
Corvinus University of Budapest
Doctoral School of Business Informatics

# Use of Ontologies and Business Process Management Systems to Measure the "Knowledge Fit" of an Organisation.

Doctoral Thesis

# Booklet of Arguments

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# 1. The purpose and background of the work

## 1.1. Why the “Knowledge Fit”?

When Facebook went public in 2012 it was quoted at 104 billion dollars, however, at that time, it did not have any revenue. (Olney, 2012) In a famous conference, Bill Gates CEO of Microsoft said: “Our primary assets, which are our software and our software-development skills, do not show up on the balance sheet at all; this is probably not very enlightening from a pure accounting point of view.” (The Economist and Economist, 1999) At the end of the last century, the economic society realised that the values of a company are not related only to its physical assets but in particular in the so-called “intangible assets.” The protection of such valuable asset is vital for the resilience of the knowledge-intensive companies.

This research aims to develop an approach to support organisations measuring their capacity to

optimise the intellectual capital that they hold in their organisation and in particular the human capital. We call this measure “Knowledge Fit”. Through this approach, we would like to provide a framework that can help the organisations to understand if the knowledge available in an organisation sufficient to succeed if it can take advantage of its human capital and if there is a sufficient alignment between the process improvement practice and the human resources.

## 1.2. Purpose of the research

The purpose of this research is to validate that the framework can produce a measure that can identify gaps and provide valuable elements to improve processes, organisation and the measuring system itself.

Finally, we will draw conclusions that will reflect upon the benefit or defects of this approach in comparison with different methods available in the literature.

## 1.3. Problem statement and research questions

Practices of process improvement stress the concept that good business performance is mainly connected with the optimal process execution.

Taiichi Ohno (Jones, 2003), father of the Toyota Production System was used to say: “Brilliant process management is our strategy. We get brilliant results from average people managing brilliant processes. We observe that our competitors often get average (or worse) results from brilliant people managing broken processes.”

The general approach of the modern practices for business process improvement does not put the organisation issues as a priority in the activities. The value, for the customers, is the first element of a re-engineering, followed by the efficient process definition and only after that technology and organisation enter in the picture. However, technology and human resources complete the picture but are not in the foreground.

However, in all re-engineering action, there is a moment of the capacity check where a foreseen process future state should be dimensioned for a future capacity.

In this research, we are exactly focusing on this capacity that must be able to support the process reorganisation. We will develop an approach to the evaluation of the required organisational capacity with a focus on the capacity regarding knowledge.

It is the common practice, in fact, to evaluate the capacity regarding FTE allocated to the individual activities as any person is equivalent in the execution.

In the literature research, we will support the idea that optimal processes require correct knowledge. This is a general truth, but the importance of having skilled resources is even more critical in those processes at high complexity.

With the new technological advancements, technology is rapidly replacing people in low

knowledge intense jobs; therefore the human resources need always to be more specialised. Specialised knowledge becomes scarce; this is when having knowledge optimisation techniques may play a crucial competitive advantage.

**Research Question 1**: How can we determine the knowledge capability required by an organisation to run its processes?

To address this problem, we will propose a theoretical measurement framework that will provide a synthetic and analytical measurement of a "de facto" situation of a "Knowledge Fit" given a formal definition of the business processes, skill test results and formal organisational deployment[1]. In this thesis, we will be determining what the level of

[1] In chapter 5 the dissertation we gave a more exhaustive explanation of the Organisation Deployment that in brief is the process of connecting individual job holder with the activities through a chain of organisation entities (individuals, positions, roles, activities).

analysis for which we should perform knowledge measures are.

**Research Question 2**: What are the possible approaches to validate a reorganisation[2] with a knowledge capability perspective?

Answering this question requires to identify an operating system that supports the formalisation of the reorganisation and, at the same time support a systematic measure of the knowledge capability for the system. To develop this, we will show how semantic enabled BPM used in conjunction with the PROKEX system and the STUDIO semantic testing platform can provide a sound environment to support the organisational simulation. With the term reorganisation, we mean any change that impacts either people, processes or the organisation systems.

[2] In our context a reorganisation can involve a change in any of the dimensions: People, Processes and Organisation. We must also pay attention to the connection between those three elements of a change: the impact that any individual change have on the other.

**Research Question 3**: Is there any possibility for a semi-automatic or automatic solution to optimise the allocation of people to perform business activities?

This third question is very connected to research question 2. In fact the framework that we are going to define on one side will provide knowledge indicators to support decisions at the topological level; at the same time may provide scenarios (using those indicators) that maximise the "Knowledge Fit" while variating the elements of the organisation.

By testing in a real case, we would like to highlight the pros and the limitation of an automatic solution that optimisation of the organisational deployment based on the maximisation of the "Knowledge Fit".

# 2. The method used and the reasons

This thesis will use case studies to validate the "measure" approach while identifying those critical points that can impact the adoption of the conceptual framework in a possible real-life implementation. It is important to mention that this thesis mainly focuses on validating the applicability of the conceptual framework and not the validity of the approach. According to Harland (Harland, 2014), in a case study, the unexpected should emerge, and when it does, there is potential to make a useful contribution to knowledge, theory and practice. The objective of the study will, therefore, explain what the reader or listener needs to consider before they contemplate change and it will be seen as critical in the sense that it avoids being dogmatic in its examination of the case and theory.

The thesis will follow a methodology that was already adopted for several theses (Török, 2014) in

this doctoral school and whose steps are the following :

- To research reference paradigms in literature
- To develop a theoretical framework
- To develop an operating environment to work with the theoretical framework
- To identify the requirements against the case study and perform the analysis of the case
- Validate the theoretical framework through the case study

This thesis develops and follows a methodology, which is known in the social sciences investigating the value of intellectual capital in the context of business reorganisation. The methodology incorporates some elements of computer science architecture that in this context can lead to different approaches by the approach that in this school already Klimkó (Klimkó, 2001) followed.

As long as the methodology that we used is based on the adoption of specific computer infrastructure, including Business Process Modelling (BPM) and

semantic web technologies, the computer science approach is the prevalent similar to what Weber (Weber, 2017) concluded in his doctoral thesis.

According to Amaral et al. (Amaral *et al.*, 2011), research methodologies in the field of computer science may be of five type:

- Formal
- Experimental
- Build
- Process
- Model

## 2.1. The scope of the research

The "Knowledge Fit" measure is using two reference formalisms: Business Process Models (BPM) (Gábor and Szabó, 2013) to describe the processes and ontologies (Jurisica, Mylopoulos and Yu, 1999) to represent knowledge. Those models include a representation of knowledge in two different context process/organisation and knowledge domains. They are both formal models to

represent codified information. In analysing and the problem, therefore, we must consider that we will address only the explicit knowledge of the individuals. We will not consider a critical area that is related to experience, attitudes that are important but cannot be captured by our framework (Warier, 2014a).

However, the approach proposed have the potential to support the elicitation of tacit knowledge and its codification through the application of an enrichment and refining process of the representation models: BPM and ontologies. (Arru, 2014)

This solution integrates the BPM life cycle with the Evans and Ali's (Evans and Ali, 2013) model of the Knowledge Management Cycle (KMC) represented in Figure 2-1.

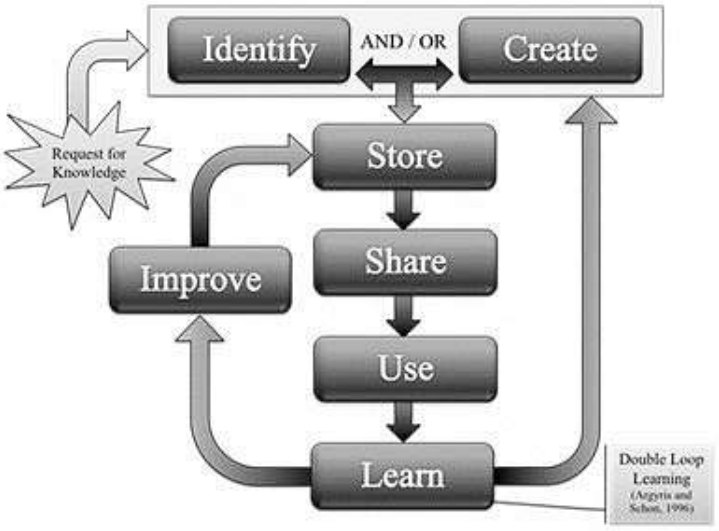


*Figure 2-1 The Knowledge Management Cycle (KMC) Model.*

## 2.2. Empirical evidences

In the final part of this thesis research, the objective is to demonstrate the applicability of the model to a real business case where actual workers will be assessed to evaluate their fit to their job in this current assignment and following a reorganisation following a process improvement exercise. In Chapter 7.2 through the business case we demonstrated the applicability and robustness of the

approach. The validation of the model will be performed by following the following final steps as described in Figure 2-2.

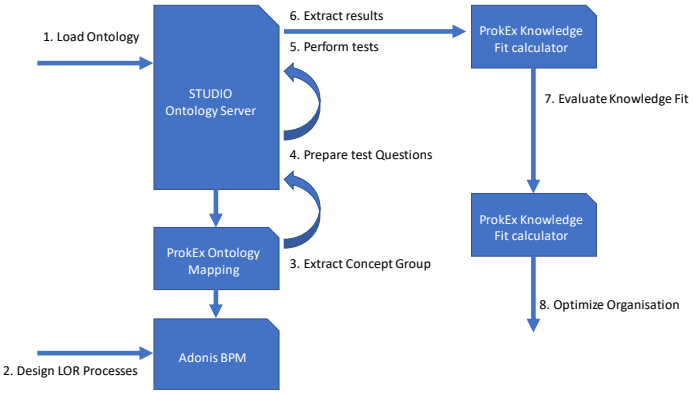


*Figure 2-2 Final validation of the Thesis*

### 2.2.1. Load Ontology

To finalise the experiment and to confirm the thesis we will load the Ontology completed after the second iteration in the STUDIO Ontology server. We will not enrich further the Ontology to demonstrate that a general Ontology developed at the corporate level can produce an acceptable output when applied in a local context.

### 2.2.2. Design LOR Processes

In IES, organisation changes resulted in modification of the GOR and the implementation of a new particular LOR as a consequence of a Process Improvement activity.

We will test therefore the Ontology generated for a generic organisation in the MOL group in the context of the particular local process as implemented in the IES logistics.

### 2.2.3. Extract Concept Group

Similarly, to the approach used in chapter 6.4.2, in chapter 7.2.2.1 we will use PROKEX to match Ontology with the BPM, and we will extract a Concept group containing all concepts that the system managed (Chapter 7.2.1 and 7.2.1.1) to identify within the process descriptions.

### 2.2.4. Prepare test Questions

The Extracted Concept group will be therefore loaded in the STUDIO software and will be the domain base for the trial to the IES associates. This phase was particularly labour intensive because the

domain experts need to prepare questions related to more than 200 concepts.

### 2.2.5. Perform tests

Once the test is set up, in Chapter 7.2.4, we implemented the test with the support of the actual IES associate working in the Mantovan IES site and few extra people working in other locations of the company or different roles. The objective is, in fact, to evaluate that other resources in the company may have a similar or better fit for specific jobs.

### 2.2.6. Extract results

In Chapter 7.3 we processed the derived results as described in section 5.6 to determine the measurements of the “Knowledge Fit”.

### 2.2.7. Evaluate “Knowledge Fit”

Chapter 7.4 focuses on the conclusions of the discussion with the local management to understand to what extent the model computed is in line with their understanding of the company and if it gives wrong indications or value added to support the Process Improvement initiative.

### 2.2.8. Optimise organisation

To conclude on the third research question, in Chapter 7.5 we use the optimisation process described in section 5.6.3 to identify an ideal best fit for the organisation to the process.

By the critics of the results, we conclude an understanding of the limits of such automatic approach and the eventual constraints that we see to be relevant in this kind of optimisations.

# 3. The main scientific findings and results of the thesis

To drive the conclusions of this research, I will take into consideration the following aspects:

- The fit to the purpose of this approach (how good it is in providing actionable information)
- Areas of further development for the approach and the technologies employed.

I will start by recall the Research Questions that were set at the beginning of this dissertation in Chapter 1.3.

For each of the questions I will show how the theoretical framework addressed it and the evidence from the business case that support the utility in the business environment.

## 3.1. Research Question 1: measurable knowledge capability

### 3.1.1. How can we determine the knowledge capability required by an organisation to run its processes?

To address this problem, we will propose a theoretical measurement framework that will provide a synthetic and analytical measurement of a "de facto" situation of a "Knowledge Fit" given a formal definition of the business processes, skill test results and formal organisational deployment. In this thesis, we emphasized determining what the level of analysis for which we should perform knowledge measures are.

### 3.1.2. Validation of the Research Question 1

In Chapter 4.4 we proposed a measurement framework namely "Knowledge Fit". This framework uses on one side the PROKEX approach to identify the required knowledge and on the other side uses STUDIO test environment to validate.

To validate the statement, I would like to clarify the following items related to the framework.

The “Knowledge Fit” introduces both analytical and synthetic indicators.

In Chapter 4.4.3 we defined an analytical measure of “Knowledge Fit” that aims to identify those knowledge elements - concepts - that we expect to have in a certain organisational level and are not present in the organisation. It is analytical because we can pinpoint directly what are the concepts that are not hold or partially hold. The scale is between 0 and 1: if all individuals that are accumulated at this level of analysis hold (because correctly answered to online testing) the concept the value is 1; if none hold the concept the value is 0.

The second measure types are the “Fit Scores” (Chapter 4.4.4) those measures from 0 to 1 how a specific topological element (individual, position, role or activity) holds the required knowledge. This is a synthetic indicator because for each topological

element we obtain only one number that shows an average of the “Knowledge Fit”.

Like the “Fit Score”, the “Spare Score” is its complement: this synthetic indicator shows which part of the corporate knowledge not necessary for the topological element is, on the other hand hold. This is a measure of the flexibility.

Those indicators can be used at different level of the organisational deployment (see Chapter 4.4.1). The main elements of the organisational deployment are at the level of the *individuals*, the *positions*, the *roles* and the *activities*.

In Chapter 7.4 we demonstrated that the measures can address organisational issues and highlight possible interventions.

It is also possible to interpret differences between the measurements and put the measurement in context with other organisational measures such as experience, logistics and other not skill related attitudes.

Based on those consideration we conclude that the "Knowledge Fit" is a proper measure of "knowledge capability" in response to the Research Question 1.

## 3.2. Research Question 2: "Knowledge Fit" aware reorganisations

### 3.2.1. What are the possible approaches to validate a reorganisation with a knowledge capability perspective?

Answering this question requires to identify an operating system that supports the formalisation of the reorganisation and, at the same time support a systematic measure of the knowledge capability for the system. To develop this, we will show how semantic enabled BPM used in conjunction with the PROKEX system and the STUDIO semantic testing platform can provide a sound environment to support the organisational simulation. With the term

reorganisation, we mean any change that impacts either people, processes or the organisation systems.

### 3.2.2. Validation of the Research Question 2

The proposed approach is described in Chapter 6 and validated in Chapter 7. This proposed approach lays on and extend the PROKEX approach as described in Chapter 5. Strength of this operating system is the possibility of translating from the Knowledge to the Process Domain to elicit implicit knowledge. In Chapter 5.6 we show how the "Knowledge Fit" plays an important role in closing the loop and support the process improvement of an organisation.

When validating this approach in Chapter 7, it results clear that organisational changes are complex activities that cannot be addressed only from a perspective. This is the reason of several failures in business process reengineering practices described in Chapter 3. We also saw that the more holistic is the approach the higher is the chance that the interventions are successful. It is also clear that so

far there are not so many approaches that bind a process approach with the knowledge dimension. In Chapter 5.6.2 we described several ways the PROKEX approach thank to the “Knowledge Fit” measures can support the improvement of an organisation and its processes in an integrated framework. In Chapter 7.4 we highlighted them in a real case that the measure fits very well other reorganisation approaches and is a good support to recommend further.

## 3.3. Research Question 3: Automatic reorganisation

### 3.3.1. Is there any possibility for semi-automatic or automatic solution to optimize the allocation of people to perform business activities?

This third question is very connected to Research Question 2. In fact the framework that we are going to define on one side will provide knowledge indicators to support decisions at the topological level; at the same time may provide scenarios (using

those indicators) that maximise the “Knowledge Fit” while variating the elements of the organisation.

By testing in a real case, we would like to highlight the pros and the limitation of an automatic solution that optimisation of the organisational deployment based on the maximisation of the “Knowledge Fit”.

### 3.3.2. Validation of the Research Question 3

In Chapter 3.9 we introduced the process maturity as an indication of how close a process or organisation is to be complete and capable of continual improvement through qualitative measures and feedback (Srinivasan and Murthy, 2012; Boutros and Cardella, 2016). The levels of those maturity models are:

- Level 1 – Documented Process
- Level 2 – Partial Deployment
- Level 3 – Full Deployment
- Level 4 – Measured and Automated
- Level 5 – Continuously Improving

While structured companies are struggling to move from Level 2 to Level 3, the PROKEX is a framework that helps organisation to move toward Level 4 and 5.

The Chapter 5.6.3 suggests that an approach to automatic organisational deployment is theoretically possible based on minimising a knowledge cost function and therefore confirming the Research Question 3.

In Chapter 7.5 however, we showed that the model automatically created based on a mere knowledge dimension is not able to recommend a proper solution. This does not show that the approach is not valid in all context. Further research is necessary for proving this. Certainly, in a context where the experience is at least as important as the skills, there is a geographical dimension to be considered and where the job attractivity is playing a relevant role like in the business case that we have developed in Chapter 7 is clear that only the “Knowledge Fit” is

not able to support automatic organisation deployment.

# 4. Remarks concerning the utilisation of the thesis

The literature has reference to measure model of intellectual capital that is mainly indirect (for instance the contribution to the equity (Sveiby, 1997) of the company). Some approaches are focusing on measuring the knowledge in comparison with a predefined domain (Jing, Liu and Zhan, 2013). However, the only tool used traditionally employed to map the fit of the knowledge in an organisation with the required processes are the so-called Competency Matrixes (Smith and Smarkusky, 2005). Recently semantic technologies (based on ontology) has been employed to test the knowledge in association with computer-aided testing systems (CAT) (Gaeta *et al.*, 2012)

The "Knowledge Fit" concept has been developed using PROKEX technology as reference technology and introduces a systematic translation between the process and knowledge domain.

The novelty of the approach includes the increased level of granularity and an integrated knowledge management approach.

Regarding granularity, this approach scales up the number of details that are typical semantic testing tools to organisational tools such as the competency matrixes.

The solution proposed for measuring the "Knowledge Fit", further, is integrated into an overall approach for developing and maintaining the knowledge base of a modern organisation that can be reused in different contexts. This allows to reuse documentation and ontology available in the organisation and provide feedback to their further development.

# 5. The publications of the author of the topic


Arru, M., 2014. Application of Process Ontology to Improve the Funding Allocation Process at the European Institute of Innovation and Technology. In A. Kő & E. Francesconi, eds. *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. Springer Verlag, pp. 133–147. Available at: http://link.springer.com/10.1007/978-3-319-10178-1_11 [Accessed August 15, 2016].

Arru, M., 2016. Developing a Measure of Intellectual Capital fit : an Approach to Improve Business Processes. In *European Conference on Intellectual Capital*. Kidmore End: Academic Conferences International Limited, pp. 382–393. Available at: http://search.proquest.com/docview/1803415572?accountid=14507.

Gábor, A. & Arru, M., 2014. Process Oriented Knowledge Transfer in the Public Administration. In *International Scientific-Practical Conference "Smart Government: Science and Technology."* Astana, Kazakhstan: ACM Press, pp. 179–184.