objective of the current research is to test the discriminating power of these characteristics by means of a survey research with a larger sample, and to propose a definition for KIBPs based on the characteristics that best discriminate between KIBPs and non-KIBPs. Yet, in order not to limit our understanding of these processes, we also take into account other differentiators of KIBPs.

### *Knowledge-intensive business processes: other differentiators*

The characteristics described above might not be the only differences between KIBP and non-KIBP. We expect the maturity and effectiveness levels of non-KIBP to be significantly higher than those of KIBP, simply because many BPM techniques have been applied to non-KIBP with the purpose of increasing their maturity in order to reduce the risk that immature processes may pose for organizations (Curtis and Alden, 2007). Process maturity reflects how successful an organisation is at systematically increasing the capabilities of the organization and its business processes in order to deliver higher performance over time. It can be measured both at the process level and at the level of the organisation (Van Looy et al., 2010; Schymik et al., 2007). As processes mature, their performance and effectiveness improves and their cost decreases (Lockamy and McCormack, 2004; McCormack, 2007). Various process maturity models have been suggested in literature, approaching process maturity from different angles (e.g., Curtis et al., 2002; Rosemann et al., 2006; Hammer, 2007). Specific attention for KIBP maturity, however, has been scarce. Even though some recent research focuses on the role of knowledge management (KM) on improving the maturity of knowledge work (Jochem et al., 2011), an overall understanding of the maturity of KIBPs in organizations today is lacking in academia as well as in practice.

**Table 1: Discretionary process characteristics mentioned in literature**

| Authors | Discretionary process characteristics mentioned |
|---|---|
| Davenport (2010) | consistency, repeatability, structuredness, complexity, formalisation, automation, interdependence |
| Hall and Johnson (2009) | degree to which the management of the process requires a scientific vs. an artful approach |
| Eppler et al. (1999) | need for creativity, predictability, half-life, contingency (predictability/repeatability), learning time, agent impact, complexity |
| Swenson (2010) | predictability, repeatability, emergence |
| Kulkarni and Ipe (2007) | use of creativity, degree of innovation and a width of decision range, unpredictability of decisions or tasks, complexity |
| Marjanovic and Freeze (2011) | structuredness, complexity, creativity, repeatability and predictability, automation |
| Harmon (2007) | complexity, structuredness |
| Marjanovic and Seethamraju (2008) | structuredness, need for creativity |

| | |
|---|---|
| Richter-Von Hagen et al. (2005) | structuredness, predictability, need for creativity |
| Sarnikar and Deokar (2010) | knowledge support, knowledge workers impact, need for creativity and innovation, learning curve, decision possibilities, contingency |
| Slembek (2003) | granularity of design, emerging |
| Papavassiliou et al (2003) | dynamism, contingency, individuality and ad hoc vs planned communication and collaboration patterns |

**Table 2: Comparison between KIBP and non-KIBP characteristics**

| KIBP | Non-KIBP |
|---|---|
| Mostly complex | Simple or complex |
| Mostly hard to automate | Mostly easy to automate |
| Mostly repeatable | Highly repeatable |
| Predictable or unpredictable | Highly Predictable |
| Need lots of creativity | Need less creativity |
| Structured or semi/unstructured | Structured |

Similar to the concept of maturity, we also lack an overall understanding of how effective KIBPs are today. Process effectiveness can be regarded as an output measure for process success, with more successful processes consistently producing better outputs at lower costs and faster cycle times (Schymik et al., 2007). One could expect, for example, that more mature processes will be more structured and less complex, or that more efficient processes will be more predictable and less complex. Therefore, the relationship between the above mentioned process characteristics and the process effectiveness and maturity of processes should also be evaluated, so that we can have an overall picture of the maturity level and effectiveness of KIBP, and we can again compare these with the maturity and effectiveness of non-KIBP.

### *Managing and Improving Knowledge-intensive Business Processes*

Research suggests that managing and/or improving KIBP should employ tools and techniques that are different than the ones used for non-KIBP (Sarnikar and Deokar, 2010; Marjanovic and Freeze, 2011). Due to the process- and expert-specific activities involved in KIBPs, many KM methods have been suggested for the management and improvement of these processes (Eppler et al., 1999; Dalmaris et al., 2007; Jochem et al., 2011). Yet, it has proven to be challenging to apply these methods to process improvement as it requires a certain level of integration between BPM and KM (Dalmaris et al., 2007; Marjanovic and Freeze, 2011). Apart from a couple of case studies (e.g., Seethamraju and Marjanovic, 2009), insights lack on how organisations deal with improving KIBPs. They might, for example, show the tendency to ignore the complex, knowledge-specific dimension of KIBP and approach KIBP improvement in the same way as non-KIBPs.Yet, due to their mostly unstructured and complex nature, one intuitively expects professionals to take into account the different characteristics

of KIBPs when managing and/or improving them. That is why we believe that important insights can be gained by looking into the specific tools and techniques used for process management and improvement today and evaluating which of these techniques (e.g., Lean, Six Sigma, Business Process Reengineering (BPR), …) – if any – are applied to KIBP. Even though these methodologies have proven to be effective, they were designed for the improvement of well-structured processes. Hence, whether they can be applied to KIBP with the same effectives is yet to be explored.

## METHODOLOGY

### *Measurement instrument*

The questionnaire used in this study was designed based on an extensive literature review as well as the results of multiple interviews (anonymized for blind review). The literature review also served as a basis for the development of the interview questions. For more information of the interview process, please see (anonymized for blind review).

Based on the output from this former study and literature, a web-based survey was developed (see Appendix for the survey). The number of items in the survey was limited to 17 questions due to the ease of termination in web surveys (Leeuw et al., 2008). To be able to capture the necessary concepts, our survey included five sections. The first section contained questions regarding process characteristics. To be able to verify if a common understanding of knowledge intensity exists, respondents were also asked to provide a description of their process and asked if they think their process is knowledge intensive or not. The second section included questions about the effectiveness of the process. In the third section, respondents were asked about the maturity level of their process. The fourth section questioned the process improvement methods used by our respondents. The fifth and the final section of the survey contained questions regarding demographic characteristics of the respondents.

Process maturity and process effectiveness were assessed by means of two concise scales that where adapted from Schymik et al. (2007). Their scale was based on previous work on Wolf and Harmon (2006) and includes items on process measurement and performance management, documentation, clarity of needed skills, use of automation tools, standardisation and the existence of an improvement approach. The process effectiveness construct includes items measuring the quality of the output, the overall performance, the consistency and reliability of the performance, the extent to which the process meets customer expectations, and cost of the process. All of these items were measured on a 5-point Likert scale. The question measuring the improvement methods were based on the literature and the exploratory multiple case study conducted by the researchers (anonymized for blind review). For these questions, respondents were provided with a list of methods and asked to mark the ones they used.

It took about 10 minutes to complete the survey. To ensure a high measurement validity and to minimize the effect of question ordering, questions and answer choices' orders were randomised. To avoid misinterpretation, all questions were formulated as crisp and unambiguously as possible, using a common vocabulary and providing explanations or examples where using specific terminology was inevitable (Groves et al., 2009). Before being launched, the face validity and comprehensibility of the questionnaire were tested on a group of academics, allowing the researchers to make a few small adjustments and further increase the quality of the survey.

### *Data Collection and Analysis*

The data was collected between September and November 2011. The survey was sent to over 800 respondents, who constituted a convenience sample based on the contact list of a European business school. Only respondents who had a job related to BPM, an interest in the field of BPM or experience with BPM were contacted. Most of the respondents completed the survey online after having been invited by means of an e-mail. A small part of the respondents completed the survey on paper during various BPM-related events. A total of 108 responses were received. An overview of demographics of the sample can be seen in table 3.

As the first step of analysis, the data was verified for inconsistencies, missing values and outliers. After visual inspection of the data 10 cases were deleted because (1) no or nonsense process descriptions were given, (2) the answers showed inconsistencies or suspicious repetition, or (3) there were too many missing values. This resulted in a sample of 98 valid responses.

Next step was to assess whether the data was normally distributed. Tests for skewness and kurtosis showed that all but three of the variables showed some degree of negative skewness (skewness values ranging from -0.822 to -0.108), and the other three had positive skewness (values ranging from 0.17 to 0.467). Most of the variables also had significant negative kurtosis (values ranging from -1.330 to -0.201). The Shapiro-Wilk test for normality returned p-values lower than 0.01 for all variables, indicating a non-normal distribution (Shapiro and Wilk, 1965). Even though we considered a social desirability bias as a potential reason of the non-normality, we believe this is not highly likely as the items were formulated in a balanced way and the chances of higher end of the scale being perceived as more socially desirable is low. We believe the most plausible explanation for this lack of normality is the presence of an acquiescence bias. This is a response bias caused by a tendency of participants to agree to items when asked whether they agree or disagree with a statement (McClendon, 1991a, Billiet and McClendon, 2000). It also occurs when respondents are asked to rate on a Likert scale how strongly they agree or disagree with a statement. Given the Likert-design and the theoretical interrelatedness of the items and because the survey did not include a balanced set of reversely-formulated items, we were unable to test this assumption (Billiet and McClendon, 2000). Therefore and because of the overall lack of normality in the data, we opted to use nonparametric tests.

Confirmatory factor analyses were performed for the effectiveness and maturity items, as they were adapted from previously validated scales. The a priori criterion was applied and only one factor was extracted for each construct, as the purpose was to confirm the factors that were previously found (Hair et al., 1998). For the effectiveness construct, due its low loading (0.209), one of the items was dropped. The rest had 0.5 or higher loadings, and satisfied the reliability expectations (Cronbach's alpha = 0.8). Thus, these items were aggregated as a measure of process effectiveness. For process maturity, 2 of the items had 0.4 loadings and were considered to be meeting the mimimal expectations (Hair et al., 1998). The reliability of the construct was also satisfactory (Cronbach's alpha = 0.7). Thus, they were aggregated as a measure of process maturity.

In order to compare process characteristics between KIBP and non-KIBP, we divided our sample into two groups based on the knowledge intensity and a visual inspection of the process descriptions. The split was between processes that scored lower than the mean on knowledge intensity (< 4.54; 1 through 4) and higher than the mean (5 or 6). The resulting groups consisted of 45 less knowledge intensive and 53 more knowledge intensive processes. It is important to emphasize here again that we did not look into the difference as "black and white", but rather comparing two extreme ends of a

continuum. Hence, to be able to compare different type of processes, we used the mean – controlled for by visual inspection – as a dividing point.

In order to get an insight into the links between the different variables, inter-item Spearman correlations were computed. To assess the discriminating value of the identified characteristics of knowledge intensity, Mann-Whitney tests were performed. Furthermore, the frequencies of the sources for improvement and improvement methods used were compared to see if any significant differences exist.

**Table 3: Demographic distribution of respondents**

| | |
|---|---|
| Occupation | % |
| Managerial or professional specialty | 36,0 |
| Executive, administrative, or managerial | 34,7 |
| Professional specialty | 16,0 |
| Technical, sales, or administrative support | 2,7 |
| Technicians or related support | 1,3 |
| Administrative support or incl. clerical | 1,3 |
| Service | 1,3 |
| Other | 6,7 |
| Level of experience with BPM: | % |
| No experience | 2,1 |
| Little experience | 19,8 |
| Moderate experience | 44,8 |
| A lot of experience | 33,3 |
| Professional experience: | % |
| 0-5 years | 11,5 |
| 5-15 years | 42,7 |
| 15-25 years | 32,3 |
| Over 25 years | 13,5 |
| Process Role: | % |
| De facto process owner (not formal) | 13,3 |
| Active contributor to the process or process worker | 29,6 |
| Other | 28,6 |
| Organizational Sector: | % |
| Financial / insurance services | 17,7 |
| Manufacturing | 5,2 |
| Government | 18,8 |
| Health care | 7,3 |
| Utilities | 17,7 |
| Consulting | 6,3 |
| Retail / wholesale | 8,3 |
| Non-profit | 1,0 |
| Professional, scientific or technical services | 8,3 |
| Other | 9,4 |
| Number of employees: | % |
| Less than 100 | 7,3 |
| 100-499 | 12,5 |
| 500-999 | 9,4 |
| 1000-4,999 | 28,1 |
| 5,000 or more | 42,7 |

## RESULTS & DISCUSSION

In order to confirm that the tested process characteristics can be used to classify KIBP, we examined the correlations of items measuring characteristics with the single-item measure of knowledge intensity of the process, using Spearman's correlation coefficient (Siegel & Castellan, 1988). The item measuring the extent to which the process is considered to be knowledge intensive was positively correlated with the creativity needed for the process (spearman's rho = 0.46, $p < 0.01$) and complexity of the process ($r = 0.67$, $p < 0.05$), and negatively and significantly correlated with the repeatability of the process ($r = -0.21$, $p < 0.05$). It was not significantly correlated with the eligibility for automation, predictability or structuredness of the process.

This shows that processes that can be categorized at the right hand side (e.g. knowledge intensive side) of the KIBP continuum require more creativity, are more complex, yet are less repeatable than non-KIBP. Processes in our sample that were located at the right hand side of the continuum are e.g. product development, and executive objective setting and evaluation. This first example clearly requires a lot of creativity, can be expected to have complex steps and is not necessarily a highly repetitive project that occurs frequently in the same way. The latter might require somewhat less creativity, but will be highly complex. It can be considered a repeatable process, but repetitions will not be highly frequent nor identical. In our sample, recorded examples from the other side of the continuum(e.g. non-knowledge intensive side), were the billing process and purchasing. Creativity in the first example is usually non-existent, and the complexity can be expected to be rather low – partly due these processes' general maturity (see further). The latter example might require a minimal level of creativity and can have steps that are somewhat complex, but it is usually executed in a rather standardized way. Both can generally be expected to be highly repetitive. In our sample the pricesses that are more towards the middle of the continuum are processes such as complaint handling, and selection and recruitment processes, which will have aspects and/or cycles inclining towards both sides of the continuum. In general, however, they are not characterized by extremely low or high levels of creativity, complexity and repeatability.

Even though these results are as expected, the fact that we did not observe significant negative correlations for eligibility of the process for automation, its predictability or its structuredness is surprising. The latter, however, might be due to differences in the process level at which structuredness can apply. A strategy formulation process, for example, can also be labelled as structured if the broader lines of this process have been defined. In a billing process on the other hand, it can be expected that even smaller and procedural steps are executed following a predefined structure. Hence, it might be the case that all processes are structured up to a certain level of detail, and that this level of detail is smaller in KIBP. As for the eligibility for automation and the predictability of a process, the reason why we did not find a difference between both types of processes may be because certain parts or sub-processes of KIBPs are predictable and/or eligible for automation, and some other parts or sub-processes depend entirely on human knowledge and execution (Kulkarni and Ipe, 2007). This is also reflected in Seidel et al.'s (2010) work on creativity-intensive processes that may include sub-processes that are structured and repeatable and other sub-processes that are unstructured and non-repeatable.

Another factor that might explain these results is the high variability of the number of process instances: when we examined the process descriptions provided by our respondents as well as our interviewees, we realized that the repeatability of a process too can be interpreted in different ways. One of the processes categorized as a KIBP, for example, was the strategic planning process of a

financial institution. Even though the process owner completes the process only once a year, he assessed it as a structured and repeatable process. Other process owners of comparable processes assessed their process as non-repeatable due to the limited number of instances compared to the non-KIBPs, where it is possible to observe cases of several thousand instances each day. The latter may also be explained by the subtle difference between a 'repeatable' and a 'reproducible' process (Reynolds, 2011). The repeatability does not necessarily consider the complexity of the processes, but it is suggested that a reproducible process needs more details and more specificity regarding the expected outcomes (Reynolds, 2011). Recent research findings also show that there can be processes that are repeatable, yet rely on deep expertise (Margaryan et al., 2011). Similarly, research shows examples of very-well structured, routine processes that are also knowledge intensive (Reimer et al., 2000; Marjanovic, 2005).

To see if the characteristics from the interview results can discriminate between KIBP and non-KIBP, we compared the two groups using Mann-Whitney test (Huck, 2004). The results were parallel to the above findings, and only the creativity needed for ($U = 706$, $p < 0.01$), complexity of ($U = 447$, $p < 0.01$), and the repeatability of the process ($U = 880$, $p = 0.02$) were significant differences. We also used Mann-Whitney test to see if there are significant differences between KIBP and non-KIBP in terms of effectiveness and maturity. Our results show that KIBPs are significantly more effective ($U = 920$, $p=0.05$) and more mature ($U = 895$, $p=0.03$) than non-KIBPs. These results were unexpected given the fact that process maturity as well as effectiveness assessments and improvements have so far mostly focused on, what we call, non-KIBPs (Marjanovic and Freeze, 2011). Given our findings as well as what the literature suggests, the intuitive expectation was that KIBPs, due to their complex and ambiguous nature, would be perceived as less mature, simply because organizations are still trying to figure out how to deal with them. However, after reassessing the processes in our sample we realized that most of the KIBPs represented tactical and strategic processes. The nature of the output of these processes, their effect on, and the overall importance of their output for the business in general might have lead our respondents into assuming that they are more effective and mature. Despite their knowledge intensive nature, these processes are usually firmly institutionalised and long-existing – characteristics that are easily interpreted as and associated with maturity. Alternatively, the high level of maturity of KIBPs in our sample might be the result of respondent bias, as the respondents did represent a group of professionals that had experience with and/or were actively involved in BPM practices. It is also important to note that our questionnaire was filled out by a single respondent from each organization. Multiple process workers evaluating the same process would result in higher reliability in findings.

Mintzberg et al.'s (1976) eminent research on strategic processes has shown that strategic processes can be characterized by complexity, novelty, open-endedness and ambiguity. They have also suggested that process workers tend to deal with these unstructured processes by reducing them into sub-processes which are structured and repeatable. This may shed some light into our findings about strategic processes being perceived as knowledge-intensive.

But how can BPM be used to better support these type of processes? As the process improvement methods such as lean or six sigma have typically been applied to transactional and structured processes, it is not possible to apply them on KIBP and expect similar results. Although we believe that KIBPs may benefit from traditional BPM techniques, a more 'knowledge-based' improvement methodology is required for them (El-Sawy et al., 2003). As recent research supports, this knowledge-based improvement methodologies should include experimentation, observation and testing, and be

'human-driven' (Marjanovic, 2011). With traditional BPM techniques, KIBPs may become cheaper, faster and more efficient. But to make them more effective and valuable, human creativity is needed.

To have better insight into how frequently certain process improvement methods are used for certain process types, we examined the frequency distribution of these variables. We selected a number of process improvement techniques that were repeatedly mentioned in interviews with process practitioners preceding the survey development. Furthermore an option was foreseen to add other techniques if needed. The selection options we thus provided were the following: Business Process Reengineering (BPR), Plan Do Check Act (also known as the Deming cycle), Lean, Case Management, Six Sigma, Theory of Constraints (TOC), European Framework for Quality Management (EFQM) Excellence Framework, other, or none at all. For more explanation on these and other process improvement techniques refer to Vom Brocke and Rosemann's Handbook on Business Process Management (2010).

Our results showed that the most frequently used methods were common among the different processes, as well as the least frequently used processes. There were no significant differences between groups, except for the use of Lean; KIBPs in our sample seem to be improved using Lean as a methodology more frequently than the non-KIBP ones do (Table 4). These findings may indicate that, even though KIBPs are fundamentally different from non-KIBPs, organizations tend to apply the same improvement methodologies on both types of processes. This result is surprising since theory has been suggesting, first, that process improvement methodologies are less frequently used in KIBP environments and secondly, that those methodologies may not be suitable to deal with KIBPs. This may be one of the reasons why most organizations struggle to manage KIBPs. KIBPs involve high amounts of exceptions and knowledge created in these processes is the basic value-adding factor (Remus, 2002). Hence, using methods and techniques typically applied to non-KIBPs may not be sufficient to manage and/or improve value creation in KIBPs. Recent research proposes that more focus needs to be put on the management of human interaction in KIBP and that knowledge-based improvement techniques are more suitable than model-based techniques for KIBP management (Marjanovic, 2011).

We suggest that this may lead to or be an indication of process standardization attempts. Yet, process standardization may undermine the performance of KIBPs, which are judgment based and require creativity, by causing the process workers to "switch to autopilot" (Hall and Johnson, 2009). Most of KIBPs include activities that cannot be automated or standardized and classical modelling approaches cannot model some of these activities, such as knowledge acquisition or dissemination (Jochem et al., 2011). This may also be the reason why many KM methods have been developed to address this problem.

This finding may also imply that organizations in many cases prefer to strive for processes that are predicable, structured and manageable (Hall and Johnson, 2009). In other words, those organizations will try to reengineer their KIBPs in the direction of the other end of the continuum, towards non-KIBPs, possibly by trying to standardize, partially automate, model and control them. Yet, if such initiatives were to be favoured these processes would risk losing the competitive advantage they bring to the organisation (Marjanovic and Seethamraju, 2008). It is important to keep in mind that the foundation of commercial success and effectiveness for most organizations today lie within the KIBPs. As mentioned in our discussion, it may easier to manage the non-KI sub-processes or tasks within the KIBPs, but what still needs to be figured out is managing the tacit part of KIBPs.

As Harrison-Broninski (2005) suggests, technology support for human interactions may be the missing link in today's BPM systems. What researchers and practitioners need to do is to develop guidelines that considers interactions of IT and management systems of all kinds, such as system-system, system-human, human-human (Bushell, 2005). These guidelines should work at high as well as low process levels, both within and between organizations.

**Table 4: Process Improvement Methods Used**

| | nonKIBP | KIBP | Total |
|---|---|---|---|
| BPR | 16 | 20 | 36 |
| PDCA | 15 | 20 | 35 |
| LEAN | 9 | 19 | 28 |
| Case management | 4 | 6 | 10 |
| Six Sigma | 2 | 4 | 6 |
| TOC | 2 | 3 | 5 |
| EFQM | 0 | 3 | 3 |
| Other techniques | 11 | 4 | 15 |
| none | 6 | 10 | 16 |

## CONCLUSION

The primary goal of this research is to improve the overall understanding of KIBPs and how they differ from non-KIBPs. We found that KIBPs and non-KIBPs have clearly different levels of complexity, repeatability and creativity required for these processes, but are not necessarily less eligible for automation or structured. We also found that these processes are not managed or improved differently than non-KIBPs, and suggest that organizations need to take these differences into consideration while managing and improving these processes, be careful not to be "straight-jacketing a key source of competitive advantage" (Seidel et al., 2010, p.416).

It is possible to observe a silent yet forceful trend in reviving human-centric processes, or KIBPs, today. For example, Dixon's (2010) health care process improvement example of a physician's simple change in the patient care process, which resulted in great improvements, or Marjanovic's example of an Australian insurance company that encourages face-to-face contact with its customers, rather than online, are brilliant examples.

Based on our findings, we define KIBPs as processes that are complex, less repeatable and require a lot of creativity. These processes also require very specific process knowledge, typically expert involvement, that are hard to predict and vary in almost every instance of the process. They depend largely on human involvement and decisions although parts of the process can be supported by automation, such as a new product or service development or marketing processes. We acknowledge that knowledge intensity is too complex to be categorized with only two dimensions (Margaryan et al., 2011). Even our sample included processes which are knowledge intensive, yet can be automated and routinized to a certain degree. But, we believe looking at the extreme ends of the spectrum may provide further insights into the core differences among KIBP and non-KIBP.

Most of the KIBPs suffer from organizational behavior issues rather than operational challenges (Kulkarni and Ipe, 2006). Hence, applying methodologies that aim to provide operational improvements may not necessarily produce the best results. Nevertheless, we found that organizations

today are applying the same process improvement techniques to both types of processes. We suggest that KIBPs should be improved through creativity and the exploitation of expertise (Seethamraju and Marjanovic, 2009). One way of doing this may be by using KM systems. Literature is abundant with research suggesting the positive impact KM systems have on complex and knowledge intensive processes (Kulkarni and Ipe, 2007; Sarnikar and Deokar, 2010). Instead of trying to diminish the variability of these processes, organizations should manage them with intuition and expert knowledge as well as a scientific approach (Hall and Johnson, 2009).

Even though some of the process characteristics and improvement methods used for these processes tested in this study are confirmed to be aligned with what theory already suggests, we believe it is more interesting to focus on the unexpected findings and pursue them further. Instead of referring to these findings as 'contradictory,' it may prove to be more productive to see them as revealing a rather unexplored area of business process research. A direction for further research may look into charting the applicability of BPM techniques in knowledge intensive environments and alternative toolsets that can be applied. Today, BPM aids dominantly non-KIBPs and as previously called for, research needs to start looking into KIBPs from a management and improvement perspective.

This study has several limitations, sample size being one of them. Given the inconclusive and unexpected findings about KIBP characteristics, we believe this topic would benefit from a more thorough case research that will provide more in-depth insights to the phenomenon. Also, with regards to our finding suggesting that KIBPs are more effective and mature, further and in depth research, such as interviews, mays improve our understanding on the relationship between maturity, knowledge intensity and creativity.

Another limitation is that BPM maturity of the participating organizations was not taken into account in this study and could have had an impact on the results as a contextual factor. Furthermore, acknowledging that KIBP and non-KIBP are two extremes of a continuum, our response set may contain processes that are situated in the grey zone between and influence the results. It should also be considered that our data was collected via a self-assessment surveys. As we cannot verify the extent to which our respondents were objective and the extent to which the questions as well as choices were interpreted uniformly across the sample, this should also be noted as a limitation.

We hope this study will encourage researchers to dig deeper into the dynamics of KIBPs in order to unearth the techniques that will work best for these processes and provide more support for recognizing the limitations of applying only scientific BPM methods on them. Managing and improving KIBPs, by definition, constitutes knowledge work and should be treated differently than managing and improving non-KIBPs.

## APPENDIX

### Survey Questions

1. Please describe the process you will be using as a subject for this survey, in a few words:

2. Please rate the following characteristics for the business process you have chosen to concentrate on for this survey:

| | Very Low | Low | Rather Low | Rather High | High | Very High |
|---|---|---|---|---|---|---|
| Knowledge intensity | | | | | | |
| Creativity needed | | | | | | |
| Eligibility for automation | | | | | | |
| Predictability | | | | | | |
| Repeatability | | | | | | |
| Complexity | | | | | | |
| Structuredness | | | | | | |

3. For this process, you can be considered as ... (choose the description that applies most to you):

   Formal process owner
   De facto process owner (not formal)
   Active contributor to the process or process worker
   Other. Please specify:

4. Please rate the maturity of the business process on a scale from 1 (very low maturity) to 5 (very high maturity)

   1 (very low maturity)
   2
   3 (medium maturity)
   4
   5 (very high maturity)

5. Please indicate the extent to which you agree with the following statements:

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Overall, this process performs well | | | | | |
| This process provides high quality output | | | | | |
| This process meets customer expectations | | | | | |
| The performance of this process is consistent | | | | | |
| This process performance is reliable | | | | | |
| This process provides high-value output | | | | | |
| This process is low-cost | | | | | |
| Overall, this process is effective | | | | | |

6. Please indicate which of the following process improvement methods you have used to improve your business process. (select all that apply)

European Foundation for Quality Management model(EFQM) / Common Assessment Framework(CAF)
Business Process Re-engineering (BPR)
Lean Management
Other (please specify)
None
Six Sigma
Theory of Constraints (TOC)
(Adaptive) Case Management
Plan Do Check Act (PDCA / Deming Cycle)

7. Please indicate the extent to which you agree with the following statements:

| | Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |
|---|---|---|---|---|---|
| The process is well documented and these documents are kept up to date. | | | | | |
| Units that perform similar activities use a similar process. | | | | | |
| Standard measures are defined for evaluating the performance of the process. | | | | | |
| The process is supported by a consistent process automation tool. | | | | | |
| The skills needed to perform the tasks in this process are defined. | | | | | |
| The process is managed by means of performance data. | | | | | |
| A process improvement approach is in place to identify and address problems and defects. | | | | | |

8. Please indicate your organization's sector:

Financial / insurance services
Manufacturing
Government
Health care
Utilities
Consulting
Retail / wholesale
Education
Non-profit
Professional, scientific or technical services
Other (please specify)

9. What is your current occupation?

Managerial or professional specialty
Executive, administrative, or managerial
Professional specialty
Technical, sales, or administrative support
Technicians or related support
Sales
Administrative support or incl. clerical
Service
Private household
Protective service
Service, excl. protective or household
Farming, forestry, or fishing
Precision production, craft, or repair

Operations, fabrication or labor
Machine operation, assembly, or inspection
Transportation or material moving
Handling or cleaning equipment, help or labor
Other

10. How many years of professional experience do you have?
    0-5 years
    5-15 years
    15-25 years
    Over 25 years

11. What is the approximate number of employees in your organization?

    Less than 100
    100-499
    500-999
    1000-4,999
    5,000 or more

12. Please select your country:

    List of countries here

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