

# Global Pandemic: Business Model Impact on Enterprises

reTHINK, reIMAGINE, reINVENT Businesses

Sandeep Gopisetty

IBM Research - Almaden

San Jose, CA

Sandeep.Gopisetty@us.ibm.com

**Abstract**— The COVID-19 outbreak is a sharp reminder that pandemics, like other rarely occurring catastrophes, have happened in the past and will continue to happen in the future. Even if we cannot prevent dangerous catastrophes, businesses need to manage risks, reduce costs, improve efficiency while digitizing products and offerings, streamlining processes to retain existing customers. As industry leaders around the globe are driving their teams forward from their attics, basements and spare rooms, the need for business continuity is vital more than ever. It is important for Enterprises to have the right tools, technology and skills to deal with this crisis. One can make use of expert advice through consulting services to understand the level of preparedness and to respond quickly with what needs to be done. It is time to quickly move beyond manual, people-dependent processes and switch to automation and orchestration to reduce the complexity. Our solution takes advantage of modeling in over 80 different types of industries and addresses both industry standard as well as custom priorities to help enterprises focus on the right investment to improve the performance of their business components.

**Keywords**- *Global Pandemic, Business models, Enterprises, Human-in-the-loop, Cognitive Solutions, Semantic Search, Domain Learning Assistant, Data Experience.*

## I. INTRODUCTION

A global pandemic such as COVID-19 creates unplanned stress test for business. Government-mandated restrictions, sudden changes to the way of working impact an organization's goals on performance, efficiency and reliability. The focus on containment of the pandemic and unavailability of staff will leave businesses vulnerable. In this environment, enterprises need a sharp focus on the activities that provide real advantage and profit to provide full value to their key stakeholder groups of customers, employees and shareholders. It's imperative that enterprises need innovative approach to respond to the epidemic including enablement of workforce enablement, communication, collaboration, and business transformation.

Component Business Models (CBM) are business components that are identified and proposed as a standard for individual segments of the most common industries. Business components help enterprises rethink the leverage they can achieve with the assets and capabilities internally while they can additionally source specialized capabilities.

CBM is a technique to model and analyze an enterprise. It is a logical representation or map of business components and can be used to analyze the alignment of enterprise strategy with the organization's capabilities and investments, identify redundant or overlapping business capabilities, analyze sourcing options for the different components, prioritizing transformation options and can be used to create a unified roadmap after mergers or acquisitions. The pandemic has put the traditional business models in a state of flux. Do firms digitally reinvent their businesses, or try to hang on as discrete parts of their organizations or be ravaged by nimbler, technologically superior upstarts from outside their core industry? Digital reinvention is about reimagining all key elements of your business strategy, operations, and technology, with a central focus on creating improved customer experiences. It calls for embracing technological change and disruption and viewing an enterprise as a collaborative unit that is part of a wide ecosystem. In the post pandemic world, firms need to achieve the benefits of scale, security, flexibility, efficiency while retaining existing customers and embracing cloud and digitization of products and services.

In this environment, enterprises need a sharp focus on the activities that provide real advantage and profit to provide full value to their key stakeholder groups of customers, employees and shareholders. Business processes have governed intra and inter-enterprise operational modeling for decades and have helped in business transformation efforts. It has been demonstrated in the past that significant outsourcing and supply chain implementation have helped companies foster innovation while also providing substantial savings.

As the implications of the global connectivity platform ripple out through the marketplace, firms face a fundamental need for specialization on two parallel tracks: external and internal. Firms can use the concept of the CBM to make the transformation to internal and external specialization a practical reality. CBM allows firms to evaluate the goals and strategy of the entire enterprise to take simultaneous advantage of internal and external specialization. Without increasing complexity, the model allows an organization to expand and evolve while reducing risk, driving business

performance, boosting productivity, controlling costs and improving capital efficiency and financial predictability.

## II. NEW WAYS OF WORKING

The pandemic has many companies planning and enabling employees to work remotely. Most enterprises needed to have a hybrid approach with a few employees on premises toward enablement of infrastructure, applications and making data accessible remotely to enhance employee productivity. In addition, moving of mission critical systems to Hybrid Cloud environment while limiting on-site technical resource as the world experiences this new health crises to keep business operations running smoothly has become high priority.

Businesses are complex systems with a number of different components and functions. These complex systems are built up of different individual modules that perform certain functions. However, as the business progresses, it can be hard to keep into account how different decisions may affect these individual modules. To maintain revenue, for example, a business user may need to consider how decisions affect the different modules of the business, in order to keep the efficiency as close as possible to normal state. In particular, the challenges are as follows. First, there are different individual modules in a business, which interact with each other, with different inputs in the business. Say for example, a convenience store business would have individual modules like acquiring raw material, maintaining inventory and staffing, providing services to customers etc. These modules are also affected by emergent external factors such as market conditions, political climate etc. Second, if the efficiency of the business model is affected, one may need to understand why it is so, and what steps one needs to take to improve it. In this case, a model can provide recommendations to the business, however they all may not be feasible. Only a business user can truly understand the feasibility of recommendations provided. In the convenience store example, perhaps a recommendation provided by model could be to employ more staff for delivery. However, the business user may not consider it feasible if suppose there is shortage of delivery staff in his area. Third, having an overall system to understand the individual business modules and provide recommendations to improve its efficiency requires detailed features. A generic system may not provide streamlined suggestions and recommendations for certain businesses. A set of recommendations for a convenience store business would not fit another business-like salon, restaurant etc. Lastly, a business user may not consider all the factors that actually might be influencing his model. Hence it is imperative to know what recommendations are being provided to businesses in similar domain space, in order to better the recommendation model.

Businesses are aware of this. The need for business continuity is vital, now more than ever. The global pandemic is Volatile, Uncertain, Complex, Ambiguous (VUCA) and force businesses to review their continuity plans. This

certainly has challenged existing business continuity methods especially in the new environment that is marked by remote working and supply chain disruptions where focusing just on processes and resources alone doesn't suffice. Enterprises need to strengthen with the right tools, technology and skills to deal with this crisis. CBM helps see expert advice through consulting services to understand the level of preparedness and to respond quickly to what needs to be done. Businesses need to switch to automation and orchestration to reduce complexity.

Enterprises are also dealing with new government mandated restrictions leading to sudden changes to the way of working, addition of new capacity, and delays in planned upgrades or migrations and these impacts the organizations goals of performance, efficiency and reliability. The focus on containment of the pandemic leading to unavailability of staff will leave IT infrastructure unattended and vulnerable. Enterprises are more vulnerable than ever to hostile groups who are always on the lookout to leverage more than one attack vector at a time to exponentially increase the impact. Any disruption to IT will significantly hinder the ability of the organization to provide help and coordinate efforts within and beyond the organization creating a far worse situation. The need for innovation approach to include workforce enablement, remote working readiness, communication, collaboration. Business continuity plan, incident response and business recovery are paramount.

As business enterprises seek new solutions, a digital platform that enables them to transform is essential. We have created a digital platform for assets, offerings and use natural language understanding to help businesses identify the best technologies to embrace this challenge.

## III. ENTERPRISE INNOVATION ACCELERATOR

Innovation has long been understood as a driver of business growth, leading to considerable research on identifying the sources and enablers of innovation. Today there is a renewed sense of urgency to accelerate innovation within organizations in the face of our increasingly complex and volatile business and societal environment.

The Enterprise Innovation Accelerator (EIA) is launched with the aims of contributing to the scientific understanding of innovation and to our ability to harness this understanding to drive innovation for IBM and our clients. The EIA project has several scientific goals related to

- i. identifying and harnessing the drivers of innovation,
- ii. supporting the collaborative and iterative discovery of new ideas and solutions by combining and matching existing knowledge, assets, and skills,
- iii. producing distinctive societal and business outcomes that are responsive to the dynamic nature of our times, and

- iv. enabling innovation through a digital platform that minimizes the need for physical co-presence.

An enterprise engagement to build and optimize their business model involves complex and quite often intricate processes that require access to domain knowledge. In addition, close collaboration among various stakeholders as well as consultants are imperative in aligning the user needs. EIA helps map assets and offerings to the various business components for an enterprise and quickly helps identification and further in evaluation of the business component. The alignment in the past has been manual and the association has always been done by subject matter experts with their domain knowledge. The semantic mapping in EIA is a novel approach with the use of synonym tag generation by understanding natural language.

The next big wave in technology growth would be in digitization of products and services. Request for Information (RFI), Request for Proposal (RFP), Request for Tender (RFT), Request for Quote (RFQ) documents describes a client's business and service requirements in natural language. RFX packages typically consists of tens to hundreds of documents each ranging from tens to hundreds of pages and come at variety of formats and structures. Processing RFX's manually is a tedious, error prone and slow process.

It would be a competitive advantage to a service provider to be able to process RFX documents to automatically extract client requirements and understand how these requirements map to the internal offerings, products or solutions of the business to improve the efficiency of preparing RFX responses, and conduct sizing and pricing of the solutions. To achieve these goals, it's important to build on research in knowledge management, computer supported collaborative work, virtual teaming, text analytics and machine learning, design of virtual experiences, conversation analysis, and more.

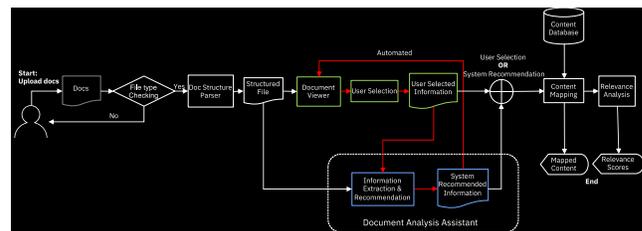
#### IV. COGNITIVE SOLUTIONS: IDENTIFICATION AND MAPPING OF SERVICE REQUIREMENTS IN RFX DOCUMENTS

Request for Information (RFI) are often preliminary documents seeking information about a specific asset or an offering from vendors. RFI's generally are in an intrigue state and often businesses aren't sure if the solution solves their problem. Request for Quote (RFQ) on the other hand is when businesses know for certain what the need is and is often evaluating it to obtain financial details from vendor(s). Request for proposal (RFP) documents describes a client's business and service requirements in natural language. RFP's are issued when a business wants to evaluate solutions from multiple vendors. RFP packages typically consists of tens to hundreds of documents each ranging from tens to hundreds of pages and come at variety of formats and structures.

Processing RFX's manually is a tedious, error prone and slow process. It is a competitive advantage to a service provider to be able to process RFX documents to automatically extract client requirements and understand how these requirements map to the internal offerings, products or solutions of the business to improve the efficiency of preparing RFX responses, and conduct sizing and pricing of the solutions. However, this is a challenging task due to the complexity and variety of forms that requirements are expressed, their level of detail, style and language expression.

Due to complexity and diversity of the type and structure of RFX documents and that of natural language that business needs, requirements and asks are expressed in, this problem remains as a challenging problem to this date. In this paper, we focus on the following technical problems from the perspective of service providers.

The document-driven innovation discovery provides an interactive way to help users select key information



accurately and efficiently from supporting documents, thereby using it as input for innovation discovery.

- a. The automated identification of business and services requirements from RFX documents. This is a challenging task as it involves digesting textual statements in all RFX documents, as a whole, and understanding which statements, together, constitute a requirement, and what type of requirements including business, functional or non-functional;
- b. Identifying the set of services that meet the client business requirements; and
- c. Extracting instructions and guiding principles that governs the bidding process including the deadlines, milestones, and a response format.

The requirement identification in Cognitive Solutions framework consists of document structure analysis, requirement identification, topic identification, candidate list identification based not just on explicit or implicit patterns but also on structure and evidence. However, no solution is complete without the expert human in the loop to map interactively the requirements to solutions. This has been well studied by my team [13] as well as in the industry but needs a fresh new look at addressing the complex problem.

*RFX Structure Analysis:* In this step, the set of RFX documents are analyzed to identify the relationships among different components in the documents starting from the sentence level, to paragraph level, section level (including all text, figure and table in the section), document level, and also crossdocument level. At the cross document level, all sections and text that are cross-referenced are linked together to build a holistic, connected model of all documents in the RFX package. In the training step, the section information is gathered to build a model of section titles that frequently contain requirements, such a “Statement of Work” sections. This information is used as one parameter to assess the likelihood a statement is a requirement.

Document Outline	Suggested Paragraphs (14)	Selected Paragraphs (0)
1. Request for Proposal (RFP) for		
2. Next Generation EDGE Platform Implementation		
3. TABLE OF CONTENTS		
4. RFP General Overview and Response Format		
a. Request For Proposal		
b. Definitions		
c. Binding Offer		
d. Costs		
e. Right to Terminate RFP		
f. Authorized Person		
g. Confidentiality		
h. Timeline		
i. Pre-Submittal Communication		
j. Written Response Format		
k. Bidders Question and Answer		
l. Formal Proposal Presentations		
m. Evaluation Criteria		
n. Supplier Selection		
o. Compliance with JJSI Policies and Security Requirements		
p. Thank you		

*Requirement Identification:* The candidate requirements that are found in the previous step are inspected and processed along with metadata and contextual information to compute a confidence score for each requirement based on the assessment of the values of features found for the candidate requirement, section and context where the statement is located in, the word dependencies and any dependencies among the sentences with the span of a requirement.

*Requirement Topic Identification:* For each identified candidate, the main topic or the service that the requirement is focusing on is identified. This is important as one of the

goals is to find the main services, and related requirements to those services, that are mentioned within the RFX.

The purpose of topic and focus identification for a given requirement is to understand it talks about which service, and about what aspect of that service. This information enables us to group and present the requirements to the user in an effective manner. Let us start by mentioning that in our context, topic is a noun phrase in a requirement that depends on the responsibility verb and matches one or more service-related vocabulary in the service catalogs. A given requirement may have one or more topics. The focus of a requirement is the topic that is the main purpose of the sentence, which is the main topic associated to the responsibility verb, which also can be known as the “object” of the sentence in linguistic terms. It should be noted that in NLP literature, there are multiple definitions for topic and focus of a sentence, which is specified following a number of rules on the syntax and semantic of the sentence, and is different but related, to the notion of topic and focus.

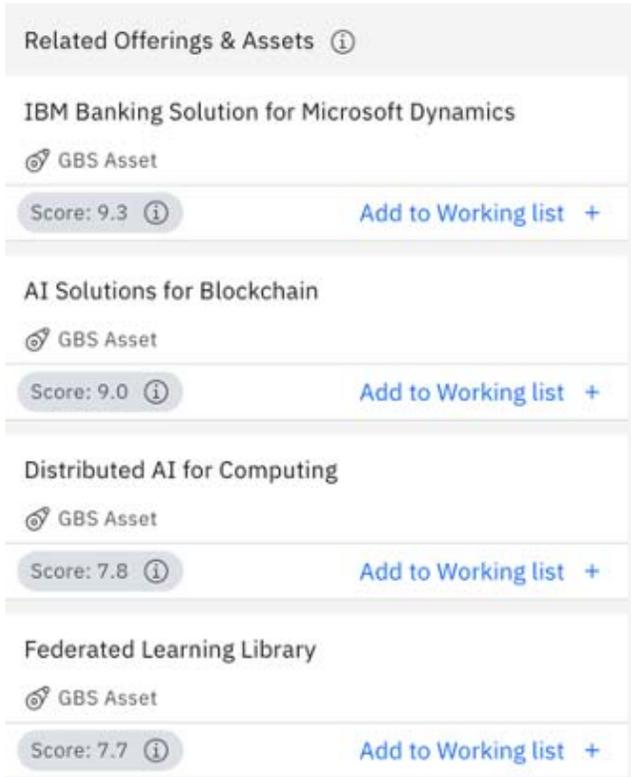
*Requirement Candidate Identification:* First the part of speech recognition tags of statements in the text are identified by applying standard natural language processing (NLP) tagger methods. We apply a number of rules that specify how requirements are often expressed by the client and look for the features that constitute a requirement per the requirement model discussed above. Also, once a requirement candidate is identified, all text following the requirement is considered to be related to the current requirement until the next requirement statement is found. All the text that are related to a given candidate requirement are processed for finding potential sub-requirements.

*Explicit Requirement Pattern:* A requirement statement where the subject is explicitly defined. In order to recognize such patterns, we apply linguistic-based rules that represent patterns. The above rules operate on part of speech tags and a vocabulary list for the subject and the responsibility verbs. Any synonyms of those keywords and verbs are also allowed under these rules.

*Implicit Requirement Pattern:* It’s well understood that not all parts of the necessary features in the requirement data model may be present in the statement. This is the typical case for a bulleted list where the responsibility is determined by the context (generally a reference to the responsible party within the preceding paragraph).

*Structure based Requirement Patterns:* in some cases, the main features of a requirement may not appear all together and structural clues enable us to identify the start of a requirement. One example is under a given heading, there is no sentence but a list of items, which are presumed as responsibilities of the service provider. The section title may

have keywords referring to responsibilities or in contrary cases to exclusions from the responsibility, which should be understood as well.

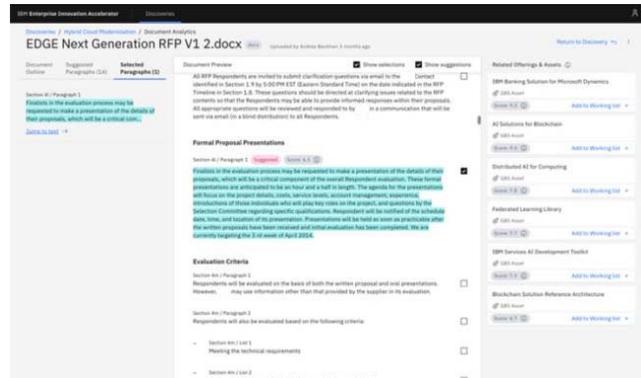


*Responsibility Evidence Assessment:* The extracted responsibility evidences are re-evaluated in their context. In particular, signals such as various forms of responsibility expressions, deliverable definitions, and dependencies are analyzed.

*Interactive Requirement Mapping Evaluation:* Once the requirements are identified, the next step is to identify which requirement is related to which service elements in the offering taxonomies and catalogs. This is highly important for understanding which offerings are within the scope for putting together a solution for the customer. Note that while the topic identification feeds into the offering mapping stage, the topics of a requirement are not necessarily providing a match to services in a given service catalog.

The purpose of this section is to introduce more accurate (by introducing a new measure of similarity between requirements and service elements in the asset and offering catalogs) and pervasive measures to identify the mapping to service offerings in a given service taxonomy and catalog. In the following, we describe our requirement to offering mapping method. We developed a graphical user interface which evaluated by a number of sponsor users. The tool

provides two complementary views. One is focused on Requirements, which shows the text of a given RFP or contract document that is highlighted and annotated with requirement information. This view is helpful as the user can see the annotated text formed into requirements, and also identified mappings to service elements in a specific service taxonomy and provide in-context feedback on each requirement and mapping. The other view shows a visualization of the grouping of the requirements based on the mapping of requirements to offerings.



## V. COGNITIVE SOLUTIONS: SEMANTIC CONTENT MANAGEMENT

The Semantic community is constantly pushing the barrier on processing and producing knowledge that is understandable by both humans and machines. Nonetheless when it comes to technical and scientific content, much of the information is locked behind formats which are not directly machine readable. Much of the information is exchanged via Microsoft Office or PDF articles, especially when the communication is across different organizations. The task of understanding requirements requires subject matter experts, and it is complex enough that it takes multiple editorial units, each focusing on different aspects of the domain, to make sure that important information from such documents is extracted, categorized and retained in structured knowledge.

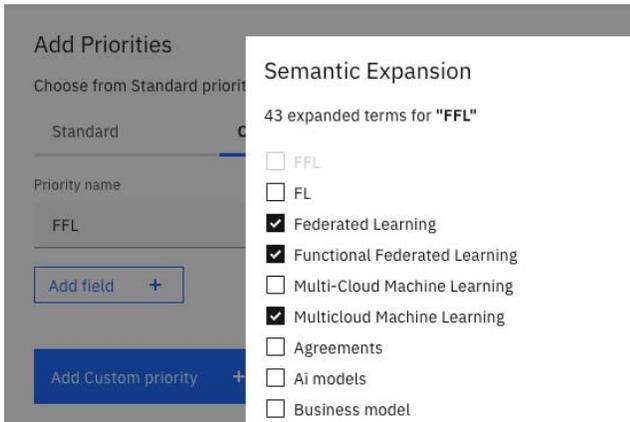


Domain vocabulary allows us to quickly build dictionaries for faceting or querying based on an understanding of how terms were used in the corpus. For example, here with the word "Croatia" seeded, it suggested all other countries in the corpus.

## VI. COGNITIVE SOLUTIONS: DOMAIN LEARNING ASSISTANT

In order for one to improve the matching of the solution, one has to understand the knowledge that is specific to the domain. Our proposed architecture includes the use of domain specific dictionaries to help enhance our semantic search engine to help better identify assets and offerings. Towards that, we employ a state-of-the-art neural network architecture for relation classification. The input of the neural network is a text with two marked entities, i.e., the entities for which the system tries to extract a relation, and it doesn't require complicated syntactic or semantic preprocessing of the text. The first layer of the network is a word embeddings layer, where each token in the input text is replaced with an n-dimensional embedding vector. In the second layer of the network a feature vector is generated, which is a concatenation of lexical and sentence level features. As lexical features we use the marked entities and the surrounding tokens, i.e., one token on the left and one on the right of the target entity.

One of the most significant problems with semantic search is its inability to leverage domain dictionary to help its search results and mapping accuracy. Our ability to integrate domain specific dictionaries applicable to various industry domains helps us improve on the semantic mapping significantly.



## VII. COGNITIVE SOLUTIONS: DATA EXPERIENCE

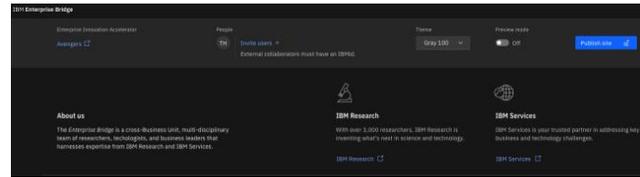
A Cognitive Solution is never complete without embracing the growing trends in technology. While the responses to opportunities are often in natural language and limited in number of pages, our solution extends beyond to provide an opportunity-based microsite.

The microsite is a personalized web page with an integrated model of collaboration with the vendors and businesses to help improve the solution mapping.

In addition to having the ability to publish the response in a Microsoft Word or Adobe PDF, we have extended it

support Podcast and Videocast options. This enables the client business to experience the content like never before. The client team are no longer bound by a specific time and event and instead have the freedom to experience the response in different formats with a built-in query capability to search the content.

We have implemented a proof of concept for the presented method and conducted experiments to evaluate the effectiveness of various aspects of the tool including business component modeling, business component analysis, requirement understanding and its mapping as well as an explorative and collaborative interaction with clients to obtain a complete 360 view.



## ACKNOWLEDGMENT

The research behind this paper would not have been possible without my current and former team members within my exceptional group. I would like to express my gratitude to Jeanette Blomberg, Chad deLuca, Anna Lisa Gentile, Daniel Gruhl, Lei Huang, Shun Jiang, Eric Liu, Aly Megahed, Taiga Nakamura, Hamid Motahari Nezhad, Guangjie Ren, Mary Roth, Steven Welch, Chung-hao Tan, and many more.

## REFERENCES

- [1] S. Gopisetty *et al.*, "Building a cognitive platform for the managed IT services lifecycle," in *IBM Journal of Research and Development*, vol. 62, no. 1, pp. 8:1-8:11, 1 Jan.-Feb. 2018, doi: 10.1147/JRD.2017.2770642.
- [2] Arar, Raphael & Ren, Guang-Jie & Jiang, Shun & Becker, Valeria & Huang, Lei & Liu, Eric. (2018). Applying User-Centered Design to Business Modeling: CBM.next as a Case Study. 164-169. 10.1109/CBI.2018.10065.
- [3] Huang, Lei *et al.* "Toward Dynamic Model Association through Semantic Analytics: Approach and Evaluation." 2019 IEEE 21st Conference on Business Informatics (CBI) 01 (2019): 130-137.
- [4] Huang, Lei *et al.* "Toward Dynamic Model Association through Semantic Analytics: Approach and Evaluation." 2019 IEEE 21st Conference on Business Informatics (CBI) 01 (2019): 130-137.
- [5] H. R. Motahari Nezhad, C. Bartolini and P. Joshi, "Analytics for similarity matching of IT cases with collaboratively-defined activity flows," 2011 IEEE 27th International Conference on Data Engineering Workshops, Hannover, 2011, pp. 273-278, doi: 10.1109/ICDEW.2011.5767639.
- [6] R. Krishnamurthy and Y. Li, S. Raghavan, F. Reiss and S. Vaithyanathan and H. Zhu, *SystemT: a system for declarative information extraction*, SIGMOD Record, 2008.
- [7] Petar Ristoski, Anna Lisa Gentile, Alfredo Alba, Daniel Gruhl, Steve Welch: Large-scale relation extraction from web documents and knowledge graphs with human-in-the-loop. *J. Web Semant.* 60: 100546 (2020)

- [8] Anna Lisa Gentile, Daniel Gruhl, Petar Ristoski, Steve Welch: *Explore and Exploit. Dictionary Expansion with Human-in-the-Loop. ESWC 2019: 131-145*
- [9] Alfredo Alba, Chad DeLuca, Anna Lisa Gentile, Daniel Gruhl, Linda Kato, Chris Kau, Petar Ristoski, Steve Welch: *Identifying High Value Opportunities for Human in the Loop Lexicon Expansion. WWW (Companion Volume) 2019: 604-609*
- [10] Ismini Lourentzou, Daniel Gruhl, Steve Welch: *Exploring the Efficiency of Batch Active Learning for Human-in-the-Loop Relation Extraction. WWW (Companion Volume) 2018: 1131-1138*
- [11] Sandeep Gopisetty et al.: *Building a cognitive platform for the managed IT services lifecycle. IBM J. Res. Dev. 62(1): 8 (2018)*
- [12] Hamid Reza Motahari-Nezhad, Larisa Shwartz: *Towards Open Smart Services Platform. HICSS 2017: 1-7*
- [13] Hamid R. Motahari Nezhad, Juan M. Cappi, Taiga Nakamura, Mu Qiao: *RFPCog: Linguistic-Based Identification and Mapping of Service Requirements in Request for Proposals (RFPs) to IT Service Solutions. HICSS 2016: 1691-1700*
- [14] Hamid R. Motahari Nezhad, Rama Akkiraju: *Towards Cognitive BPM as the Next Generation BPM Platform for Analytics-Driven Business Processes. Business Process Management Workshops 2014: 158-164*
- [15] Jovan Stevovic, Jun Li, Hamid Reza Motahari-Nezhad, Fabio Casati, Giampaolo Armellin: *Business process management enabled compliance-aware medical record sharing. Int. J. Bus. Process. Integr. Manag. 6(3): 201-223 (2013)*
- [16] Jorge L. C. Sanz: *Entity-centric operations modeling for business process management - A multidisciplinary review of the state-of-the-art. SOSE 2011: 152-163*
- [17] D. Gruhl, K. Haas, J. Pieper, C. Robson and T. Stuart, "Information Enrichment Service Systems," *2007 IEEE International Conference on Service Operations and Logistics, and Informatics*, Philadelphia, PA, USA, 2007, pp. 1-6, doi: 10.1109/SOLI.2007.4383941.
- [18] A. Gentile et al., "Large-scale relation extraction from web documents and knowledge graphs with human-in-the-loop," *Web Semat. 60: 100546 (2020)*
- [19] Wolf, C.T. 2019. Explainability scenarios: towards scenario-based XAI design. *Proceedings of the 24th International Conference on Intelligent User Interfaces, IUI 2019, Marina del Ray, CA, USA, March 17-20, 2019 (2019), 252-257.*