CORVINUS UNIVERSITY of BUDAPEST

Doctoral School of Economics, Business and Informatics

COLLECTION OF THESES

Domonkos Pál Gáspár

Business driven method for managing business process changes in the era of digitalization

PhD. dissertation

Supervisor:

Katalin Ternai, Ph.D.
Associate Professor

Budapest, 2024

Department of Information Systems

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Contents

1. Motivation and research background

In my several years of practical experience in the field of process and organizational management, I have observed that, although change management is widely recognized as a distinct step in the process management lifecycle, there is a lack of comprehensive supporting solutions that are easily accessible to practitioners, despite the information available in process models that would allow this. Having become acquainted with previous research at our Institute in the area of information retrieval and analysis from business process models and textual process descriptions, I started to investigate how the problem could be solved by integrating and further developing these results. A review of the literature revealed a lack of work proposing a practice-oriented approach to operationalizing change management and presenting a multi-purpose evaluation and recommendation tool that relies exclusively on inputs commonly available in enterprises.

The novelty of the research lies in the operationalization of change management in business processes. By comparative analysis and further elaboration of information in process models and descriptive text formats, and by exploiting the scientific field of organizational change management, the result of the comparative analysis is used to provide tailored, practical recommendations for operational change management of business processes. Given the frequency of significant process- and later organizational changes during digital transformation, a degree of automation has been built into the solution to assist the change manager in performing his role more efficiently.

There is a consensus in academia and in the practitioner world that change management has a crucial role to play in the effective implementation of digital transformation (Bellantuono et al., 2021; Komkowski et al., 2023; Govindan et al., 2023; Luks, 2022; Pronchakov et al. 2022; Kumar et al., 2021). Change implementation occurs at two levels: one in terms of organizational structural changes, and the other at the personal and psychological level. Both domains have their own scientific basis and literature (Motzer et al., 2020; Pena et al., 2022), yet successful digital transformation requires that both are addressed in an integrated way, and that these actions are linked to broader transformation management activities. Change management is a multidisciplinary field where the role of the leader is key to the successful execution of change management activities.

Given the importance of change management, it is relevant to note that managers often feel overwhelmed by the practical aspects of implementing the change process, which, due to the complex and multifaceted nature of change, can undermine the successful implementation of the change itself. Success in the domain requires specific leadership skills. In addition, change

management implementation needs to be consistent across the organization, requiring all leaders to drive change in a coordinated manner (Muluneh et al., 2018). Surweys reveal, that despite their best efforts, leaders and stakeholders often doubt the true effectiveness and efficiency of organizational change management activities (Budde et al., 2022; Naicker et al., 2021).

The complexity of the practical implementation of change management activities has contributed to its being an under-researched area despite its explicit importance in studies of digital transformation (Luks, 2022; Farina et al., 2021; Nakayama et al., 2020). Particularly prominent is the lack of research and analysis on the operationalization of change management (El Faydy et al, 2023). Although much research addresses the conceptual and methodological aspects of change management, such as its phases, scope and associated responsibilities, there is a significant lack of research on the issues and problems that arise in the actual implementation of change management. Although the academic and practitioner world recognizes the managerial responsibility for operationalizing change management, it does not propose universally applicable and scalable support or concepts for the effective and coordinated implementation of change management measures throughout the organization concerned. Consequently, it can be said that improvement on the practice of change management would result in direct economic benefits.

The importance of textual analysis in the field of process management research is illustrated by the fact that processes are in most cases presented in an unstructured textual form both inside and outside the organization (e.g. rules, best practices, ...). The share of this format within the total resource is estimated at 80% (Grimes, 2008). Recent new methodologies and open source software (Kherva et al., 2020) have allowed closed vocabulary text analysis (Short et al. 2010) to be replaced in the last 3 decades by the open vocabulary method of natural language processing (NLP), which uses any word and/or phrase in the text as a unit of analysis (Oswald et al. 2020), thus facilitating the move towards a more meaningful approach to text analytics. However, the application of existing methods on small, specific-language corpora remains a challenge (Kobayashi et al. 2018), which has limited the usability of language processing for regulatory (compliance) checking in sources such as text-formatted regulations and industry standards.

The present research contributes to closing this research gap and consisted of two parts: the development of the method and the proof of concept. The main research questions were:

A) **Business Process, Business Process Models, Business Process Management Lifecycle**: how well is Business Process Management represent an accepted organizing logic in the business?

How is process management positioned in different business methodologies? What modelling languages are common? What are the levels of business process modelling? How does Business Process Lifecycle incorporate Change Management? What are the change types?

B) **Compliance in the Context of Business Process Change.** Which are the approaches identified for compliance in business processes? What is the most fitting for our context? How can the coded information be extracted from text-based sources?

C) **Examining Change Management.** What Change Management approaches had made inroads into business, what are their commonalities, can these commonalities be supported with information from business process models?

D) **Extracting information from process models, data transformation and building a process ontology:** How can stored information be extracted from process models? How does the extracted information become a further processable, structured set of information?

E) **Comparative analysis and presentation of findings:** How can the change element set be compared and used in a goal-oriented way for change management? What information and in what format can best support change management?

F) **Review of utilization possibilities:** in what areas can the prototype be useable? Are there any other utilization possibilities in sight?

2. Research methodology

The research aims to address a problem in industrial practice from a new perspective. It is interdisciplinary and exploratory in nature, following the guidelines of Gioia et al (2021), and aims to find a solution that proves useful at both theoretical and practical levels. Both qualitative and quantitative methods were used in the research. The research was carried out in a research team with industrial partners. The industrial partners provided the data used in the research and were consulted in the specification of the target product. The members of the research team participated as specialists in specific fields. My contribution was the definition of the concept, the definition of the tool architecture for the feasibility study, the specification, training and validation of the software solutions and search algorithms, and beyond that, in general, the design and implementation of research directly related to change management and liaising with industrial partners.

2.1. Assessment of available inputs in a practical process management environment

The first phase of the research was to define the problem and the information that could be utilized to find a solution. We worked with the following inputs from an industrial partner:

- Models of two processes: one was the current and planned version of the travel management process. The other was a model of the UX design process. All process models were modelled and delivered in Adonis process management software.
- Documents, two of which are the regulations related to the UX design process (ISO14971 and IEC 62366) and five different internal process specifications (SOP - Standard Operating Procedure), which were used to teach our algorithm. All documents were available in PDF format.
- Both companies use the ADKAR change management methodology, so it was necessary for us to adhere to it for the organizational change management related subjects.

In addition to defining the inputs, the final output, the Change Management Report, was defined in consultation with our industry partners.

2.2. Introduction of the process change management support concept

Our goal was to develop an integrated, semi-automated concept that supports process change management activities, using as input only typically available information in its original format, and as output provide intuitively usable support to the manager(s) implementing the change. This support is provided in the form of a report. The concept should support both process change triggers: process improvement and compliance checking.

The process attributes should therefore be localised in process models and textual process descriptions, extracted and converted into a common structure for comparison. There is also a need for a suggestion mechanism that provides tailored recommendations for the change management activities based on changes identified in process attributes.

2.3. Presentation of process change management support concept

From the concept emerges the architecture of a semi-automated system capable of handling both process models and textual descriptions of processes. From these two sources, the necessary information is extracted, processed and compared in order to support change management practitioners with situation-specific, actionable recommendations.

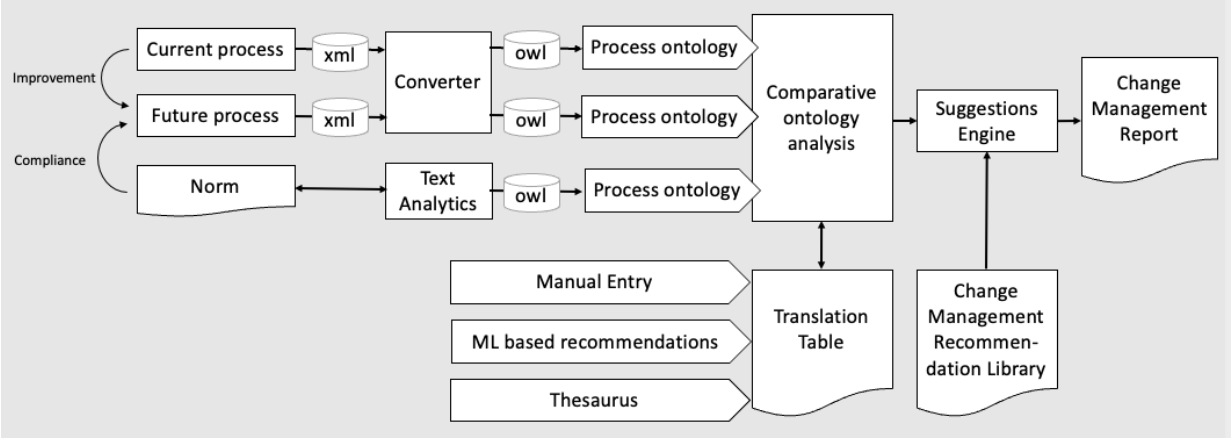


Figure 1: Architecture of the change management support concept

The structure provided by process ontology allows for the comparative analysis of processes. The identified differences are processed by the Suggestions Engine, which analyses the differences and matches each difference with one or more action recommendations stored in the Change Management Recommendation Library for the organizational change manager. Finally, the recommendation engine formats the outputs into the defined structure of the Change Management Report.

The solution is an integrated system of several technical and logical elements, some of which are enhancements of existing solutions, others are newly created. I have relied on commercial products for i) business process modelling (Adonis), ii) ontology management and comparison (Protégé), and iii) analysis of the results of the algorithms developed (Rapid Miner).

Converter

The content of the process model is extracted from the business process modeling software into an XML export file, which is mapped into a process ontology file using an enhanced XML -> OWL converter created at the institute. The converter is a dedicated JAVA-based program that extracts the necessary elements from the XML according to certain rules. The result of the conversion is an OWL file that can be further processed using the Protégé software. The necessary classes and subclasses and propertys have been created.

Text analytics

As can be seen from the literature, current widely available NLP tools have difficulties in processing industry standards. This has necessitated the custom development of the text analysis software and algorithms used in our research. We followed Hickmann's (2022) 5-step model for text processing and needed 2 loops with different goals: i) first finding the process steps in the text, and then ii) finding the process attributes for each step.

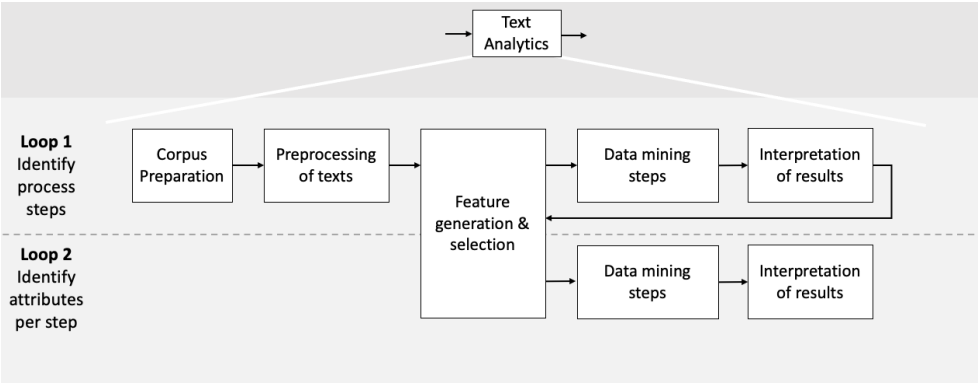


Figure 2: Steps of text analytics

From the DOCX format converted from PDF, the algorithm extracts the entity-relation-object relationships with the corresponding word forms. The results are then imported into an Excel spreadsheet for tagging. The tagging was a manual activity. It was performed according to the attributes defined in our ontology (Document, Role, IT System). The results of the tagging were then imported into Rapidminer, using 60% of the data as a learning set and 40% as a validation set. The analysis was performed on a lemmatized version of the text. The Naive Bayes algorithm was applied to estimate the probability that a word (e.g. provide) referring to a relation is followed by an attribute. The data were analyzed in a confusion matrix generated by the program. The algorithm was improved in another two cycles to demonstrate the potential for further improvement on it.

Ontology comparison

The ontology comparison demonstrates the differences between two processes. In direct comparison, there are two aspects that needed to be dealt with. i) The results of the text analysis are to some extent noisy, which can lead to the detection of potentially false positive differences. To reduce noise, we performed a text similarity analysis on the text analysis results before further processing. ii) Semantic and linguistic differences, i.e. different expressions and forms with the same meaning, should not be identified as differences. To solve this problem, I introduced a so-called Translation Table to link words with the same meaning and apply them to the two ontologies before running the comparison.

Translation Table

The Translation Table was not originally identified as part of the architecture, but its necessity became obvious. Its purpose is to store the similarities between features, ensuring that irrelevant differences between them do not affect the results of the analysis. It is created manually, as a Change Manager decision is required to approve the similarity. The translation table is basically a mapping of attributes and refines the ontology being analyzed. The use of a translation table produces a transposed version of the ontology, which is the basis for the comparison operation.

Recommendation Library

Variations in process attributes will result in different change management responses. These 'responses' are stored in the form of recommendations in the Recommendation Library. One variable of the recommendation conditions is the type of attribute change (new, changed, removed), while another variable relates the recommendation to the phases of the organizational change management methodology used by the company. The literature recognizes that there is no consistent approach to operationalizing change management. Our recommendations have been developed according to the ADKAR methodology, but for practical application it is essential that the library of change management recommendations is open and configurable for all companies using the tool.

Change Management Report

Based on the information from the ontology comparison and the recommendation library, the Recommendation Engine generates the Change Management Report, which is the ultimate goal.

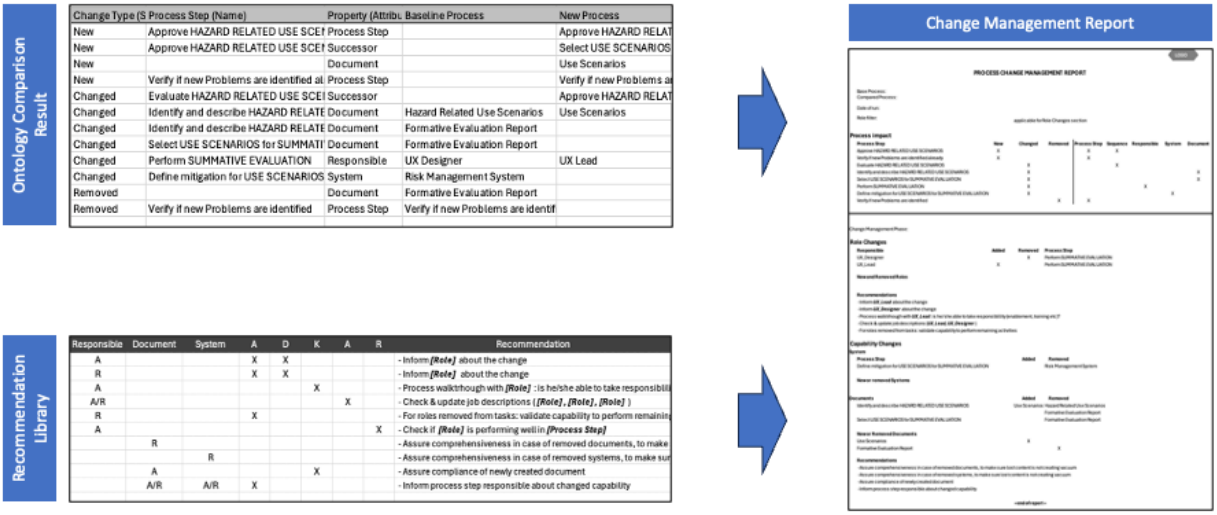


Figure 3: Assembling the Change Management Report

The first part of the report generation is based on the Change Type (New, Changed, Removed) and the "Process Step" of the Property values. For each item with the category "Process Step", the Change Type is examined. These are used to generate the first half of the list, i.e. each process step is represented as a category. The Recommender Engine then examines the rest of the process and the corresponding Change Type. The Change Types containing the values for the corresponding process step are displayed in a merged form (one step - one row) on the first part of the report.
In the second part, the same records are analyzed from a different perspective. Here, the key values are the process attributes in the Property field (the "Process Step" values are ignored), based on which the values are processed and displayed.

2.4. Utilization of process change management support concept

The original aim of my research was to provide support to process managers and change agents implementing process change. I explored this by comparing current and future models of the travel management process provided by one of our industry partners, and by comparing the UX design process within the company to the relevant standard. During the concept development and validation process, several potential use cases were identified:

- The architecture created can be used to support other compliance checks, not only those with the standards. These may include internal and external instructions or compliance with legal requirements.
- In the context of a major corporate transformation, the tool can be used in a targeted way to ensure that individual managers manage change in a similar and consistent way. For example, when changing a process that affects several departments, it is important to ensure

that the managers of the areas involved communicate in a similar way with their teams in terms of timing and content, or if several processes are changed at the same time, that the change management activities are similar for all processes.

- Integrate change management into the project plan when implementing ERP and other enterprise information systems. Considering organizational change management as a methodology allows harmonization with other, more technical project plans. This possibility is of particular interest in the light of the fact that ERPs are increasingly configured based on the creation of process models in BPM tools (e.g. Signavio-SAP). Process models created for an ERP implementation can also be used as inputs to our change management solution.

3. Results of the thesis

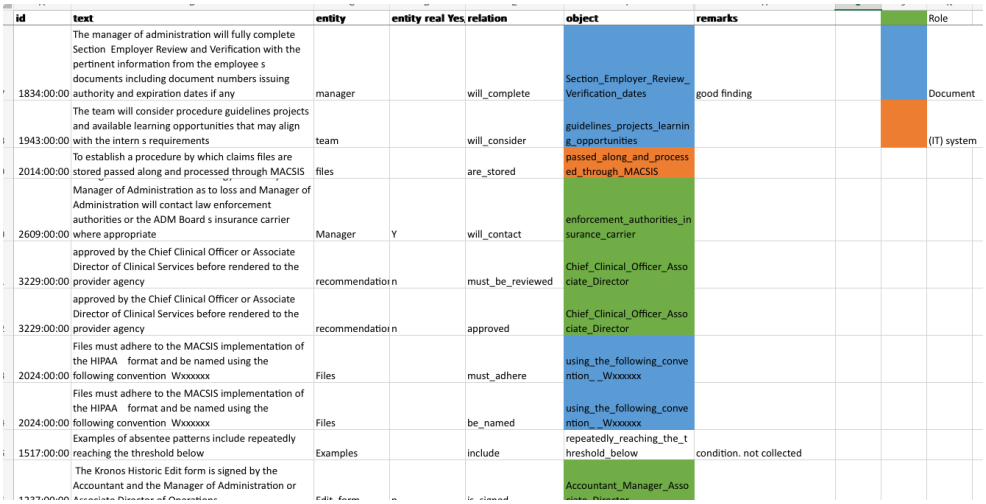
3.1. Results of the Business Processes, Process Models, Process Model Life Cycle Assessment

Through a literature review, I have shown that there is a long tradition of business processes as a structuring and managing element of enterprises. There are several modelling languages, however most often when business processes are developed in practice, practicality and ease of use are in focus, resulting in a semi-structured model. A common feature of Business Process Lifecycle Management (BPLM) models is that the implementation of process change is a separate step. Business process change is motivated by the need to improve processes or to ensure compliance with a particular regulation.

3.2. Results of Compliance Checking in the Context of Business Process Change

Compliance checks are carried out in different ways depending on their timing. Practice distinguishes between Design Time Compliance Checking (DTCC), which checks compliance at the design stage of the process and Run Time Compliance Checking (RTCC) and Backward Compliance Checking (BCC). Both latter methods aim to check the implementation of the process on a technical basis to determine whether implementation is or has been done in accordance with the rules. Our research is in the area of DTCC, however, our strict reliance on natively available sources meant that we have been unable to utilize any of the existing DTCC methods due to their reliance on artefacts (prepared text, compliance ontology, etc.) that are not commonly available in practice. This necessitated the development of an algorithm that would serve our purpose.

Seven available documents were converted from PDF to DOCX format. From each sentence in the docx, the algorithm extracted the entity-relation-object relationships with their corresponding word forms and recorded the result in Excel. The total dataset to be extracted consisted of 1207 rows, according to the attributes defined in our ontology (document, role and IT system).



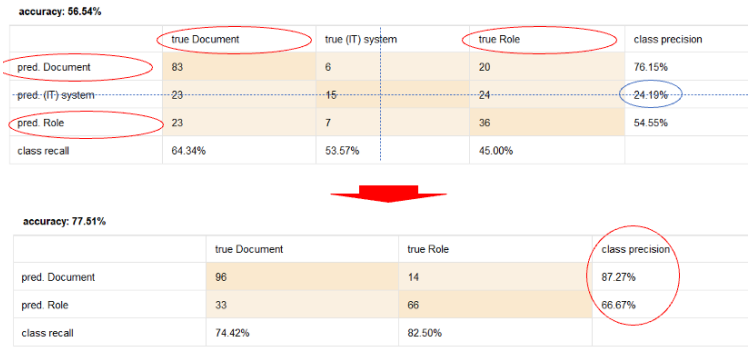
id	text	entity	entity real Yes	relation	object	remarks		
								Role
1834:00:00	The manager of administration will fully complete Section Employer Review and Verification with the pertinent information from the employee s documents including document numbers issuing authority and expiration dates if any	manager		will_complete	Section_Employer_Review_Verification_dates	good finding		Document
1943:00:00	The team will consider procedure guidelines projects and available learning opportunities that may align with the intern s requirements	team		will_consider	guidelines_projects_learning_opportunities			(IT) system
2014:00:00	To establish a procedure by which claims files are stored passed along and processed through MACSIS	files		are_stored	passed_along_and_processed_through_MACSIS			
2609:00:00	Manager of Administration as to loss and Manager of Administration will contact law enforcement authorities or the ADM Board s insurance carrier where appropriate	Manager	Y	will_contact	enforcement_authorities_insurance_carrier			
3229:00:00	approved by the Chief Clinical Officer or Associate Director of Clinical Services before rendered to the provider agency	recommendation	n	must_be_reviewed	Chief_Clinical_Officer_Associate_Director			
3229:00:00	approved by the Chief Clinical Officer or Associate Director of Clinical Services before rendered to the provider agency	recommendation	n	approved	Chief_Clinical_Officer_Associate_Director			
2024:00:00	Files must adhere to the MACSIS implementation of the HIPAA format and be named using the following convention Wxxxxxx	Files		must_adhere	using_the_following_convention_ _Wxxxxxx			
2024:00:00	Files must adhere to the MACSIS implementation of the HIPAA format and be named using the following convention Wxxxxxx	Files		be_named	using_the_following_convention__Wxxxxxx			
1517:00:00	Examples of absentee patterns include repeatedly reaching the threshold below	Examples		include	repeatedly_reaching_the_threshold_below	condition. not collected		
	The Kronos Historic Edit form is signed by the Accountant and the Manager of Administration or				Accountant_Manager_Asso			

Figure 4: The tagged attributes (excerpt)

Out of a total of 1207 tagged rows, 593 were identified and tagged as process attributes. The results of the tagging were imported into Rapidminer, using 60% of the data as a training set and 40% as a validation set. The Naive Bayes method is used to evaluate the probability that a relation will be one of the attributes after a word referring to a relation (e.g. provide). The data were analysed in the confusion matrix.

To ensure the accuracy of the results, all results above 50% were considered acceptable, as this means a better hit rate than guessing, while results above 80% were considered good. As there is no uniformly accepted accuracy value in the literature and expert opinions vary considerably in this area, going up to 70% and below (Foody, 2023), we chose a value from the higher end and set the result for the good accuracy range at 80%. Controversially, any result that fell below 50% was considered unacceptable.

Since the attribute "IT-System" had a very low-class accuracy, it was excluded from further research. We were able to do this because "IT Systems" typically has a limited vocabulary, which can be built up as a library in the algorithm, thus allowing us to find this type of attribute. Running the analysis in the reduced scope resulted in higher accuracy scores, 87.27% and 66.67% for documents and roles respectively.



accuracy: 56.54%

	true Document	true (IT) system	true Role	class precision
pred. Document	83	6	20	76.15%
pred. (IT) system	23	15	24	24.19%
pred. Role	23	7	36	54.55%
class recall	64.34%	53.57%	45.00%	

accuracy: 77.51%

	true Document	true Role	class precision
pred. Document	96	14	87.27%
pred. Role	33	66	66.67%
class recall	74.42%	82.50%	

Figure 5: Results in the original and in the reduced confusion matrix

The initial algorithm is marked as v1 to indicate the gradual evolution of the algorithm. This version included the construction of a dictionary of roles and documents from the tagged dataset and terms from Naïve Bayesian analysis that identified a role or document with at least 1% probability. The 1% probability value is explained by the diversity of linguistic expressions. We manually reviewed the expressions against our criteria. The analysis covered only verbs, and there was no overlap between them in the context of Documents and Roles.

Improvement of the algorithm

The algorithm has been improved in two rounds, necessitated by the realization that there are very few Roles in such a document, and therefore a more precise specification is needed. This became apparent when the algorithm was validated on a standard not previously included in the dataset (Role recall rate 17%) In version 2, we added capitalization distinction following the observation that many explicitly named documents and roles are capitalized. In version 3, the recognition of nouns following auxiliary verbs and their classification as roles was changed. The improvements resulted in visible gains, increasing role recognition from 17% to 63% on the validation standard, while document recall values remained above 80% throughout.

In summary:

- Refining the algorithm has led to significant improvements in finding roles, while the document retrieval rate has remained constant at around 80%.
- The algorithm did not miss a significant number of attributes, so all expected attributes were found in the results.

The algorithm underwent refinements in two iterations (v2 and v3), which resulted in significant improvements. This suggests that our technique is appropriate, and that further testing could yield even better results.

3.3. Results of Examining Change Management

In my review of the literature, I have illustrated that the human processing of change has long been a field of research, and initially emerged as a sub-field of psychology. More developed versions of change management for organizations have also been introduced into the field of business management. There are many change management models, but the ones that have typically gained recognition in the corporate environment are those that effectively manage both the human and organizational components of change. These models are designed to provide real support to managers and process owners in implementing change. In essence, all change management models

identify three basic phases: i) preparing for change, ii) leading change and iii) helping to embed new behaviors. In the literature review, I have provided a comprehensive analysis of the topic. One of the widely recognized models is the ADKAR methodology, which is used by our industry partners and which I refer to in our research when integrating pragmatic change management recommendations into the concept.

Process models support change management by allowing information stored in their relevant attributes to be extracted, structured and analyzed so that need for changes can be identified.

3.4. Results of Extracting Information from Process Models, Data Transformation and Building a Process Ontology

Process ontology is the basis for the analysis of change. When comparing two processes, the first step is to extract the actual process models, then compare them and ultimately produce a report to support change management.

BPM tools, including Adonis, have a built-in process comparison function. After testing the feature, we concluded that the solution does not meet our expectations, as it lacks the necessary functionality and is not able to include sources other than the process model in the analysis, which is necessary for the comparison with the textual process descriptions. Therefore, we searched further for a suitable tool for our purpose and developed our process ontology based on the structure presented by Kő and Ternai (2011).

Name	Type	Description
Task	class	class representing the activities of the process model
Role	class	which can be related to the Task class: responsible_for_execution, accountable_for_execution, approved_by, consulted and informed
IT_system	class	representing the IT systems used for the activities
Document	class	representing the documents used in the activities
Process	class	representing the name of the process
accountable_for_approving_results	relationship	linking elements of the Task class to the responsible element within the Role class
Cooperationpartecipation	relationship	linking elements of the Task class to the consulted within the Role
To_inform	relationship	linking elements of the Task class to an informant within the Role
followed_by	relationship	interpreted as between elements of the Task class, linking successive activities in the process
referenced_document	relationship	linking elements of the Task class to a document within the Document class
referenced_it_system	relationship	linking elements of the Task class to software tools within the IT_system class

Figure 6: Final ontology structure

The ontology developed included all the process attributes and their relationships needed for our research. According to this ontology structure, the Converter was enhanced.

3.5. Results of the comparative analysis and the presentation of findings

Translation table

By incorporating the Translation Table into the concept, we have addressed the potential translation problems arising from i) the use of different languages and inconsistent coding in the process model, and ii) terminology and semantics-based attributes that differ from those derived from the raw text data. A Translation Table is defined as a dictionary generated by three different types of input:

- manual input by the change manager in case of identified discrepancies or deliberately different terminology
- the results of text similarity analysis
- the addition of an online interpretive dictionary, whose suggestions must however be approved to ensure real divergences

The Transition Table generates a new version of the similar process ontology as input for the Recommendation Engine

Noise reduction

From a wide range of text similarity algorithms, we have selected the most suitable ones to gain a deeper understanding of which set of algorithms is the worthiest of further research. In the text similarity analysis, the attributes of each process are listed, and the elements are compared with the elements of the other list, and the text similarity algorithm calculates the similarity score. The attribute pairs and their corresponding similarity scores are recorded in a newly created file.

A similarity score of 1 (100%) was excluded from the analysis, as it represents the full similarity, which is not considered as a discrepancy in ontological analysis. The similarity criterion was set at 80%, however, this is an arbitrary value defined by balancing the number of hits and the accuracy of the hits.

Three text similarity algorithms were run, representing different categories (text distance and text representation/character-based and text representation/word composition-based), with the following results:

Algorithm	Hit rate
Jaccard	75%
Ratcliff Obershelp	69%
Cosine	56%

Figure 7: Hit rate of the different text similarity algorythms

Based on the above, it is appropriate to further develop the text similarity checks using the Jaccard algorithm, which has been found to produce the most favorable results in this research. The potential for assisting the building of the Translation Table with text similarity algorithms is evident and further investigation of this topic could be the focus of a future research.

Technical report

The result of the comparison of the Protégé software ontology should be processed by a transformation. This output is transformed into a so-called Technical Report (TR), which serves as input to the Recommendation Engine discussed in the next chapter.

The intermediate technical report (TR) is needed for the following reasons:

- To achieve an easily processable structure of the data.
- To clean the output of the Protégé by removing irrelevant output content.
- To reformat the data into a grammatically correct structure (e.g. removing underscores and other marks between words).

Finally, the Technical Report will make the result of the ontology comparison processable to produce, utilizing the Recommendation Library as well, the Change Management Report specified by the Recommendation Engine in collaboration with the industry partner.

4. Summary

The primary objective of the research has been achieved: to develop and demonstrate the feasibility of an integrated conceptual framework that supports the operationalization of business process change management, based solely on information typically available in enterprises. Our collaborative industrial partners ensured that industrial applicability was consistently present alongside scientific rigor, which enabled us to achieve a result that was highly valued by our industrial partners.

In my research I combined the fields of process management, change management and text analysis, as my aim was to explore the attributes of business processes in process models and textual process descriptions and standards, and the methods to extract them. This was followed by the creation of process ontologies, analysis of discrepancies, and presentation of information and recommendations for organizational and individual change management actions.

It is demonstrated that a technology ecosystem that supports both the core cases of business process change, process improvement and compliance testing, is feasible. The feasibility study of the current concept can be the basis for further development to achieve the next level of technological maturity by further improving the applied algorithms.

Based on feedback from our industrial partners, the developed concept could well support the implementation of business process changes in large enterprises. Usability goes beyond individual use. It can also be used in a cross-functional context, linking and aligning change management across different interrelated departments. Based on this idea, the concept can be used to facilitate enterprise-wide quality assurance of process change management. As regards compliance support, the technology used allows the inclusion of internal, non-statutory requirements in the scope of the analysis.

The use of process ontology allows the ecosystem of concepts and tools developed to be applied to any business area. This is possible because the process model and the domain-specific standard or text can be easily interchanged without affecting the functioning of the system. Furthermore, the flexibility of the system allows the use of other change management methodologies. The presented concept also includes manual intervention options, ensuring generalizability and a high level of configurability.

The exploratory, multidisciplinary research presented in this thesis has succeeded in answering the research questions and, through this, in achieving the fundamental research objective. The developed concept and its feasibility study answer the main research question. Further development of the prototype could be the subject of further research.

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