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Sallos, M; Yoruk, E. and Garcia-Perez, A.

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A Business Process Improvement framework for Knowledge-Intensive Entrepreneurial Ventures

Mark P. Sallos, Esin Yoruk and Alexeis García-Pérez

Centre for Business in Society, Faculty of Business and Law, Coventry University, UK

Abstract

Pushed by the transition towards the knowledge economy, as well as several other change drivers, an ever-increasing number of knowledge intensive ventures are relying on operational knowledge intensity in order to generate value. Through their interaction with their varied stakeholders -- from actors within their supply chains to educational and financial institutions -- knowledge intensive enterprises are increasingly becoming a key component of regional economic stability. Within their complex environment, these organisations lack the support of suitable frameworks to inform their efforts to optimise, adapt and improve their underlying business processes in order to maximise the efficiency of their performance and pursue growth ambitions. This paper examines the distinct nature of knowledge intensive entrepreneurial ventures (KIEs) and the applicability of current Business Process Improvement (BPI) frameworks to their setting. Finally, a KIE-oriented business process improvement framework is developed through an integrative adaptation of the concepts of knowledge intensity and knowledge management to the principles of business process redesign and re-engineering reported in existing literature. The proposed framework contributes to the existing literature in the subject of BPI modelling for knowledge intensive entrepreneurial ventures by addressing a distinct set of improvement concerns that this type of organisations face at a process level.

Keywords:

knowledge intensive entrepreneurship; business process improvement; business process redesign; business process re-engineering; innovation.

1. Introduction

The effects of perpetual technological development, such as the inception of unprecedented global-oriented platforms for communication, trade and knowledge sharing on the nature and direction of economic value generation are unquestionable. This pivotal phenomenon has been addressed within the literature through the notion of the Knowledge-Based Economy – a term initially developed by OECD to describe an economy that is reliant on the production, dissemination and utilisation on knowledge and information (Sabau 2010). Since its inception, the construct grew to explicitly incorporate technology, as outlined by Brinkley (2006) who uses it to describe an economy where primary value generation is achieved through the convergence of intellectual assets and technology.

As the dynamics of value generation models morph interdependently and adapt to the changes imposed, entrepreneurial opportunities emerge, even in non-technologically intensive sectors, for innovation and growth. Furthermore, operational models which rely on knowledge assets – a central indicator of knowledge intensity (Kapyla et al. 2011) – can manifest growth, innovation and disruption at a scale that is disproportional to the asset base or scale of their organisational setting. Companies which exhibit a convergence of entrepreneurial attributes and knowledge-intensity are of particular importance within the Knowledge-Based Economy, as adaptive actors, sources of employment and value generation, habitats for individual skill development, and as the foundation of future economic development.

From a literary perspective, the study of knowledge-intensive enterprises is a relatively novel phenomenon, post-dating the inception of the knowledge based view of the firm (Curado and Bontis 2006). Reoccurring themes within such studies include entrepreneurship, innovation networks, human and intellectual assets, as well as various applications of knowledge (Madsen et al. 2003, Groen 2005, Malerba and McKelvey 2016). As a result, a growing body of literature explores the wider role, characteristics, tendencies and consistency of such organisations. However, in spite of their growing societal importance, the distinct setting of knowledge intensive enterprises has not yet been the subject of extensive exploration from an operations management perspective, resulting in a literary gap on how to operationally assist the sustainability, adaptation, innovation or growth orientation of such firms. More specifically, there is a literary gap concerning how the wider defining traits of knowledge intensive enterprises are manifested and supported at a process level.

The current paper aims to explore knowledge intensive enterprises from an operational perspective, and propose a conceptual framework for business process improvement (BPI) developed to explicitly address the organisational profile of knowledge intensive enterprises, namely knowledge intensive entrepreneurial ventures. By this way, the paper aims to link business process management (BPM) literature with the extant literature on knowledge intensive entrepreneurship (KIE) concept (Malerba and McKelvey 2016). In the context of BPM, the existing literature incorporates knowledge intensity into BPM at process level and mostly deals with knowledge intensive business process (Kalpic and Bernus, 2006; Dalmaris et al., 2007; Isik et al., 2013). However, as knowledge intensive business processes are present in any type of firm -particularly in the current competitive business world, there is a growing need for their study. This paper contributes to the literature by investigating and modelling business process improvement specifically in the knowledge intensive entrepreneurial ventures. Our argument is that the already underlying core competences accumulated in the form of knowledge intensity in the knowledge intensive entrepreneurial ventures provide a favourable platform for the business process improvement activities.

This is achieved through an extensive literature review, the development of a KIE profile, the explicit selection of an epistemological stance which avoids the ambiguity associated with the notion of knowledge, the development of a business process ontology, and of a corresponding process improvement methodology designed to address the distinct operational constraints and properties of such firms and support their performance. These components have been selected to have a complementary effect, conceptually based on the structure of the Dalmaris et al. (2007) knowledge intensity framework.

As a result, the output can be differentiated from alternative knowledge intensive business process improvement (KBPI) conceptual frameworks through its focus on the distinct needs and organisational setting attributes of KIEs. Furthermore, through its business process management component, it expands the scope of existing KIE research through the inclusion of an operational dimension, while supporting such companies analyse their business functions, pursue process improvements, and support growth initiatives, based on setting-specific motivations.

2. Review of Literature

2.1 Business Process Management, Improvement, Re-design and Re-engineering

As business models and environments become more dynamic, there is increased pressure on organisations to adapt their operations and ensure that their performance leads, or at least follows, the competitive narrative. While the identification of relevant change triggers is key in leading change efforts, the operational assimilation and implementation of the desired change is manifested at a process level, through its effects on functions, structures, flow, and vision (Kang 2015). The resulting utility of business processes (BPs) as structural cells is used by Adamides and Karacapilidis (2006:557) to present the construct as the “prevailing unit” of business analysis, performance assessment and decision-making support, especially within the context of business modelling.

In spite of its industrial origins which constrain the generalizable utility of some of its methodological constructs (Dalmaris 2007:280), Seetharamraju and Marajonvic (2009:920) argue that Business Process Management (BPM) has evolved beyond its initial focus on process automation technology, to incorporate people, systems, processes and strategy. This is especially relevant for any application of BPM within a knowledge intensive environment, due to the embedded/informal nature of the above elements within such companies. Isik et al. (2012) identify the transition towards the knowledge economy as a challenge for traditional BPM as a result of the increase in process variability, complexity and human-centricity, while also arguing its potential as a driver for the quest of new evolutionary approaches of dealing with these problems.

Beyond their general management, Zellner (2012) presents the improvement of BPs (BPI) as an organisational priority. The core paradigms of BPI cover initiatives ranging from marginal continuous improvements to business process re-engineering. Scholars such as Siha and Saad (2008) make a clear distinction between process re-engineering and improvement by presenting BP-R (reengineering) as a particular BPI approach. In the absence of such a distinction, the literature can often generate confusion in regard to the variation between the terms. Zellner (2012:602) highlights that the difference lies in the degree of implied change: while BPI is seen as incremental/evolutionary, BP-R is perceived as more radical process. Furthermore, both concepts (Business Process Improvement and Business Process Re-engineering) are classified as forms of Business Process Re-design (BPR).

The underwhelming presence of human and organisational aspects within BPI methodologies has also been discussed by Ranjbarfard et al. (2012), who particularly emphasise the importance of recognising knowledge as a performance-determining variable. They argue that even though knowledge is often found in informal settings, it can still be an integral part of many business processes - thus having to be recognised as such where applicable. The quoted added complexity and variable levels of impact perhaps explain why such factors might historically have been excluded or under-represented from a process management perspective. However, the macro-environmental shift towards knowledge as a key competitive driver is generating an ever-increasing number of organisational settings in which such historical mono-disciplinary methodologies are of limited use. Seethamraju and Marajanovic (2009) reinforce the message of association between the process and its knowledge habitat, arguing that BPI is in itself knowledge intensive.

In order to better understand knowledge intensity at a process level, and the appropriate measures for the management of knowledge intensive business processes (KIBP), Isik et al. (2012) have analysed the literary patterns of characteristics expected of such processes. Their findings include various traits, ranging from the role of the knowledge worker, complexity and number of stages, levels of uncertainty and risk, level of decision, to the part played by the decision maker, as well as his/her required expertise. Isik et al. (2012) highlight that the most frequently occurring and arguably most relevant such characteristics are: the level of predictability, creativity requirements, repeatability, and complexity. Finally, based on the study, the need for distinctive approaches for effectively managing and improving such processes is unanimously acknowledged, and the applicability of current management tools and methodologies (including Lean and Six-Sigma) to KIBPs is questioned.

While much of the existing BPM/BPI literature is of limited use for the KIBPs, the knowledge intensity element of the KIE concept can work as an operational tool to connect KIE with the BPM/BPI.

2.2 Organisational Categorisations Incorporating the Concept of Knowledge Intensity

The increasingly dynamic nature of the current business environment has been attributed to factors such as globalisation, sustained technological progress (Wright et al. 2013), intra and inter-organisational communication structures, and the expanding array of ever-maturing enterprise support methodologies (Adesola and Baines 2005, Marjanovic and Freeze 2012). However, one of the most

noticeable occurrences of the last decades has been the emergence of knowledge-intensity as a pillar of economic growth. Despite much emphasis, there is no generally agreed criteria for what may describe a knowledge intensive organisation.

Starbuck (1992) introduced the notion of knowledge-intensive firms as an alternative to the asset-intensive and capital-intensive classifications used by economists. The central driver for this categorisation was the assertion that such companies possess properties which make them atypical in noteworthy ways, and thus require distinct literary consideration. Karreman (2010) highlights that Starbuck's insight preceded the wave of emphasis on knowledge and capabilities, which later guided much of strategy and organisational theory.

The premise of knowledge-intensity as a category-defining variable became central for a variety of distinct yet related sub-constructs used by scholars to engage and document the growth in frequency and contribution of companies. This approach uses knowledge assets to generate value at a scale that is both disproportional to their tangible assets and available capital, and have the potential to generate disruption and innovation (Muller and Zenker 2001). Thus, knowledge-intensity provides a platform that reconciles novel operational models with existing ones through a shared base of dependence on human capital, as well as relational and structural assets (Kapyla et al 2011). For example, Professional Service Firms (PSFs) are presented by von Nordenflycht (2010:155) as "extreme examples of knowledge-intensity" which lie at the convergence of three characteristics: knowledge intensity, as exhibited through the high density of human capital; low capital intensity, described as a limited dependence on non-human assets for value generation; and a professionalised workforce, the presence of which being indicated by a professional ideology and self-regulation. In that sense, there is clearly an overlap between the PSFs and Knowledge Intensive Business Services (KIBS) -- another sub-cluster of knowledge intensive companies. Muller and Doloreux (2009) argue that, while KIBS have been treated as a distinct organisational category within a significant body of literature, the term lacks an unanimously agreed upon definition. Instead, several reoccurring descriptive themes are used to illustrate the characteristics of such companies. These include the non-consumer orientation of their output, knowledge intensity that is manifested internally through the qualification of labour and externally based on the properties of the transactions between the service provider and the service user, and a reliance on human capital for undergoing complex operations "of an intellectual nature" (Muller and Doloreux 2009:65). As a result, novel non-manufacturing organisational models and areas of activity (i.e. web development companies) which have yet to (or do not seek to) obtain their professional status could be classified as a

KIBS, but not as a PSF. Both KIBS and PSFs are, in the wider sense, sub-segments of the knowledge intensive firm view, which are further defined through the inclusion of additional variables (i.e. service output, non-consumer oriented, professional nature of human capital) (Muller and Doloreux 2009, Von Nordenflycht 2010).

Authors such as Nummela et al. (2005) and Baptista Nunes et al. (2005) narrow down the spectrum of knowledge intensity by including company scale as a variable of analysis. Thus, knowledge intensive SMEs are explored as sub-segments of knowledge intensive organisations, which share both knowledge intensity and scale induced attributes. However, as the purpose of such categorisations is the development of a construct that reflects a cohesive set of defining characteristics shared by the set of actors of interest, differentiating between defining and circumstantial traits can affect the output of the analysis. To that purpose, Malerba (2010) proposes knowledge intensive entrepreneurship (KIE) as an alternative implementation of knowledge intensity, which can better explain and support the growing number of disruptive entrants that play an active role in the transition towards the knowledge economy.

2.3 Knowledge Intensive Entrepreneurship: A Platform to Study

Knowledge Intensity and Business Process Improvement

The emergence of start-up culture has highlighted a need for employing knowledge intensity with complementary effect to entrepreneurship theory for the development of a conceptual framework which addresses distinct properties of a growing number of companies. Central to the KIE model are knowledge intensity, innovation and the entrepreneurial status as a composite defining property based on which secondary characteristics can be inferred, such as organisational age, scale, maturity and growth orientation. Its literary origin and disciplinary context differentiate KIE from alternative knowledge intensity based organisational categorisations, due to its primary focus on entrepreneurship which is examined through a Schumpeterian perspective, evolutionary economics and innovation systems. As a result, the model is positioned outside of the individual-based perspective of entrepreneurship, and instead places focus on firm-level entrepreneurial experimentation (Malerba and McKelvey 2016).

Unlike KIBS, PSF or knowledge intensive SMEs, the KIE model bears no indicators of direct succession from Starbuck's (1992) or Alvesson's (1993) work on knowledge intensity based organisational categorisations. Instead, the KIE view on knowledge intensity is relatively distinct, covering a well-defined spectrum of measures and indicators, such as investments in R&D, networking, or human

capital, based on the operational model of the enterprise. This schism is in line with the recommendations of Rylander and Peppard (2005), who question the utility of the KIF organisational category due to its increasingly limited analytical utility, and propose its use as a bridging concept towards alternative models that explain the evolving distinct behaviour of organisations. Within KIEs, knowledge intensity is associated with novel knowledge and innovation, the absence of which being deemed an exclusion factor.

In addition to knowledge intensity and the organisational novelty that is associated with the entrepreneurial status of such ventures, emphasis is placed on the innovativeness and opportunities exhibited as eliminatory attributes. So, knowledge intensive organisations which do not manifest an ability to employ their knowledge assets in a novel way, or to generate novelty in terms of their output are excluded from the categorisation (Malerba and McKelvey 2016). On the other hand, the framing of knowledge intensity within the KIE model is more inclusive than that found within similar concepts, as it does not exclude specific sectors based on their general technological density or reliance on manufacturing. Thus, these key constructs are argued to enable the study of drivers of growth, innovation and disruption in the knowledge economy in a way that highlights their cyclical nature and anchoring in knowledge intensity, without excluding non-service organisations, or those which operate in a field lacking a professional status.

2.4 Knowledge Intensity: Convergence through Knowledge Assets

The semantic variability surrounding the use of knowledge as a categorising criterion has been the subject of literary debate (Alvesson 2001, Rylander and Peppard 2005). Alvesson (2001) argues that the notion of knowledge intensity as an organisational attribute has been used to cover a wide spectrum of potential positions, resulting in ambiguity. For example, the differentiation between a knowledge worker and a non-knowledge worker can be less than evident, unless an effective grounding criterion is established. This ambiguity within the context of prior literature ('mainstream') on knowledge intensive organisations is suggested to cover the notion of knowledge itself, its significance, and the results which emerge from knowledge work. The KIE model explicitly provides such criteria, however to do so, it must rely on related and potentially similarly ambiguous notions such as 'innovative opportunities' (Malerba and McKelvey 2016).

Kapyla et al. (2011) address the argued conceptual ambiguity associated with knowledge intensity through the notions of intellectual capital and knowledge assets. This perspective enables the analytical

breakdown of knowledge-intensity through its core indicators, as highlighted through literature: Human assets, such as competence, personal traits, knowledge and education; structural assets, through factors such as culture, processes, documented information, IPR, and leadership; and relational assets which include the stakeholder relationships, contracts and arrangements, and the organisation's image and brands (Kapyla et al. 2011:318). These three categories of knowledge assets encompass the manifestations of knowledge intensity based on input, processes, and output. Furthermore, the various knowledge intensive company categorisations are built based on specific configurations of such assets and their proportional utility. The knowledge assets perspective provides a comparative analytical framework between all knowledge intensive organisational categorisations, as it includes the core units of value generation in such companies.

In their inquiry on the role of the various knowledge assets in knowledge intensive organisations, Kapyla et al. (2011) found a dichotomy between the structurally-focused companies seeking growth and a decreased dependence on specific individuals, and those that prioritise factors such as profitability, and employee and customer satisfaction. These results indicate that structural assets are a core component of operational scaling, even in knowledge intensive environments. Furthermore, Moreno and Casillas (2008) point out the significant body of literature associating high growth in firms with entrepreneurial behaviour and innovation. When coupled with the high rate of change within knowledge intensive sectors and the high risk of knowledge leakage through staff turnover which affects SMEs that rely on human capital (Baptista Nunes et al. 2005), the importance of a strong structural knowledge asset base for sustainable KIEs is evident, yet is not a prevailing theme within the concept's emerging literary base.

Based on their various characterisations, business processes are not bound to firm-level knowledge-intensity, as they can also be employed in non-knowledge intensive settings (Isik et al. 2012, Unger et al. 2015). Nevertheless, an organisation's high reliance on knowledge assets for value generation will also be manifested at a process level through higher knowledge requirements expected of the intellectual capital, a greater importance of collaboration due to the complexity of the task, and implicitly, less structure as well as a less predictable and repeatable flow of activities (Unger et al. 2015). This point is further illustrated by Papavassiliou and Mentzas (2003), who argue that, in knowledge intensive companies, business processes often bypass rigidity in favour of goal-orientation.

In that sense, the premise of setting specific methodological applicability based on underlying assumptions and developmental context, coupled with an assertion of the operationally distinct setting of KIEs, can be inferred to indicate a need for KIE-specific support constructs which are able to account

for and coordinate both firm level and process level knowledge intensity. In continuation, we provide a conceptual framework for business process improvement in a knowledge intensive entrepreneurial venture whereby the common link in both concepts is the knowledge intensity.

3. Towards A Conceptual Framework for Business Process Improvement in Knowledge-Intensive Entrepreneurial Ventures

Our conceptual framework to study BPI is framed within the concept of KIE developed by Malerba and McKelvey (2016).

3.1. Characteristics of KIEs

In order to effectively adapt BPI into a KIE setting, it is necessary to consider the key features of such organisations as application settings. We draw on Malerba and McKelvey's (2016) conceptualisation of KIEs. In that sense, KIE is a firm level concept (in contrast to individual or person-centred approach to entrepreneurship within the Individual-Opportunity nexus), which provides us with an effective platform to study BPI. Their definition of KIE incorporates four basic characteristics of firms (Malerba and McKelvey, 2016: 21):

- i) Being a new firm,
- ii) Being innovative,
- iii) Having a significant knowledge intensity in their activity, and
- iv) Exploiting innovative opportunities in diverse sectors and contexts.

These characteristics of a KIE provide a robust platform for the analysis of BPI. They allow for BPI analysis in newly formed and particularly knowledge-based firms (see Table 1). Firstly, new entrepreneurial ventures are innovative in nature exploiting available opportunities (Schumpeter, 1934), which then is expected to influence their business process improvement activities. All firms, old or young, manage business processes, yet new and innovative firms will also place significant emphasis on the improvement of their business processes. Secondly, having significant knowledge intensity in their activity motivates entrepreneurial firms to exploit innovative opportunities to their best. Malerba and McKelvey (2016) argue that this opportunity exploitative behaviour is embodied in the elements of business models of such firms with the ultimate aim to create value and growth. Carayannis et al. (2015)

furthermore state that it is indeed the innovative business models that promise organisational sustainability.

In order to guide subsequent analysis, we further add to the operational characteristics likely to shape BPI in the context of KIEs, as extracted from the literature, based on their defining/constraining properties: size, entrepreneurial status and knowledge intensity. While organisational size is a derived property based on the KIE model's definition of entrepreneurial firms, it is of key importance from a BP perspective due to the differences in how small and medium companies operate when compared to corporations. Additionally, the other key organisational traits used for defining such firms, such as the intensity of knowledge within their activities and their pursuit of innovative opportunities, lack a presence in operational management theory and are of limited value for BPI meta-modelling. A compilation of the key summative characteristics based on the literature review can be found in Table 1.

Category	KIE Characteristics	KIE characteristics explained
Size-derived	New firm/ entrepreneurship	Resource limitations for finance, human resources and time Limited understanding of business improvement strategies Lack of familiarity with business process improvement methodologies Short-term orientation Entrepreneurial and opportunistic approaches Informal decision making systems Operational focus Significant competitive pressures Flexible and agile Reflective to external stimuli
Knowledge-derived	Innovativeness	Innovation oriented Growth oriented
	Knowledge intensity in activities	High importance of social capital Knowledge as a property of physical capital, social capital, organisational capital Appetite to departure from routines

		Propensity towards information sharing, collaboration and open innovation Novel and complex work processes involving problem solving and non-standardised production Practitioner creativity High education and professionalization of the workforce Low importance of traditional (material) assets
	Exploiting innovative opportunities	(Over)confidence and risk appetite Decision making under uncertainty and complexity Business models aiming at creating value and growth

Table 1. KIE characteristics.

The size-derived characteristics of new entrepreneurial firms are usually accompanied with resource limitations in terms of finance, human resources and time (Wolff and Pett, 2006) and lack of familiarity with business process improvement methodologies (Khan et al., 2007), which then may reflect onto limited understanding of business improvement strategies. However, this is most of the time compensated by flexibility and agility characteristics of new firms (Wolff and Pett, 2006) and their response to change guided by short-term orientation and being reflective to external stimuli (Ates and Bitici, 2011). At this point, robustly possessed knowledge-derived characteristics play an important role in new firms to overcome disadvantages that can impact on their BPI processes. The innovation orientation, the desire to grow by creating value, the proactiveness in taking risks (Miller, 1983; Covin and Slevin, 1988, 1989; Lumpkin and Dess, 1996) and readiness to make decisions under risky and complex circumstances (Busenitz and Barney, 1997) are essential attributes, yet only when supported by the knowledge-intensity element. This knowledge intensity element is often explained by the existence of social capital (Burt, 1997; Nahapiet and Ghoshal, 1998) and thereafter the high proportion of knowledge as a property of physical and human capital (Starbuck, 1992) represented as high level of education and professionalization of the workforce (Baptista Nunes et al., 2005). It is also explained by the willingness for information sharing, collaboration and open innovation (Chesbrough, 2003, 2007; Van de Vrande et al., 2009). The ultimate effect of these will generate the ability to execute novel and

complex work processes involving problem solving and non-standardised production and departure from routines (Kapyla et al., 2011).

These characteristics will be used throughout the discussion as anchoring points for the various assumptions made. They frame the analysis and contextualise the output to a distinct literary profile. As KIEs present a significantly different application setting than the traditional industrial environment where BPI was first conceived, it is important to establish how the particularities of such entrepreneurial organisations impact the scope of process improvement initiatives. Emphasis is also placed throughout the discussion on the idea of knowledge-intensity as an organisational property which can also be observed at a process level. This does not negate the existence of traditional BPs within KIEs – instead, it highlights the knowledge intensity inherent with the heavy reliance on structural, human and relational knowledge assets presented by such companies.

3.2. Knowledge Intensity: The Missing Link between KIE and BPI

Knowledge intensity is a significant characteristic of KIE. Knowledge intensity has also been a significant component in the analysis of knowledge intensive business processes (Dalmaris et al., 2007; Isik et al., 2013) operationalised thorough the use of knowledge management (Kalpic and Bernus, 2006; as well as knowledge flows (Yoo et al., 2007; Ranjbarfard et al. ,2012). Knowledge intensity, therefore, emerges as the common concept in both KIE and BPI literatures, albeit being analysed at different levels, i.e. unit of analysis as firm level and unit of analysis as process level. We argue that the firm level aspects of knowledge intensity generally overlap with the process level aspects. Moreover, firm level aspects largely influence the process level.

For the purposes of our conceptual framework, we treat knowledge intensity as the significant concept connecting KIE with the improvement of BPs through three core components: “a foundational theory of knowledge [...], an ontology for the representation of a business process, and a method for process audit, evaluation and improvement” (Dalmaris et al. 2007:302).

An explicit epistemological position is key in relation to the critique associated with the use of knowledge as an analytical construct at both a process and an organisational level (Alvesson 2001). Within the context of the current work, knowledge will be explored from a constructionist perspective,

as suggested by Campos and Sanchez (2003), which corresponds with the tacit-explicit continuum. Campos and Sanchez (2003) suggest that tacit knowledge can be either cognitive, or technical-expert. The differentiation between the two types of tacit knowledge is relevant within the current context, as they play different roles in the KIE value creation environment. Technical-expert knowledge is action derived and thus a core internal process improvement driver, especially in the absence of a strong explicit knowledge foundation. Due to the multi-disciplinary nature of BPI, an argument can be made in favour of conceptual consistency, as both tacit and explicit knowledge are reoccurring components of entrepreneurial studies, as well as BPM research.

However, in order for tacit knowledge to be fully exploited within the organisation, it must first be converted from its non-verbal original state, leading to issues such as the individual's willingness to participate in the process as well as his/her ability to do so (Gubbins et al. 2012). In addition, the transfer of such knowledge involves two core stages: externalisation, at which point previously personal knowledge gets encoded linguistically, and internalisation, which focuses on the beneficiary of the transfer assimilating the explicit knowledge resulting from externalisation. Based on the characteristics of KIEs, their often effective communication and collaboration structures can facilitate tacit knowledge conversion and dissemination efforts, further strengthening their shared knowledge base.

The second reoccurring element of most process improvement methodologies is the ontology. Kalpic and Bernus (2006) highlight that the properties and features of the BP modelling sequence should be determined by the purpose of the model itself. Thus, in the context of BPI within a KIE environment, the ontology should represent a simplification of the core components and flows that affect the performance of BPs. Kalpic and Bernus (2006) also suggest that companies should be aware of both their internal and external knowledge generation flows, raising awareness of the importance of an accurate representation from an ontological perspective.

3.2.1. Core elements of knowledge intensity at firm level

An attempt to operationalise knowledge intensity will help with better understanding of the basis for BPI. Most of the time, knowledge intensity is bounded by firm-level indicators influencing the business process level. In other words, a general well-being at the firm level in terms of robustness of the knowledge intensity will generate favourable habitat for the well-being of BPI. Based on this assumption, we then, open the box of knowledge intensity with an aim to operationalise the concept for the purposes of our conceptual framework.

Even though innovative opportunity is an ambiguous and therefore difficult to operationalise concept embedded in business models of firms, knowledge intensity allows for operationalisation. Malerba and McKelvey (2016), to begin with, offer use of indicators such as investment in research and development; networking with universities; or advanced human capital; albeit they don't differentiate between probable elements of knowledge intensity. In that sense, Kapyla et al. (2011) provide a useful analytical framework for discussion of knowledge intensity as an organisational characteristic categorised around human, structural and relational assets that altogether help form or assess the extent of knowledge intensity in the firm. Although they do not provide specific indicators for operationalisation of the concept, it is our aim to explicitly bring in the measurement aspects for the knowledge intensity concept for the purposes of our conceptual framework. Thus, we offer the indicators in Table 2 for the measurement of elements of knowledge intensity at firm level as belonging to a three-pronged framework encompassing human, structural and relational elements.

Elements of knowledge intensity	Selected Indicators for operationalisation
Human related elements	Flexible human resource management Training High rate of R&D personnel Highly professional workforce High rate of personnel with postgraduate degrees
Structural elements	Existence of internal R&D unit Employment of state-of-the-art production technologies Lateral, not hierarchical, organisational forms Capability to respond to change (agile character)
Relational elements	Social capital Network embeddedness with the research environment Network embeddedness with the value chain User involvement in process Cooperation with rivals

Table 2. Operationalising the knowledge intensity concept.

Human related element of knowledge intensity would incorporate measurable indicators such as the rate of R&D personnel, rate of personnel with undergraduate/postgraduate degrees, highly skilled/professional workforce, the extent of technical training in the firm, flexible human resource management. The high proportion of knowledge/firm resources as embedded in human capital (Penrose, 1995; Starbuck, 1992) can be represented by the high level of education and professionalization of the workforce (Baptista Nunes et al., 2005). From entrepreneurship perspective, human capital is crucial factor in opportunity identification and exploitation (Shane, 2000; Ucbasaran et al., 2008).

Structural element of knowledge intensity would focus on the locational characteristics of knowledge other than human capital, for instance the existence of an R&D unit, high technology production methods, creative organisational forms that are able to respond changes promptly and effectively (Ginsberg, 1988; Bottani, 2010) and governance forms of lateral approach rather than hierarchical (Williamson, 1999, Coombs and Metcalfe, 2000).

Relational or networking elements of knowledge intensity would encompass social capital, the flow of knowledge into and out of the firm in the form of collaboration with the immediate research environment, supply chain, the suppliers and value chain, users and even the rival firms. Social capital are the first degree informal links that facilitate firm's access to valuable networks in supply chain and related markets during the initial phases of the entrepreneurial venture (Burt, 1997; Nahapiet and Ghoshal, 1998). During the later phases of firm life cycle, networking elements are explained by the information sharing and intense collaboration activities with different types of partners in the supply and value chain and the research environment that allow for flows of tacit knowledge (Von Hippel, 1986, 1988; Hagedoorn, 1993; Hite, 2005; Humphrey and Schmitz, 2008; De Fuentes and Dutrenit, 2012; Bodas Freitas et al., 2013). Empirical evidence suggests that innovativeness in the knowledge intensive enterprises is directly related to their attention to and cooperation with their users (Radosevic and Yoruk, 2012). Radosevic and Yoruk (2016) also provide evidence for the justification of networking as an additional component of entrepreneurial orientation particularly in the knowledge intensive entrepreneurial ventures, that complement innovativeness, proactivity and risk taking components.

3.2.2 Core elements of knowledge intensity at process level

A fundamental difference between BP modelling in a KIE environment and in a traditional organisation

lies in the core focus of the model itself: the flow of knowledge, the flow of work or the integration of these two. By reviewing the literature, Ranjbarfard et al. (2012) found that, while most BP models focus on the flow of work, an increasing number of meta-models are designed to illustrate or at least incorporate the flow of knowledge as a variable. Amongst these, only one has been found to explicitly address BPIs as a potential goal, while the most frequent desired output utility of the models is analysis and diagnosis derived. This indicates a literary reluctance to address the variability associated with BPs from an improvement perspective. Furthermore, in terms of patterns, the most frequently reoccurring process elements amongst these knowledge-oriented models are: “Role”, “Task”, “Process”, “Outcomes”, “External data” and “Glossary of terms”.

Within the context of their own ontology of BP components involving knowledge flows, Ranjbarfard et al. (2012:272) suggest nine core elements derived and adapted primarily from the Dalmaris et al. (2007) framework. These are:

- “Activity” presented as a summative construct of the smallest work denomination, the Task;
- “Person”, or the individual(s) involved in the activity;
- “Knowledge Object” defined as a suggestion that is intended to fix a problem, or to assist fixing a problem;
- “Knowledge Path” or the sequential progression of Knowledge Objects, which is also usable for the analysis of their lifecycle;
- “Role”, one of the primary value adding constructs that is assigned to Persons and integrates their respective Knowledge Objects;
- “System” defined as tech-natured active element used to modify, copy, move, delete, record and disseminate Knowledge Objects;
- “Environment” consisting of all that is external to the BP with the ability to influence it,
- “Competency” presented as the sum of the requirements of the Role; and
- “Group”, an assembly of goal-cohesive Roles.

None of these elements are atypical for KIEs based on their established characteristics, resulting in an effective simplification of the building blocks of a BP. However, to supplement the emerging ontology, an environmental dimension will be added as a mechanism for the representation of meta-organisational knowledge flows that are typical in a KIE environment through the effects of networks in innovation systems (Malerba and McKelvey 2016).

3.2.3. Key activities of BPI in KIE: The Meta-Model

Kalpic and Bernus (2006:47) discuss the four main activities that deal with knowledge manipulation from both an internal and an external perspective proposed by Holsapple and Joshi (2002). These are:

- The ***acquisition activity***, where potential sources of knowledge are identified in the external environment, based on which usable contextual representations are developed;
- The ***selection activity***, where relevant knowledge is identified within an organisation's existing knowledge resource base. This activity is the internal equivalent to the previously highlighted external acquisition;
- ***Internalisation***, where the knowledge is incorporated within the organisation;
- Use, which is the umbrella term for the ***development of novel knowledge through the processing of existing knowledge, as well as knowledge externalisation***.

The explicit acknowledgement and incorporation of these activities within the context of the model ensures the avoidance of counterproductive ambiguity, while also facilitating the representation of the meta-organisational two-way knowledge flow exchanges typical for KIEs. As a result, the high proportional dependence on relational and human knowledge assets can be accounted for at a process level, and used to drive process improvement initiatives. Based on this, the ontological meta-model proposed by this research is presented in Figure 1.

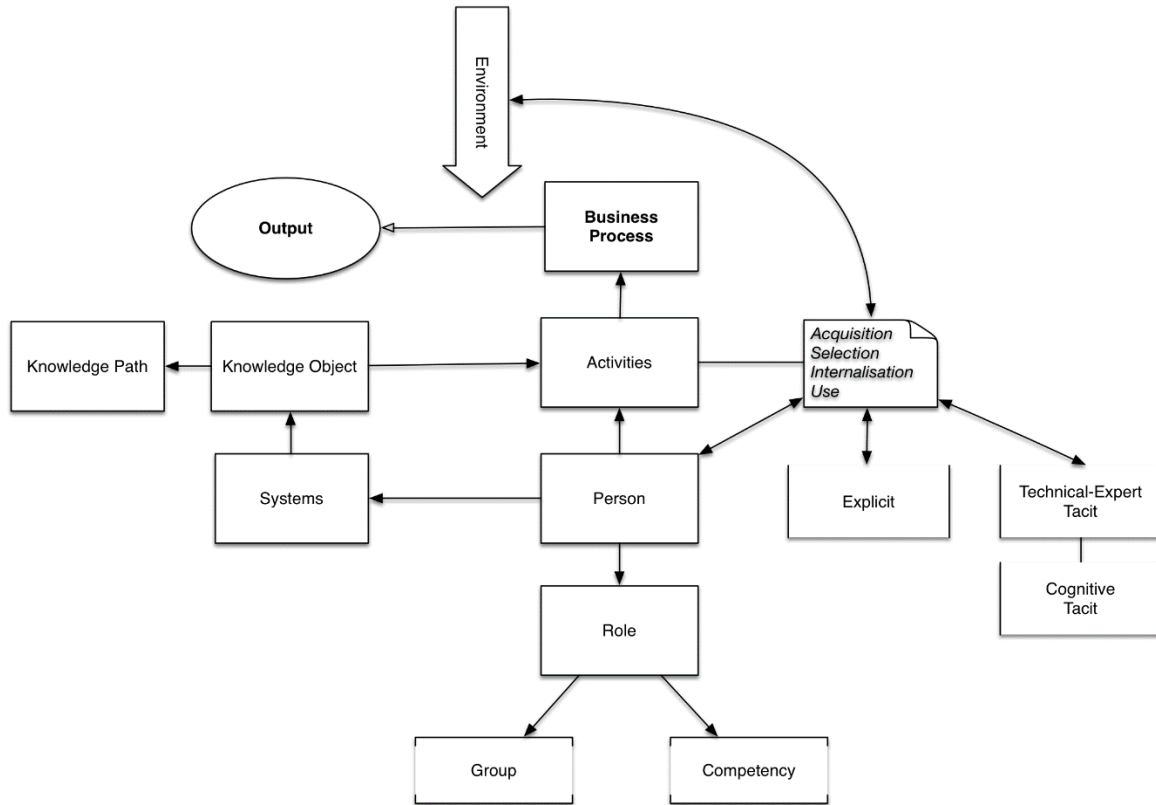


Figure 1. BP Meta-model in a KIE.

The knowledge object is modelled as an output of the person, shaped through the use of systems, with the necessary intra and meta-individual derived knowledge being fed from the four above-mentioned activities. While a more passive determinant of the technical output (and an often unquantifiable variable due to its highly embedded nature), the cognitive tacit dimension of knowledge embodied in the skilled workforce has also been included. This is due to its effect on soft factors such as the culture of the group within the KIE and the motivation levels of the person, as well as its impact on the willingness of the individual to engage in the tacit-to-explicit conversion process. Thus, the resulting knowledge objects are person-derived. Special consideration is allocated to both the tacit dimension of knowledge prevalent in KIEs, as well as the external knowledge drivers that can often shape the process requirements as well as the personal capabilities, thus acting as change triggers.

From a critical perspective, the meta-model does not explicitly differentiate between the distinctive input of the variety of stakeholders associated with most KIEs. Therefore, elements such as “customer” have not been included within the ontology due to the high degree of potential variability that they

would imply, due to their rooting within the nature of the BP itself. Furthermore, the model is built on an underlying assumption of a certain degree of structure, which might not always be present within the organisational setting of some knowledge intensive companies, as highlighted by Papavassiliou and Mentzas (2003).

In addition to the structure, the nature and extent of the process improvement can be affected by the maturity of the process. Jochem et al. (2011) argue that, when dealing with BPI, it is important for the target BP's maturity to be acknowledged. Doing so can guide the selection of a suitable approach for the specific application setting, identify the skills required, and impact process design. For this purpose, a five level maturity model is proposed, which goes from Level 1 - where the BPs have an informal character in both design and handling, to Level 5, at which stage the processes are sustainable, prone to continuous improvement, optimised and facilitators of continuous, current and holistic knowledge management efforts. The process maturity level can also be seen as an indicator of potential for improvement, as a lower level can suggest sub-optimisations, whereas higher levels imply a degree of operational stability and autonomous improvement. Subsequent to the implementation of a BPI methodology, Adesola and Baines (2005) propose its assessment based on feasibility, usability and usefulness - thus allowing the organisation to analyse and adjust the sequential improvement efforts as needed to maximise their utility.

From a comparative perspective, the Adesola and Baines (2005) methodology is designed to address the support of the user throughout all of the stages of BPI. A comparison with the other three models considered for this purpose (see Figure 2) suggest that they either fail to achieve this, or maintain a level of context dependency regarding their sequential phase division. Thus, they are of distinct relevance for either specific improvement goals or organisational settings. Furthermore, out of the four, only two models address the concept of the improvement loop which can be relevant for companies that either employ a continuous improvement approach, are exposed to a fast changing, evolving environment, are unsatisfied with the output of the improvement initiative, or where relevant new insights or knowledge has emerged.

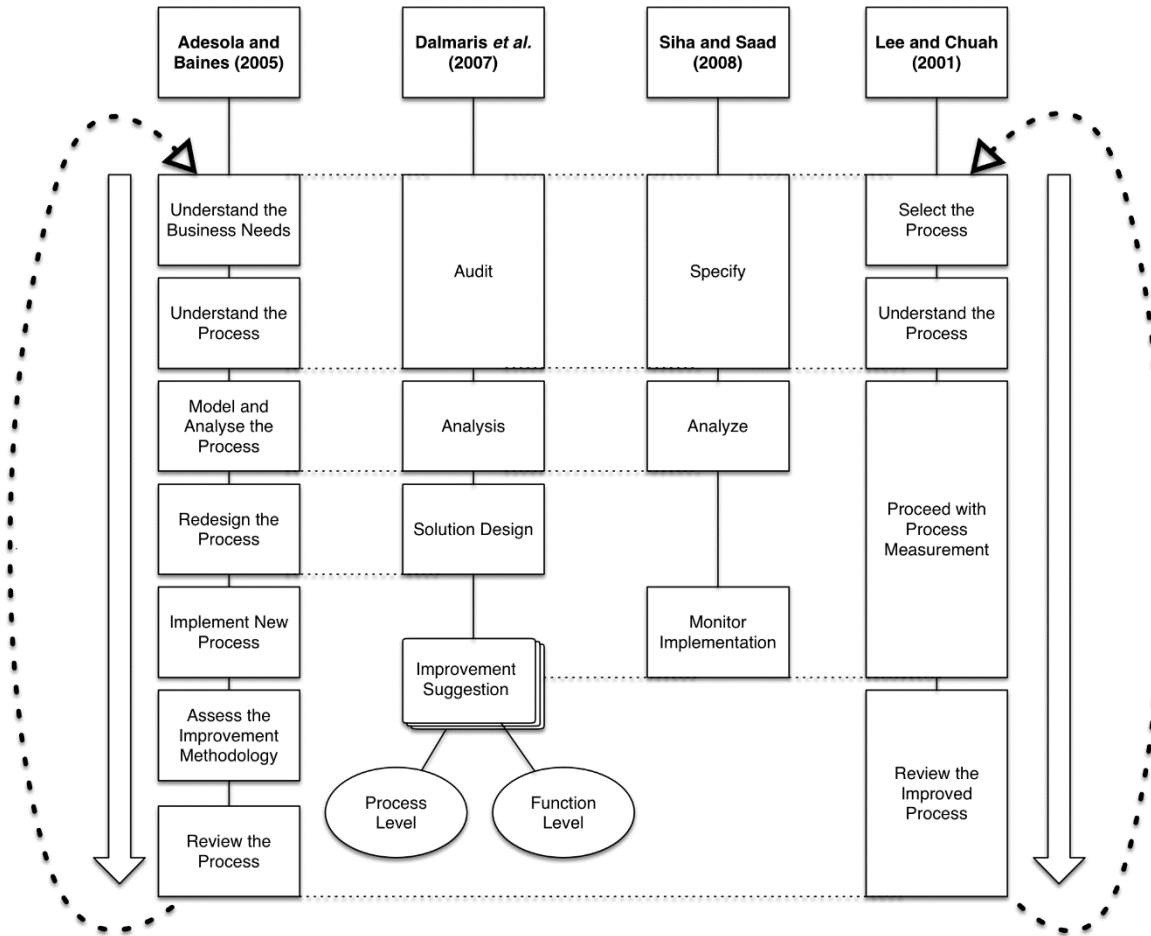


Figure 2. Structural Comparison of BPI Methodologies

3.2.4. The conceptual model for BPI in KIEs

Based on this, the suggested model for BPI within a KIE environment (Figure 3) is based on the Adesola and Baines (2005) core framework, and also incorporates the key variables and literary recommendations specific for KIEs which have been discussed in the previous sections.

At the process level, these include:

- a fundamental consideration for resource availability,
- an awareness of the BPs knowledge intensity and maturity levels,
- an anchoring in the KIBP process ontology,
- explicit acknowledgement of the role of both internal and external knowledge constructs and

inputs from an ontological perspective,

- a platform for the ontological modelling of the process,
- consideration for the context and the dependencies of the process for the facilitation of more holistic monitoring efforts,
- a degree of inter-layer dynamics and differentiation between process and function improvement,
- on-going performance assessment throughout the methodological layers, and
- the management of any potential resulting activity-derived knowledge.

Complementing the above, we argue that in a KIE emphasis on the influence of the firm-level knowledge-assets (human, relational, structural) over the process, in a hierarchical representation of knowledge intensity contributes significantly to the BPI methodology. The output also supports continuous improvement efforts and cyclical process re-design, thus facilitating the development the pre-existing agility that is typical for KIEs.

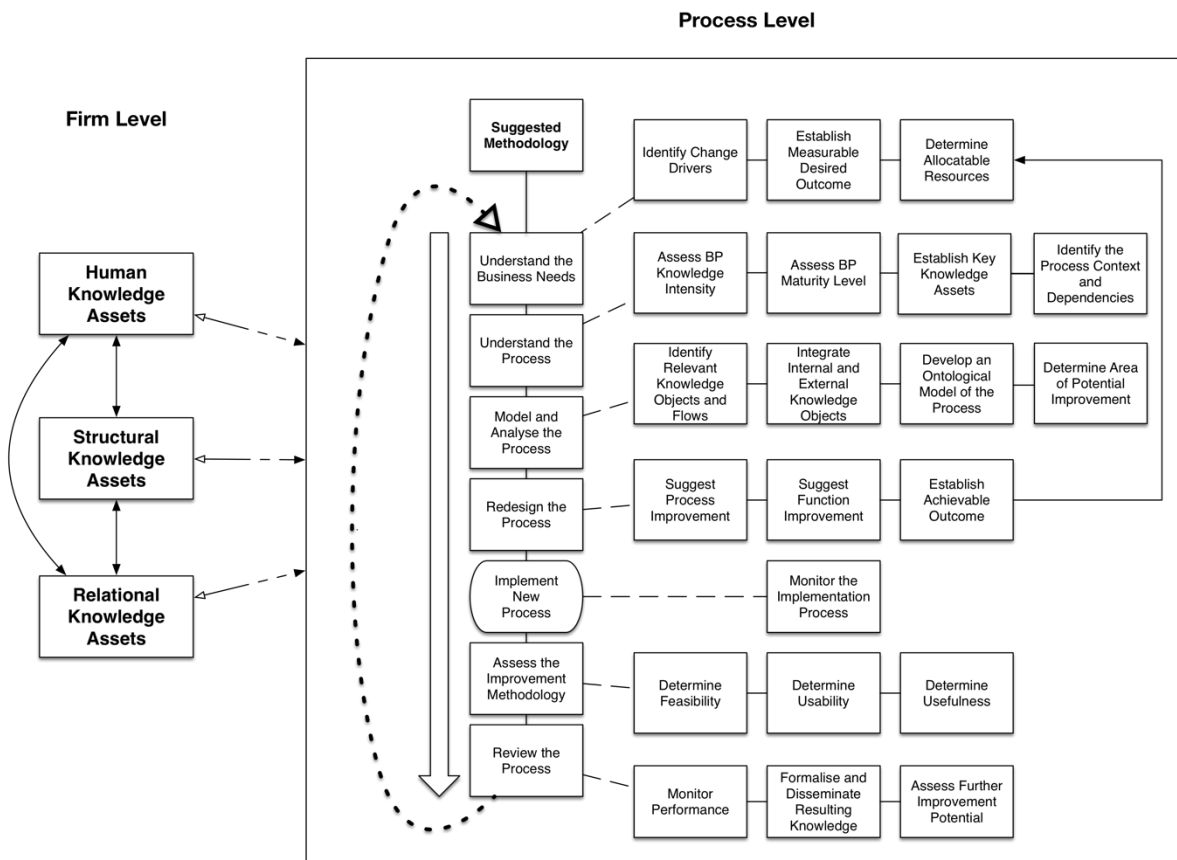


Figure 3. BPI Methodology for KIEs

Structurally, the three components of the output (epistemology, process ontology and BP methodology) have been built on the view proposed by Dalmaris et al. (2007), and adjusted to address potential issues of applicability within a KIE environment. Furthermore, they have been assembled to ensure modularity and adaptability to application-setting variability.

From an alignment perspective, the epistemological view, the ontological representation of the BP, and the BPI methodology have been selected and adapted to ensure cohesion as an integral solution for KIEs. Furthermore, in spite of its varied theoretical underpinnings, the proposed conceptual model is self-sufficient and has not been built on assumptions of familiarity with the wider body of literature, or specific methodological or ideological constructs which would limit its applicability and appeal for KIEs. Thus, it has the potential to facilitate the improvement of knowledge intensive BPs within a wide variety of small and medium entrepreneurial settings. By encompassing a mechanism for determining its applicability for pursuing distinct improvement objectives, it also enables users to avoid resource wastage on implementation efforts beyond its scope.

4. Conclusion

In spite of their growing importance for business and society, the study of knowledge-intensive enterprises and their distinct setting is a relatively new phenomenon. In particular, the literature reporting on efforts to operationally assisting the sustainability, adaptation, innovation or growth orientation of such firms is limited. Thus, there is an urgent need for the domain to be researched from an operations management perspective. With a view to fill this gap, this research has sought to develop a more comprehensive understanding of the concept of a knowledge intensive enterprise by studying what its key features are and how these are manifested and supported at a process level. This has been achieved by developing an innovative business process improvement framework for knowledge intensive entrepreneurial ventures.

The proposed framework integrates key concepts from the knowledge intensity and knowledge management literature, adapting these to the principles of business process redesign and re-engineering. Its development has been informed by a thorough examination of the distinct nature of knowledge intensive entrepreneurial ventures and the challenges they face in their efforts to improve their business processes.

Our research therefore serves to bridge the existing gap between the operations management literature and the growing body of work addressing knowledge intensive entrepreneurship. Furthermore, the extensive review of the literature supporting our contribution has uncovered the convergence of several streams of literature through the multi-disciplinary nature of the framework developed.

In addition to our contribution to the body of knowledge in the domains of business process improvement and knowledge intensive entrepreneurship, this research has a number of implications for both theory development and management decision making.

From the perspective of theory development, the combination of key variables and literary recommendations specific for KIEs at both process and firm-level enables contributions to this domain from past Knowledge Management and Business Process Improvement researchers. Our contribution offers a blueprint for the combination of the contributions of current research on specific topics such as human resources management, relational capital and structural knowledge-assets, for the development of the theory of knowledge-intensive entrepreneurship.

Practical implications of our contribution include the potential to facilitate the improvement of knowledge intensive business processes within a wide variety of small and medium entrepreneurial settings. In particular, it enables organisations to avoid resource wastage on implementation efforts while pursuing distinct improvement objectives.

Our proposed framework has been designed with emphasis on minimising assumptions (e.g. managers' familiarity with the existing literature, availability of resources, static and structured intra-organisational conditions, internal scope of knowledge flows, constant improvement potential, etc.) which could affect its applicability. In doing so, our contribution informs decision makers within KIEs in their growth efforts and operational scaling from a structural knowledge assets perspective and, more specifically, through process improvement.

Future steps in the development of our research will focus on the study of its applicability in specific settings through a series of case studies. This would contribute to better understanding and addressing both its generalisability and practical implications.

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