Generation of Concern-based Business Process Views

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***Abstract*—Business processes usually have distinct organizational stakeholders with contrasting concerns regarding them. The multitude of concerns often results in multiple business process models with dominant perspectives in detriment of others which is common to see among the different departments of an organization such as Human Resources, Information Technology, Risk, and Auditing. To the best of our knowledge, there seems to be a lack of approaches that explore the generation of concern-based business processes to obtain consistent views shaped by departmental interests. Therefore, this research fills a gap in addressing organizational stakeholders' needs through concern-based business process decomposition and filtering of process activities applied over a consolidated business process model in order to maintain consistency between views. As an outcome, we expect the support and satisfaction of the complex and contrasting concerns of the distinct organizational departments.**

***Index Terms*—View generation, business process modeling, process decomposition, organizational concern-based business process views, departmental interests, BPMN.**

I. Introduction

Business processes translate the knowledge about how an organization operates, and represent one of its core assets as a result of their direct impact on the attractiveness of offerings, influence on customer's experiences, and ultimately revenue [1], [6].

Their significance justifies that business processes often cross multiple departments and inter-organizational boundaries to improve understanding and communication among them, then being shared across different stakeholder groups, which have distinct perspectives and give contrasting importance to the same business process (BP). This drives stakeholders to create and look for a business process from a modeler's perspective, which means in a way that better fulfills their concerns and special requirements.

However, this can give rise to process models that don't have the same principles applied to all of their parts, meaning they lack consistency due to heterogeneous schemes for naming its activities and entities, usage of different modeling styles and process hierarchies with arbitrary depth and level of detail [1]. These inconsistencies make process understanding difficult by stakeholders as well as hamper the tasks of process analysis, redesign, reuse, and automation as they may lead to erroneous interpretations of process content and may neglect information.

One way of providing stakeholders with consistent concern-based business processes is to generate views from a common business process - consolidated model - according to the requirements of its stakeholders. This means to have as a starting point, a model that combines multiple business process views. The design of this consolidated model is out of the scope of this paper yet is introduced in [3]. A view is a partial expression of a system's architecture concerning a particular viewpoint. A viewpoint establishes the conventions by which a view is specified, depicted, and created [10]. Subsequently, this paper's approach can be considered an application of ISO 42010 [7] to business process modeling. ISO 42010 addresses the creation, analysis, and sustainment of architectures of systems whose stakeholders are parties with interests in that system, and their interests are expressed as concerns. According to ISO 42010, a view is also a suitable fit to address one or more of the concerns of the system's stakeholders. Thus, we want our business process views to help leverage Business Process Management (BPM) benefits by giving each stakeholder an appropriate process representation.

Then, to facilitate the consistent modeling of business processes from different perspectives, this paper presents an approach that copes with the multiple views and goals of the different stakeholders, according to their concerns or focus. Our approach enables the generation of views shaped by departmental interests since the practitioners' comments to previous works as Cardoso and Sousa [2] led to the idea that generating views only based on the six interrogatives (5W1H): Who, Where, What, When, Why, How is too simple and seldom adequate to represent stakeholders' needs. There's a lack of a method for presenting these needs in the task of business process modeling, keeping in mind the required consistency, which lead us to the problem of validating and improving an already existing view generation approach, in order to address the stakeholder's concerns and to generate more complex views.

In order to tackle the aforementioned issues, view generation is based on stakeholder's concerns by doing business process decomposition according to the concerns that are involved in the specification of its activities. Decomposition deals with breaking down a system into progressively smaller subsystems that are accountable for some part of the problem domain [5]. Thus, the functional decomposition of a process entails its recursive separation into progressively fine-grained activities. The lowest level of decomposition consists of in-

divisible atomic activities. Furthermore, the concerns, which have an associated dimension, are shaped by departmental interests and mapped to each of the process activities, making it possible to assign to each activity, its level of Risk, Auditing, Human Resources (HR), and Information Technology (IT). Along with it, there are various levels of detail in which the activities can be decomposed. This is accomplished through a hierarchical structure called taxonomy tree, which is associated with each dimension. It is the tweaking of the dimensions and respective taxonomies that allows the generation of different views out of a consolidated business process model.

To this extent, our solution aims at:

1) give results-based answers to the following hypotheses:
   - **H1)** is the existing view generation algorithm from Cardoso and Sousa [2] extensible enough to generate BPMN 2.0 concern-based business process views for organizational stakeholders?
   - **H2)** even if extensible, is the existing view generation algorithm from Cardoso and Sousa [2] viable and easy handling in real life contexts?
2) regardless of eventual limitations one may discover, propose the necessary artefacts to improve Cardoso's approach to enable the easy generation of complex views that benefit specific organizational stakeholder viewpoints while addressing their concerns.

The remainder of this paper is structured as follows: Section II reviews relevant background and positions this paper concerning related work, identifying the research gap of interest. Section III intuitively illustrates a real scenario that is used to show the presented problem. Section IV describes the proposed approach for the generation of concern-based business process views and Section V demonstrates some of the results. The evaluation is described in Section VI. Finally, Section VII concludes the paper and presents the evaluation of user satisfaction and the directions for future research.

II. Related Work

Several definitions for BP have been proposed over the years. In the early 1930s, Nordsieck describes a business process as a sequence of activities producing an output. An activity is then the smallest divisible unit of work performed by a work subject. More recently, Dumas et al. in [6] define a BP as a collection of inter-related events, activities, and decision points that involve a number of actors and objects, which collectively lead to an outcome that is of value to at least one customer.

Therefore, the concepts, methods, techniques, and tools to manage business processes are also defined as BPM, which plays a central role at operational, organizational, and technological levels [4], [9]. Since BPM is represented through the BPM lifecycle and our objective is to assist and supply stakeholders with consistent and updated models that convey their concerns, our research is mainly focused on one of the six phases of the BPM lifecycle - process discovery - that, according to [6], documents the current state of the relevant processes in one or several AS-IS process models.

Over the years, there have been efforts to create notations, methodologies, and frameworks to support business process modeling which is defined by Mendling in [11] as the human activity of creating a business process model. Some approaches apply Enterprise Architecture (EA) frameworks since EA consists of understanding the different elements that compose the enterprise and how those elements are interrelated [18]. Among others, the Zachman Framework [19] is probably the best-known framework to describe the architecture of an enterprise by proposing a two-dimensional matrix-like structure to classify and organize the business and technical models of an organization, and The Open Group Architecture Framework (TOGAF) [8] is process-driven generic and flexible enough to provide a comprehensive approach for designing, planning, implementing, and governing an enterprise information architecture. Although multiple classification schemes allow categorizing the modeling perspectives, we posit that these always crosscut the six orthogonal primitive linguistic interrogatives (5W1H) that are fundamentals of communication and used as columns in the Zachman Framework.

Despite the number of techniques to support business process modeling, there is no agreement on the modeling criteria to be used by the different organizational stakeholders. Initially, to tackle the existence of conflicting process specifications for the same organizational process, depending on the distinct stakeholder's perspectives and on the modeler's view regarding that particular process, Sousa et al. in [17] apply some properties derived from the six Zachman Framework dimensions to propose a rule for identifying business process activities and then aid the task of different stakeholders consistently modeling the same process. They use the 5W1H as independent concerns for the decomposition of a business process which makes each activity determined by the values of the six dimensions.

Following [17], Pereira and Sousa in [14] use the aforementioned decomposition rule and the classification, recursiveness, and cell uniqueness rules of the Zachman Framework to define business process equivalence through activity equivalence, by considering that each dimension of the framework is, in fact, a hierarchy of concepts typically presented as a tree. Once processes can be decomposed until the level that one dimension is sufficient to describe that process, the leaves of the process tree can be called activities which means processes that have no further decomposition. Then, using the activity decomposition rule, the authors argue that two activities are dimensional equivalent if, for each of the six dimensions, the concepts that represent them at the chosen level in the dimension's taxonomy tree are the same.

In line with [17] and [14], Pereira et al. [13] state that a business process can be functionally decomposed into a set of individual tasks, which formally speaking means that the decomposition results in a hierarchical structure defined as organizational taxonomy which asserts a controlled vocabulary to design business processes and encompasses six business concepts, each associated with one of the six Zachman Framework dimensions. A taxonomy helps to structure, classify, and

model the concepts and relationships pertaining to business process design while enabling a community to commit using the same terms in the same ways [13]. For each of the concepts, there is a taxonomy tree, meaning they can be decomposed infinitely into other instances that conceptually belong to the same concept.

Therefore, [13] triggered other works that concentrate on integrating different business process views and generating new views from a common knowledge base.

View integration first emerged in the field of conceptual database design to support the coexistence of different representations of the same real world objects [12]. Hence, Colaço and Sousa in [3] apply BPMN 2.0, which is the most used modeling language for specifying the control-flow associated with a BP, to propose a method for integrating distinct business process views into a consistent and consolidated business process model. For that purpose, they use the business process repository of the *Atlas*[1] tool from Link Consulting to enable the stakeholders to classify the various elements of their models while uploading them and then building each taxonomy for each view by classifying process activities in accordance with the six Zachman Framework dimensions. It is through this classification that a consolidated model and an organizational taxonomy are created and turn out to be even more detailed as more models are uploaded to the repository.

The consolidated process models of the process repository were later used by Cardoso and Sousa [2] to generate business process views. They made a process view generation algorithm that takes into account the level of detail desired by each stakeholder for each dimension. However, there was room for further exploration of the viability of their approach in terms of representing stakeholders' needs regarding organizational departments like HR, IT, Risk, and Auditing.

Afterwards, due to a relative scarcity of available methods and techniques to generate consistent and furthermore organizational concern-based business process models, our approach differs as we focus on developing a method to improve an already existing approach to allow stakeholders generating business process views with the same peculiarities of [2], but having their complex concerns portrayed rather than only focused on answering the 5W1H interrogatives.

Fig. 1 resumes the existing relationship between our work and the ones that triggered significant research efforts leading to the solution presented in Section IV.

III. Motivational Example

To promote the reader's understanding of the research problem, this section describes a simplified example of a *Bank Credit Granting* process. This scenario is used throughout the paper.

'The Credit Granting Process starts when the client needs funding and requests it. At this point, the Bank is responsible for making a proposal and finding the offer that suits the client the best. Once the proposal is drafted and analyzed, an intervention can be required. Otherwise, there is a final decision and an agreement between all the parties involved. Before the granting of the credit, there is also an agreement's check, and the dispatch is handled. At the same time, during the execution of the whole process, there is an examination of compliance with the Bank's credit policies and an evaluation of the efficiency of workflows.'

[1]http://www.linkconsulting.com/atlas

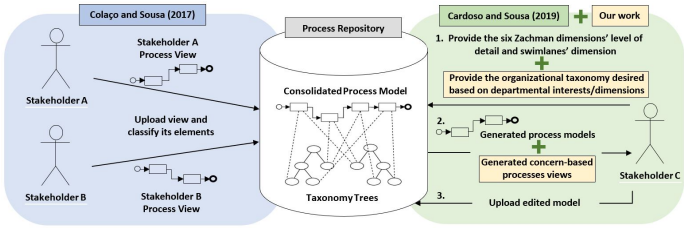

Fig. 1. Illustration of the relation between [3] (in blue) and [2] (in green) works and our research (emphasized in yellow).

Fig. 2 illustrates two models specified in BPMN 2.0, representing the business process views from two out of several departments that monitor the aforementioned process: the HR and Risk departments. To perform this monitoring, each department models their own view of the process based on the concerns of their interest and on the resources that each has to manage. The HR's interests are focused on the management of all the parties involved in the process, while Risk's interests are related to the Risk associated with each activity of the process.

At this level of detail, this simplified Bank process is performed by three distinct parties (functional, strategic, and administrative) and has three types of risk associated (financial, business, and operational). On the one hand, the HR department does not aggregate the *'Ask for client's info'* activity with *'Evaluate the procedures against illegal acts'*

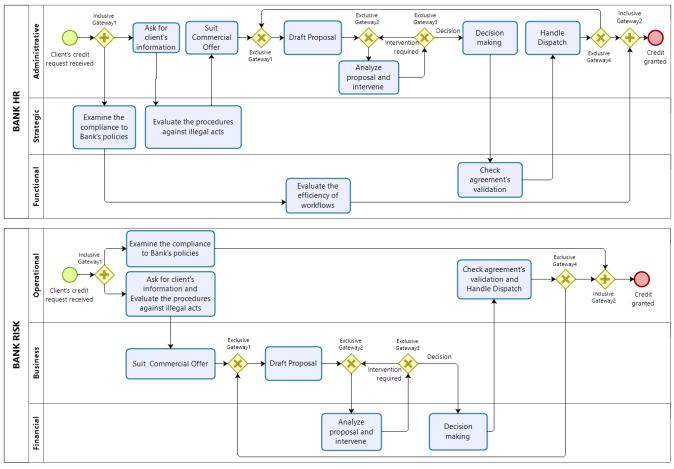

Fig. 2. BPMN process views of the *Bank Credit Granting* process, designed by HR (top) and Risk (bottom) departments.

activity once they are performed by people of different areas: administrative and strategic, respectively. On the other hand, the Risk department aggregates the *'Check agreement's validation'* and *'Handle Dispatch'* activities since they have both an operational risk associated. Also, the Risk view has only 7 activities while the HR view has 10 activities because the Risk view has more activities aggregated and it is not interested in the *'Evaluate the efficiency of workflows'* activity.

In the scope of our problem, we want to make it possible to generate views with the peculiarities described above and to model additional and more elaborate views. To the best of our knowledge, there is no existing method that allows generating concern-based business processes to obtain consistent views from the perspective of departmental stakeholders' interests.

IV. Methodology

A. The Big Picture

In the current state of affairs, our research is an add on to the work recently performed by [3] and [2], as illustrated in Fig. 1. The existing approaches guide process stakeholders in constructing taxonomy trees by classifying process activities according to the Zachman contextual dimensions (5W1H) and allow the generation of views by providing the level of detail desired for each dimension.

Notwithstanding the above, aiming to meet organizational stakeholders' needs, our solution goes further to present them with a method that enables the generation of departmental business process views such as HR, IT, Risk, and Auditing. For that purpose, our approach considers each department as a dimension, and departmental concerns such as departmental functions, roles, and areas, as the criteria for process decomposition instead of the six Zachman contextual dimensions. This means each decomposition step separates a different departmental concern from the other concerns that specify the activity. Hereupon the activities' classification performed by the stakeholders is made according to departmental interests, and the decomposition steps are automatically performed by choosing the level of detail desired for each dimension (i.e. department).

B. The Process Repository

As a crucial component of our solution, there is a need to disclose the content of the *Atlas*' repository that is relevant to our work. The process repository is structured as it follows:

- the dimensions that allow the visualization of different views;
- an organizational taxonomy for each dimension, which contains a collection of concepts organized into a hierarchical structure - taxonomy tree - and consequently a level of depth that increases proportionally with the level of detail desired;
- the consolidated BPMN process models;
- the mapping between the activities of the consolidated process models and the leaf nodes of the taxonomy trees.

The existing *Atlas*' repository metamodel is shown in Fig. 3 through a simplified Unified Modeling Language (UML) class

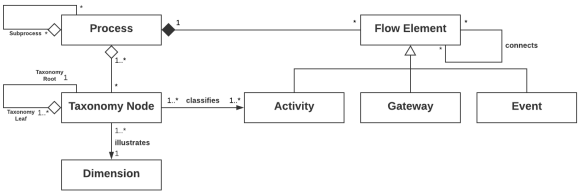

Fig. 3. UML class diagram of the *Atlas* tool's process repository metamodel.

diagram. As shown, a Process is composed of Flow Elements that can be Activities, Gateways, or Events. Flow Elements are bidirectionally connected by sequence flows, making these connections represent the position of a Flow Element relative to another. A Process also has organizational taxonomies represented by Taxonomy Nodes whose aggregation with each other conceptually creates a taxonomy tree, illustrating a Dimension. Each organizational taxonomy has a single Taxonomy Root to which all the respective Taxonomy Leaves are attached as it is elucidated in the Taxonomy Node class's self-association. The leaves of the taxonomy trees classify each Activity of the Process.

However, the current repository's state dictates a few modeling constraints:

1) a small subset of BPMN elements such as activities, gateways, non-boundary events, and swimlanes is supported. Both pools and lanes are inferred from the associations between the taxonomy trees' leaf nodes and the process activities. The correspondent taxonomy tree root is depicted in the pool whereas its descendants in lanes;
2) only well-structured consolidated models are allowed. The splits and joins should be paired into single-entry-single-exit (SESE) blocks, respectively;
3) a standalone process activity appears in all views unless it is aggregated with other activities, thus forming a different activity.

To elucidate the readers, an example of a process model based on the repository metamodel is shown in Fig. 4 which states the information that the process repository contains for the *Bank Credit Granting* process introduced at the beginning of this paper as a motivational example. For the sake of simplicity, the associations between Process and Flow Element objects are not depicted. In the situation in question, the *Bank Credit Granting* process is only connected with two dimensions: *HR* and *Risk*, each with 2 levels of detail. For instance, the *HR* dimension has the concept *Bank* HR as Taxonomy Root Node at level 1 and the concepts *Functional*, *Administrative*, and *Strategic* at level 2. As expected, the Consolidated Process Model shows the links between the Flow Elements accordingly with the associations made within the Business Process Model. Also, each activity, if applicable, is linked with one of the Leaf Nodes for each Organizational Taxonomy. For example, the *'Evaluate the Efficiency of Workflows'* activity is linked with the *Functional* leaf node as regards to the *HR* dimension and is not linked with any leaf node as regards to the *Risk* dimension,

once that activity is not a concern for the Risk stakeholders. These results can be visually understood in Fig. 2 where we can observe the only appearance of the aforementioned activity in the *HR* view and mapped into the *Functional* lane.

C. The Generation Method

Our solution is somehow related to business process variability modeling since more and more process variants are created to portray stakeholder's distinct concerns of the same process. According to [16] a process variability modeling approach is classified based on how it captures the relation between a set of elements of a process and the corresponding elements in its variants. Then, the *activity specialization* classification is the one that most nearly resembles the approach outlined here, since it only allows variants in process activities and not in other types of elements, which is aligned with the hierarchical abstraction technique that will be used: *functional decomposition*.

Our view generation approach is based on stakeholders' concerns by doing business process decomposition according to the concerns that are involved in the specification of its activities. Thus, the *functional decomposition* of a process entails its recursive separation into progressively fine-grained activities. The lowest level of decomposition consists of indivisible atomic activities. Furthermore, the concerns, which have an associated dimension, are shaped by departmental interests and mapped to each of the process activities, making it possible to assign to each activity, its level of HR, IT, Risk, and Auditing. Along with it, there are various levels of detail in which the activities can be decomposed. This is accomplished through the taxonomy trees associated with each dimension. It is the tweaking of the dimensions and respective taxonomies that allows the generation of different views out of a consolidated business process model.

The current repository algorithm supports the generation of views based on the criteria for activity decomposition presented in [17]. Those criteria have one aggregation condition for each Zachman contextual dimension, yet the set of conditions is not fixed to those six dimensions. The choice

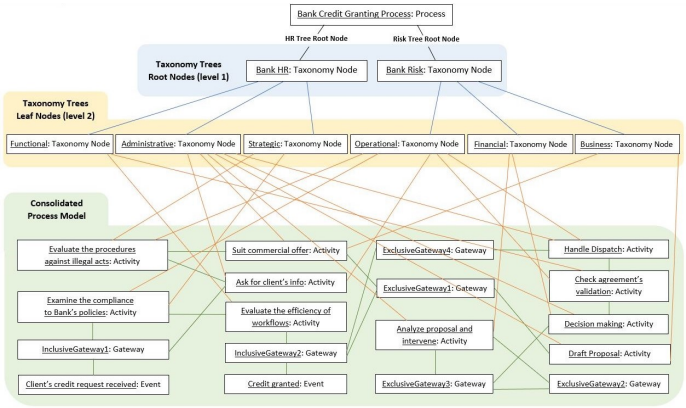

Fig. 4. UML object diagram of the repository content for the *Bank Credit Granting* process.

of dimensions and their respective structure is configurable, then since there are as many conditions in the repository as there are dimensions, stakeholders can easily define new ones. However, in our approach, we concentrate on departmental dimensions, and our rule for decomposing process activities given a consolidated process model is presented below:

One activity δ can be decomposed into two activities α and β if and only if the activity δ is not deemed atomic, meaning it can be further decomposed. Once atomic, and given 2 dimensions 'd1' and 'd2', the activity δ is decomposed if and only if one of the following two conditions applies:

- *the activity δ has different taxonomy concepts within dimension 'd1' at a specific level of detail;*
- *the activity δ has equal taxonomy concepts within dimension 'd1', but different taxonomy concepts in other dimension 'd2' at the chosen level of detail of the latter.*

For instance, given a consolidated process model of a *Bank Credit Granting* process, if one chooses the HR dimension at level of detail 3 and the Risk dimension at level of detail 1, a given activity δ is decomposed if it is performed by different stakeholders at level 3 of the HR organizational taxonomy. However, if another chooses the HR dimension at level of detail 3 but the Risk dimension at level of detail 2, the activity δ could be even more decomposed if it has different types of Risk associated at level 2 of the Risk organizational taxonomy.

Nevertheless, considering the 3^{rd} constraint enumerated in the previous section, the views obtained from the iterations of the aforementioned rule to the consolidated process models may contain activities that, even though they are correctly mapped into a taxonomy concept (i.e. taxonomy node of an organizational taxonomy) within that view, they may not be needed to represent stakeholders departmental interests. This translates into filtering each activity's concern for a determined view, which is pictured in blue, in Fig. 5. This filtering is based on the information provided by the stakeholders and uploaded in the modeling phase of a consolidated model in the process repository (left side, Fig. 1).

As described in Fig. 5, *an activity α is of concern to a view V if one of the following two conditions is verified:*

- *the activity α is performed by V;*
- *the activity α is of interest to V because that knowledge is relevant to get other tasks done.*

Hereupon, as an add on to the already existing view generation algorithm, Fig. 5 shows a method that uses: (1) an *Activity Filter* as a condition to exclusively pick the activities required to serve the stakeholder's needs regarding a specific view, and (2) a *Taxonomy Node Finder* to find a node (i.e., departmental function, role, area, or other) in the organizational taxonomy of *V* that suits each activity. Otherwise, if both conditions are not met, the activities are mapped into a Taxonomy Outsider Node that becomes part of the taxonomy tree of *V* but is not relevant to *V*.

As a result of applying the method, a concern-based and filtered view *V* is generated, distinguishing the activities that

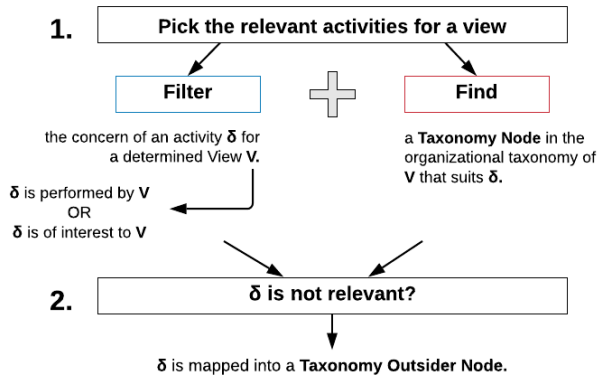

Fig. 5. Illustration of the proposed method that only picks relevant activities for a view.

are relevant to the view V from those that are not.

We call to this method, our solution artefact. Recalling our hypotheses, we can say with a great level of confidence that the answer to the hypothesis **H1** is 'yes'. Through the solution artefact that we propose, we realize that the existing view generation algorithm from Cardoso and Sousa [2] is extensible enough to generate BPMN 2.0 concern-based business process views for organizational stakeholders.

However, in the next sections of *Demonstration* and *Evaluation* of the artefact, we present conclusive results of applying our method in two distinct real life case studies, which will assist us in answering the hypothesis H2 and in reaching our initial goals.

V. Demonstration

In this section, we show and explain the results of applying our method to a real life case study performed in a Bank, so that we can demonstrate and test the usefulness of our research. Firstly, the departmental stakeholders with interest in getting their views portrayed in the *Atlas* tool upload a consolidated process model in the process repository. This step is portrayed in blue, in Fig. 1. Then, the stakeholders create taxonomy trees by classifying each process activity according to their concerns which, in the particular case of our work, are departmental. Finally, by providing the level of detail desired for each dimension and through the process view generator represented in green in Fig. 1, our method is automatically applied, and it generates the business process views of Fig. 6. For demonstration purposes, we recall the *Bank Credit Granting* process example whose description is in Section III. We will show an upgrade of the HR and Risk views in Fig. 6 with more activities and a higher level of detail (taxonomy level 3) thus taking advantage of the dynamic taxonomies to help the reader's understanding our solution since the views illustrated in Fig. 2 are considered too simple due to practitioners' comments to previous works.

In Fig. 6, the swimlanes of the left and right views are used to represent the HR and Risk dimensions, respectively, and each activity of the *Bank Credit Granting* process is mapped into a taxonomy concept regarding the HR and Risk organizational taxonomies that we present below:

- HR dimension $\Longrightarrow$ Bank HR (level 1):
  - Administrative (level 2)
    - Employee Customer Service (level 3);
    - Board Authority (level 3);
    - Financial Advisory (level 3);
    - Maintain Employee Data (level 3)
  - Functional (level 2)
    - Performance Management (level 3);
    - Technology (level 3)
  - Strategic (level 2)
    - Compliance (level 3);
    - External Relations (level 3)
- Risk dimension $\Longrightarrow$ Bank Risk (level 1):
  - Strategic/Business (level 2)
    - Technological/Obsolescence (level 3);
    - Commercial (level 3)
  - Financial (level 2)
    - Credit (level 3);
    - Market (level 3)
  - Operational (level 2)
    - BPM – service delivery, client, business practices (level 3);
    - Legal (level 3);
    - Security (level 3);
    - People (level 3)
  - Outsider (level 2)

As required, the higher the dimension's level of detail, the more the process activities are decomposed, so if the lowest level of detail is chosen for all dimensions, there is no activity decomposition which corresponds to the consolidated model. The name of the composed activities is simply the aggregation of the names of the activities that originated it.

On the one hand, on the left of Fig. 6, the HR view shows a scenario where all the activities (1) have a taxonomy node (in the HR organizational taxonomy) where they fit and (2) are a concern of the HR department who is interested in knowing all the parties and knowledge needed to perform each activity of the process. Also, as level 2 of Risk was chosen in the HR View (highlighted in purple as Risk: 2), activities like the ones highlighted in brown: *'Price the loan and deposit interest rates'* and *'Evaluate the conditions in which the client will be able to pay'* are decomposed because even if mapped into the same taxonomy concept at level 3 (Financial Advisory) within the HR dimension, they are part of different taxonomy concepts at level 2 of the Risk dimension (Commercial and Credit, respectively).

On the other hand, on the right of Fig. 6, the Outsider lane in the Risk view (highlighted in orange) represents the taxonomy node where all the activities that are not relevant to the Risk view will be mapped. Hereupon, by applying our method we

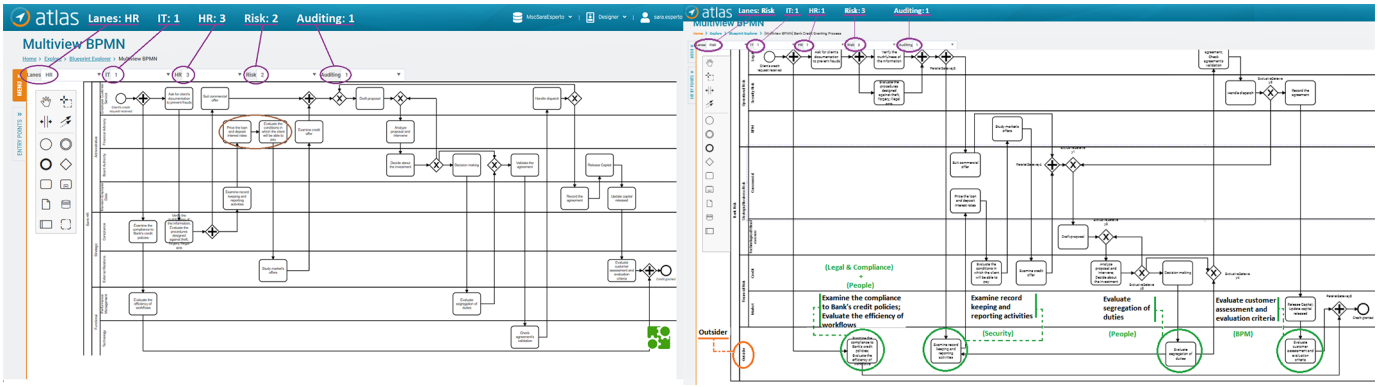

Fig. 6. Screen of the *Atlas* tool after the generation of HR (left) and Risk (right) business process views at level 3 of detail.

conclude that all the activities highlighted in green (1) have a taxonomy node (in the Risk organizational taxonomy) where they fit and that relation is written in green in brackets, but (2) are not a concern of the Risk department since those activities are mostly performed by the Auditing department, and they are not of interest to Risk because the knowledge they provide is not relevant to get Risk activities done. Nevertheless, those activities are necessary to keep the process' flow and in case that process fails, the stakeholders are easily aware of the problem's origin.

Then, reducing the number of relevant process activities is fundamental, especially when stakeholders are dealing with intricate processes like this. Afterwards, HR and Risk departmental stakeholders are presented with more enriched but less complicated views that better suit them by concentrating and only showing the concerns stated by them in the first instance.

VI. Evaluation

A. Case Studies (CS)

Real Life Case Study #1 - Bank

On the one hand, the *Bank Credit Granting* process described in Section III portrays a real life CS whose concern-based views we aim to accomplish through the solution we propose. To achieve that, a Bank institution from Portugal named Caixa Geral de Depósitos (CGD) made us available 4 different views from 4 distinct departmental stakeholders that we will use to validate our research. Section V makes a comparison between the results collected and observed from the use of our artefact and those 4 views which are our point of arrival.

Real Life Case Study #2 - Company

On the other hand, in order to understand if we developed a useful artefact for stakeholders and if it portrays their concerns shaped by departmental interests, we made a public inquiry based on some views generated through the *Atlas* tool and the execution of our method. Those views are from a Company's *Purchase Order and Reimbursement Expenses* process and they assist us to get feedback from practitioners and to discover the impact of our solution on a daily basis. The feedback will also help to answer the H2 hypothesis.

B. Definition of Evaluation Methods

The assessment of our proposed artefact is made through the use of Design Science Research (DSR) evaluation methods already established in the literature. In particular, Prat et. al [15] recognize as evaluation practices the practice-based evaluation of usefulness or ease of use, and demonstration.

Furthermore, Prat et. al particularly suggest making use of a taxonomy of evaluation methods for Information Systems (IS) artefacts, composed of six dimensions: criterion, evaluation technique, form of evaluation, secondary participants, level of evaluation, and relativeness of evaluation. Then, an evaluation method is a unique combination of characteristics for the six dimensions. In Table I, we benefit from this taxonomy and from the characteristics that apply to detail the two evaluation methods for the Case Study #1 and Case Study #2, which are *Demonstration/Comparison* and *Practitioners Feedback*, respectively.

In Table I we outline the five evaluation criteria used to validate our research.

TABLE I
SPECIFICATION OF THE EVALUATION METHODS USING THE TAXONOMY DEFINED IN [15].

	Demonstration/ Comparison	**Practitioners Feedback**
Criteria	Effectiveness Technical Feasibility	Efficacy Usefulness Operational Feasibility
Evaluation Technique	Illustrative Scenario	Survey
Form of Evaluation	Analysis	Analysis
Secondary Participants	CGD Bank of Portugal	Practitioners
Level of Evaluation	Real World Example	Real World Example
Relativeness of Evaluation	Absolute	Relative

C. Demonstration/Comparison for CS #1

The *Demonstration* component of this evaluation method is somehow already proved through the earlier shown results captured by the *Atlas* tool while executing our method under the Real Life Case Study #1, in Section V.

Regarding the *Comparison* component and the *effectiveness* evaluation criterion, we describe below some outcomes obtained when comparing the initial 4 departmental views provided by CGD Bank with the views obtained through the *Atlas* tool. For paper purposes, we only visually present a glimpse of the results obtained, more precisely, for the IT.

1) ***HR results****:* when compared with the initial HR view from the Bank, we noticed that all the activities that are of interest to this view were mapped in the lanes where they were supposed to be. Also, as predicted, the stakeholders were presented with an Outsider lane where all the activities that didn't concern them in the first place were mapped. However, if they change their mind, it is always possible to generate the HR view of the Fig. 6 where all the activities find a taxonomy node (in the HR organizational taxonomy) where they fit and then enabling the Bank to know all the parties involved to perform each activity.

2) ***Risk results****:* alike the previous comparison, the activities were mapped to the taxonomy node/lane where they fit and according to the organizational taxonomy provided by the stakeholders at a level of detail of 3. However, unlike the HR view, some activities that weren't considered in the Risk view provided by the Bank were maintained in the lanes other than the Outsider lane since those activities were considered to also have a Risk associated. The only activities mapped in the Outsider lane were the ones directly and only related with the Auditing view, therefore not being relevant to the Risk department. The interactions with the *Human* pool and the pool itself was replaced with more general activities that represent those interactions since the artefact we present is narrowly defined to work with single pool process models.

3) ***IT results****:* at the bottom of Fig. 7, we have the automatically generated IT view by choosing the IT dimension to be represented in the lanes with a level of detail of 3. The comparison results are quite similar to the ones obtained for the HR view. All the activities in which the IT departmental stakeholders are interested are mapped in the lanes where they are supposed to be (highlighted in orange). Even if not mapped to the exact taxonomy concept that they were at first instance in the view provided by the Bank, that is not a problem, because when considering an organizational taxonomy tree with more concepts and levels, stakeholders can find sharper fits for their activities.

Also, not all the activities of the Bank provided view can find a level of detail of 3 in the IT taxonomy, which is the case of the *'Analyze proposal and intervene'* and *'Check agreement's validation'* activities, that both in level 2 and 3 of detail are mapped in the *Business Analysis* and *Security IT*, respectively. Similarly to the Risk view, some interactions with a Human pool represented by exchanges of messages,

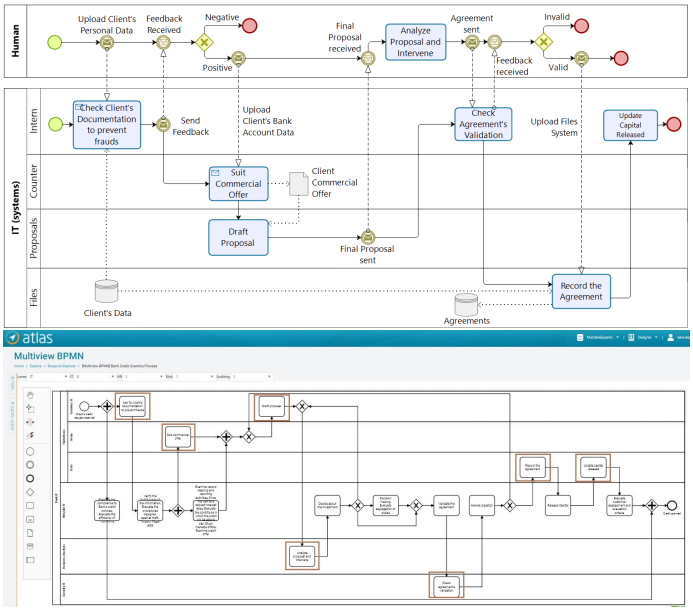

Fig. 7. IT View of the *Bank Credit Granting* process, manually modeled by the IT stakeholders (top) and automatically modeled in the *Atlas* tool at level 3 of detail (bottom).

are replaced with more general activities like *'Ask for client's documentation to prevent frauds'*.

4) ***Auditing results****:* last but not least, the comparison of the Auditing views is one of the most important, once it allowed us to see the prominence of keeping in mind the flow of the processes. We noticed that most of the Auditing activities were a consequence of other activities in the sense that those activities need to occur to be "Examined" and "Evaluated" by the Auditing stakeholders that mostly do their job in parallel.

D. Practitioners Feedback for CS #2

As a litmus test for our solution, we recruited leaders of the business process industry to participate in a small survey with the objective of gathering feedback from practitioners that deal with the challenges of business process modeling and related documentation, on a daily basis.

The participants were previously asked to sign a consent form where we also elucidate that their involvement presented no potential risks and no anticipated benefits to them. The survey was online and it was made available after an explanation and a whole demonstration of the solution in the *Atlas* tool. The goal of the survey was to evaluate and obtain feedback from the views generated regarding the Real Life Case Study #2.

The survey consisted of 4 sections. In the first one, we intended to explain the role of the practitioners by inviting them to put themselves in the position of a stakeholder of one of the 4 departments of our research (IT, HR, Risk and, Auditing). Later, they were presented with a few statements about the concern-based views generated through the *Atlas* and they were asked to evaluate the proposed solution in terms of Efficacy, Usefulness, and Operational Feasibility which are

the selected evaluation criteria for this evaluation method (see Table I). More precisely, the survey was composed of a few statements for each criterion and the practitioners needed to pronounce their agreement with each statement in a five-point scale ranging from strong disagreement to strong agreement, and then justify their answer.

In terms of **efficacy**, one of the respondents neither agrees nor disagrees that the IT view expresses his concerns while agreeing and strongly agreeing that the remaining views model his concerns in a relevant way, encouraging stakeholders to better figure out business processes' reality. Overall, the respondent considers that the proposed solution is capable of modeling concern-based business process views that simplify the interests that each stakeholder wants to see depicted, rather than having a single complex view that aims to satisfy all the stakeholders at the same time.

Regarding the **usefulness**, the respondents agree that the proposed solution is geared towards to provide automatic assistance to stakeholders for obtaining concern-based business process views, once it adjusts the views' complexity to the needs of each moment. For example, in some circumstances, general views fit better than detailed ones. However, the statement about our works' positive impact in the task of modeling business processes is more contested, since the practitioners consider that it does not necessarily impact modeling, but certainly the visualization, exploration, and analysis of business process models.

Finally, in the last statement which is intended for evaluating the **operational feasibility** of our work, there is consensus that if integrated into the daily practice of an organization, the proposed solution would probably get the support of management, employees, and other relevant stakeholders, anywise one can not absolutely assure, but the guess is that people would approve such concern-based views.

E. Discussion

Based on the results reached in both the implementation and integration of our method in the *Atlas* tool and later through its demonstration in Section V and comparison with a Real Life Case Study #1 of a Bank, we feel confident in saying that our solution is **technically feasible** to handle and implement, once it can be easily integrated with an already existing artefact and then effortlessly operated.

Also, given the results of the comparisons made between the views provided by the Bank and the concern-based business process views generated by the *Atlas* tool, we can conclude that the solution also achieves its evaluation criterion of **effectiveness** by generating correct and also consistent business process views with various levels of detail and by portraying different stakeholders' concerns.

Then, through the evidence we were able to extract from practitioners survey about the Real Life Case Study #2 of a Company, we can conclude that the **efficacy** and the **usefulness** criteria were satisfied, yet we can not effectively conclude that the solution is **operationally feasible** since the respondents did not take a position of strong agreement about that topic. Their explanations lead to the idea of the need for accurate process support and evidence to help integrate our solution into the daily practice.

Even though we achieved quite profitable results, we believe that the deployment of the solution in a real organization would be of great value, since only the widespread and intensive use would allow a better validation of what we discuss here. This use would not only allow a better evaluation of the operation feasibility criterion but also determine, with a higher level of confidence, the achievement of the other criteria.

Finally, after answering to the hypothesis **H1** in Section IV-C, we recall the hypothesis **H2**, which answer is 'no'. The results achieved in this section and the previous one lead us to assert that even if extensible, the existing view generation algorithm from Cardoso and Sousa [2] is not viable and easy handling in real life contexts, once it didn't aim at offering to stakeholders the views that better fit their interests and represent their concerns like we did in our proposal. Through the practitioners' feedback, we discern that mapping stakeholders' concerns with the six dimensions (5W1H) of the Zachman Framework is not as viable and useful to organizations' as mapping them into organizational departments. Stakeholders are more interested to know who in the HR department is in charge of a specific activity and what are the risks associated when performing it. Only answering to 5W1H is too simple, seldom adequate, and not of great value to organizations. Their processes are more complex and cross inter-organizational boundaries and multiple departments, then requiring improvements of understanding and communication among them.

VII. Conclusions

Views address a set of related concerns and are tailored to particular stakeholders. The decomposition of business processes, when keeping stakeholder's concerns in mind, makes concern-based views an excellent mechanism to consciously convey details about an architecture and, in our particular case, to an organization that wants to see their departmental interests modeled.

Once we support the answers to the hypotheses **H1** and **H2** with evidence, we can conclude that our 1^{st} goal of giving results-based answers to both hypotheses was achieved. In summary, the existing view generation algorithm from Cardoso and Sousa [2] is extensible enough to allow the generation of BPMN 2.0 concern-based business process views for organizational stakeholders, yet not viable and easy handling in real life contexts, leaving room for improvement, such as researches like ours.

This research aimed to expose the problem of the nonexistence of an approach that represents and benefits the multiple organizational stakeholder's needs, always remembering the required consistency. Our contribution to this problem is grounded on the development of a method, that supported by a business process repository, offers to the research community a solution that can be applied to tackle those organizational needs making it possible to obtain concern-based

views based on existing consolidated models and organizational taxonomies. By continuing to use the organizational taxonomies together with the proposed dimensions and the possibility of choosing different levels of detail, we also expect to aid departmental stakeholders in communicating and expressing their distinct concerns when engaging in business process design. Moreover, the solution was intended to allow stakeholders to convey their concerns in a structured manner. That was accomplished by proposing an interactive solution in which the user is able to provide some inputs used to choose the dimensions and to create the organizational taxonomies, and consequently to model the final results. Hereupon, our method consists of a solution artefact that improves Cardoso and Sousa approach [2] by allowing the easy generation of more complex views that benefit specific organizational stakeholder viewpoints while addressing their concerns. Then, we achieved our 2^{nd} goal.

Despite some limitations that are intended to be extinguished in future work, this method differentiates itself from the other proposals as it consists of an incremental approach that can adapt to the growth of organizations and their business, by embedding time into the business process models. As far as we know, there are no other techniques or proposals to business process design that fulfill the requirements that our solution fulfills.

Finally, we consider to have addressed our research problem once we validated and improved an already existing view generation approach, allowing it to address the stakeholders' concerns and generate more complex views like the ones shaped by departmental interests as HR, IT, Risk, and Auditing.

A. Future Work

As future work, some limitations imposed on the consolidated business process models and in the view generation phase should be mitigated through the following considerations:

1) increase the number of supported BPMN flow elements with a focus on data and message flows, and more than a pool per process, then improving the communication of the generated business process models and bearing in mind the real world users' interests;
2) embody the generation of executable BPMN process models;
3) improve the business process design in order to remove some of the modeling restrictions imposed on the consolidated process models. Also, do some research work about open source BPM platforms to solve the placement of the gateways. A bad placement sometimes leads to the overlay of the sequence flow symbols. *Camunda* BPM platform appears to be a good answer once it is a native BPMN 2.0 process engine that can be embedded inside *Java* applications and it is flexible enough for workflow and process automation.

Besides handling our proposal's limitations, future work involves creating a higher number of case studies with a larger number of practitioners involved and industries other than banking and sales. This way we could not only obtain a higher accuracy on the results but also raise some interesting challenges we have not addressed like finding edge cases in which the solution is not a sharp fit.

Apart from that, it would be interesting to bring other phases of the BPM lifecycle to this research and also imagine the benefits and emerging constraints brought up for the business process orchestration subject.

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