A Measurement Ontology for Beliefs, Desires, Intentions and Feelings within Knowledge-intensive Processes

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Abstract. *In Knowledge-intensive Processes (KiPs) participants perform activities and collaborate with each other driven by their Beliefs, Desires, Intentions and Feelings (BDIFs). Measurement provides useful information for reaching conclusions and making decisions. However, it may present some particularities such as a difficulty to quantify intangible and subtle concepts like BDIFs. This paper presents an ontology that provides a way towards capturing and leveraging the intensity of BDIFs from their expression within conversations registered during KiP's execution. It was built based on the Measurement Ontology Pattern Language, the Speech Act Theory and the Knowledge-intensive Process Ontology. Its application is exemplified in a real life scenario.*

1. Introduction

A Knowledge-intensive Process (KiP) is specified as a composition of prospective activities (events) whose execution contributes to fulfilling a goal and whose control-flow, at the instance level, typically presents a high degree of variability. KiPs are present in several domains, such as in customer support services, air traffic control, design of new products/services, planning a marketing campaign, management of data quality, IT governance and strategic planning [Marjanovic and Freeze 2011]. In each of these scenarios, human knowledge and involvement are key to the KiP execution [Isik et al. 2013]. The participation of human agents in a process become evident when they interact with each other, exchanging knowledge in order to achieve process goals. To perform their work, these agents consider their inherent Beliefs, Desires, Intentions and Feelings (BDIFs) that motivate them to act. When agents interact, these elements are present in their communications, which in most of the times are performed using natural language. Little et al. (2016) posed that the expansion and use of knowledge in organizations depend on both formal and informal social processes via effective communication. Furthermore, KiP scenarios demand agents to make unpredictable decisions and execute actions that require their specific knowledge and creativity. All these elements turn the analysis and management of this type of process more challenging, and current management techniques are considered inadequate for KiPs [Isik et al. 2013]. Event though effort is being made via work-flow management, adaptive case management, production case management and groupware to support KiPs [Pillaerds and Eshuis 2017], focus is mainly given on process design and execution and very few works deal with KiP analysis.

From a knowledge perspective, Richter-von Hagen et al. (2005) recognize the calculation of performance indexes as a challenge because, differently from traditional

perspectives such as time, cost and quantity that are directly quantifiable, knowledge-related measures require different techniques. Thus, the problem investigated in this work is the difficulty to analyze KiPs via quantifiable measures. More specifically, this work focus on the definition of measures for BDIFs, that are crucial aspects of human behavior that drive the execution of a KiP. One possible approach to define BDIF's measures is to analyze registers of human communication provided by information systems that partially support a KiP (such as emails, online chats and forum threads) by means of the Speech Act Theory (SAT) [Austin 1975]. This approach relates specific types of illocutionary acts to the expression of particular types of intentional moments (BDIFs). This relationship opened a path to analyze speech acts as expressions of human knowledge and cognition that drive the execution of KiPs [Richetti et al. 2017].

This work proposes a formal conceptualization to measure BDIFs in KiPs, which is built on top of two existing ontologies. First, we adopt the Knowledge-intensive Process Ontology (KiPO) [dos Santos França et al. 2015] as a precise definition of what are the structural elements that characterize a KiP. Second, the Measurement Ontology Pattern Language (M-OPL) [Barcellos et al. 2014] was employed as a formal conceptualization for measurement definitions. The resulting output is a domain ontology for the measurement of BDIFs in KiP scenarios. Our proposal contributes to foster the analysis of this kind of process beyond the traditional process analysis that is proven incomplete in knowledge-intensive scenarios [Isik et al. 2013]. The proposed ontology aims to provide a common and precise agreement of which concepts and relations are needed to quantitatively analyze the occurrence of speech acts that represents BDIFs, and is a basis for conversation analysis and modeling. To exemplify the relevance of the proposed ontology, it was applied in a real life scenario, were after performing measurements, some conclusions about the behavior of BDIFs in a KiP were drawn. The paper is organized as follows: Section 2 presents background knowledge and Section 3 the related work. Section 4 describes the ontology proposed to measures BDIFs in KiPs. Section 5 presents the application of the ontology in a real life scenario, and Section 6 concludes the paper.

2. Background

2.1. Knowledge-intensive Process Ontology (KiPO)

KiPO [dos Santos França et al. 2015] is a domain ontology comprising the key concepts and relationships that are relevant for understanding, describing and managing a Knowledge-intensive Process. It is grounded on UFO (Unified Foundational Ontology), a foundational ontology that has been developed based on a number of theories from Formal Ontology, Philosophical Logics, Philosophy of Language, Linguistics and Cognitive Psychology [Guizzardi and Guizzardi 2005]. This way, each KiPO concept is defined according to the UFO constructs, which in turn are described in terms of its meta-properties (sortality, relational dependence, mixin, rigidity, among others). According to KiPO, a KiP execution is driven by the agent's intentions towards achieving the process objectives, and the flow of activities within a KiP is determined by intentional moments inhered in process participants, such as Beliefs, Desires, Intentions and Feelings. Along with the BDI Architecture proposed in [Rao and Georgeff 1991], KiPO also considers agent's Feelings as a mental moment about someone or something that is motivated by their own beliefs and also influence the motivation of an agent to act. KiPO is structured into 5 sub-ontologies, reflecting the relevant perspectives to represent a KiP.

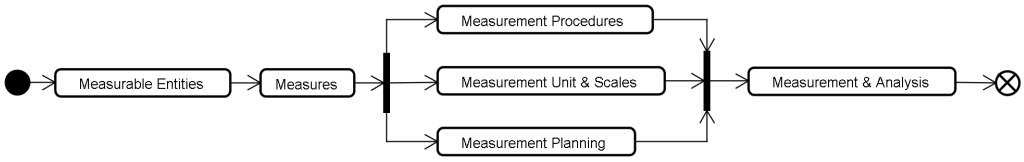

Figure 1. UML Activity Diagram with the usage sequence of M-OPL patterns.

The Business Process Ontology (BPO) comprises the traditional elements of business process modeling (such as activities, event flows, input/output data objects) and serves as the basis from which specific knowledge-intensive elements are specialized. The Collaboration Ontology (CO) depicts concepts to explain how knowledge artifacts are exchanged among process participants, and how the collaboration takes place. The Decision Ontology (DO) aims at making explicit the rationale of the decisions made by the process agents. The Business Rules Ontology (BRO) provides the means to describe some parts of the KiP from a declarative perspective, describing the rules that govern a KiP, especially the parts of the process which are very flexible and not subject to predefined event flows. Finally, the Knowledge-intensive Process Core Ontology (KiPCO) comprises the core concepts of a KiP, such as Agents, their Goals and Mental States, Knowledge-intensive Activities (KiAs) they perform and the contextual elements involved in a KiA execution.

2.2. Measurement Ontology Pattern Language (M-OPL)

An Ontology Pattern Language (OPL) [de Almeida Falbo et al. 2013] offers a network of interrelated ontological patterns that provides support for solving ontology development problems for a given field, plus a sequence of steps that guides the order for them to be addressed and suggesting one or more patterns for solving them. M-OPL [Barcellos et al. 2014] is a set of interrelated patterns and steps describing how to combine them to build an ontology about measurement in a specific domain. M-OPL concepts and relations are aligned to the basic categories of the UFO foundational ontology, which aims to incorporate a solid and semantically precise basis. M-OPL is organized in six ontological patterns with the following measurement aspects: Measurement Entities, which includes patterns related to the entities and their properties that can be measured; Measures, which deals with defining measures and classifying them according to their dependence on others measures; Measurement Units & Scales, which concerns the scales related to measures and the measurement units used to partition scales; Measurement Procedures, dealing with the procedures needed to collect data for measures; Measurement Planning, which addresses the goals that drive measurement as well the measures used to verify goals achievement; and Measurement & Analysis, which concerns data collection and analysis. Fig. 1 shows the proposed usage sequence of the ontological patterns of M-OPL as an UML Activity Diagram. The black-filled circle is the Entry Point of the process. The first step is the usage of the Measurable Entities pattern, followed by the Measures Pattern. After this second step the process splits in three parallel pattern usages: Measurement Procedures, Measurement Unit & Scales and Measurement Planning. After these latter three steps, the usage of the Measurement & Analysis pattern is recommended, and then the process finishes.

2.3. Speech Act Theory

Initially proposed by Austin (1975), the Speech Act Theory investigates how context and intention contribute to the literal meaning of utterances within a conversation. SAT employs foundational issues about the nature of communication and illocutionary force, technical and empirical issues in the semantics of non-declarative clauses, and social, moral, and political issues arising from normatively important or problematic kinds of speech [Harris et al. 2017]. This theory elaborates on the analysis of the intended communicative act of an utterance, that is, what the utterance was meant to achieve when performed by a speaker. Speech acts may be analyzed on three levels: a locutionary act, the utterance itself; an illocutionary act, its intended significance, such as a request, an order or a promise; and a perlocutionary act, the actual effects caused by the speech act, for example the act of fulfilling the uttered request. Searle and Vanderveken (1985) define five types of illocutionary acts of utterances:

- Assertives: represent a state of affairs. Assertives require that the speaker believes his assertion and that he is committed to the truth. The mental state expressed in assertive illocutions is belief. Example of verbs applied in assertive speech acts are state, claim or assert;
- Commissives: commit the speaker to a future course of action. Commissive speech acts create practical reasons for the speaker to do the action to which he commits himself. The mental state expressed in commissive illocutions is intention. Example of verbs applied in commissive speech acts are promise, threat or intend;
- Directives: make an attempt to get the hearer to do something. In a directive illocution, the speaker wants or desires the hearer to do what he attempts to get him to do. The mental state expressed in directive illocutions is desire. Example of verbs applied in directive speech acts are order, command or challenge;
- Declaratories: perform an action which brings into existence a state of affairs by representing oneself as performing that action. The illocutionary point of a declaration is to bring about changes in the world. Example of verbs applied in declaratory speech acts are declare, bless, fire or bid;
- Expressives: express propositional attitudes of the speaker about a state of affairs. The notion of expressive speech acts is in the sense of what people say to express, manifest, or give vent to their feelings. Example of verbs applied in expressive speech acts are congratulate, thank or apologize.

In our proposed ontology, we applied SAT to support the identification of Intentional States expressed by process agents during a communication. Thus, we consider that Intentional States are externalized by the expression of a communicative act in the form of Speech Acts. We are aware of the distinction between the ontological nature of Speech Acts and Intentional States: the former are actions - or intentional events - that depend on physical realizations, such as writing on paper or speaking; while the latter are mental moments independent of physical realization. We argue that Intentional States can be indirectly analyzed by inspecting physical realizations of Speech Acts.

3. Related Work

Mate et al. (2016) proposed a Business Modeling and Indicator Metamodel to conceptualize essential elements of indicators, covering Key Performance Indicators, Key Result

Indicators and Measures in business environments. The metamodel was part of a framework that applied data mining techniques for providing information about the elements in the model and an iterative process that guides the discovery and definition of indicators. However, the authors did not detail the measurement process, and also the proposed metamodel did not consider the support of foundational ontologies which helps to characterize as accurately as possible the conceptualization they commit to [Guizzardi 2006]. Grounding the metamodel to a foundational ontology may reveal important conceptual distinctions that would otherwise be unconsidered in informal characterizations. In [Wang et al. 2015], the authors investigated a set of dialogue patterns in online Question & Answer (Q&A) communities to understand the knowledge-sharing process of the participants. Their framework was based on dialogue act theory, network analysis and process mining. Even though they applied speech act patterns, they did not present formal definitions for the measurements and did not account for the mental moments and motivations of the agents participating in the Q&A communities' process. Even though SAT is a theory developed in the 60's, there is still recent work that applied this important theory in the analysis of discourse, social media and computer-mediated communication. Examples of recent SAT application scenarios are shown in [Abbasi et al. 2018] and [Rus et al. 2017].

In a previous work, we proposed a method based on SAT and Process Mining techniques, data historically registered in a process log was analyzed to automatically discover the flow of speech acts of process participants, their corresponding expressed BDIFs, and their impact on process performance [Richetti et al. 2017]. We applied the proposal in a real life organization, where we were able to come up with speech act patterns (viewed as event sequences) and their relation to good (and bad) process performance. This previous work focused on a technical implementation of a pipeline to discover and analyze speech acts, however, it lacks a formal definition of how performed speech acts discovered in message logs can be measured and related to representations of BDIFs.

4. A Measurement Ontology for BDIFs

In this section, we present a domain ontology to capture the conceptualization regarding measurement of BDIFs within conversational contexts taking place during the execution of KiPs. The proposed ontology applies the catalog of ontological patterns and steps described in [Barcellos et al. 2014], thus specializing M-OPL for BDIFs in the KiP domain. We further detail the steps we followed (Fig. 1) to build the ontology. The first step is to use the Measurable Entities pattern. To define entities in this pattern, we used the taxonomy of Speech Acts types from Searle and Vanderveken (1985) to relate each speech act type to a corresponding mental moment (BDIF) expressed by it[1]. The diagram presented in Fig. 2 resumes the Speech Act types and their expressed Mental Moment types. A Mental Moment is an intentional moment inherent to an Agent, i.e., the capacity of some properties of certain individuals to refer to possible situations of reality. A Mental Moment only becomes explicit when it is externalized, or communicated. Thus, the occurrence of a Speech Act can be viewed as the expression of a Externalized BDIF.

Take for example, the scenario of a customer support KiP in a company that provides ICT (Information and Communication Technology) services, and the particular

[1]Since Declaratory Speech Acts demand extralinguistic elements that require additional context to be identified that go beyond message logs, they were left out of the scope of this paper

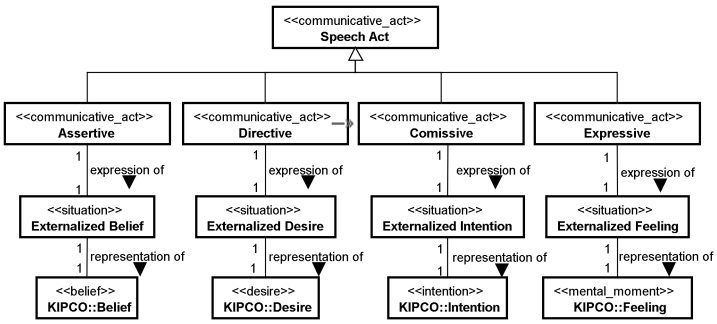

Figure 2. Relation of Speech Acts with Beliefs, Desires, Intentions and Feelings.

KiP instance in which a given customer files a complaint in the company's system reporting that his wifi service is down, which generates a ticket. While handling this ticket, the company technician (a process agent) decides to execute a series of activities trying to diagnose, and then correct the problem. Each activity he executes is logged in the system, and during each execution he may use the system to interact with the customer - to get more details about the problem - or with other technicians - who may have more experience in a specific technology or equipment, and he may also comment on the reasons that led him to decide upon an activity. In this scenario, if this agent registers a message in the system with the sentence "I believe that the wifi router protocol is not compatible with the security system", which contains an assertive speech act, this expresses a Belief of this technician. He then may send a message to another technician asking "Could you please tell me the exact technical specifications for this wifi router?", which contains a sentence with a directive speech act, thus expressing an Externalized Desire. If the other technician responds by saying "I promise you to send these specifications within 2 hours", this sentence contains a commissive speech act that expresses a Externalized Intention of the other technician. Finally, the first technician may reply with the message "Thank you for your time", externalizing his Feeling by an expressive speech act.

Then we define how written communications can provide evidences to support the analysis of a KiP. In Fig. 3, gray-backgrounded classes are new elements we added that are specific to the domain of KiPs, specializing the concepts of the original Measurement Entities Pattern. A Message Flow is an object that consists of several Messages. A Message is a Proposition (thus, an Endurant) that may be either in an active phase (Message in Formulation [Brown-Schmidt and Tanenhaus 2006]) or in an inactive phase (Sent Message). This behavior is explored in [Guizzardi et al. 2016] where it is argued that Endurants have a causally active phase (such as an active enrollment), and a causally inactive phase (such as a finished assignment). In the latter, the properties of the Endurant can no longer be manifested and its qualities become immutable regarding their values.

A Message Flow represents a Message Log in real-life information systems, since it contains all the messages exchanged by process agents, where each Sent Message is characterized by its own timestamp. In addition, Messages (such as emails, forum and chat messages) may contain one or more Sentences, and each Sentence contains the propositional content of none or multiple Speech Acts. A Speech Act is a communicative act emitted by a Sender, in which he utters a Sentence to a Hearer with a Proposition. In the context of this work, a Proposition is a Sentence that is the propositional content of

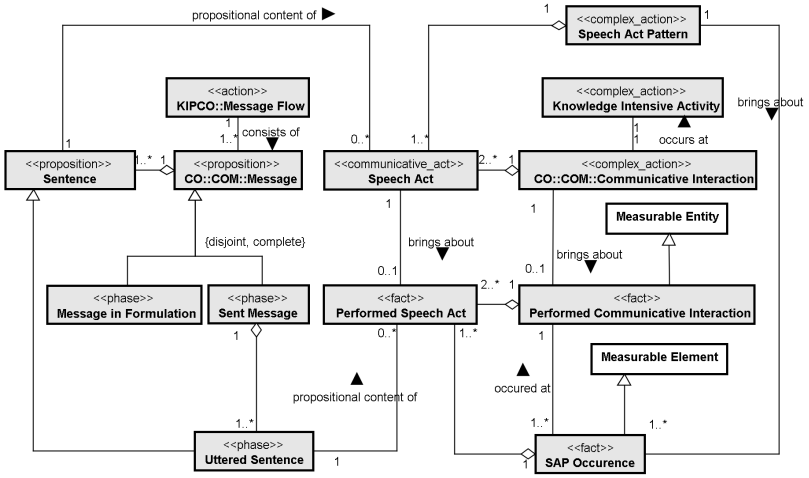

Figure 3. Usage of the Measurable Entities Pattern.

the Illocutionary Act. For example, in the sentence "John, tell me how you solved this problem", a Directive Speech Act has the propositional content of making John tell how he solved a problem. In the KiP domain, a Communicative Interaction is the aggregation of Communicative Acts within the execution of a Knowledge-intensive Activity. A Speech Act Pattern is composed by a sequence of Speech Acts that occurs recurrently during a Communicative Interaction. These patterns help explaining how the communication process develops throughout a Knowledge-intensive Activity. For example, consider a process where two participants disagree on the technique to be applied to solve a server outage. John says "I believe we should first test the connection", but Bob replies "No, directly restarting the server will solve the problem". In this case, process participants expressed Beliefs, with no explicit commitment to any action. This (Belief-Belief) pattern may indicate more discussion time, possibly increasing the time to solve the problem.

Situations are portions of reality that may be comprehended as a whole, and are similar to the notion of state of affairs; however, unlike state of affairs, situations are bound to specific time points. Events transform a portion of reality to another, and may change reality by changing the state of affairs from one (pre-state) situation to a (post-state) situation. What is proposed to be measured is the difference in reality from a pre-state to a pos-state caused by events [Guizzardi et al. 2013]: "an event brings about a situation *s*, in which case the occurrence of an event *e* results in the situation *s* obtained in the world at the time point end-point(*e*)". Thinking in terms of events that already occurred and were registered by an information system, a Sent Message aggregates Uttered Sentences with the propositional content of Performed Speech Acts, which represent factual situations (facts) obtained at particular time points. Two or more Performed Speech Acts can be aggregated in a Performed Communicative Interaction. For the purpose of measurement a Performed Communicative Interaction is defined as a Measurable Entity having a Speech Act Pattern Occurrence (SAP Occurrence) as a Measurable Element.

Once Measurable Entities and Measurable Elements are defined, the next step is to use the Measures Pattern. In a Performed Communicative Interaction, it is possible to count the occurrences of Speech Act Patterns during the execution of a Knowledge-intensive Activity. Fig. 4 presents the use of the Measures Pattern to define the Measure

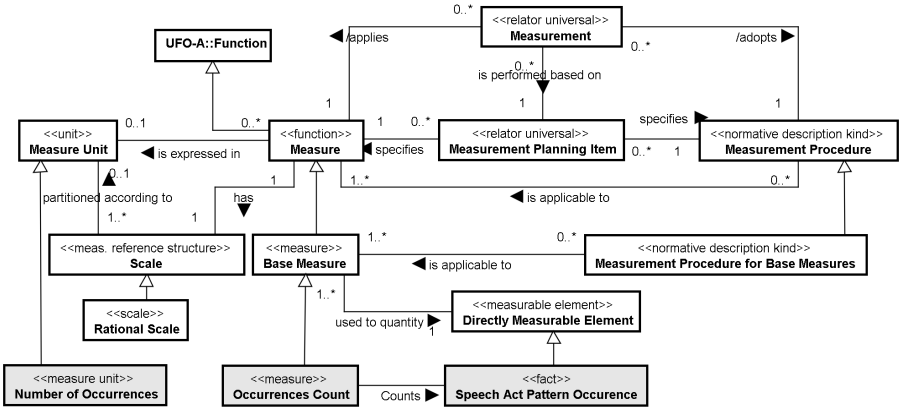

Figure 4. Usage of the Measures, Measurement Unit & Scales and Measurement Procedures Pattern.

"Occurrences count", which counts the occurrences of a Speech Act Pattern. The same diagram shows the definitions provided by the usage of the Measurement Unit & Scales and Measurement Procedures Patterns. For the Occurrences Count Measure, the measurement unit is the Number of Occurrences of a given pattern with a Rational (an interval with a rational zero) scale. The general Measure Procedure provided by M-OPL is applicable to our KiP domain. The Measurement Planning pattern addresses the goals that drive measurement. A Measurement Planning Item connects the Measurement Goal, the Information Need and the Measurement Procedure. Fig. 5 presents the elements that extend the Measurement Planning Pattern for BDIFs measurement in a KiP. The Information Need for this measurement is to know which Speech Act Patterns (SAPs) occurred in a Message Flow (MF). This Information Need refers to the measurable element SAP Occurrence. From the Information Need, Measurement Goals may be identified. In the KiP domain, there is a Simple Measurement Goal (Check to occurrence of a Speech Act Pattern in a Performed Communicative Interaction (PCI)) that may be aggregated in the Composed Measurement Goal "Check the most frequent Speech Act Patterns in a Message Flow". The Measurement & Analysis Pattern presents the concepts related to the Measurement itself (Fig. 6). A Measurement is performed based on a Measurement Planning Item, which adopts a Measurement Procedure, where by the application of a Measure function over Measurable Entities and Measurable Elements it is possible to determine a Measured Value.

5. An Application of the Proposed Measurement Ontology

Even though there is no single Information System capable to fully support KiPs [Di Ciccio et al. 2015], some KiPs may have partial support from domain specific systems such as Help Desk Management Systems or Hospital Management Systems. All these information systems can be a rich source of information for KiP analysis. An example is the possibility to analyze messages sent among KiP participants that are registered by these specialized systems. As BDIFs are quite subjective elements, by the use of the proposed ontology, their externalized representation expressed in forms of Speech Acts present in Sent Messages may reveal insights from the behavior of the participants during the execution of a KiP. This ontology helps to present a clear definition of these relations and also how to measure these elements in order to obtain objective measures from them. In order

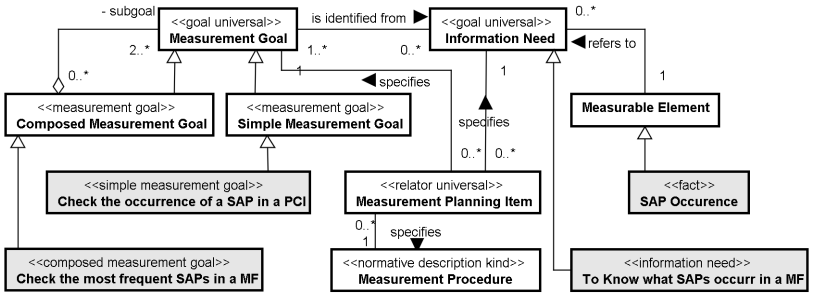

Figure 5. Usage of the Measurement Planning Pattern.

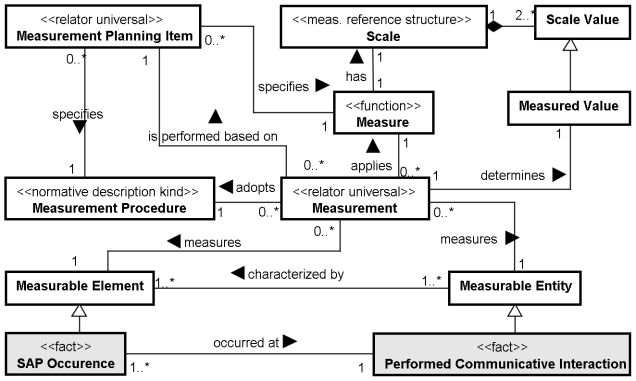

Figure 6. Usage of the Measurement & Analysis Pattern.

to show the application of the proposed Ontology, a real life dataset of an ICT Outsourcing Company was analyzed. One of their main services is to provide technical solutions to incidents reported by their clients. Company's operations are supported by a process-aware system called OTRS[2], that is capable to register messages both from their customers and from company's technical agents. The kind of process performed by the company is typically a KiP, since it involves the application of technical skills, troubleshooting abilities, collaboration and information exchange between participants, and also ad-hoc decisions are frequently discussed and taken as most of the problems are situational.

The dataset[3] contains 5.725 distinct instances, or tickets, labeled as "incidents" reported in the second semester of 2015, stored in company's OTRS repository, comprising 20.548 messages sent during troubleshooting process instances. To discover Performed Speech Acts in Uttered Sentence's from Sent Messages, it was applied the Speech Act Extraction pipeline presented in [Richetti et al. 2017]. Table 1 shows and excerpt of this Message Flow with the result of Speech Act extraction from the Uttered Sentences. It was considered that in a single instance one Knowledge-intensive Activity (the troubleshooting) happened with one Performed Communication Interaction occurrence. This PCI is composed by all Performed Speech Acts identified in the Uttered Sentences within the Sent Messages related to that process instance. Once discovered, the Performed Speech Acts can be grouped as SAP Occurrences. To perform this step, the ProM[4] framework was employed to analyze with the standard "Explore Event Log" visualization. This visu-

[2]https://www.otrs.com/

[3]An anonymized copy of the dataset is available in: https://github.com/phpr-unirio/ontobras2018

[4]http://www.processmining.org

Table 1. Excerpt of the Message Flow extracted from OTRS.

PCI Id	Timestamp	Uttered Sentence	Performed Speech Act	User Role
218367	2015-07-29 12:05:04	...I request verification on my computer because it shuts off with little time unused.	Directive	Customer
218367	2015-07-29 15:48:30	Please be advised that your request registered in the call #9168 is being treated...	Assertive	Agent
218367	2015-07-29 16:47:26	...your request regarding computer shutdown recorded in the call #9168 was completed...	Assertive	Agent

Table 2. Top 5 most frequent Speech Act Pattern Occurrences.

Speech Act Pattern Occurrence	No. of Occurrences
assertive|agent → assertive|agent → assertive|agent	461
directive|agent → assertive|agent → assertive|agent → assertive|agent → assertive|agent	350
assertive|agent	200
directive|agent → assertive|agent → assertive|agent → assertive|agent	350
directive|customer	179

alization groups similar process traces and count their occurrence in the dataset. This way, the tool performed the Measurement Procedure needed to determine the Measured Value of a SAP Occurrence. In order to satisfy the Composed Measurement Goal "Check the most frequent SAPs in a MF" Table 2 presents the TOP 5 most frequent SAP Occurrence in the analyzed Message Flow. It is possible to observe that all 5 patterns contains only Speech Acts performed by a single participant, being a company's agent or a customer. This does not mean that there are no Perceptions of the Message by a Receiver and a proper reply. In this scenario, part of the communication is performed via telephone calls, and in this case they are not registered in OTRS.

Despite this limitation, the mainstream behavior of the agents is to perform a sequence of assertive acts, that in most cases consist on standard phrases with slight modifications depending on the problem solved that express informations and responses to the customers, such as: "Dear [CUSTOMER], we inform you that your request [...] in the call #145727 was completed by the Field Operations Team who took great pleasure in helping you". In the same sense, the fifth most frequent pattern is a directive act performed by the customers by email and the solution is communicated back by the agents via telephone (not registered). The Company's process owners confirmed that sometimes in favor of a quicker resolution, they prefer to directly call the customer and then solve the problem. It is also worth nothing that all speech acts presented in Table 2 are either Assertives or Directives, expressing Beliefs and Desires. Intentions in form of Commissive acts are not present in this set of patterns. By inspecting all other discovered patterns, Commissive acts occurred only in 406 out of 5.725 PCIs. Even less frequent, it may be important for business to know in what kind of situations Commissive acts, that express Externalized Intentions, are made explicit in a Sent Message. An example is on Performed Communicative Interaction number 228466 where the agent uttered the following Sentence: "Finished: You can reply to this message if you want to have the ticket reopened or do not agree to its closure". This Sentence contains an offering, which characterizes a Commissive act with the Intention of the agent to close the ticket unless the customer replies in contrary. Expressive Speech Acts (Feelings) occurred only in 203 out of 5.725 PCIs, and no interesting Speech Act patterns were found containing Expressive acts in this dataset.

6. Conclusions

The main contribution of this work is to define concrete measures for BDIFs when they occur in the context of a KiP. This work provides a way to understand how participant's mental moments are expressed during process execution. This allows process managers to classify conversations by counting pattern occurrences and relating them to other domain-specific indicators, in order to derive best practices or speech act patterns related to undesired process outcomes, e.g. long time-to-solve incidents. The results confirm that externalized BDIFs may be identified and measured from messages registered by information systems, and also can provide quantitative information for process analysis. A limitation to be investigated and improved is the automated approach used in the speech act extraction that relies on the identification of a verb list for each speech act type, that sometimes does not identify indirect speech acts and more complex forms of illocutionary acts [Searle and Vanderveken 1985]. The generalization of the analysis is limited by this example scenario, and the behavior of BDIFs in other KiPs may be totally different, although the measurable entities and elements proposed in the ontology are general for any KiP. Future work includes the formalization of additional measures related to KiPs, such as decisions, contingencies and business rules in order to provide a more comprehensive support for the analysis of KiPs. Additional SAPs will be investigated in different scenarios in order to analyze if some pattern occurrences are common among different domains or if they are always bounded to specific scenarios.

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