

Improving Enterprise IT Governance and Management by Applying Competitive Intelligence and External Context Discovery on COBIT 5.0

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Abstract: COBIT 5 is a framework for governing and managing enterprise Information Technology (IT) that supports enterprise executives and management staff in defining and achieving business goals and related IT goals (ISACA, 2012a). Specifically, Chapter 3 of COBIT 5 specification presents some examples of events in the enterprise's internal and external environment that can typically signal or trigger a focus on the processes related to IT governance and management. However, despite the fact that COBIT 5 highlights such processes that consider the external environment, it misses to integrate them; moreover, it lacks a knowledge perspective. Therefore, we propose an adaptation to the COBIT framework to apply competitive intelligence on its processes. This would allow the organization to be proactive (rather than reactive) against external changes. In this scenario, we specifically propose to apply the BPECREL (Business Process External Context Relevance) method to identify and prioritize external variables that impact on the execution of a process and of its specific activities. We evaluated this proposal in an example, which showed that some discovered external variables influenced the process execution and its specific activities.

1 INTRODUCTION

The governance and management of enterprises do not occur disorderly. Every enterprise needs to design its own implementation plan, depending on issues arising from the internal and external environment, such as (ISACA 2012a): ethics and culture; applicable laws; regulations and policies; mission; vision and values; governance policies and practices; business plan and strategic intentions; operating model and level of maturity; management style; risk appetite; capabilities and available resources; and industry practices. Especially in the Information Technology (IT) area, it is important to control and work up existing enterprise governance enablers.

COBIT 5 is a framework for governing and managing enterprise Information Technology (IT) that supports enterprise executives and management staff in defining and achieving business goals and related IT goals (ISACA, 2012a). Nevertheless, an adequate approach for effectively adopting and

adapting COBIT 5 for each enterprise should consider the context needs. Besides, COBIT is often sustained by other frameworks, good practices and standards, and these also need to be adapted to suit specific requirements (ISACA 2012a).

A number of factors may indicate a need for improvement in IT governance and management within an enterprise. Chapter 3 of the COBIT 5 (2012a) specification presents some examples of events in the enterprise's internal and external environment that can typically signal or trigger a focus on the processes related to IT governance and management:

- Merge, acquisition or divestiture;
- A shift in the market, economy or competitive position;
- A change in the business operating model or sourcing arrangements;
- New regulatory or compliance requirements;
- A significant technology change or paradigm shift;
- An enterprise-wide governance focus or project;

- A new CEO, CFO, CIO, etc;
- External audit or consultant assessments;
- A new business strategy or priority.

However, despite the fact that COBIT 5 highlights these processes that consider the external environment, it lacks their integration and a knowledge perspective.

Therefore, we propose an adaptation to the COBIT 5 framework to use competitive intelligence on its processes. This would allow the organization to be proactive (rather than reactive) against external changes. In this scenario, we specifically propose to apply the BPECREL (Business Process External Context Relevance) method (Ramos et al., 2010); (Ramos et al., 2011); (Ramos, 2011), which identifies and prioritizes external variables that impact on the execution of a process and of its specific activities. The BPECREL method is based on Competitive Intelligence concepts and Data Mining techniques. We evaluated our proposal in an example, which showed that some discovered external variables influenced the process execution and its specific activities.

This paper is structured as follows: Section 2 presents the COBIT 5 framework. Section 3 summarizes the BPECREL Method. Section 4 shows an example scenario. Section 5 concludes this work and points to promising evolutions.

2 COBIT 5 - A BUSINESS FRAMEWORK FOR THE GOVERNANCE AND MANAGEMENT OF ENTERPRISE IT

According to (ISACA, 2012a), in COBIT 5 specification the “COBIT” (formerly known as Control Objectives for Information and related Technology), is used only as its acronym. COBIT 5 is a complete, internationally accepted framework for governing and managing enterprise information technology (IT) that supports enterprise executives and management in their definition and achievement of business goals and related IT goals (ISACA, 2012a). COBIT describes five principles and seven enablers that support enterprises in the development, implementation, and continuous improvement and monitoring of good IT-related governance and management practices (ISACA, 2012a). COBIT 5 is generic and useful for enterprises of all sizes, whether commercial, not-for-profit or in the public

sector (ISACA, 2012a). It helps enterprises create optimal value from IT by maintaining a balance between achieving benefits and optimizing risk levels and resource use.

COBIT 5 is based on five key principles for governance and management of enterprise IT (ISACA, 2012a): (1) Meeting Stakeholder Needs; (2) Covering the End-to-end Enterprise; (3) Applying a Single, Integrated Framework; (4) Enabling a Holistic Approach; (5) Separating Governance From Management.

The COBIT 5 process reference model succeeds the COBIT 4.1 process model and aggregates the Risk IT and Val IT process models to it (ISACA, 2012c). In this model, the IT-related practices and activities of the enterprise are subdivided into two main areas: governance and management.

Governance ensures that enterprise objectives are achieved by evaluating stakeholder needs, conditions and options; setting direction through prioritization and decision making; and monitoring performance, compliance and progress against direction and objectives (EDM) (ISACA, 2012a). Management plans, builds, runs and monitors activities in alignment with the direction set by the governance to achieve the enterprise objectives (PBRM) (ISACA, 2012a).

Management is divided into domains of processes. The four Management domains are in line with the PBRM responsibility areas (plan, build, run and monitor) (ISACA, 2012c). These domains are: APO-Align, Plan and Organize; BAI-Build, Acquire and Implement; DSS-Deliver, Service and Support; and MEA-Monitor, Evaluate and Assess (ISACA, 2012a). Some Enterprise IT Management processes are (ISACA, 2012c):

- APO03 Manage enterprise architecture;
- APO04 Manage innovation;
- APO05 Manage portfolio;
- APO06 Manage budget and costs;
- APO08 Manage relationships;
- APO13 Manage security;
- BAI05 Manage organizational change enablement;
- BAI08 Manage knowledge;
- BAI09 Manage assets;
- DSS05 Manage security service;
- DSS06 Manage business process controls.

COBIT 5 processes cover end-to-end business and IT activities, i.e., a full enterprise-level view (ISACA, 2012c). COBIT 5 covers all functions and

processes required to govern and manage enterprise information and related technologies wherever that information may be processed (ISACA, 2012a). COBIT 5 addresses all the relevant internal and external IT services, as well as internal and external business processes (ISACA, 2012a). The COBIT 5 Framework relates COBIT 5 processes to IT goals, and these ones to enterprise's goals. For example, the COBIT 5 Enterprise Goal "8-Agile responses to a changing business environment" primarily depends on the achievement of the following IT-related goals:

- 01-Alignment of IT and business strategy;
- 07- Delivery of IT services in line with business requirements;
- 09- IT agility;
- 17- Knowledge, expertise and initiatives for business innovation.

These IT-related goals primarily depend on the achievement of other COBIT 5 Processes. As an example, the IT-related goal "09- IT agility" primarily depends on the achievement of the following COBIT 5 processes:

- EDM04-Ensure Resource Optimization;
- APO01-Manage the IT Management Framework;
- APO03-Manage Enterprise Architecture;
- APO04-Manage Innovation;
- APO10-Manage Suppliers;
- BAI08- Manage Knowledge.

Some COBIT 5 processes that need to identify external variables are (ISACA, 2012a):

- EDM01- Ensure Governance Framework Setting and Maintenance: this process has an activity to analyze and identify the internal and external environmental factors (legal, regulatory and contractual obligations) and trends in the business environment that may influence governance design.
- APO04- Manage Innovation: this process comprises two Key Management Practices (KMPs), one to maintain an understanding of the enterprise environment (APO04.02) and the other to monitor and scan the technology environment (APO04.03).
- MEA03- Monitor, Evaluate and Assess Compliance with External Requirements: this process is more detailed in section 4.

However, none of these COBIT 5 processes define how to identify the external variables. The next section presents a way of doing it.

3 THE BPCREL METHOD

This section presents BPCREL, a method that identifies and prioritizes external variables that impact the execution of specific activities and outcomes of a process, applying Competitive Intelligence (CI) concepts and Data Mining (DM) techniques. BPCREL was previously proposed in (Ramos, Santoro and Baiao, 2010)(Ramos, Santoro and Baiao, 2011)(Ramos, 2011) and is illustrated in Figure 1.

Steps 1 to 7 of BPCREL are responsible for applying two CI methods – Key Intelligence Topics (KIT) (Herring, 1999) and Critical Success Factors (CSF) – to systematically define information at the strategic level. Key Intelligence Topics (KITs) support the specification, definition and prioritization of information needs at the strategic level of the organization. They represent items that must be constantly monitored to guarantee business success.

The specification of the contents of each KIT is more detailed by several KIQs (Key Information Questions). For example, the KIT "Strategic Investment Decisions" may consist of the following KIQs: "What is the involvement of other investors in competitors?" and "What are the critical investments from competitors?" (Vuori and Pirttimäki 2005). According to BPCREL, KITs are identified through interviews with managers, asking open questions. Each KIT may fall into one category, and grouped into surveillance areas. The three KIT categories are: (i) strategic decisions and actions; (ii) topics for early warning, considering threats and issues that decision makers want to know previously, and (iii) major players in the market, such as customers, competitors, suppliers and partners (Herring 1999).

Finally, Step 8 of BPCREL follows a KDD process to predict the process goal (defined in step 1) and to determine the relevance of the external context variables (identified by the KIT/KIQ approach) to the process outcomes and to the process activities outcomes.

The 8 BPCREL steps are detailed as follows.

Step 1 – Identify Process Goal(s). Identify all the goals related to a given process and their appropriate measures (Rosemann *et al.* 2008).

Step 2 – Select KIT Category. Herring (1999) has divided KITs into three categories: 1) Strategic Decisions and Issues, 2) Early-warning KITs, considering threats and issues on which decision makers do not want to be surprised and 3) Key player KITs (such as customers, competitors, suppliers and partners). Each of the three categories

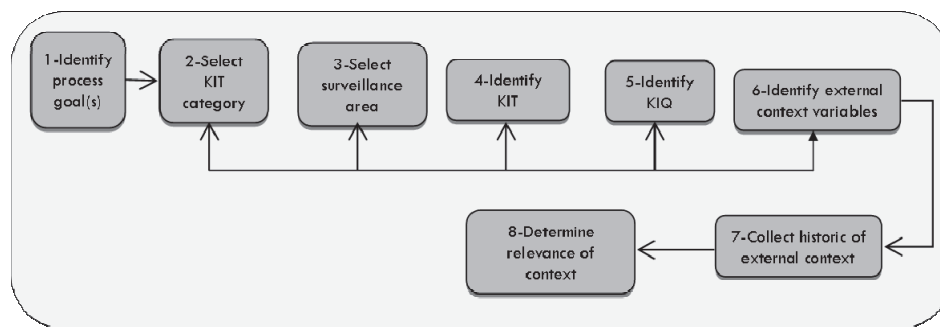


Figure 1: Method for external context variables identification.

is selected iteratively, to conduct the subsequent steps.

Step 3 – Select Surveillance Area. Steps 3 to 6 are part of a top-down approach, in which top level areas must be considered to give support to the next step. General surveillance areas are: social, technology, economic, ecology, political, legal and competitors, due to all industries are influenced by them. However, they can be selected from any framework, such as Five Forces model (Porter, 1979), SLEPT or STEEP Analysis (The Times, 2010), or from a combination of them. BPCREL focuses on events that occur externally to the process (or ultimately to the organization where it runs) and somehow interfere within this process. Rosemann *et al.* (2008) propose that the external layer of their model is composed of the following types of context: suppliers, capital providers, workforce, partners, customers, lobbies, states, competitors. This step is repeated for each of the three KIT categories.

Step 4 – Identify KIT. Key Intelligence Topics (KITs) are identified by interviewing the main decision-makers and asking them open-ended, non-directive questions (Herring and Francis 1999). An interview protocol is very useful to ensure the consistency of results (Herring 1999). Repeat this step for each of the surveillance area selected.

Step 5 – Identify KIQ. Key Intelligence Questions (KIQs) should be identified for each KIT. KIQs represent the information needs listed in the KIT, i.e. what the manager needs to know to be able to make the decisions. It is possible to have the same KIQ for more than one KIT. Repeat this step for each KIT selected.

Step 6 – Identify External Context Variables. Each KIQ may reference one or more external variables. These are the external context variables and are identified in this step. It is possible to have the same variable for more than one KIQ. Repeat

this step for each KIQ identified in the previous step. For each process goal, the result of all the executions of steps 2 to 6 will be the final Intelligence Tree with the following columns: Process Goal, KIT category, Surveillance Area, KIT, KIQ and External Context Variable.

Step 7 – Collect Past Information of the External Context. In this step, historical data of each identified external context variable is collected and stored in the organizational memory. This data should refer to the same period of which data about the process (and its activities) outcome is also available.

Step 8 – Determine Relevance of the External Context to the Process Outcomes and to the Process Activities Outcomes. This step applies data mining techniques to prioritize which context variable to capture and store in the Organizational Memory, according to its relevance. A KDD process (Fayyad *et al.*, 1996) is followed that automatically finds the most relevant subset of external context variables that best predict the process (and its activities) outcome. Before applying any KDD process, it is necessary to understand the application domain and identify what is expected to be discovered from the customer's viewpoint (Fayyad *et al.*, 1996). Each KDD step is detailed as follows:

Step 8.1 (Selection) – this step consists on creating a target data set (or focusing on a subset of variables or data samples), on which discovery is to be performed. In this step, the historical data of the external context is associated to the process activities outcomes and to the process execution results, for the same period.

Step 8.2 (Pre-processing) – this step consists on cleaning and pre-processing the target data set in order to obtain consistent data;

Step 8.3 (Transformation) – this step consists in finding useful features to represent data so that the target data set is reduced. By applying

dimensionality reduction or transformation methods, the effective number of variables under consideration can be reduced, or invariant representations for the data can be found (Fayyad et al., 1996).

Step 8.4 (Data Mining - DM) – generically, data mining consists of searching for patterns of interest in a particular representational form. Many models can be created to allow comparing which one has the best accuracy for predicting a target attribute. BPCREL applies feature selection and decision tree data mining techniques to discover which subset of external context variables more precisely lead to a specific process outcome.

Step 8.5 (Interpretation/Evaluation) – this step consists on the interpretation and evaluation of the mined patterns. The decision tree constructed in the previous step provides an adequate representation for knowledge managers to understand and interpret the circumstances in which a change in an external variable impacted the results of process instances in the past and, further, which activities of the processes were impacted. We argue that this interpretation will enable the decision maker to prepare process adaptations required to handle future modifications in the external variables, or at least to quickly react to those changes in the environment, when they occur.

4 AN EXAMPLE SCENARIO OF APPLYING BPCREL METHOD TO SUPPORT A COBIT 5 PROCESS

This section illustrates an example of how we propose to apply competitive intelligence and data mining for supporting COBIT 5 processes that need to monitor external variables. With this objective in mind, we propose to apply the BPCREL method (described in Section 3) to every main business process of the organization. This will allow the organization to know the relevance of each identified external variable to each business process (and to their specific activities).

This Section describes an example scenario in which we have applied the BPCREL method on a fictitious organization with 3 main business processes. Our focus is to support the COBIT 5 process “Monitor, Evaluate and Assess Compliance with External Requirements process (MEA03)”.

4.1 The COBIT 5 MEA03 Process

The COBIT 5 MEA03 process (“Monitor, Evaluate and Assess Compliance with External Requirements”) – which will be referred to as the MEA03 process from now on – evaluates that “IT processes and IT-supported business processes are compliant with laws, regulations and contractual requirements”. MEA03 also obtains “assurance that the requirements have been identified and complied with, and integrates IT compliance with overall enterprise compliance”. It belongs to the Management Area and to the Monitor, Evaluate and Assess Domain.

According to the COBIT 5 specification (ISACA 2012a), the MEA03 process is primary related to two COBIT 5 IT goals: “02-IT compliance and support for business compliance with external laws and regulations”; and “04-Managed IT-related business risk”. These two COBIT 5 IT goals are primary related to the following COBIT 5 Enterprise goals: “04- Compliance with external laws and regulations”; “15- Compliance with internal policies”; “03- Managed business risk (safeguarding of assets)”; “07- Business service continuity and availability”; and “10- Optimization of service delivery costs”.

The MEA03 process is formed by four Key Management Practices (KMPs):

1. Identify external compliance requirements;
2. Optimize response to external requirements;
3. Confirm External Compliance;
4. Obtain assurance of external compliance.

The first KMP (MEA03.01) identifies and monitors changes in local and international laws, regulations and other external requirements that must be complied with from an IT perspective, on a continuous basis. This KMP has six activities and the first one is to assign responsibility for identifying and monitoring any changes of legal, regulatory and other external contractual requirements relevant to the use of IT resources and to the processing of information within the enterprise business and IT operations.

Since COBIT 5 does not specify how to identify external requirements, we propose applying the BPCREL method for this purpose on every main business process.

4.2 Business Processes

Our example scenario assumes an Organization with 3 main business processes (BP): BP1, BP2 and BP3.

Each BP has its goals. For every BP, the organization is interested achieving its BP goals. A BP could be a software development process in a software house organization, for example, and in this case the organization must make decisions such as whether or not to authorize the beginning of a software development project; what to do to maximize the chances of an ongoing project to be concluded; and whether to deactivate a project or to continue with it (Ramos et al., 2011); (Ramos, 2011).

4.3 Application of the Method

In this example scenario, we executed the 8 steps of the BPECREL method to define relevant external variables that influenced the main business processes (BP) of our hypothetic organization, as shown in section 4.2. The result after applying steps 1 to 7 of BPECREL is a list of possible relevant external variables, illustrated in Table 1. Step 8 outputs a list of the relevant external variables and a decision tree showing the relation among them and with the BP activities and goals (Figure 2).

Step 1 to 7. For the defined process goal of every BP (BP1, BP2 and BP3), the result of all the executions of steps 1 to 7 was a list of possible relevant external variables that can impact the goals of BP1, BP2 and BP3, illustrated in Table 1. The first column discriminates the 3 BPs. The last column lists the goals for each BP. Intermediate columns show fictitious candidate external variables identified through the CI questionnaires. A cell with “yes” states that this external variable was identified for this BP. The list of candidate relevant external variables per BP is composed by all the variables referring to columns with a “yes” cell in the BP table line. For example, the list of candidate relevant external variables identified for BP1 and its Goal1 is {X, Z, W, T}. According to BPECREL specification, the historical data of each identified external context

variable is collected and stored in the organizational memory.

Step 8. In this step we followed the KDD process for BP1, BP2 and BP3. We applied the Feature Selection technique to filter variables according to their relevance. The C&RT (Standard Classification Trees with Deployment) technique is used to build a decision tree that explicitly shows the relation among the relevant external variables, the process outcomes and the process activities outcomes for predicting the BP goal.

Table 2 shows the list of relevant external variables per business processes identified by BPECREL. Line 2 of Table 2 shows 2 variables (Z and T) with p-value lower than 0.05 for BP1, among the 4 possible external variables shown in Table 1. These 2 variables stand as the most important predictors to determine the BP1 goal. The p-value of a variable is inversely proportional to its relevance, that is, the lower a p-value of a variable is for a specific process BPi, the more relevant is this variable for this process. For example, in Table 2, the most relevant external variable for BP1 is T, the 2nd most relevant is Z; in the case of BP2, the most relevant external variable is W, followed by N, M and Z. For BP3, the most relevant variable is Z, followed by Y, M and finally N.

Step 8.4 (Data Mining) – Decision trees are powerful tools for classification and prediction that can be generated by data mining techniques. In this step, we show an example of a decision tree C&RT (Figure 2).

Step 8.5 (Interpretation/Evaluation) – The decision tree C&RT of Figure 2 shows the relation between the relevant external context variables, the relevant process activities outcomes and the relevant process outcomes of BP1 and its Goal 1. The Goal 1 of BP1 is represented by a binary outcome (dependent) variable “Goal 1” that can have 1 of 2 values: “bad” or “good”.

Table 1: Identified candidate external variables per main business process.

Business Processes	External Var X	External Var Y	External Var Z	External Var W	External Var M	External Var N	External Var T	BP Goal
BP1	Yes	-	Yes	Yes	-	-	Yes	Goal 1
BP2	Yes	-	Yes	Yes	Yes	Yes	Yes	Goal 2
BP3	Yes	Yes	Yes	-	Yes	Yes	-	Goal 3

Table 2: p-Value of relevant external variables per business process.

Business Processes	External Var X	External Var Y	External Var Z	External Var W	External Var M	External Var N	External Var T	BP Goal
BP1	-	-	0,0002	-	-	-	0,0001	Goal 1
BP2	-	-	0,04	0,001	0,0003	0,0002	-	Goal 2
BP3	-	0,0002	0,0001	-	0,03	0,04	-	Goal 3

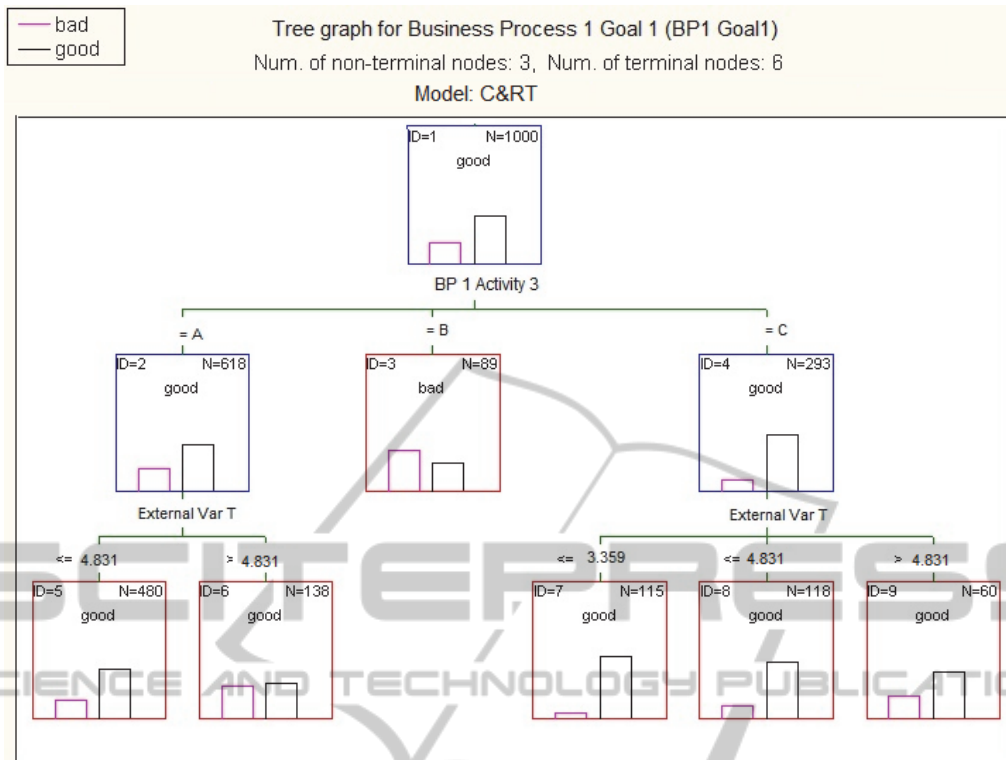


Figure 2: Part of the decision tree C&RT for the Business Process 1 considering the best predictor variables to the dependent variable Goal 1 of BP1.

Each box in the tree of Figure 2 shows the number of instances classified at that node and the distribution of the dependent variable values (Goal1). The root node (ID=1) contains 1,000 instances (i.e. all the instances in the dataset), and splits data to 3 descendants based on the outcome of “BP 1 Activity 3” (A, B or C). The central root descendant (ID=3) contains 89 instances, where most of them lead to Goal 1 as “bad”. This node is not split further because most instances have the same value of Goal 1 (“bad”). The other 2 root descendants split further based on the “External Var T” predictor variable. These split resulted in 5 leaf nodes. The second leaf node (ID=6) clearly shows the relevance of the external variable to the process activity 3, by evidencing that when the “External Var T” raises above 4.831 then both Goal 1 outcomes from BP1 occur with almost the same probability. This may fire a change during the process execution, with the process manager taking actions for maximizing the chances of the goal of BP1 being “good” (or, otherwise, minimizing the chances of being “bad”).

5 CONCLUSIONS

5.1 Analysis and Discussion

The COBIT Framework relates COBIT 5 processes to IT goals, and these to enterprise goals. The use of BPECREL method in COBIT allowed not only to discover which external variables should be monitored, but also to know which business processes were impacted by these variables. The BPECREL method can go deeply until discovering the activities of business processes that were impacted by these external variables.

The models generated by the BPECREL method allow the decision makers to take agile and proactive actions, such as quickly updating a business activity or a whole business process when there is a specific change in an external variable, since the models show the effects this change has produced in the past.

It is important to note that a possible external variable identified on BPECREL may not have its relevance identified by the method. This may happen when the variable was not enough relevant to the BP or when the dataset did not have enough

information characterizing its relevance. The decision makers may decide to monitor or not the external variables that were not relevant after applying BPECREL. In cases that a variable is related to many BPs (as with External VarX in table 1 and table 2), it may be worthy monitoring it even if its relevance was not detected. Moreover, the number of impacted BP by an external variable may increase its relevance. For example, even though VarZ is not considered the most relevant, it impacts the greatest number of BPs.

We can also observe that BPECREL is associated with some other activities of MEA03. It is possible to assess the impacts of variations on external variables such as legal aspects that biased the process even positively or negatively and thus helping to make previsions while tendencies to new deviations occur.

However, the discovered knowledge depends on the amount of detailed information available in the processes logs. Thus, it is essential to collect the appropriate information about the execution of activities within the enterprise.

5.2 Final Considerations and Future Work

The application of BPECREL processes, such as illustrated in this paper, highlights opportunities for integration with other COBIT 5 processes. For example, knowledge management initiatives may store all knowledge gained in applying BPECREL to facilitate their subsequent reuse in decision making; moreover, innovation management initiatives may adopt BPECREL to come up with opportunities for process improvements.

Supporting the identification and prioritization of variables to be considered in the context of the external environment allows that changes in those variables might trigger decision making, by adapting the process (new requirements) or implementing new business rules. Those are typical issues that IT processes should also understand and provide fast answers. Therefore, the knowledge gained on business are reflected and aligned with actions in IT processes.

As future work we suggest conducting case studies to validate the proposal of improving COBIT by applying the BPECREL method in the MEA03 process and in other COBIT 5 processes, such as innovation management and risk management; improving COBIT by creating a new COBIT 5 process or adapting a exiting one to centralize all competitive intelligence activities used by COBIT 5,

such as defining external variables in the innovation management and in MEA03 process. This could be done by adapting the knowledge management process. We also suggest applying the BPECREL method in other COBIT 5 processes using all surveillance areas proposed in the BPECREL method and not the surveillance areas indicated in some COBIT processes.

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