

Using Process Indicators to Help the Verification of Goal Fulfillment

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Abstract: Process modelling is often criticized as lacking proper alignment with business goals. Although there is literature on different proposals to address the issue, the verification of this alignment remains an obstacle during process enactment. We make use of key process indicator (KPI) in a process design method to annotate processes/activities with proper information. The method derives this information from the business goals and uses it to calculate process indicators. We demonstrate through a real example, modelled with the ARIS business process model tool, how the method produces proper indicators, which should be used during process enactment.

1 INTRODUCTION

Business processes models allow the organization to document information about how it works and help monitoring organizational development, modifications and evolutions, in an effective way. Business processes translate inputs into outputs creating products, while aiming at achieving goals. Therefore, we may infer organizational goals through its processes goals. However, the relation between processes and goals are not always explicit and such relations are in general, difficult to determine.

In order to verify process-goal alignment, it is not enough to determine the relationship of goals and processes in a model. It is necessary to define which elements in the process can help us check if these alignments are correct and consistent within the organizations. This is discussed in profusion in academia, (Guizzardi and Reis, 2015), (Sousa and Leite, 2014), (Cardoso *et al.*, 2011), (Cappelli *et al.*, 2010), (Behnam, 2010), (Braubach *et al.*, 2010), (Singh and Woo, 2009), (Soffer and Wand, 2005) and (Kueng and Kawalek, 1997), but the state of practice is still far from these proposals. Difficulties are numerous, from lack of understanding of the appropriate level of goals' abstraction, exacerbated

focus on operational layer, the lack of and effective ability to measure goals achievement through business processes execution, to the absence of appropriate computer support (Cardoso *et al.*, 2011), (Behnam, 2010), (Braubach *et al.*, 2010), (Singh and Woo, 2009).

This is particularly present in the scenario of organizations that model their processes without identifying and organizing their goals beforehand. Another issue is that the majority of the business process model tools available in the market, such as ARIS tool (ARIS, 2016), while enabling a goal macro viewpoint through a relation between goal diagrams and value-chain models, still have different sort of problems. Some of these problems are: (i) lack of differentiation between functional and non-functional goals; (ii) difficulty in identifying whether the process has activities that when performed satisfactorily comply with desired goals; (iii) difficulty in identifying process activities in which the artefacts used to measure the goals are produced; (iv) difficult in identifying the actors responsible or involved in meeting specific goals (in particular, strategic ones).

The imprecise definition of these elements is due to the low expression of the goal modelling languages adopted by these tools. These limitations contribute negatively by decreasing, for example,

the ability to assess project risks, the identification of possible points of failure, the mitigation of impacts on processes and goals changes, and often even the prevention of the projection of most appropriate solutions in a timely manner to attend internal and external demands.

In this context, this paper presents a method based on the relationship among goal models, business processes models, and key performance indicators (KPIs) to enhance the support for the analysis of the alignment between processes and goals. KPI's are elements that can measure the achievement of a goal and is calculated using information produced during process execution. This analysis enables the verification of business process capability in producing the information necessary for the calculation of process indicators, which allows the verification of goals fulfilment. Thereby, we seek to provide a solution for the alignment between process and goal to be obtained and analysed satisfactorily; avoiding the difficulties mentioned and allowing the organization to effectively ensure that processes are modelled in order to achieve its strategic goals. An overall strategy related to this proposal was presented in (Sousa and Leite, 2014), which summarizes Sousa's dissertation (Sousa, 2012). In this paper, we focus on the information needed to treat indicators as part of business processes in the ARIS framework.

The proposed method was used in an industry real case study, using ARIS platform and supported by the development of a "script" on ARIS Design platform, which enables the automation of the proposed analysis. At the end, a final report containing information about all the elements involved is presented (e.g., actors, activities, information, indicators, goals and processes).

This paper is organized as follows: Section 2 presents related works, Section 3 shows the proposal and the method used in this work, Section 4 apply the method in a real scenario, Section 5 explain how the method was automated in ARIS tool and Section 6 presents conclusions and future works.

2 RELATED WORK

This is not a new issue. Some proposed ideas indicate forms of organization, formal establishment and practices for the implementation and evaluation of the alignment between processes and goals. Kueng and Kawalek (1997) presented a methodology to model and evaluate processes at a conceptual level that supports the specification of goals and the fundamental purpose of a designed

system. To do so, one ought to (a) define the goals related to the business process, goal measurement criteria and constraints; (b) derive and define the business activities; (c) describe and define roles; and (d) model the objects that will contain the obtained information. Although the authors' aims are correlated to our, they don't focus on what is required for the goals to be systematically measured. They pose a strong focus on the relation among goals, activities and how to support process automation through an object-oriented approach.

An extensively used approach is the Balance Score Card (BSC) (Kaplan et al, 1996) that guides organizations on how to translate its mission and strategy into goals. BSC establishes a comprehensive set of performance measures that, when associated to business processes allow the alignment checking between goals and processes. However, it is not possible to find out the alignment between goals and processes.

OMG developed the Business Motivation Model (BMM) (OMG, 2008), which seeks to provide a framework for the development, communication and management of business goals by identifying the factors that motivate their establishment and the elements that are part of business plans. The model presents how these elements and goals are interrelated through policies and business rules. Thus, a BMM model seeks to answer, primarily, to two major questions: a) what is required to achieve organization's desires? b) why does each element in the business plan exist? Although supporting a person to answer these two questions, BMM does not try to identify which are the processes and or activities achieved by each goal.

Other researchers as (OMG, 2008), (Almeida and Guizzardi, 2008), (Kavakli and Loucopoulos, 2006), (Yu *et al.*, 2006), (Bresciani *et al.*, 2004), (Liu and Yu, 2004), (Cysneiros *et al.*, 2003), (Guizzardi *et al.*, 2003), (Yu, 1996), (Davenport, 1993), have shown the representation of intentionality in the process models as a possible solution in order to guarantee the alignment between goals and business processes. The explicitness of intentionality seeks to represent the dependencies between processes and the actors' needs and desires. It is believed that through this kind of representation, one can ensure alignment between goals and processes. However, these works do not respond what to do with the tons of goal and process models that are currently already part of the organizations' model repositories. Our work on the other hand may be applied to pre-existing goal and process models.

Some approaches focus on the alignment among different methodologies and tools as Koliadis (2006) who proposes methodologies to guide analysts to

reflect changes in a i* model (Yu, 1996) (that represents goals models) into a model using Business Process Model Notation (BPMN) (that represent process models) and vice versa. Neiger and Churilov (2004) follow the same line describing a framework for integrating business processes (modelled in ARIS using event-driven process chain – EPC - notation) and goals (modelled on VFT framework - Value Focused Thinking - of decision sciences). These works are interesting especially because the proposed methods can be applied in both directions (i.e. goals to processes and processes to goals). However, the alignment is intuitively indicated rather than presumed by the indicators, as in our work. In this respect, we believe our work provides stronger proof of alignment than the cited ones.

Other approaches propose the implementation of part of the methodology through the analysis of the models generated by various methods, but with technological constraints that currently do not meet market needs, such as the one proposed by Halleux et al. (2008).

Researchers such as Nurcan *et al.*, (2005) propose a reformulation on the way of thinking in processes through process modelling oriented to maps that consist of a representation system based on intentions and strategies. This map is able to abstract from business processes details to emphasize organizational goals and their satisfaction. Although it is extremely interesting from a strategic point of view, its use in organizations requires a reformulation in the way processes are modelled.

del-Rio-Ortega *et al.* (2012) proposed the PPINOT metamodel that is based on Process Performance Indicators (PPI) which are linked to process elements. In our approach we depart from the detailment of goals requirements in terms of business process elements that are used to express goal satisfaction.

Guizzard *et al.* (2015) proposed a method that supports the identification of the activities in a business process that satisfy organization's goals. This work focuses on the alignment between processes and goals in the operational level by translating process models into i* models. We go further into exploring this alignment using indicators and analysing the existence of the necessary information to verify goals-process alignment in their original notation.

For all seen, there are still gaps regarding a precise verification of operational processes models to be considered suitable for a performance analysis in relation to its intended goals. We are convinced that procedural BPM methods are useful and more naturally elicited from stakeholders. We understand

that our proposal, by integrating business process models with goal models, will profit from the fact that several organizations have their business processes modelled.

3 THE PROPOSAL

In ARIS, the Organizational Value Chain is composed by macro processes that can be decomposed into other processes. A process can contribute to the achievement of one or more organizational goals. All defined goals must be related to at least one process.

Each existing goal in an organization (regardless of the level of abstraction) requires that a set of conditions be satisfied in order to the goal can be considered fulfilled. The term "condition" refers, for example, to the development of a product, to a process status, to the production of some information, to the triggering of a specific event or anything that can be reached from the execution of a process. These conditions (or set of conditions) expected by a goal are defined by elements named as "indicators". When indicators are linked to goals they express the conditions that must be reached in order to consider the goal satisfied. When interconnected with processes they represent the conditions that are expected to be reached by a process instance. There is a smoothly difference, based on the level of abstraction and perspective.

The business process is accomplished by executing a set of activities. The successful conclusion of the process is entirely related to the production of the necessary conditions for fulfilment of their goals. That is, the process is responsible for producing all the expected conditions in order to achieve the goals related to it. The production of these conditions is closely linked to the different states and transformation of information that is processed during the execution of activities.

As the natural execution of the process generates the different conditions necessary to achieve the goals of the process, it is understood that the indicators must be defined according to the production of these elements during their execution. The elements produced by the process are vestiges that indicate if the process actually produced what is expected, which is defined by the indicators.

Therefore, the elements that are needed to calculate an indicator are produced in the process (generally modelled as a product (output) of the activities). Considering these elements, we addressed the pre-conditions necessary for the

enactment of a given indicator. Namely, if there is an absence of information necessary for a given indicator at design time, we report the possibility of misalignment among goals and processes.

As such, our work presents a method that checks the possibility of fulfilment of the goals of a business process, at design time, making possible a future analysis of the information generated during process execution.

3.1 The Method

The proposed method has 5 phases as presented below:

1. Identify the goals of the process: list the goals that must be achieved by the process.
2. Identify the purpose of the indicator: define KPIs that must express the goals satisfaction.
3. Identify the target for the indicator: Identify the targets for each process goal.
4. Correlate information to calculate the indicator: Identify and list information needed to calculate each indicator.
5. Identify the sources of information needed to calculate the indicator: Check if the information needed to calculate each KPI are produced in the related processes or comes from other processes.

In summary, the proposed method allows the verification of whether the process produces the necessary information to calculate the indicators related to process goals. If so, business process and goals models are said to be aligned. However, if some information is missing, then a potential misalignment between process and goals is reported.

3.2 The Method through ARIS Tool

Figure 1a shows a VAC (Value Added Chain) model using ARIS tool. It consists of a business process that is decomposed into two sub-processes: Process 1 and Process 2. Process 1 has its identified goals (goals 1 and 2). Figure 1b shows the KPIs 1 and 2 of Goals 1 and 2 respectively and information used to calculate each KPI. The alignment between goals and indicators is done by checking where in the process the information required for calculating KPIs is produced. Process activities (Figure 1c) are modelled in EPC language. Process 1 has two roles (Role 1 and 2) and comprises three activities (Activities 1, 2 and 3). There is also five information entities (Information 5, 8, 9, and 10). These information entities are the data necessary to calculate the KPI's.

In ARIS tool, each activity can be detailed in its operational level. Figure 2 (a, b, c) demonstrates models of activities 1, 2 and 3 respectively, containing roles, input and output information. The rectangles represent input or output information handled during process execution. Information represented as a puzzles are the ones used to calculate the KPI's.

By analysing the activities of the Process 1, it is possible to verify that the information needed to calculate KPI 1 is being produced by activities 1 and 3. However, KPI 2 cannot be calculated because information 9 and 10 are not being produced by process 1. Therefore, Process 1 can be verified only in relation to Goal 1. The method permits to verify if the process represents or even produces the necessary information to calculate the indicators related to its goals.

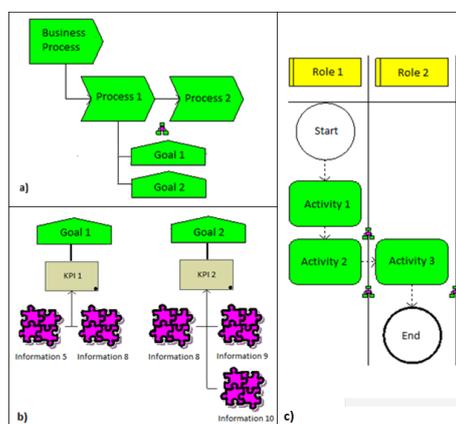


Figure 1: a) Business Process x Goal, b) Goal X Indicator X Information, and c) Process 1 in detail.

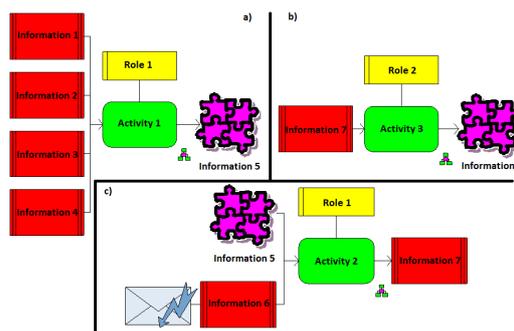


Figure 2: Activities X roles X inputs X outputs.

4 APPLICATION IN A REAL SCENARIO

In order to validate the proposed method, it was applied in the process "Manage requests of project practices support" of the IT department of a large Brazilian oil and gas company. This process is responsible for the analysis, prioritization, implementation and monitoring of the demands that come from the organization's business areas to the Support Department related to Project Practices (SPP). The process model, in ARIS, comprises 56 activities and is, therefore, too long to be displayed in its entirety. Thus, its summary is described below:

The process begins with the identification of a needed SPP service by the customer, who makes his/her request. Next, the client's business area manager has the possibility to inform whether he/she wants to approve all requests from his/her area, only be notified about the requests or even not being notified. Upon arriving at the SPP, the demand is received by the manager, who defines its nature and decides if the demand can be attended by SPP. Then, the effort to attend the demand is estimated (in terms of man-hour) and the demand is analysed by a responsible in charge, depending on the estimated value (in HH or cost). If approved, the demand returns to the manager who will delegate tasks to performers and monitor the execution of the attendance. Upon execution, the service is validated by a validation group. It is approved or not by the client and at the end he/she fills out a questionnaire to evaluate the service.

The process "Manage requests of project practices support" has two goals (defined by the organization): "Ensure efficiency in attending SPP demands" and "Ensure the management of SPP demands attendance process". Due to space reasons, only the alignment of the first goal is presented in this section. To be achieved, this goal ought to be measured, hence indicators (defined by the organization) are used with this aim. Figure 3 shows the four indicators necessary to verify the fulfilment of this goal and the information used in their calculation. The indicators are: "Adequacy and level of plan attendance", "Time spent with planning", "Compliance with effort estimates" and "Compliance with data estimates". Each of these indicators is calculated based on two or more information. For example, the indicator "Compliance with effort estimates" is calculated based on the "Estimated effort" and "Real effort".

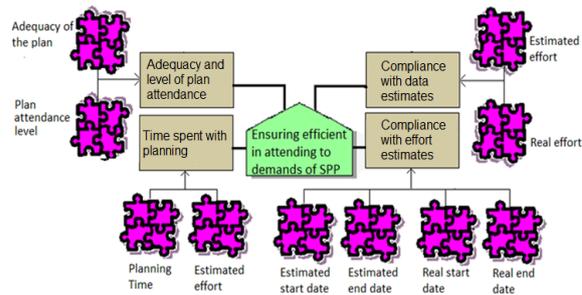


Figure 3: Indicators X Information of process "Manage requests of project practices support"

Each indicator has associated with it a calculation method (defined by the organization). Table 1 shows each calculation method of the indicators shown in Figure 3.

To check whether the alignment between the process "Manage requests of project practices support" and the goal "Ensure efficiency in attending SPP demands" exists, it is necessary to identify if the indicators related to this goal can effectively be calculated during process execution. To this end, the information used to calculate this indicator should result from the execution of activities of that process.

Table 1: Indicators X Calculation Method.

Indicator	Calculation Method
Adequacy and level of plan attendance	Does not apply. The manager defines the adequacy (low, medium or high) and the level of depth (low, medium or high) according to his/her experience in attending demands and the SPP historical information.
Time spent with planning	$TEMPL = (Planning\ Time / Estimated\ effort) * 100$
Compliance with effort estimates	$EFFest-HH = (Real\ effort - Estimated\ effort) / (Estimated\ effort) * 100$
Compliance with data estimates	$ESTIMATED_TIME = Estimated\ end\ date - Estimated\ start\ date$ $REAL_TIME = Real\ end\ date - Real\ start\ date$ $DATAest-T = (REAL_TIME - ESTIMATED_TIME) / ESTIMATED_TIME * 100$

Taking the "Manage requests of project practices support" process, we find three activities that effectively provide the information for the calculation of these four indicators. They are "Estimate demand," "Plan demand implementation"

and "Run demand tasks". These activities are presented in Figure 4, Figure 5 and Figure 6

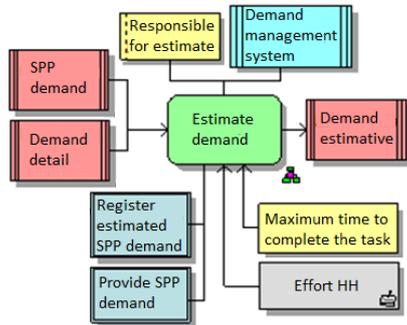


Figure 4: "Estimate demand" activity model.

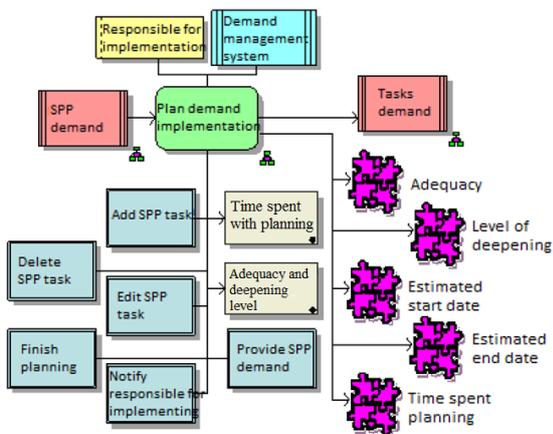


Figure 5: "Plan demand implementation" activity model.

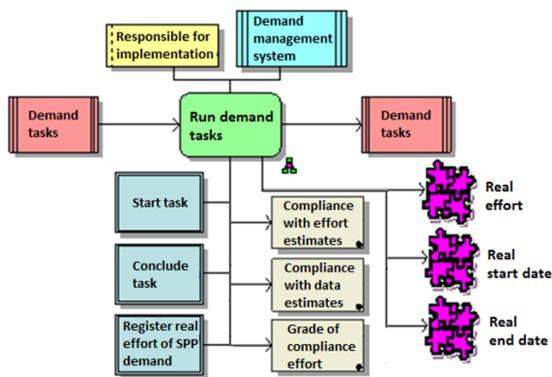


Figure 6: "Run demand tasks" activity model.

Analysing the models, it is possible to verify that:

- The indicator "Adequacy and level of plan attendance" can be calculated based on the information of adequacy and level of depth, generated by the activity "Plan demand implementation";

- The indicator "Time spent with planning" can be calculated based on the information of the time spent with the activity "Plan demand implementation" and on the information of the estimation effort generated in the activity "Estimate demand."
- The "Compliance with effort estimates" can be calculated based on the information of the estimation effort resulting from the activity "Estimating demand" and real effort, after the "Run demand tasks" activity.
- The "Compliance with data estimates" can be calculated based on the information of estimated start date and estimated end date generated in the activity "Plan demand implementation" and the information of the real start date and real end date obtained from the "Run demand tasks" activity.

As all indicators can be calculated from information obtained in the activities of the "Manage requests of project practices support" process, then it is concluded that this process is aligned with the goal "Ensure efficiency in attending SPP demands", and as such, during execution time, it is possible to calculate possible detours in the process concerning this specific goal.

5 METHOD AUTOMATION IN ARIS

The ARIS Business Architect tool has a module called Script Editor, which is an environment for script programming. This module offers a set of specific functions for manipulating elements from the ARIS database created in the modelling activities. These scripts can be programed to navigate through objects and models extracting the existent information, however, it is also possible to create elements and models in an automated way.

In the extraction of elements information, ARIS provides as output files the following formats: RTF, PDF, HTML, TXT, DOC, XLS and XML. These reports can feed databases and support services.

The script for our proposal automation was developed to produce spreadsheets containing information about the elements. It can be started from a goal or a process. First, the script checks for missing elements that would prevent its implementation. If everything is correct, the script will tour the models and their objects, obtaining the necessary information to fill in the fields of the spreadsheet.

The report was developed in an XLS format. The final XLS file has one spreadsheet for each element (process or goal) involved and one containing general summary.

Table 2 shows an example of spreadsheet generated from the analysis applied in a process that has a relationship with the "Goal 1" (Figure 1). The information is ordered as follows:

Information about the process that started the script – name, description, name of goals related with the process, name of the goals valued by the script, all the information present in the process.

Information about the goal valued – name, description, list of indicators names present in the goal model.

For each indicator related with the goal, the spreadsheet has: name, description and name of the necessary information to calculate the indicator which are present in the indicators diagram.

For each of group of information the spreadsheet has: name, description, name of activities where the information is present in the process, followed by their roles.

Table 2: Results from process analysis for Goal 1.

Process	
Name	Process 1
Goal(s) Related	Goal 1; Goal 2
Goal evaluated	Goal 1
Information been used in the process	Information 1; Information 2; Information 3; Information 4; Information 6; Information 7;
Goal	
Name	Goal 1
Indicator(s) related	KPI 1;
KPI	
Name	KPI 1
Information necessary to calculate KPI 1	Information 5; Information 8;
Information necessary to calculate KPI 1	
Name	Information 5
Activity	Activity 1; Activity 2;
Role(s)	Role 1;
Information necessary to calculate KPI 1	

Name	Information 8
Activity	Activity 3;
Role(s)	Role 2;
Conclusion	All necessary information to calculate KPI 1 is in the process.

Finally, a list of the information present in the indicators model and related to the indicators of the evaluated goal that were not found in the process are presented. If all information were found, the spreadsheet shows a message informing of this condition. As such, being an automated way to detected problems with verification of alignment during design time.

This same information structure is presented in the other spreadsheets, but the general spreadsheet (containing the summary of the analysis) will be created only if exists one more goal or process to be analysed.

6 CONCLUSIONS

Using modelled processes that are not aligned to the organizational goals is risky. After all, organizations must keep up with their own strategies, besides assuring that organizational processes work towards achieving such strategies. Nevertheless, the current scenario shows that BPM methods do not effectively solve the misalignment problem between goals and processes. In an attempt to provide a solution for that, our research provides a method, which has been used with success in a real case study. The experience showed that the method supports the analysis of goals and business alignment, helping the analyst to identify if there is any need for reengineering. The paper describes the method and exemplifies it by means of a case study. As such, we show that it is possible to detect problems during design time that will impose obstacles to misalignment detection at execution time.

As usual, in modelling approaches, it is paramount to provide effective automated support. We could achieve the needed results in our case study, by applying scripts with a first cut prototype. Nevertheless, in that case, we faced some limitations due to the BPM suite adopted in the organization and the fact that it is a proprietary system. For the future, we plan to provide more sophisticated support to the user on identifying and analysing the impact of alignments and misalignments of goals and processes. Moreover, we also aim at applying

this method in other studies to confirm our findings, and to integrate it to process runtime alignment verification.

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