GovernIT: A Software for Decision-making Support on Automated IT Governance Models

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Abstract

We developed a software tool named GovernIT to support the creation and evolution of computer-driven Information Technology (IT) governance models. This software automates the design of decision maps to coordinate decision-making interactions among IT units. It also allows the assessment of business drivers and IT risks to automate the generation of implementation roadmaps for decision-support mechanisms. The software has been used by students of an IT Governance Course to assess undesirable IT behaviors for 21 organizations, to design their target IT governance model, and to generate their IT process implementation roadmap. The results of this implementation evidences the positive impact of dynamic decision maps for controlling IT risks and efficiency.
Keywords: knowledge-based system, decision-support mechanisms, ICT governance model, risk evaluation, IT processes prioritization.

1. Motivation for Developing the GovernIT Software

Information Technology (IT) has become a strategic enabler for business processes in the entire organization. Nevertheless, a greater level of complexity is reached to manage the ever increasing amount of IT assets that are adopted (*e.g.* infrastructure, architectures, people, IT processes, services, information systems). Moreover, the high dependency of the business on IT exposes a risk associated with the business' viability and continuity if the IT assets are performing as blockage and not as enablers.

IT Governance is an approach looking to control those incremental levels of complexity. IT Governance is defined as "specifying the decision rights and accountability framework to encourage desirable behavior in the use of IT [14]". From a general point of view, implementing IT governance requires three activities: (a) to define which IT decisions are critical and should be controlled, (b) to define who has the right of making those decisions, and (c) to determine the mechanisms to control how those decisions should be made. We observe the following challenges when trying to accomplish these activities.

C1. *Lack of control on IT governance models.* From a strategic point of view, the main artifact of an IT governance model is a decision map. A decision map defines the rights and accountability of organizational structures (*e.g.* committees, roles) on strategic IT decisions (*e.g.* investment prioritization). However, these decision maps evolve continuously and therefore require to be easily adjusted and communicated to keep transparency and control of a decision-making process. Automating the creation and evolution of decision maps avoids document-based artifacts, which are static and obsolete for governance purposes. Moreover, stakeholders require identifying and relating negative

impacts on IT risks, efficiency, and profits to justify and trace the evolution of decision maps. Therefore, these undesired IT behaviors are easily communicated to decision-makers, who must compare them with the expected business behavior (*cf.* operating model [13]).

C2. *Customization and Integration of IT Governance frameworks.* Multiple frameworks provide a general guide for adopting IT Governance alignment mechanisms (*e.g.* IT processes) within organizations (*e.g.* ITIL [1], RiskIT [7], COBIT [6]). Most organizations try to assess, design, and implement most of these mechanisms at the same time (macro processes, indicators, matrices, etc.). This approach requires a considerable amount of resources and time, and leads to deliveries that are too complex to communicate and control (*e.g.* dozens of procedures and authority matrices). Therefore, the organizations require tools to prioritize and select these mechanisms in terms of organization-specific needs. Multiple stakeholders must evaluate the relative importance of every organization-specific goal and risk in order to assure accuracy in the selection process. A detailed and incremental design of only those prioritized mechanisms must be performed to create a governance model that can be controlled.

We developed a computational tool named GovernIT that helps companies to perform IT governance analysis (see Section 2). GovernIT contains 32 general IT decisions classified into five categories (*i.e.* principles, enterprise architecture, infrastructure, business applications, investment), as a starting point to create a decision map. These decisions and categories were adopted from [14]. GovernIT also contains an algorithm to identify current and target decision-making archetypes (*cf.* business monarchy, IT monarchy, federal, IT duopoly, feudal [14]). GovernIT contains an algorithm that computes an implementation roadmap for COBIT IT processes based on the specialization and evaluation of organization-specific business-and-IT strategic elements. The algorithm adopts and extends the following linking artifacts defined in literature: generic IT risks [7] with IT processes (*cf.* Implementation book [6]), generic business goals [8] with generic IT goals [9], and generic IT goals with IT processes (*cf.* Enabling Processes [6]).

GovernIT has been used to support the creation and evolution of IT governance models for several organizations that are selected by master students of an IT Governance Course. These students used GovernIT in 21 organizations to assess undesirable IT behaviors, to design their target IT governance model, and to generate their IT process implementation roadmap. The results show the positive impact of dynamic governance models on IT risks and efficiency (see Section 3). Section 4 discusses the main capabilities of GovernIT when it is used in an educational context and also a contrast with related tools when it is used for consulting. Conclusions and future work are presented in Section 5.

2. A Software for Automating IT Governance Models

2.1. Software Functionalities

The following GovernIT functionalities define a method to create and evolve an IT governance model for an organization.[1] Two main types of functionalities are defined: Configuration and Analysis (CA), and ITG Mechanisms Prioritization (MP).

CA1. Creation and specialization of critical IT decisions to allow fine-grained control. Any organization can load the set of 32 predefined IT decisions or start defining from scratch the set of IT decisions to be controlled. The output is hierarchy of decisions structured by their specificity, importance, or any other relevant criteria. Figure 1 illustrates a decision hierarchy for two of the five dimensions for which critical IT decisions must be controlled. This decisions hierarchy can be modified at any time.

[1] A detailed description of GovernIT can be found at: https://github.com/governit/GovernIT/wiki.

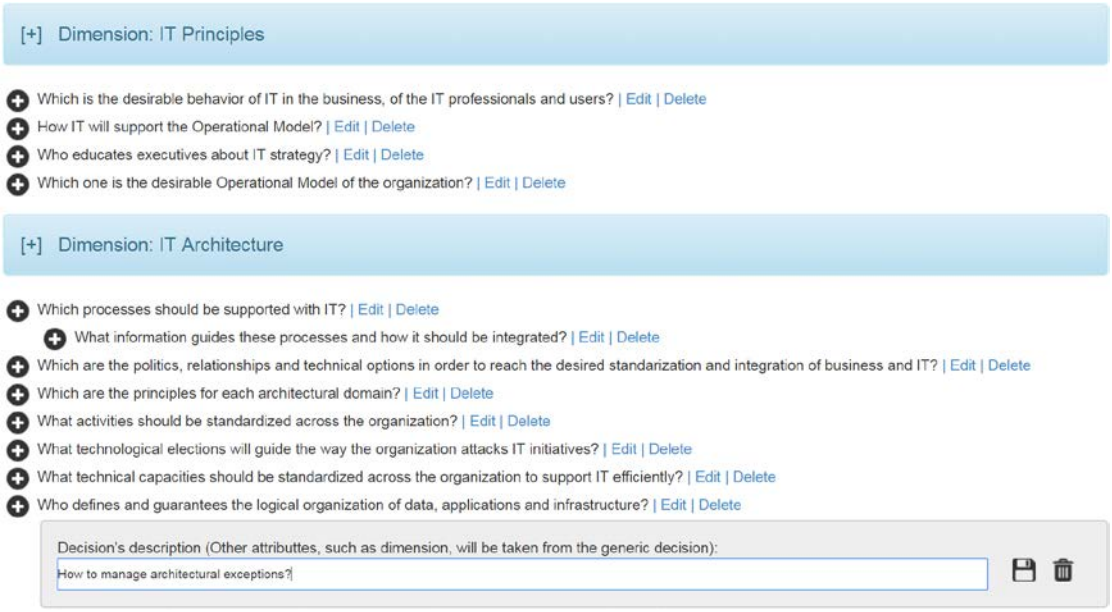

Fig. 1. Hierarchy of critical IT decisions to be controlled within an organization.

CA2. Creation of governance structures and automatic identification of potential function conflicts. Governance structures are created by specifying a name, a type (*i.e.* role, committee, business unit), a profile (Business Executive, IT Executive, IT Staff, IT-Business, Business Units Group, Process Owners, Individuals), and the functions of each one. Potential conflicts are identified and highlighted automatically if there is syntactic match on functions among governance structures within the same organization.

CA3. Creation of decision maps (IT decisions vs. governance structures) to analyze current and expected decision-making behavior through time. A decision map is modeled as a matrix that allows relating IT decisions in each category with governance structures depending on its current behavior in the decision: who makes the decision (Decides), who executes the decision made (Acts), who is consulted to make a decision (Consulted), and who is notified of the decision made (Informed). A decision map defines decision-making rights and accountability for the catalogue of decisions. Multiple decision maps can be created to represent, analyze and controlling current (AS-IS) and expected (TO-BE) decision-making behavior through time (*e.g.* no duplication of IT investments).

Analysts can specify issues or improvements related to the decision-making behavior for each decision within decision maps. An issue corresponds to a gap between the actual and expected behavior on decision archetypes. An issue can be specified by selecting predefined IT risks and by describing undesired impacts (*e.g.* on growth, on profit, on efficiency) related to the decision-making behavior. Figure 2 illustrates a set of issues identified for the current decision-making behavior within an organization. In particular, the current schema that is identified for decision-making in this organization creates undesirable behaviors from IT. For instance, IT risks such as duplication of IT initiatives and the creation of complex architectures that limit their evolution can be materialized if multiple IT areas from different business units are taking the same decision. Moreover, multiple isolated and costly IT support areas can be created at making this decision without coordination.

Then, a new decision map can be created by changing the responsible of decision-making according to the expected IT behavior across the organization. The IT expected behavior must be closely related to the expected business behavior which is typically scoped by the organization's operating model [13], which defines the choices of the level of business process integration and standardization. An operating model defines how companies implement their business processes and IT infrastructure across business units, and how they deliver services to customers: (i) independently with shared services (Diversification model), (ii) independently with seamless access to shared data (Coordination model), (iii) with

standardized operation but autonomy on transactions or data (Replication model), or (iv) with standardized operation and integrated data (Unification model).

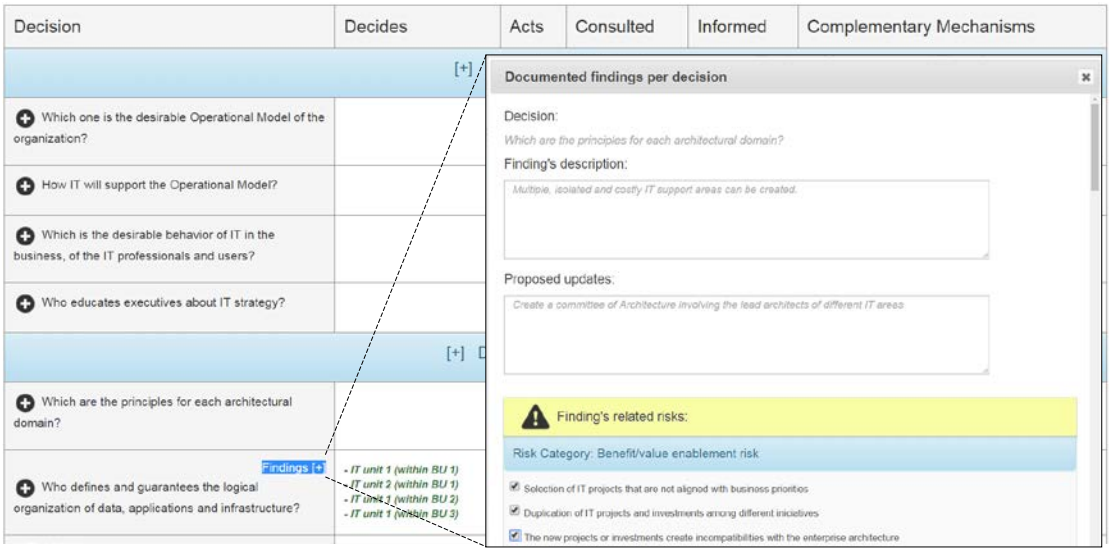

Fig. 2. Analysis of issues in the current decision-making behavior specified in a decision map.

CA4. Identification of archetypal approaches to IT decision making. GovernIT contains an algorithm that identifies and illustrates the coincidence percentages of each group of IT decisions (dimensions) with each IT decision archetype (*i.e.* business monarchy, IT monarchy, federal, IT duopoly, feudal, anarchy [14]). The algorithm defines a set of rules to compute the archetype by analyzing the relationships between the decisions scope in a decision map (*e.g.* decides, consulted) and the structure profiles associated with those decisions. These rules also evaluate the number of related structures to identify an archetype. Every IT decision is evaluated separately to identify its own archetype, and then a relative consolidated percentage is calculated per decision dimension with each one of the archetypes. Figure 3 illustrates a resulting decision archetypes matrix, which allows decision-makers to compare and adjust them with the expected business behavior.

Fig. 3. Decision archetypes matrix. Adopted from [14].

MP1. Definition of organization-specific risk matrices to quantify the financial impact due to risk materialization. GovernIT provides a generic IT risks assessment matrix that relates materialization impact scales (Insignificant, Marginal, Moderate, Serious, Critical, Catastrophic) with frequency scales (Unlikely, Rarely, Occasional, Moderate, Frequent, Constant) [7]. Each cell has a numeric impact value that is predefined by assuming a linear behavior between impact and frequency scales. However, these values and scales can be customized for each organization (*e.g.* by assuming a logarithmic behavior). Additionally, the organization can provide a Financial Impact per Risk Value (FIpRV) for each impact unit that can be used to quantify the financial impact due to risk materialization. Figure 4 illustrates a risk matrix for an organization in which the FIpRV is valuated as 16000 USD. If a risk is assessed with a risk level of 20, it means that the possible materialization of that risk will have a financial impact of 320.000 USD.

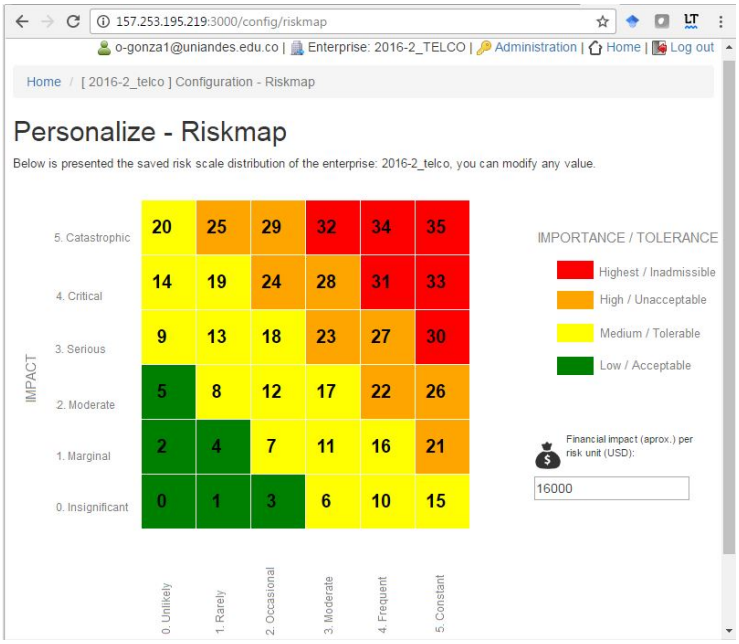

Fig. 4. Setup of an organization-specific risk matrix.

MP2. Identification and assessment of organization-specific IT risks. Analysts can create multiple evaluation scenarios (*e.g.* per governance structure) by specializing IT generic risks [7] into organization-specific IT risks. A specialized IT risk is created by specifying the potential event that can generate a negative impact and the type of risk (inherent, residual). Specialized IT risks must be evaluated in terms of impact and frequency scales, whereas the impact of generic IT risks corresponds to the average among specific risks' scores. All created scenarios can be combined into a corporate risk assessment scenario. Risk scenarios are inputs of the process for prioritizing governance mechanisms.

MP3. Identification and assessment of organization-specific goals. Analysts can create multiple evaluation scenarios (*e.g.* per governance structure) by specializing generic business goals [8] and IT goals [9] into organization-specific goals. Each generic goal can be specialized into one or several specific organization-specific goals. An importance value by using a scale from 1 (low importance) to 5 (high importance) is assigned to each generic goal that was specialized. Business and IT goal scenarios are inputs of the process for prioritizing governance mechanisms.

MP4. Creation of prioritization scenarios by selecting multiple assessment scenarios. A prioritization scenario defines the critical IT processes to be implemented to control how decisions are made. GovernIT allows creating and simulating prioritization scenarios by selecting a risk assessment scenario, a business goals assessment scenario, and an IT goals assessment scenario. A specific weight (percentage importance) can be assigned to each scenario depending on the organization interests.

GovernIT contains an algorithm that automatically performs the prioritization and defines the roadmap for implementing governance mechanisms (IT processes). The algorithm calculates 2 partial scores (risk-related importance and goal-related importance), and a consolidated score. First, the risk-related importance is computed by analyzing (1) risks with the highest risk level scores from the risk scenario, (2) related processes from those risks (*cf.* risks-IT processes linkage in Section 1), (3) related risk categories from those risks, (4) relative measure of number of related risks, and (5) relative measure of the number of occurrences in the most important risk categories identified. Second, the goal-related importance is computed by analyzing (a) the score of IT Goals vs Business Goals, (b) IT goals importance, and (c) the score of IT Goals vs IT processes (*cf.* goals-IT processes linkage in Section 1). Finally, the consolidated scores is the sum of partial scores. Figure 5 illustrates the consolidated and partial scores that will define the implementation order of IT processes aligned with the needs of the organization.

ID COBIT PROCESS	DESCRIPTION	RISK IMPORTANCE SCORE 70% (0-3.5)	GOAL IMPORTANCE SCORE 30% (0-1.5)	CONSOLIDATED SCORE 100% (0-5)
APO03	Manage Enterprise Architecture	3.1	1.25	4.35
DSS05	Manage Security Services	3.1	0.85	3.95
BAI03	Manage Solutions Identification and Build	3.05	0.85	3.90
BAI02	Manage Requirements Definition	2.8	0.65	3.45
...	...	...	...	...

Fig. 5. Prioritized IT processes to support the expected decision-making behavior.

2.2. Software Architecture

GovernIT is a web-based application developed following two architectural styles: Model-View-Controller (MVC) and component-based. Functionalities, models, and even data are encapsulated into separate and independent domain-specific components to offer a high degree of maintainability, extensibility and modifiability as illustrated in Figure 6.

This implementation supports the coupling and decoupling of components based on specific contextual needs (consulting application or educational purposes). A core transversal component provides management services (*i.e.* authentication, authorization, master data access). Meanwhile, the secondary components provide specific services to the core transversal component, including the creation of evaluation scenarios and the creation of decision maps.

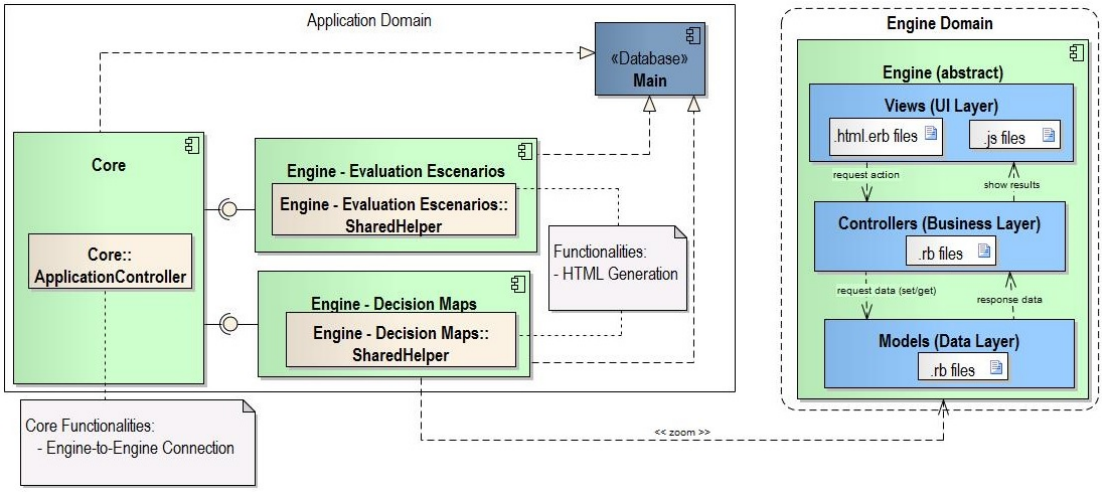

Fig. 6. GovernIT' software architecture.

3. Adoption and Use of GovernIT in an Educational Context

3.1. Data Collection and Analysis

GovernIT has been used to support the creation and evolution of IT governance models for several organizations that are selected by students of an IT Governance Course. This course is part of the Master in Business and Information Technology (MBIT) program at the Universidad de los Andes in Colombia. Each semester, 7 to 10 groups are created by 4 to 5 students, who select an organization on which to perform two major exercises on the GovernIT tool: a complete impact analysis of the AS-IS and TO-BE IT decision-making status, and a prioritization of IT processes to be implemented. All the information related with the analysis performed by the students was documented, derived, gathered and/or consolidated in a time horizon of 3 years.

The impact analysis of strategic IT decision-making behavior takes into account 21 companies from 9 different economic sectors. In total, 11 decision maps were developed by students to establish the current state of IT decision-making, and 16 decision maps to establish its desired state. The Financial Services sector had 6 registered companies (28.57% of the total), followed closely by the Government-Military sector with 5 companies (23.81% of the total). Additionally, students analyzed the alignment between the designed decision maps and the expected business behavior (*cf.* operating model analysis in Section 2.1). This expected behavior was declared by top managers of the analyzed organizations.

The process of collecting decision-making information within each organization was carried out independently by each group of students. Students take around four weeks to identify and design both decision maps and to analyze their impact on decision-making rights. This information is gathered from interviews and checklists performed to business leaders within the organization, and from existing documentation from ongoing initiatives around IT decision-making. The process of assessing IT risks, business goals, and IT goals for process prioritization involves at least two stakeholders from the organization: a business leader and an IT leader. Students guide this assessment in around three weeks and based on this information they use the algorithms of GovernIT to select the main IT process to be implemented. A user account is shared by all members of the group, who use it to perform the analysis directly on site at the time of collecting information during the interviews and guided assessments. Afterwards, students perform an analysis of capabilities (based on a maturity model) and a detailed design of the selected process. Both activities are performed manually since they are not automated within GovernIT.

Based on the information available in GovernIT it was possible to identify certain trends and special behaviors around the strategic IT decision-making processes in the organizations that were subject to analysis. Specifically, differences in the strategic IT decision-making process among economic sectors (different industries) and social sectors (if the organization belongs to the public or private sector). Additionally, indicators of non-explicit relationships were identified among the expected operating model and the strategic IT decision-making model. Showing up next the results derived from the performed analysis.

3.2. Results: Contrasting Current State (AS-IS) and Desired State (TO-BE) Behaviors

Figure 7 illustrates the current state of the strategic IT decision-making model from all economic sectors. We identified the following findings for the aforementioned companies:

- Most dimensions, except for Infrastructure, have a significant percentage (between 22% and 27%) of decisions without a clear responsible to decide. Therefore, individuals take decisions that turns out into anarchy. There are also IT application and investment decisions that business units make without coordination. This entails in low levels of process integration and extra costs to share data.
- IT Duopoly is the predominant archetype identified in the governance models for all dimensions with a frequency oscillating between 24% and 36%. However, its

predominance is not conclusive with respect to the other archetypes that approach that order of magnitude.

- A high percentage between 22% and 27% of the decisions in the IT Principles, IT Architecture, and IT Applications dimensions do not have a responsible of making them. The IT Duopoly archetype is predominant for the Infrastructure dimension, a behavior that can be attributed to the technical level required to make this kind of decisions. In the case of the Investment and Prioritization dimension, both IT and business personnel participate individually (*cf.* Feudal archetype) and collaboratively (*cf.* IT Duopoly archetype) in decision-making process.

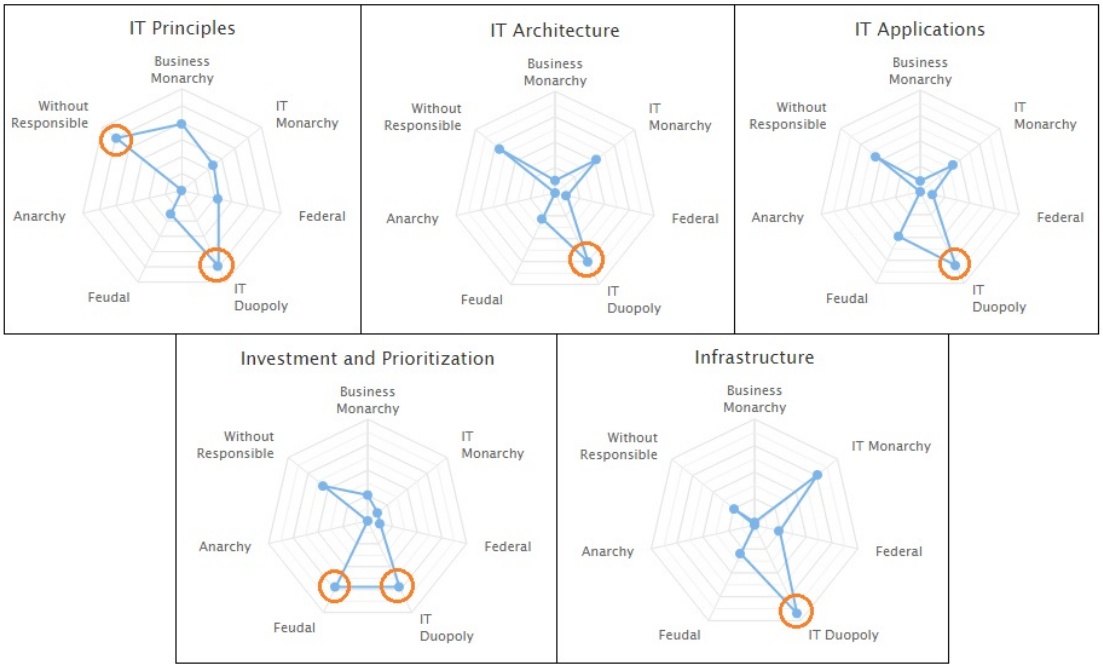

Fig. 7. AS-IS governance archetypes distribution.

Figure 8 illustrates the desired state of the strategic IT decision-making model that students designed for companies. The following are the main findings contrasting the current decision-making state with the designed state.

- IT Duopoly is the predominant archetype (with a frequency that varies between 36% and 52%) that is desired for these companies to scope decision rights on governance models. This shows a desire of giving more decision rights to IT-aware roles. This can be confirmed by taking into account that the second predominant archetype is the IT Monarchy with a frequency ranging from 20% to 34% of the total.
- Except from the IT Principles dimension, the other dimensions have in their desired situation a tendency to minimize the appearance of the archetype Business Monarchy to levels between 3% and 10%. This shows a desire to involve technical people in technical decisions.
- The Anarchy in decision-making does not exceed a frequency of more than 3%, demonstrating the need to eliminate this type of behavior within the decision-making models.

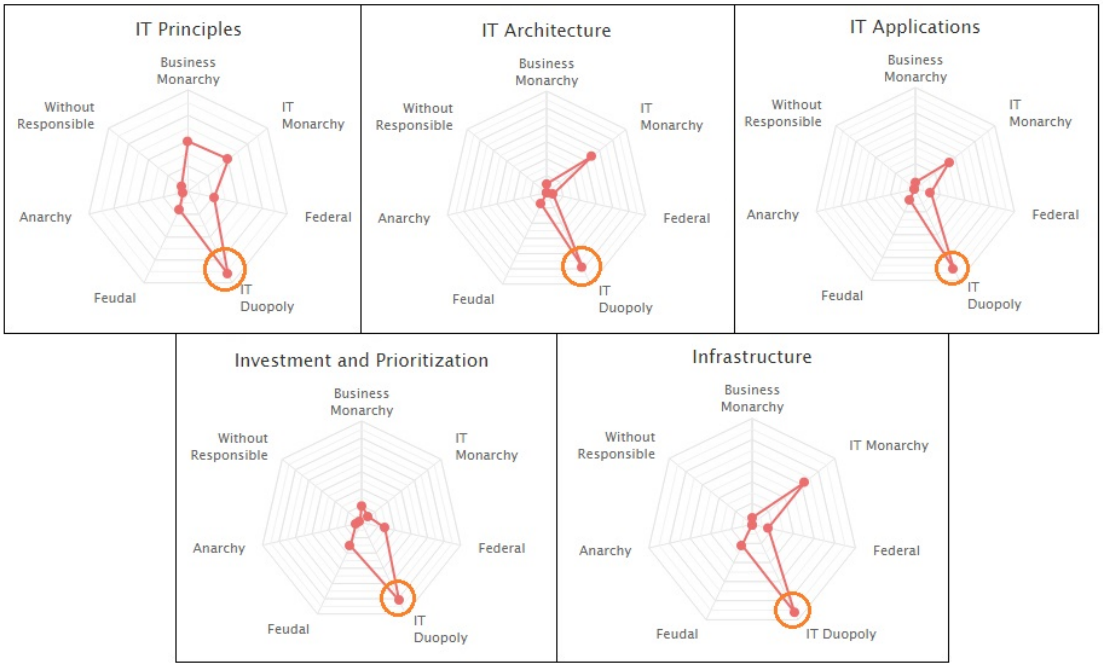

Fig. 8. TO-BE governance archetypes distribution.

Figure 9 illustrates the operating models that can be inferred by the aforementioned decision archetypes (cf. operating model analysis in Section 2.1). On the one hand, current state results show that 31,25% of the organizations established a Diversification model, 25% established a Replication model, 37,5% established a Coordination model, and 6,25% established a Unification model. On the other hand, desired state results show an expected behavior towards high levels of business process integration. 43,75% of the organizations established a Coordination model, and 56,25% established a Unification model. The Diversification and Replication models were not considered for its lack of integration level, required for the organizations that were subject to the analysis.

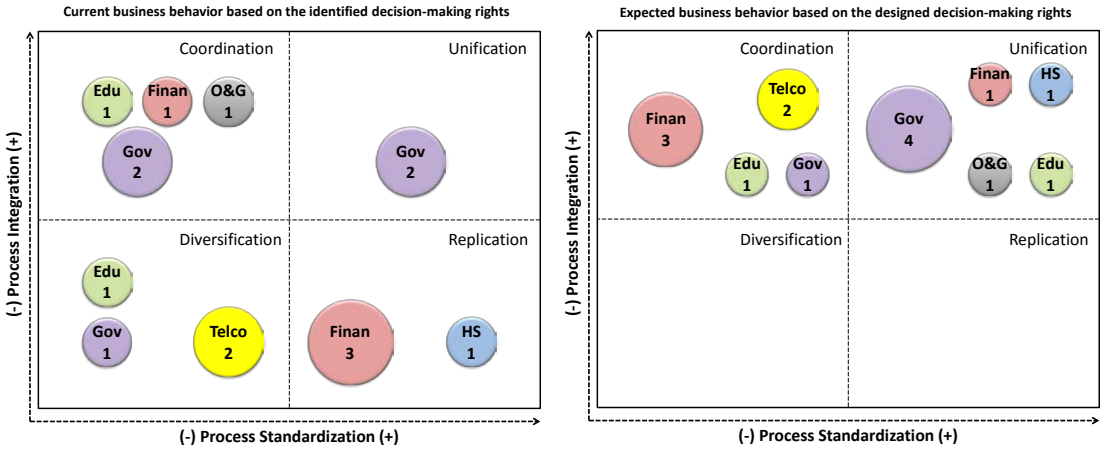

Fig. 9. Distribution of current and expected business behaviors based on decision-making rights by industry: Higher Education (Edu), Financial Services (Finan), Oil & Gas (O&G), Government/Military (Gov), Telecommunication (Telco), and Health Services (HS).

3.3. Detailed Analysis for Financial Services

We selected the companies within the financial services industry to analyze in detail the relationship between the operating models of each of these companies and the behavior in the way decisions are made. This industry had 3 companies of the private sector and 1 of the public sector registered in GovernIT. Figure 10 illustrates the transformation that companies within this industry designed as a desire behavior for IT assets. This behavior can be controlled according to the decision-making model defined in GovernIT.

For all private sector entities, a Replication operating model was identified in its current state (AS-IS), whereas for the public sector entity a Coordinated model was identified. In the design of the desired situation (TO-BE) all the entities of the private sector agreed that the ideal operating model would be coordinated in order to increase the integration of information and internal processes. This behavior can be attributed to entities such as banks tending to define their business strategy with a customer orientation, and since most of their services can be estimated as a candidate to be offered to their entire universe of clients, the integration of information is an essential step in that direction. In turn, the change in the operating model implies a decrease in the level of standardization of internal processes. This behavior can be attributed to the fact that the versatility in the different business units of this type of entities requires a little more flexibility for the definition of their own processes, because although the standardization favors the operational efficiency, it can affect the capacity of the business units to face market changes.

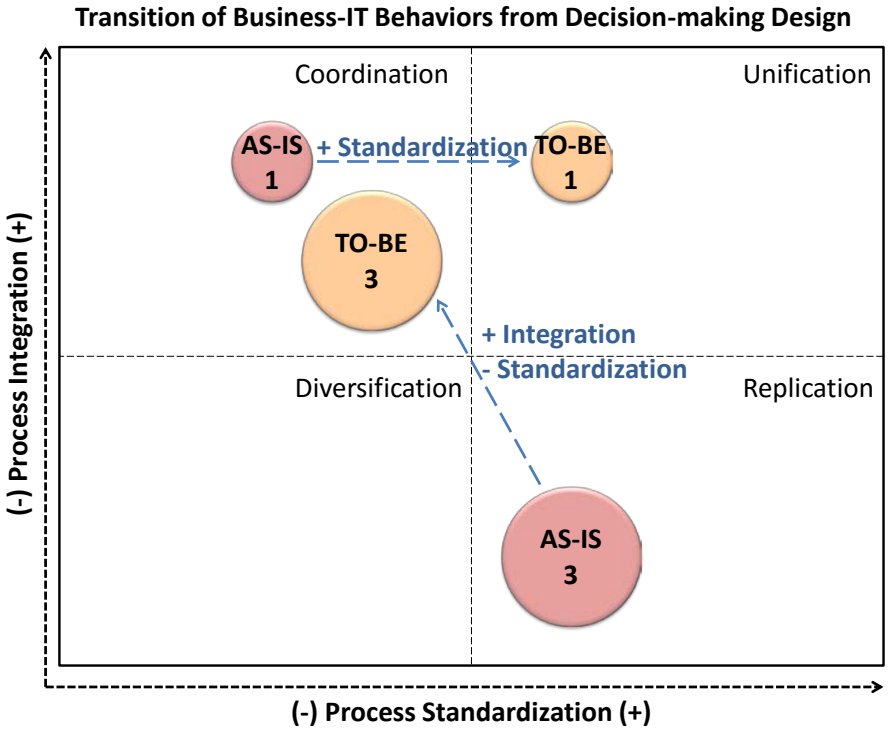

Fig. 10. Analysis of operating models expected for financial companies based on the decision-making design.

For the case of the public sector entity, the Unified model was identified as ideal for the desired situation (TO-BE). The increase in the level of standardization of internal processes can be attributed to the need to maximize the operational efficiency of the entity by reducing operating costs. For the case of integration of information and internal processes, the current level of integration is desirable, so there is no change in this dimension of analysis.

4. Relevance of GovernIT

4.1. Capabilities of GovernIT in an Educational Context

The aforementioned functionalities of GovernIT allow a Computer Supported Knowledge Management in which governance information on critical decisions to control, decision-making rights and their implications (*i.e.* threats, value delivery, resource utilization), IT risks assessment, and IT-Business goals assessment is managed. The tool offers students an educational method to design, evaluate, and evolve decision maps by connecting them with governance mechanisms such as decision making structures (*e.g.* committee, role, business unit) and IT processes (*e.g.* risk management, level agreements). Therefore, this repository of guidelines and mechanisms for governance is used by the students to evaluate strategic and operational capabilities and to prioritize them to define an implementation roadmap for the governance model.

The students have provided insights of using GovernIT and acknowledge that this tool allows them to control the design and evolution of ITG models. First, by using this tool is easy to identify new and existing decisions to control, to assign decision rights on them, and to trace the evolution of decision maps regarding their impact on IT risks, efficiency, and profits. Therefore, the decision-making process is transparent and can be easily communicated to current and new employees of a company without the need of reviewing static and conflicting artifacts such as their contract-based functions. Second, students valuate the much less effort and amount of resources to prioritize and select IT processes in terms of organization-specific needs. Therefore, a detailed and incremental design of only those prioritized IT governance mechanisms is performed to create a governance model that can be controlled and communicated.

4.2. Contrasting GovernIT with Related Tools

Several software solutions have been developed within the Governance, Risk, and Compliance (GRC) IT domain. Most of them automate operational mechanisms (*e.g.* IT processes) given by IT governance and architecture frameworks (*e.g.* COBIT, TOGAF, ITIL). Nevertheless, there is a gap on tools to control strategic and tactical concerns fir IT governance [4] such as management of decision-making rights and prioritization of operational mechanisms. These are the main capabilities of the proposed GovernIT tool.

MetricStream [10] implements IT management processes such as Risk, Compliance, Threat and Vulnerability, Audit, and Policy. Daptiv for IT Governance [2] manages IT portfolios by formulating strategy and business priorities, monitoring the implementation of IT investments, and managing financial aspects of IT. iServer for IT GRC [11] allows organizations to model their entire composition in a standardized way. Additionally, a set of ITIL processes are available to be implemented by the organizations. Eramba [3] is an open-source software that supports BIA (Business Impact Analysis) and Assets Analysis, to understand and quantify the possible impacts of risks that have not been addressed and of security controls that have not been implemented. Project Objects IT Governance [12] measures the performance of running applications and systems. Open Pages IT Governance [5] is a source to direct and notify users of the IT incidentals by documenting organizational entities, process, risks, controls, tests and results.

The aforementioned tools are very specialized in automating technical IT governance needs for IT GRC, and IT Portfolio Management. In contrast, GovernIT automates strategic IT governance concerns such as (1) structuring and directing the IT decision-making flow and archetype, (2) defining IT decision making structures (*e.g.* committees), and (3) linking together risks, business goals, IT goals, and IT processes to generate a tailored and prioritized implementation plan for operational mechanisms. The latter artifact can guide the adoption of the aforementioned software tools.

5. Conclusions and Future Work

IT governance look for directing, controlling, and monitoring the desired behavior of IT assets through risks optimization, resources optimization, benefits delivery, and decision-making transparency. These goals are archived by designing and monitoring mechanisms for directing and controlling decision-making rights. We developed the GovernIT software in order to allow the creation and evolution of computer-driven IT governance models. Therefore, an IT governance model is supported on the same assets it controls to avoid losing control itself.

GovernIT is continuously used by master students of an IT governance course to manage IT governance models and to prioritize IT process implementation mechanisms for real life companies. This software releases them from undesirable behaviors on ITG such as static and un-controlled agreements on decision-making rights, a high complexity in selecting governance mechanisms, and the implementation of non-prioritized mechanisms.

The IT governance implementations allowed us to identify opportunities to incorporate in the near future. First, the analysis of IT process dependencies as a prioritization criteria. Second, the control of operational mechanisms such as the automation of final IT processes, service agreements control, business quantification value, metrics control and management, and rationalization of IT assets. A higher IT capability and maturity on IT governance requires the design of more specific governance mechanisms. For example, the design of an IT process must consider the modeling of principles, methods, information and tools to reach an operational state. The usage of IT to control governance mechanisms becomes fundamental as the maturity level advances.

References

1. Cervone, F.: ITIL: A Framework for Managing Digital Library Services. Digit. Libr. Perspect. 24 (2), 87–90 (2008)
2. Daptiv: IT Governance and Portfolio Management Software, http://www.daptiv.com/. Accessed April 11, 2016
3. Eramba: IT Governance, Risk and Compliance Software, http://www.eramba.org/. Accessed April 14, 2016
4. González-Rojas, O., Gómez-Morantes, J., Beltrán, G.: Identifying Gaps on IT Governance Capabilities: Findings in the Logistics and Transportation Industry in Colombia. In: Proceedings of the 26th International Conference on Information Systems Development. AISeL, Larnaca (2017)
5. IBM: OpenPages IT Governance, http://www-03.ibm.com/software/products/en/openpages-it-governance/. Accessed April 11, 2016
6. ISACA: COBIT 5: A Business Framework for the Governance and Management of Enterprise IT. ISACA (2012)
7. ISACA: The Risk IT Practitioner Guide. ISACA (2009)
8. Kaplan, R. S. and Norton, D. P.: The balanced scorecard–measures that drive performance. Harv. Bus. Rev. 70 (1), 71–79 (1992)
9. Keyes, J.: Implementing the IT Balanced Scorecard: Aligning IT with Corporate Strategy. 1st. P. 528, Auerbach Publications (2005)
10. MetricStream: MetricStream IT GRC Solution, http://www.metricstream.com/. Accessed April 11, 2016
11. Orbus Software: iServer for IT Governance, Risk and Compliance, http://www.orbussoftware.com/. Accessed April 11, 2016
12. Project Objects: IT Governance Software, http://www.projectobjects.com/. Accessed April 11, 2016
13. Ross, J., Weill, P., and Robertson, D.: Enterprise Architecture as Strategy: Creating a Foundation for Business Execution. Harvard Business School Press (2006)
14. Weill, P.: Don't Just Lead, Govern: How Top-Performing Firms Govern IT. MIS Q. Exec. 3 (1), 1–17 (2004)