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SINIS: A GQM + Strategies-based approach for identifying goals, strategies and indicators for IT services

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A B S T R A C T

Context: Measurement is a key process to support organizations in managing and improving processes, products and services. The literature on IT (Information Technology) Service states that IT services should support critical business processes and should be measured in order to provide useful information for decision-making. However, there is a lack of clear guidance regarding what should be measured and which critical business processes should be considered.

Objective: We conducted this work aiming to answer the research question: How to support identification of IT service goals, strategies and indicators at different organizational levels and aligned to business goals?

Method: We defined SINIS, a method to identify Goals, Strategies and Indicators for IT Services, which has been developed to support IT service departments in identifying IT service goals, strategies and indicators to provide information for decision-making at different organizational levels and in alignment with business goals. SINIS supports defining strategies to achieve IT service goals, and identifying indicators to evaluate the strategies and goals achievement. SINIS is based on process improvement approaches (mainly GQM + Strategies) and approaches related to IT service management (mainly COBIT Goals Cascade)

Results: SINIS was used in a case study in the IT Infrastructure and IT Security departments of a large global company. Results showed that participants were able to build the GQM + Strategies Grid and discard useless indicators. In addition, team members became more devoted to measurement and strategies, and better understood relations between goals, strategies and indicators. Templates, examples and checklists useful to learn how to execute SINIS and to properly record the produced results were used by the study participants.

Conclusions: Initial evidences show that SINIS supports building the GQM + Strategies Grid and helps IT service departments to define strategies and identify useful indicators, contributing to focus efforts on strategies aligned to IT service and business goals.

1. Introduction

The service sector (involving information, health, education, tourism, entertainment, and others) has been recognized as the largest economic sector in developed countries and as an expanding sector in emerging markets [47]. This scenario has led organizations to shift from traditional production-based business models to new service-based ones [17]. In this sense, many organizations have started to use IT (Information Technology) to build service capabilities into their products, in order to be able to provide more accurate and faster service to customers [36].

Services involve delivering value to customers by facilitating the results they want to achieve without forcing them to take on the costs and risks of ownership. IT service management is a set of specialized organizational capabilities for providing value to customers through services. Its practice has been growing by adopting an IT management service-oriented approach to support applications, infrastructure and processes [39].

Guidance on how to implement and improve IT service practices is a key factor to improve service performance and customer satisfaction [19]. The use of suitable measures can help to monitor processes executed for delivering services and to support initiatives to improve managing IT service-related processes. Measurement activities can help organizations to monitor the performance of their projects and processes, leading to a high-maturity scenario. Thus, it is necessary to identify the processes to be measured and the measures to be used.

Effective service measurements should cover meaningful indicators,[1] in order to be able to verify goals achievement [11,16]. In

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[1] In this work, we use the indicator definition given by Barcellos et al. [8–11], who state that an *indicator* is a measure directly used to monitor goals achievement.

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this sense, the selection of the processes to be measured and the measures to be used should be aligned with organizational goals, so that measurement results can provide relevant information for decision-making and business support.

The IT service literature does not provide clear guidance or strict suggestions about which processes and measures should be considered for measurement. Moreover, properly identifying measures and indicators is not a trivial task. Even if a set of measures is available, it is still not easy to identify the proper measures and identify indicators for IT services [42]. Several factors contribute to the difficulty in defining measures and indicators for IT services, including: (i) lack of approaches to guide the definition of IT service indicators, (ii) lack of practical examples involving IT service indicators, and (iii) lack of measurement capabilities in IT supporting tools [27,33].

In the Software Engineering area, there are several proposals to aid organizations in measuring and improving software processes. GQM + Strategies [6] is a goal-oriented measurement approach that supports identifying goals at different organizational levels, defining strategies (i.e., initiatives, such as projects or other actions) to achieve the goals, and identifying measures/indicators to monitor strategies and goals. By establishing strategies aligned to organizational goals, it is possible to identify the processes involved, and measure and improve them. In addition, teams can focus on initiatives truly related to organizational goals, and understand how their work is aligned to those goals and how their work will be measured.

In view of the above, we developed *SINIS* (a method to identify Goals, Strategies and Indicators for IT Services), which applies principles from GQM + Strategies to help organizations define proper goals, strategies and indicators for IT services derived from and aligned to business goals. SINIS proposes a process which guides the steps to be followed by organizations in order to identify IT service goals, strategies and indicators. In addition to the process, SINIS provides a set of templates, checklists and examples to help organizations perform the SINIS process.

SINIS can help organizations which are just starting IT service measurement as well as organizations which have already started it and want to review or improve their goals, strategies or indicators. In the first scenario, SINIS can guide organizations on defining IT service goals, strategies and indicators aligned to their organizational goals. In the second scenario, SINIS can help organizations to review the defined IT service goals, strategies and indicators, and identify those aligned to organizational goals. SINIS can also help these organizations to define new IT service goals, strategies and indicators, if necessary.

To develop SINIS, we started by performing incremental learning cycles (five in total). Each cycle consisted of an investigative study performed to obtain knowledge relevant for developing SINIS. Five studies were performed. First, we carried out a systematic literature review to identify measures suitable for IT service measurement [49]. This study provided a set of measures which can be used as input to SINIS activities. Second, we performed a case study at a large company to investigate aspects which should be considered when identifying IT service indicators (for instance, the same indicator may be related to several IT services) [48]. Third, we performed a case study at an organization to evaluate the measures identified in the systematic literature review, and to identify new measures used by the organization. This study also contributed to SINIS development, because it allowed us to improve the set of measures identified in the systematic review. In this study, we also investigated impacts among IT service-related processes [50]. Understanding these impacts is important to establish proper strategies for achieving IT service goals. Fourth, we performed an action research involving the use of GQM + Strategies to identify indicators to IT service-related processes [51]. This study showed us that GQM + Strategies could be applied in the IT service domain, but some extensions would be necessary. Finally, we performed a qualitative study followed by a case study to investigate how to define or elicit strategies to achieve IT service goals [54]. The use of causal analysis techniques was found to be a way of identifying aspects on which strategies for achieving IT service goals should be focused.

SINIS was developed by following the Design Science Research method and involving two design cycles. In the first design cycle, we produced SINIS first version to be used by organizations starting IT service measurement (the first scenario previously mentioned). We conducted a case study to evaluate the use of this first version in the IT Infrastructure department of a large company [52]. This version considered only the scenario where organizations are interested in creating IT service goals, strategies and indicators from scratch. The case study results revealed limitations and opportunities for improvement, such as the need for checklists to support the execution of SINIS activities, and the need for changing SINIS activities to help organizations that have already started IT service measurement and want to review or improve goals, strategies or indicators (the second scenario previously mentioned). Based on these results, in the second design cycle we evolved SINIS to a newer version, which is presented in this paper. We made changes to SINIS activities and we also defined a set of checklists to support each SINIS activity. The improvements made allow organizations not only to start defining goals, strategies and indicators from scratch, but also to review goals, strategies and indicators in place, having a chance to improve them and the relations between them, include new ones or discard those not aligned to any goal. After developing the new version of SINIS, we conducted a case study applying it in the IT Security department of a large company. The new version of SINIS and the study performed to evaluate it are addressed in this paper.

The remaining of this paper is structured as follows: Section 2 provides the background for the paper, Section 3 presents the research method used to create SINIS, Section 4 introduces SINIS, Section 5 addresses the case study in which SINIS was used, Section 6 presents conclusions, related works and implications.

2. Background

There are several definitions of service. At a certain level, these definitions generally reflect the point of view of academic disciplines or economic sectors. According to OGCa [39], a *service* is “a logical representation of a repeatable activity that has a specified outcome. It is self-contained and is a ‘black box’ to its consumers.” *IT services* (e.g., software application services and network services) support business services realization [13]. Thus, they are an important means towards establishing Business-IT alignment [1,23].

Service quality is an abstract concept due to the nature of the notion of service, which is intangible and non-homogeneous, and whose consumption and production are inseparable. It is a measure of how much a service level meets or does not meet customers’ requirements and expectations. The intangibility of services makes it difficult to understand how customers observe and evaluate service quality [41].

To be able to offer quality, suppliers should continually assess how they are providing services as well as the future expectations of customers. Providing consistent quality is important, but is also one of the most difficult aspects of the service industry (ISO/IEC 20000, [26]). In order to assess and improve service quality, suppliers need to evaluate the quality of the processes they perform to deliver services. Guidance on how to develop and improve maturity practices for IT services is a key factor to improve service performance and customer satisfaction [19]. There are several models and standards addressing processes related to service, such as CMMI-SVC [19], ITIL [39], and ISO/IEC 20000 (ISO/IEC, [26]). All of them require the use of measures to monitor service-related processes.

Measurement plays a key role in process improvement initiatives [18,33] and can quantitatively demonstrate quality, predict processes behavior, and allow suppliers to increase the probability of achieving the expected IT service quality [37,45]. The basic element for measurement is measure, which quantifies aspects of entities to characterize

them. When data are collected for measures, it is possible to analyze them and obtain useful information. When information provided by a measure can be used to monitor goals achievement, measure is said to be an indicator [8–11].

In the literature, there are several works addressing aspects related to measurement and IT services. SINIS was developed based on the knowledge provided by some of them, namely: GQM + Strategies [6]; COBIT Goals Cascade [25]; Balanced Scorecard [29]; IT service standards such as ITIL [39], ISO/IEC 20000 (ISO/IEC, [26]), CMMI for Services [19]; and the Reference Software Measurement Ontology [11]. GQM + Strategies and COBIT Goals Cascade served as the main basis for SINIS. Therefore, these approaches are briefly presented in the following.

2.1. GQM + Strategies

The *GQM + Strategies* approach for goal-oriented measurement [6] is an extension of the Goal-Question-Metric approach [5], or GQM. It supports deriving, linking and disseminating goals and strategies across various levels of an organization, and helps verify the success or failure of strategies and goals using a measurement system. In GQM + Strategies, the *strategies* term refers to projects, actions or initiatives performed to achieve goals.

GQM + Strategies provides a model that relates goals and strategies at various organizational levels. One or more *strategies* can accomplish a *goal*. Context factors and assumptions influence goals and strategies. *Context factors* represent known organizational environment variables. *Assumptions* are predicted, estimated or guessed unknowns, which can impact the interpretation of measurement data, as well as associated goals and strategies [6].

GQM + Strategies supports not only the identification of goals and strategies at various levels of the organization, but also the definition of measures aligned to the organization's goals, and measurement data interpretation and compilation at each level [31]. For the latter purposes, GQM is used. A *GQM model* consists of a measurement goal plus associated questions, measures, and supplementary interpretation models. At each level, for each goal, a GQM model measures goals achievement considering the related strategy [6].

GQM + Strategies elements[2] and related GQM models are organized into a *GQM + Strategies Grid*, a graphical representation showing goals and strategies at each organizational level, including GQM models required for monitoring and verifying goals achievement. The grid makes goals and strategies explicit, as well as the related measurement initiatives. In addition, at each organizational level it is possible to get a clear understanding regarding how the strategies at that level contribute to goals at higher levels.

2.2. COBIT goals cascade

COBIT (Control Objectives for Information and related Technology) [25] is a good-practices framework created to support enterprise IT governance and management. *COBIT Goals Cascade* [25] is the mechanism to use stakeholder needs to derive enterprise goals, IT-related goals and enabler goals, which should be specific, actionable and customized. This derivation allows setting specific goals at each level of the organization, aligned to business goals and stakeholder requirements.

COBIT Goals Cascade is composed of four steps to cascade goals from top level (e.g., enterprise goals) to lower levels (e.g., IT-related goals), and then, similarly to strategies in GQM + Strategies, COBIT Goals Cascade introduces *enablers* as a way to achieve IT goals. The four steps of COBIT Goals Cascade are: stakeholder drivers influence stakeholder needs, stakeholder needs cascade to enterprise goals, enterprise goals cascade to IT-related goals, and IT-related goals cascade to enabler goals.

COBIT Goals Cascade provides a reusable catalog with 17 enterprise goals, 17 IT-related goals, 37 processes and more than 100 indicators [25]. Organizations can reuse these elements. For example, an organization with the enterprise goal “Business service continuity and availability” could use the COBIT Goals Cascade catalog and search for IT-related goals related to this enterprise goal. It could select the IT-related goal “Adequate use of applications, information and technology solutions,” and then search for processes related to this IT-related goal (e.g., “Manage Change Acceptance and Transitioning process”) and indicators to measure the processes (e.g., “Number or percent of releases that fail to stabilize within an acceptable period”). However, as different market situations and environments require different measures, COBIT Goals Cascade recommends that each organization should build its own goals cascade, compare it with COBIT's, and then refine it [25].

COBIT is considered a framework to address IT governance challenges in a holistic way [3]. However, industry considers implementing COBIT Goals Cascade to be a difficult task, and it may be applied selectively [4]. In this sense, Steuperaert [46] proposed an improvement to COBIT Goals Cascade, which introduces an additional, limited set of Enterprise Strategies associated with IT-related processes.

3. Research method

The primary research approach adopted to develop SINIS was Design Science Research, which concerns on creating and evaluating new IT artifacts to help organizations to address important information-related tasks [22]. We used this research approach because the object of study is an artifact – specifically, a method including a process and instruments (checklists, templates and examples) to support the execution of that process – that aims at helping organizations to identify IT service-related goals, strategies and indicators. For considering the artifact context of use, its development should involve cycles of experimentation in the IT service industry.

According to HEVNER [22], Design Science Research is an iterative process including three cycles: the *Relevance Cycle*, the *Design Cycle* and the *Rigor Cycle*.

A Design Science Research project begins with the *Relevance Cycle*, which involves defining the problem to be addressed, the research requirements, and the criteria to evaluate research results. The problem addressed by the present research project involves the need of IT service organizations or departments to define suitable indicators to monitor IT service goals aligned to organizational goals. Considering the identified problem, we decided to develop a method to guide organizations in identifying IT service indicators by using organizational goals to derive IT service goals and strategies. We defined five requirements for SINIS:

(R1) Allow identifying indicators and strategies at different organizational levels to facilitate reporting the right information to each decision-making management level;
(R2) Foster alignment between indicators and business goals at those different levels;
(R3) Provide procedures and instruments (such as checklists, templates and examples) to support execution;
(R4) Allow reusing indicators; and
(R5) Adopt a consistent measurement terminology.

These requirements were established based on aspects indicated in the literature. Requirements R1 and R2 were defined based on [6], who emphasize that measurement should be aligned to organizational goals and cascaded to several organizational levels to provide useful information for each of them and for the organization as a whole. In addition, those authors advocate using strategies as a way of achieving the established goals, and implementing a measurement system to verify the achievement of goals and the success or failure of strategies.

[2] A GQM + Strategies *element* is composed of an organizational goal, the strategies related to it, and the context factors and assumptions that influence them [6].

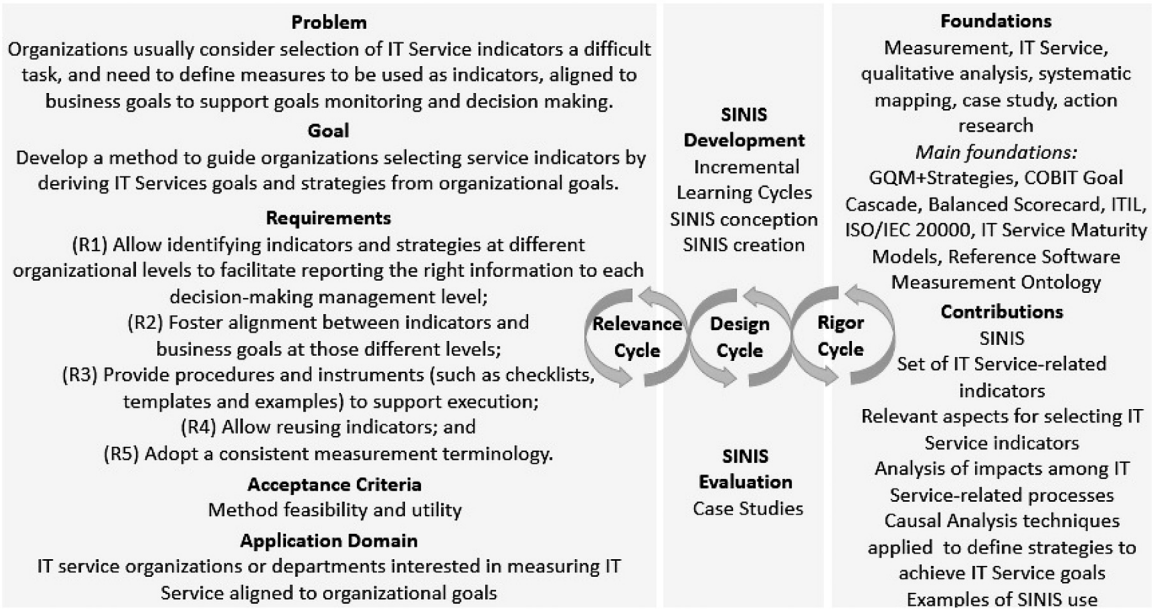

Fig. 1. Overview of the design science research cycles in this work – based on [22].

Requirement R3 was based on studies which recommend the use of instruments to support execution of measurement-related activities. Basili et al. [6] suggest using questions for eliciting goals and categories for classifying goals, while Petersen et al. [40] suggest semi-structured interviews as a complement to templates, as well as notations for obtaining information regarding goals, strategies or indicators. Requirement R4 was based on [28,27,30], who state that identification of indicators can take a long time and suggest that reusing existing indicators can save cost and time, while also inspiring the creation of new indicators. Finally, Requirement R5 considered works by Garcia et al. [20] and Barcellos et al. [8–11], which discuss problems in measurement terminologies and point out the need to use a consistent terminology to promote mutual understanding.

Established requirements should be considered as a criterion to evaluate the proposed method. Moreover, it should be evaluated to what extent SINIS can be used to support identifying goals, strategies and indicators for IT services. For that, *feasibility* and *usefulness* of the method should be considered. SINIS should be considered *feasible* if it can be executed according to its description, if it produces what it is supposed to deliver (IT service-related goals, strategies and indicators) and if its execution requires efforts considered acceptable. On the other hand, SINIS should be considered *useful* if SINIS application provides benefits for the organization. Thus, we defined feasibility and usefulness indicators as follows: *feasibility* = applicability & efficacy & acceptable effort (applicability = SINIS can be executed according to its description; efficacy = SINIS produces what it is supposed to deliver; acceptable effort = SINIS execution requires efforts considered acceptable) and *usefulness* = SINIS use provides benefits for the organization.

The *Design Cycle* involves developing and evaluating artifacts or theories to solve the identified problem. In the present work, the proposed artifact is SINIS, which was developed through two design cycles, each one of them resulting in a version of SINIS. The first design cycle resulted in the version presented in [52]. The second design cycle resulted in the current version, which is presented in this paper. SINIS evaluation was carried out through two case studies. First version of SINIS was evaluated through a case study in an IT Infrastructure department of a large company and provided results for us to improve SINIS [52]. The current version of SINIS was evaluated through another case study in an IT Security department of the same company. In order to develop SINIS, as discussed in the Introduction, we performed five incremental learning cycles, consisting of investigative activities to gain useful knowledge to create SINIS.

Finally, the *Rigor Cycle* refers to using and generating knowledge. Rigor is achieved by appropriately using foundations and methodologies from a knowledge base grounding the research, and adding knowledge generated by the research to contribute to the growing knowledge base. In this work, the main foundations are knowledge related to IT services, measurement, systematic literature review and evaluation methods such as case study. Several pieces of the knowledge used to develop SINIS were obtained through the five incremental learning cycles performed. Certain sources were particularly useful for developing SINIS, with pieces of knowledge which they provided being incorporated in SINIS: principles from GQM + Strategies [6] and Process Analysis [15] were used to support defining indicators and strategies aligned to business goals at different organizational levels, contributing to satisfy R2 and R3; ideas from COBIT Goals Cascade [25], Balanced Scorecard [29], ITIL (OGCa, [39]), ISO/IEC 20000 [26], and CMMI for Services [19] were used to develop checklists, templates and examples provided by SINIS to support its execution, contributing to satisfy R3 and R4; and the Reference Software Measurement Ontology addressed in [8–11] provided the measurement conceptualization and terminology adopted in SINIS, contributing to satisfy requirement R5.

The main contribution to the knowledge base is SINIS itself, as a new method to support the identification of goals, strategies and indicators for IT services. Additionally, the investigations performed in the five incremental learning cycles also contributed to the knowledge base, providing: (i) a set of measures suitable for IT service measurement [49]; (ii) aspects to be considered when identifying IT service indicators [48]; (ii) knowledge related to analysis of impacts among IT service-related processes [50]; (iii) relevant knowledge about using GQM + Strategies in the IT service domain [51]; and (iv) knowledge involving the use of causal analysis techniques to identify aspects to be addressed when defining strategies to achieve IT service goals [54]. Lastly, the studies carried out to evaluate SINIS in industry can serve as examples for other people to apply SINIS.

Fig. 1 summarizes the main information related to the Design Science cycles in this research. As shown in the figure, there are intersections between the Relevance and Rigor cycles and the Design Cycle – i.e., the Design Cycle takes into account the Relevance Cycle (e.g., the method should meet the established requirements) and the Rigor Cycle (e.g., the development of the method should be grounded in scientific theories and methods).

3.1. Threats to validity

There are some threats involved in the way we developed SINIS. First, the use of various existing approaches, libraries, frameworks and techniques from the literature as a basis to build SINIS could result in a method hard to be understood and used. In order to minimize this threat, we defined SINIS as a systematic process to be used as a step-by-step procedure, and we created a set of supporting instruments (checklists, templates and examples) to help the users on performing SINIS activities. By doing that, previous knowledge of approaches, libraries, frameworks and techniques used as a basis to SINIS is not required. Moreover, the use of these several bases to SINIS could result in a method that fails to achieve its requirements and it would be bad to found out that only after the method is created. To treat this threat, we adopted a development approach based incremental learning cycles. This way, each of the basis to SINIS was evaluated in the IT Service domain before being incorporated to the method.

In the context of the incremental learning cycles there is a threat that comes from the fact that some studies performed in the incremental learning cycles were performed in the same company. This could result in a method designed for a single-case scenario. In order to minimize this threat, we performed the studies in different departments, involving different people. Besides, we created supporting instruments based on specialized literature instead of on particular characteristics of the organization. By doing that, we provide a more general solution that can be used by other organizations. Moreover, we considered in the method scenarios involving organizations that do not have any defined goals, strategies or indicators, as well as organizations that have already started measuring, but need to improve their goals, strategies or indicators. This amplifies the range of organizations that can benefit from using SINIS.

Concerning construct validity, which is related to the measures used to evaluate the object of study, the main threat refers to the indicators used to evaluate SINIS, since they may not be able to fully represent the properties they operationalize. To minimize this threat, we defined indicators for the properties we considered necessary to SINIS be applied to solve the problems it was conceived to solve. These properties were used as acceptance criteria in SINIS evaluations.

As for internal validity, the main threat is that all studies performed during SINIS development were conducted by researchers, including the two case studies performed to evaluate SINIS. The researchers' participation can have affected the studies' results (different results could be obtained if the researchers have not intervened in the studies). Trying to minimize this treat, researchers' participation was limited to activities in which their intervention was really necessary (for example, researchers performed themselves all activities in the systematic mapping, while in studies involving IT service departments, researchers limited to observe or guide activities' execution). Additionally, except by the last case study (discussed in Section 5), data obtained from studies were analyzed and interpreted by more than one researcher.

The strategy we adopted to evaluate SINIS is case-based. One of the biggest threats in this context is the ability to generalize from the case-specific findings to different cases [56]. Thus, the main threat to external validity in this study is about results' generalization. Generalizations produced in Design Science Research are considered middle range, generalizing beyond the case level, but not intending to be universal [55]. They are valid to restrict ranges of contexts and, although are not universal, they are more useful in practice [56]. In case-based research, after getting results from specific case studies, generalization can be established for similar cases. For evaluating SINIS, we selected a large organization with IT service culture and well-established IT-related service departments and processes. We considered that scenario favorable to apply SINIS and a good one to provide results that could be also expected in other similar organizations. We performed two case studies in different IT service-related departments of this same organization. The first version of SINIS was applied in the IT Infrastructure department [52] and the second version, the one addressed in this paper, was applied in the IT Security department. Thus, SINIS results cannot be exhaustively generalized. However, we believe that it is plausible that they can be generalized for similar environments.

4. SINIS – a method to support identifying goals, strategies and indicators for IT services

SINIS is a method to support organizations in identifying IT service-related goals, strategies and indicators in alignment with organizational goals. The method allows identifying strategies that contribute to goals achievement and indicators that can be used to monitor strategies and goals. In this work, the strategy term is used as proposed in GQM + Strategies [6]. Thus, it refers to projects, initiatives or actions defined or performed aiming at goals achievement.

As discussed in the previous sections, SINIS reuses knowledge provided by other proposals, being based mainly on GQM + Strategies [6] and COBIT Goals Cascade [25]. In fact, SINIS could be understood as an extension of GQM + Strategies for the IT service domain. SINIS extends GQM + Strategies by addressing aspects that are particular to IT services, such as IT service goals and indicators. Moreover, different from GQM + Strategies, SINIS provides guidance on how to identify processes to be considered in strategies and also defines a step-by-step procedure supported by checklists, templates and examples that help organizations to use the method. In SINIS, like COBIT Goals Cascade and GQM + Strategies, goals are cascaded from organizational top levels (organizational goals) to lower levels (IT service goals and strategies).

SINIS consists of a process comprising a set of activities to identify (or define) relevant IT service goals, strategies and indicators, along with a set of templates, checklists and examples to support performing these activities. Considering that SINIS involves IT service and measurement-related activities, we suggest that it should be applied by personnel familiar with IT service processes and measurement; however, no knowledge of the approaches used as foundations for SINIS (e.g., COBIT Goals Cascade and Balanced Scorecard) is required.

SINIS can help organizations which are just starting IT service measurement as well as organizations which have already started it and want to review or improve their goals, strategies or indicators. Both scenarios are covered by activities listed below and we indicate to skip any activity when applicable. Fig. 2 shows an overview of SINIS. The SINIS process is composed of five phases. In the figure, the activities of each phase are identified with the same color. Below we describe SINIS phases and activities, and also present some of the templates which may be used when performing the activities. A full description of the SINIS activities plus all the checklists, templates and examples provided to help SINIS use is available at [53].

SINIS goal is to help IT service organizations to:

- Define IT service goals, aligned with business goals;
- Define strategies for people (or teams) to work on aiming at IT service goals achievement;
- Define indicators and measurement plans to measure the achievement of IT service goals and strategies;
- Define interpretation models for indicators.

4.1. Elicit context factors and assumptions for IT services

This phase involves obtaining relevant information about the organization and the IT service department at which SINIS will be used that can influence the selection and definition of goals, strategies and indicators.

IT service goals and strategies are defined within the context of the organization, where options are limited by the capabilities, issues or constraints of the organization. Thus, it is necessary to identify context factors and assumptions. Context factors are aspects which are factually

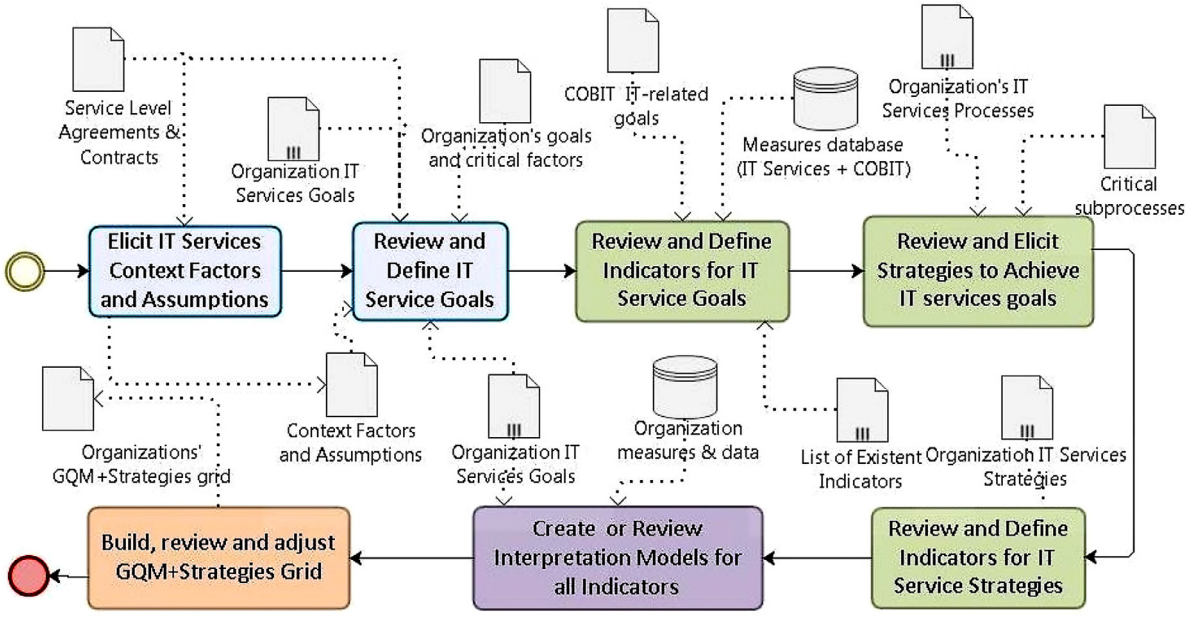

Fig. 2. Overview of SINIS.

known (e.g., the organization needs to improve service availability) and assumptions are aspects which are believed to be true, but with little or no evidence (e.g., in the organization, IT service costs cannot be increased). Context factors and assumptions provide useful information to define the scope of the IT service goals and strategies. In addition, differentiating between what we factually know and what we believe to be true will help later to properly interpret measurement data and find potential reasons for strategies which did not succeed [6].

Documents (such as service level agreements and contracts) can be used as a source for identifying context factors and assumptions. If documents are not available, meetings with stakeholders can be used to gather information. Examples of questions which can be used to elicit context factors and assumptions are presented in Table 1. Context factors and assumptions can be recorded by using the template shown in Table 2.

Table 2
SINIS template for context factors and assumptions.

Context Factors	
Context factor	*<Description of context factor – what is factually known – related to IT services >*
Context factor source	*<Description of the source from where the context factor was obtained>*
Date	*<Date when context factor was considered>*
Responsible	*<Person responsible for describing this context factor>*
Assumptions	
Assumption	*<Description of assumption – what we believe is true but have little or no evidence about – related to IT services >*
Assumption source	*<Description of the source from where this assumption was obtained>*
Date	*<Date when assumption was considered>*
Responsible	*<Person responsible for describing this assumption >*

4.2. Define IT service goals and indicators

This phase involves gathering, defining and reviewing IT service goals based on organizational goals. In addition, it addresses defining indicators to monitor the identified IT service goals. It is composed of four activities, which are described below.

(i) Select IT Service Goals: During this activity, existing IT service goals are reviewed to select those aligned to organizational goals. Information about IT service goals can be obtained from analyzing documents or interviewing IT service department managers. If the organization has not defined IT service goals, it must skip this activity and perform the next one.

SINIS provides a checklist with actions to be performed when identifying IT service goals, including: ensuring that the scope of a goal is related to something that the IT service department is able to deliver; verifying whether the service goal is actually related to an organizational goal that identifies which IT service process is related to the goal; classifying the goal as Maintaining, Increasing or Reducing something; quantifying the degree to which the goal should be achieved; defining a timeframe to achieve the goal; identifying the primary role responsible for the goal; and identifying the relevant constraints which may prevent

Table 1
SINIS questions to support elicitation of IT service context factors and assumptions, (based on [6,40,42]).

	SINIS questions to support elicitation of IT Services Context Factors and Assumptions
1	What is the scope of the IT service department?
2	Which are the clients of the IT service department?
3	What information can be gathered from existing service level agreements and contracts with clients about the provided services?
4	What can be extracted from issues root cause on history reports about the provided services?
5	What can be extracted from customers satisfaction reports about the provided services?
6	What can be linked to IT services from organization vision, mission and values statements?
7	Which are the organization's goals?
8	What links can be identified between the IT service department and economic, social, political, market trends, and environmental and technological aspects?
9	Which are the perceived IT services critical success factors?
10	What can be used from existent measurement models, data, baselines and targets?

Table 3
Template for recording IT service goals.

IT service Goal	
IT service Goal	*<Name of the IT service goal>*
Activity	*<Is the goal to Maintain, Increase or Reduce?>*
Object	*<What is the object the goal is related to?>*
Magnitude	*<What is the quantity of the goal which should be achieved?>*
Time Frame	*<When should the goal be achieved?>*
Responsible	*<Who are the role primarily responsible for achieving the goal?>*
Constraints	*<What relevant constraints may prevent achieving the goal?>*
COBIT Goals Cascade	
IT-related Goals	• *<One of 17 available IT-related goals from COBIT:* • *Aligning IT strategy and business strategy* • *Ensuring IT compliance and supporting business compliance with external laws and regulations* • *Ensuring commitment of executive management to IT-related decision-making* • *Managing IT-related business risk* • *Realizing benefits from IT-enabled investments and services portfolio* • *Ensuring transparency of IT costs, benefits and risks* • *Delivering IT services in alignment with business requirements* • *Adequately using applications, information and technology solutions* • *Ensuring IT agility* • *Ensuring security of information, processing infrastructure and applications* • *Optimizing IT assets, resources and capabilities* • *Enabling and supporting business processes by integrating applications and technology into business processes* • *Delivering programs providing benefits, on-time, on-budget, and meeting requirements and quality standards* • *Providing reliable and useful information for decision-making* • *Ensuring IT compliance with internal policies* • *Ensuring competent and motivated business and IT personnel* • *Developing knowledge, expertise and initiatives for business innovation>*
BSC Dimension	*<Finance, Customer, Internal, or Learning and Growth>*
IT service-related Processes	*<Process which can impact goal achievement>*

achieving the goal.

Table 3 shows the template for documenting an IT service goal. The template is based on GQM + Strategies [6] and requires information regarding the Balanced Scorecard (BSC) dimensions [29] related to the IT service goal. BSC dimensions are helpful in subsequent activities which involve reusing COBIT Goals Cascade indicators [25], since in COBIT Goals Cascade goals are classified by BSC dimension. In addition, it is relevant to identify IT service-related processes because measures associated with them might be useful as indicators [21].

(ii) Include New IT Service Goals: This activity consists in defining new IT service goals, following SMART principles: Specific, Measurable, Achievable, Relevant and Time-Bound [14]. In addition, goals should not be broad or vague. They should be broken down into specific results, written using words which clearly describe the results to be achieved as evidenced by indicators [12]. Examples of questions which can support defining IT service goals include the ones presented in Table 1 and also the following [6,40]: What does the IT service department plan to execute in the next period? What future is envisioned for the IT service department in the following years? How does the IT service department want to grow, gain new clients or provide services based on new competencies? What is the definition of success for the IT service department? Does the IT service department need or desire to improve any aspect of its service delivery?

(iii) Associate Existing Indicators to IT Service Goals: During this activity, the indicators in use by the IT service department are gathered and analyzed, and then it is verified whether indicators are associated with the IT service goals. Information about the indicators can be gathered from existing measurement documentation, repositories or from meetings. Indicators not related to any IT service goal should be discarded. For each indicator, a measurement plan should be established in order to allow properly understanding the indicator and make explicit its related goals. SINIS provides a template for documenting measurement plan for indicators, including the following information: related IT service goal related, measurement goal, information need, indicator, measurable entity type, base measures, measure calculation formula, measurement procedure, measurement responsible, measure unit, measurement moment and measurement periodicity.

(iv) Create New Indicators for IT Service Goals: During this activity, new indicators should be defined and associated to IT service goals. New indicators should be defined when the existing ones are not able to provide the necessary information, or when there is no indicator. Reusing indicators can help to reduce the effort, time and cost spent on this activity. In this sense, measures suggested in the COBIT Goals Cascade process [25] and in the IT service list of measures provided in [49] can be reused or can inspire defining new ones. The defined indicators should be described in measurement plans including the information cited in the previous activity.

4.3. Elicit strategies to achieve IT service goals, indicators and interpretation models

This phase involves identifying processes critical to IT services and root causes for the main issues to be addressed by strategies for achieving IT service goals. In addition, this phase addresses defining indicators and the respective interpretation models to monitor the defined strategies. It comprises five activities, described below.

(i) Gather Existing Strategies: During this activity, if the organization already has a list of IT service strategies planned or on course to achieve IT service goals, these strategies are gathered and reviewed. Information about the strategies can be gathered from documents, meetings records or by interviewing IT service managers and teams.

Strategies should be analyzed considering if their results contribute to achieve IT service goals. When the name or description of a strategy is not clear, it should be rewritten to clarify how it aligns with the related goals. However, when the results of an existing strategy do not contribute to goals achievement, the strategy should be reformulated or stop being executed, to avoid wasting efforts working on a strategy not aligned to any goal. Table 4 shows the SINIS template for documenting strategies.

(ii) Analyze Critical IT Service Processes: This activity consists of analyzing critical processes as a way to support defining strategies to achieve IT service goals. A critical process is a process which can impact business goals, a failed process, or a process which might fail [24]. Strategies should focus on critical processes or aspects that impact goals

Table 4
SINIS template for strategies [52].

IT Strategies	
IT service Goals	*<Associated IT service goals>*
Strategy Name	*<Name of the strategy>*
Strategy Scope	*<Description of scope for the strategy>*
Strategy Owner	*<Personnel responsible for the strategy>*
Strategy Sponsor	*<Sponsor for funding the strategy>*
Strategy Complexity	*< Low, Medium, High>*
Strategy Risk	*< Low, Medium, High>*
Strategy Cost	*<Cost to perform the strategy>*
Strategy Context Factors	*<Context factors considered for this strategy>*

achievement. Thus, SINIS recommends that critical processes related to IT service goals are identified and modeled to provide a detailed view about how the processes relate to goals and to provide insights for establishing strategies. In addition, relationships between processes should be investigated to identify critical cause-and-effect relationships which should be considered when establishing the strategies [51].

SINIS does not specify any technique or detail level to model processes. The important is that process modeling be sufficiently understandable to allow identifying possible conflicts, issues, difficulties or problems which might impact goals achievement and, thus, should be addressed by the strategies. Questions which can help identify critical processes include: Which processes related to IT service goals have the highest potential for improvement? Is there a plan for improving them? Which processes are currently not performing well? Which processes have strong correlation with goal results? Which processes are important for stabilizing performance? Which processes pose significant risks for a goal, or might prevent it from being achieved? Which processes serve as key inputs to a goal? Which processes consume much effort to be performed?

After gaining clear knowledge about the target processes, an investigation should be carried out to identify which part of the processes (i.e., sub-process) should be addressed by strategies. A root-cause investigation can help identify causes of problems in the critical processes and understand which part of the processes should be focused by the strategies. For performing causal analysis, several methods can be used such as document analysis, interviews, brainstorming, flowcharts, Five Whys, and Pareto, among others [43].

(iii) Establish Strategies to Achieve IT Service Goals: This activity involves determining what needs to be done to achieve IT service goals. During this activity, existing strategies are reviewed, and new strategies are defined in a round of brainstorming meetings conducted with the stakeholders. The purpose of these meetings is to relate strategies to IT service goals, discard useless strategies, adjust deficient strategies and define new ones. A same strategy can be related to different goals and more than one strategy can be necessary to achieve a goal.

SINIS advocates that strategies to achieve IT service goals should focus on processes which impact goals achievement (i.e., critical processes) and on solving difficulties which prevent goals achievement. Based on the results of the root-cause investigations performed in the previous activity, strategies to achieve IT service goals are defined. When defining the strategies, specific context factors and assumptions should be elicited for each strategy. They must be consistent with the general context factors and assumptions previously defined in the Elicit IT service Context Factors and Assumptions phase.

(iv) Identify Indicators for Strategies: In this activity, similar to what is done to IT service goals, strategies are made measurable by specifying indicators to measure them. Indicators identified during the Associate Existing Indicators to IT Service Goals and Associate Existing Indicators to IT Service Goals activities can also be associated to strategies defined to the goals the indicator relate to. Moreover, new indicators can be defined. For each indicator, a measurement plan should be established. In order to reduce effort, time and cost, SINIS recommends reusing existing measures by consulting measures suggested in the COBIT Goals Cascade [25] and in the list of IT service-related measures [49].

4.4. Create interpretation models for all indicators

In this phase, interpretation models for all indicators (related to IT service goals and strategies) are created. This activity is executed only at this moment to avoid rework and wasted time in case of discarding or adjusting any indicator. Interpretation models determine how collected data should be interpreted to support informed decisions about IT service strategies and goals achievement. Targets can be defined based on previous service level agreements and contracts, reports or business needs. Meetings with stakeholders can be used as a way to gather information. Questions to support obtain relevant information for defining interpretation models include: What is the expected result (or range) for each indicator in order to achieve the associated goal? If the result is above or below the range, should it be interpreted as good or bad? What was the last measured result for each indicator? Who are the personnel responsible for interpreting the indicator? How/when should the indicator be interpreted? Table 5 provides a template for recording interpretation models.

4.5. Build, review and adjust GQM + Strategies grid

During this phase, context factors, assumptions, goals, strategies and indicators are organized into a GQM + Strategies Grid in order to provide an overview of the results produced during the previous activities. The grid helps validate information and identify items which need to be reviewed. Flexibility is important to allow iterative changes in the GQM + Strategies Grid, to ensure that the overall plan is aligned with and reflects the organization needs [38]. Ideally, the grid should present the cleanest possible view of the defined IT goals, strategies and indicators. Fig. 3 shows the template that can be used to create the grid. SINIS suggests designing the grid in a way that goals, strategies and indicators at different levels can be viewed on a single page. In addition, general context factors and assumptions should also be included, making it possible to verify whether they are up-to-date. Thus, if there is a need to update the context factors and assumptions, the grid provides a convenient view of the goals, strategies and indicators which would be impacted by the changes.

The GQM + Strategies Grid interpretation models should be presented to all stakeholders in order to be validated and have the applicability, completeness, accuracy and consistency of the goals,

Table 5
SINIS Template for Interpretation Models for Indicators.

Related Indicator	*<Name of the indicator >*
Target	*<Value desired for the indicator in order to achieve the associated goal>*
Range	*<Upper and lower values to be achieved by the indicator, defined based on historical data or organization goal>*
Baseline	*<Reference value that reflects a previously measured behavior of the indicator considering historical data>*
Interpretation Model	*<Procedure to be followed to analyze data collected for the indicator >*
Interpretation Responsible	*< Role performed by personnel in charge of analyzing the data>*
Interpretation Moment	*<Activity during which the data analysis should be performed>*
Interpretation Periodicity	*<Frequency at which the data analysis should be performed>*

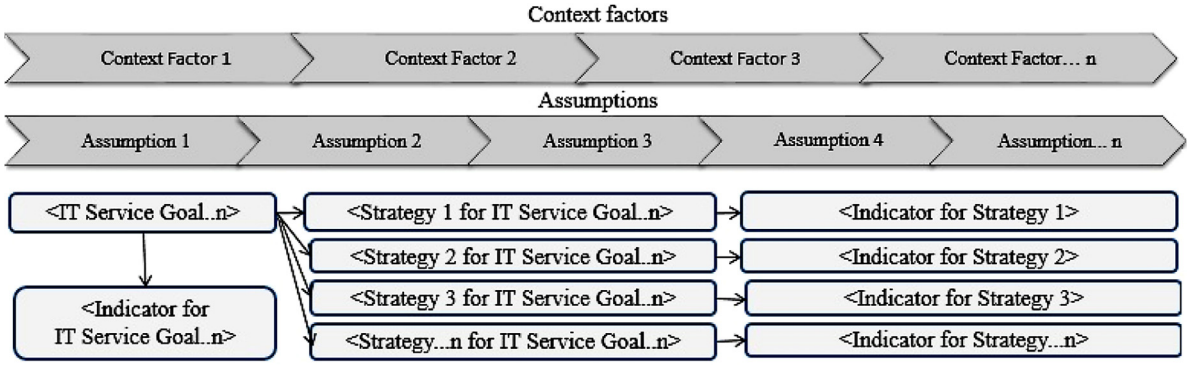

Fig. 3. SINIS Template for GQM + Strategies Grid.

strategies and indicators evaluated. In addition, discussions can point out potential findings and opportunities for improvement. It is recommended to involve personnel who were not involved in applying SINIS, but who will be eventually involved in or impacted by the execution or results of the defined strategies. During this phase, if any adjustment is needed, it is possible to go back to the activity in which the adjustments need to be made, and then continue applying SINIS again from that point to the end. For example, if an IT service goal needs to be adjusted, the related indicator, interpretation model, and strategies also need to be revisited.

5. Applying SINIS

As we discussed in Section 3, the strategy we adopted to evaluate SINIS is case-based. By following this strategy, we study individual cases and try to hypothesize a generalization for a similar population [56]. Thus, to evaluate the use of SINIS in a practical context, SINIS was applied in a case study to define IT service goals, strategies and indicators in an IT service department of a large company. The following sections present the case study design (Section 5.1), execution and data collection (Section 5.2), analysis, interpretation and lessons learned (Section 5.3), and threats to validity (Section 5.4).

5.1. Case study design

The *goal* of the case study was to evaluate the use of SINIS in a real context in industry as a way to support identifying IT service-related goals, strategies and indicators.

Considering this goal, the following *research question* should be answered:

(RQ1) To what extent can SINIS be used to identify goals, strategies and indicators for IT services?

The *organization* selected for the study is a large global organization headquartered in Brazil (referred here as “Organization A” to maintain confidentiality). This organization operates in over 30 countries and has offices, operations, exploration and joint ventures across five continents. SINIS was applied in the *IT Security department*. The IT Security department is part of the IT Services area that, in turn, is part of the Information Technology (IT) organizational unit of the Organization A. The IT Security department is headed by an IT Security Manager with the help of an IT Service coordinator, who coordinates the 15 members that compose IT Security team and acts as an interface between the manager and the team. IT Security team performs processes such as access management, vulnerability management, threat management, proactive monitoring and risk management. Some of the responsibilities of the IT Security department are: define the IT Security strategy, translating it into a roadmap of projects and initiatives towards the security and protection maturity defined by the leadership of the company; establish and monitor governance making sure the decisions on information security are being taken at the right level of the company; ensure the performance of IT Security processes and their related technological components by ensuring compliance with the policies, standards and processes established in the company; manage the agreed levels of services in the provision of IT security services; act on incidents and issues related to IT security; guarantee that employees are aware of the value of information becoming committed to their role in protecting it, reducing the likelihood of successful cyberattacks; and act as the center of excellence in cyber-security for the whole digital surface of Organization A, offering a catalogue of services for prevention and detection security operations.

The IT Security manager reported that his team was spending too much effort to perform measurements not aligned with the organization and the department goals. Thus, neither the coordinator nor team members did not know why they were spending time on measurement activities, leading them to lose motivation and confidence in the measurement results. Although many measures had been collected, the team members did not know how these measures were related to IT Security goals, or whom they should be reported to or how to interpret the measurement results. Moreover, the IT Security manager was asked by the board of directors of the organization to build a single-page report with a dashboard showing IT Security indicators. He was unsure of which indicators were more relevant to be included in the dashboard and would have to review the indicators and build a high-level dashboard. The study *participants* were the IT Security coordinator, the IT Security manager and the IT Security team.

The *procedure* planned for performing the study consisted of following the SINIS phases and activities, and using the provided templates, checklists and examples to define IT service goals, strategies and indicators to the IT Security department.

For answering the study research question, it is necessary to evaluate if SINIS is feasible and useful. As discussed in Section 3, SINIS should be considered feasible if it can be executed according to its description, if it produces what it is supposed to deliver (IT service-related goals, strategies and indicators) and if execution requires efforts considered acceptable. On the other hand, SINIS should be considered useful if its application provides benefits for the organization. Thus, after SINIS use, *data collection* should be done through interviews with participants to get feedback about SINIS. The research question should be used as the main question for the interviews and some supporting questions related to the research question should be used in the case the interviewee does not provide enough information based only on the research question. Examples of these supporting questions are: Did SINIS help to properly identify IT service goals? Did SINIS help to properly identify IT service strategies? Did SINIS help to properly identify IT service indicators? Did SINIS help to properly identify the relations between IT service goals, strategies and indicators? Did the produced grid help to understand the relations between IT service goals, strategies and indicators? Did the checklists, templates and examples help to perform SINIS activities? What benefits were perceived

from SINIS use? What problems or limitations were perceived when using SINIS? Do you consider the effort demanded to perform SINIS acceptable? Interviews should be recorded and transcribed in a document. *Data validation* should be done by showing the document containing the recorded data to the participants (personally or by email) and asking for their validation. After collecting and validating data, they should be interpreted (*data analysis*) aiming to verify if SINIS was considered feasible and useful. Thus, the answers provided by the interviewee(s) should be analyzed aiming to get information that allows verifying if it was possible to execute SINIS activities based on their descriptions, if SINIS produced what it is supposed to deliver, if its execution required efforts considered acceptable and if its use provided benefits for the organization.

5.2. Case study execution and data collection

In this section, we describe how SINIS activities were performed and present some results produced during SINIS application. The activities were conducted by the first author and performed together with the study participants. As suggested in SINIS, during some activities we performed meetings and semi-structured interviews, taking a maximum of 2 hours each. Some meetings/interviews involved the IT Security coordinator, while others included all team members (including the IT Security manager), and others the domain expert (a team member). After applying SINIS, we conducted an interview with the IT Security coordinator to obtain feedback about SINIS use.

5.2.1. Elicit IT service context factors and assumptions

In this phase, relevant context factors and assumptions were identified based on organizational goals and other information about the organization. Considering that the main organizational goal was to reduce costs, the first context factor identified was *Organization main goal is to reduce cost* and the related assumption was *the IT Security department should not increase costs*. Based on information provided by the IT Security manager, the second context factor identified was *IT Security department does not have people dedicated to measurement activities* and the related assumption was *a member of the IT Security team is responsible for collecting and storing data for indicators and presenting the results to the manager at the weekly meeting*.

5.2.2. Define IT service goals and indicators

As described in Section 4, this phase starts with the **Select IT Service Goals** activity. According to the IT Security manager, there was not any established IT service goal, since the team collected and reported indicators, not thinking about goals. Therefore, it was not possible to select IT service goals. Thus, the **Define New IT Service Goals** activity was performed**.** By using questions suggested by SINIS and conducting some meetings, the following IT service goals were identified:

Reduce the costs of resolving IT Security incidents;

- Reduce the time for resolving IT Security incidents;
- Increase the efficiency in executing controls;
- Reduce the number of users with elevated access to the Internet;
- Increase the efficiency of blocking malware messages;
- Reduce the number of users having SAP Segregation of Duties (SOD) conflicts;
- Increase the productivity of the IT Security team;
- Maintain the compliance of applications with IT Security policies;
- Increase the detection and remediation of vulnerabilities;
- Increase the efficiency of workstations and the protection of servers.

Each IT service goal was documented by using the template suggested by SINIS. An example is presented in Table 6.

Once the IT service goals were identified, it was necessary to **Associate Existing Indicators to IT Service Goals**. The IT Security coordinator provided a spreadsheet with 39 indicators. For each indicator, the spreadsheet informed only its name and the role responsible for data collection, being, most of times, difficult to understand what the indicator really measured. Thus, it was necessary investigate the indicators meaning by asking the IT Security coordinator and team. Based on the obtained information, we changed the name of some indicators to make it clearer (e.g., the *Profiles* indicator was renamed to *Number of Profiles Maintained by the Identity Access Management (IAM) System*). Although the IT Security coordinator referred to the spreadsheet content as a list of indicators, it should be understood as a list of measures, because the measures were not aligned to any goal (the IT Security department did not have any established goal at that time). The relations between the indicators and the defined IT service goals were identified. For example, the indicator *Percentage of incidents where field intervention was necessary to solve the issue (manual/total)* was associated to the IT service goals *Reduce the cost of resolving IT Security incidents* and *Reduce the resolution time for IT Security incidents* because resolve an incident manually tends to demand more effort and time and have a higher cost than resolve it automatically. Thus, a high number of incidents that had to be manually solved impacts the achievement of those goals. Seven indicators were discarded, because they did not relate to any IT service goal. Table 7 shows the indicators and the related IT service goals.

Table 6
IT service goal documented according to the SINIS template.

IT service Goal	Reduce the costs of resolving IT Security incidents
Activity	Reduce
Object	Costs associated with resolving IT Security incidents
Magnitude	10%
Time Frame	Annual
Responsible	IT Security Department
Constraints	Do not increase cost
COBIT Goals Cascade IT-related Goal	Delivery of IT services in line with business requirements
BSC Dimension	Customer
IT service-related Process	Incident Management

By using the template suggested by SINIS, a measurement plan was established for each indicator, containing information about the indicator and its relationship with IT service goals. An example is presented in Table 8.

After relating indicators to IT service goals and establishing measurement plans, the IT Security team decided that the selected indicators were enough. Thus, it was not necessary to perform the **Create New Indicators for IT Service Goals** activity.

5.2.3. Elicit strategies to achieve IT service goals, indicators and interpretation models

During this phase, strategies to achieve the IT service goals were established, as well as indicators to monitor the strategies. The first activity of this phase is **Gather Existing Strategies**. The IT Security coordinator reported that the department did not have documented strategies. In fact, this was expected, since at the beginning of this study the team informed that the goals they should achieve were not clearly defined. Considering that it was not possible to selected existing strategies, it would be necessary to define them. Aiming to identify the processes and aspects to be addressed by the strategies to be defined, we performed the **Analyze Critical IT Service Processes** activity. In this activity, we analyzed the processes related to the IT service goals and for some of them (according to the priority established by the IT Security coordinator and team) we developed the process model and investigated causes that could influence the IT service goals achievement. It is important to point out that the process modeling suggested by SINIS is not intended to be exhaustive. Its purpose is only to support discovering parts of the processes and issues that the strategies should

Table 7
Selected indicators and related IT service goals.

Indicator	IT Service Goal
Number of opened audit findings	Increase efficiency in the execution of controls
Number of opened audit findings expiring next month	
Number of reported phishing cases	Increase efficiency in blocking of malware messages
Number of messages blocked by the gateway	
Number of virus events	Increase efficiency of workstations and protection of servers
Percentage of machines with antivirus up-to-date	
Percentage of machines without antivirus	
Antivirus (SLA) server	
Antivirus (SLA) workstations	
Percent of total number of threats that were solved/deleted/eliminated within one month	
Number of threats against servers or workstations that presented issues and could not be deleted or quarantined	
Number of profiles maintained by Identity Access Management system	Increase the productivity of the IT Security team
Number of application owners that participate in IAM (Identity Access Management) processes	
Number of legal or internal audit investigations supported by IT Security team	
Number of IT users	
Number of applications that use Identity Access Management system for authentication	
Number of found vulnerabilities unique on Organization A environment	Increase detection and remediation of vulnerabilities
Vulnerability management resolution rate	
Number of critical applications with critical vulnerabilities	
Number of servers and workstations scanned	
Number of IT Security exceptions accepted	Maintain adherence of applications to IT Security policies
Number of technical notes impacting security	
Number of technical notes expiring next month	
Number of projects with issues identified	
Number of projects monitored by IT Security	
Number of internet users by high tiers	Reduce the number of users with elevated access to Internet
Incidents opened and closed in current month	Reduce the cost of resolving IT Security incidents
Percentage of incidents where field intervention was necessary to solve the issue (manual/total)	
Percentage of SAP job functions	Reduce the number of users with SAP Segregation of Duties (SOD) conflicts
Percentage of SAP approved risky profile users	
Number of SAP manual actions	
Incidents opened and closed in current month	Reduce the resolution time for IT Security incidents
Percentage of incidents where field intervention was necessary to solve the issue (manual/total)	

focus on.

For example, for the IT service goals *Reduce the cost of resolving IT Security incidents solution,* and *Reduce the time for resolving IT Security incidents*, we analyzed the *Incident Management* process and noticed that manual resolution of incidents was usually more expensive and time-demanding than automatic or remote solutions. Thus, strategies to achieve these goals should focus on avoiding situations that lead to manual resolution of incidents. The analysis of the Incident Management process revealed that manual resolution occurs when the IT Security is unable to automatically remove or remotely resolve a threat. Considering that, we conducted a causal analysis to investigate what causes the inability to automatically remove or remotely resolve a threat. The main identified causes were related to Measurement (Remote support team is not measured by amount of solved incidents), Method (Remote access can only be done with user presence), Machinery (Remote support team does not justify when redirect an incident to local support team) and Manpower (Remote access failure to user's workstation or server). The domain expert informed the among these causes, the one related to Machinery, whose effect avoids remote access necessary for remote solutions, is the most critical. It is related to an error in the default installation of users' workstations that prevents enabling the Remote Procedure Call service. This service is required to

Table 8
SINIS measurement plan for the indicator "Percentage of incidents where field intervention was necessary to solve the issue (manual/total)".

Measurement Plan	
Related IT service Goal	Reduce the cost of resolving IT Security incidents; Reduce the resolution time for IT Security incidents
Measurement Goal	Reduce the rate of manual resolutions for IT Security incidents
Information Need	What is the number of IT Security incidents that needed a manual intervention to be solved?
Measurable Entity	Incidents Management Process
Indicator	Percentage of incidents in which field intervention was necessary to solve the issue (manual/total)
Base Measures	NM = Number of IT Security incidents that needed a manual intervention to be solved TN = Total number of IT Security incidents
Measurement Calculation Formula	NM/TN
Measurement Procedure	Extract the incidents list from Remedy application where the Designated Group is IT Security, the Status is solved, and the Summary is antivirus events. Export the incidents list to a spreadsheet in the Microsoft Excel. In the exported spreadsheet, filter and count the number of lines where the Resolution Type was manual (NM), and compute the total number of lines (TN). Store the spreadsheet in the IT Security measurement directory in the current month's folder. Apply the measurement calculation formula and obtain the value of the Percentage of incidents where field intervention was necessary to solve the issue (manual/total).
Measurement Responsible	Incidents Analyst
Measurement Unit	–
Measurement Moment	5th working day of the month
Measurement Periodicity	Monthly

Table 9
SINIS strategy "Enable Remote Procedure Call on Workstations".

IT service Goals	Reduce the cost of resolving IT Security incidents; Reduce the resolution time for IT Security Incidents
Strategy Name	Enable Remote Procedure Call on workstations
Strategy Scope	Create (i) a new installation image to workstations, test it and used it in new workstations, and (ii) a script to enable and start Remote Procedure Call service in every restart in existent workstations.
Strategy Owner	End User Manager
Strategy Sponsor	IT Service Director
Strategy Complexity	Low
Strategy Risk	Low
Strategy Cost	No Cost – Usage of internal resources only
Strategy Context Factors	The End User department would not hire a new service provider to deliver the strategy because there is no available budget
Strategy Assumptions	The End User department would execute the strategy with existing resources and cannot guarantee when the strategy would be completed. There are users with personal workstations that do not have standard installation image and do not login in network to run the script.

be enabled and running for a remote access session to be established. Therefore, strategies to achieve the *Reduce the cost of resolving IT Security incidents solution,* and *Reduce the time for resolving IT Security incidents* should consider this issue.

Taking the findings of the processes analysis into account, we performed the **Establish Strategies to Achieve IT service Goals** activity. Considering the previous example, the following strategy was defined: create (i) a new installation image to workstations, test it and use it in new workstations, and (ii) a script to enable and start Remote Procedure Call service on every restart in existing workstations. The defined strategies were documented by using a SINIS template, as shown in Table 9.

Next, the **Identify Indicators for Strategies** activity was performed. During this activity, measures suggested in the COBIT Goals Cascade and in the IT service list of measures were consulted. However, the organization decided to keep using the indicators already in place and define new indicators, not reusing indicators suggested in the COBIT Goals Cascade and in the IT service list of measures. For identifying the indicator related to the strategy presented in Table 9, we asked the domain expert how to verify whether the strategy was successful. He stated that he would need information about the relation between the number of times that remote resolution could not be performed due to Remote Procedure Call not being enabled and the number of manual incidents. Thus, for monitoring the strategy, the indicator described in Table 10 was defined.

5.2.4. Create interpretation models for all indicators

After documenting all the indicators (i.e., indicators related to IT service goals and strategies) the **Create Interpretation Models for all Indicators** phase was initiated to determine how the data collected for the indicators should be interpreted, and to drive decision-making. Table 11 shows as an example the interpretation model established for the indicator described in Table 10.

5.2.5. Build, review and adjust the GQM + Strategies grid

In the last phase, the grid containing all the information produced during the previous activities was built. The context factors, assumptions, goals, strategies and indicators were organized in a GQM + Strategies Grid and presented to the IT Security coordinator and team to gather feedback. Fig. 4 shows a fragment of the resulting grid.

After applying SINIS, we conducted an interview with the IT Security coordinator aiming to get feedback about SINIS use. Since the IT Security team was overloaded building the single-page report demanded by the board of directors, and the IT Security coordinator acts between the IT Security manager and the IT Security team and communicates with both of them, the IT Security manager designated him to summarize perceptions on behalf of all the study participants. IT Security coordinator is graduated in Computer Science, has 20 years of experience in Information Technology and has played the IT Security coordinator role for 7 years. The research question was used as the starting point for interview and according to the coordinator answers, the supporting questions were used. The interviewee was told to feel free to talk as much they wanted to. The interview took around 60 min and it was recorded and transcribed. Transcript was validated with the coordinator by email.

5.3. Case study analysis, interpretation and lessons learned

In this section, we discuss results about how the research question was answered and we also present some lessons learned that we intend to use in the future to improve SINIS.

5.3.1. Results

When answering the research question (To what extent can SINIS be used to identify goals, strategies and indicators for IT Services?), the coordinator said that by using SINIS, the IT Security team was able to properly define IT service goals aligned to business goals, review existing indicators, keep only indicators aligned to goals, create strategies to achieve the defined goals and indicators to monitor the strategies. Process modeling and causal analysis helped the IT Security team to clarify and understand bottlenecks in the processes and possible root causes for problems that prevent goals achievement. According to the

Table 10
Measurement plan for "Enable Remote Procedure Call on workstations".

Related IT service Goal	Reduce the cost of resolving IT Security incidents; Reduce the time of resolving IT Security incidents
Measurement Goal	Reduce
Information Need	How many times remote resolution was not performed because Remote Procedure Call was not enabled?
Indicator	Percentage of manual incidents caused by remote resolution fail due to not enable Remote Procedure Call
Measurable Entity	Incident Management
Base Measures	NMI = Number of manual incidents caused by remote resolution fail due to not enable Remote Procedure Call TN = Total number of manual incidents
Measure Calculation Formula	NMI/TN
Measurement Moment	First day of the month to measure data from previous month
Measurement Periodicity	Monthly
Measurement Procedure	N1: Extract data from the Incidents Report considering the Incident Type and the Incident Resolution field N2: Extract data from the Incidents Report considering the Incident Type
Measurement Responsible	Personnel from IT Security responsible for antivirus
Measure Unit	Percentage

Table 11
Interpretation Model.

	IT service Goal Indicator	IT service Strategy Indicator
Indicator	Percentage of incidents where field intervention was necessary to resolve the issue (manual / total)	Percentage of manual incidents where remote support failed due to Remote Procedure Call (RPC) not being enabled
IT service Goal/Strategy	IT service Goals: Reduce the cost of resolving IT Security incidents and Reduce the time of resolving IT Security incidents	IT service Strategy: Enable Remote Procedure Call on workstations
Target	20%	10%
Range	Reduction	Reduction
Baseline	60% last year	40% last year
Interpretation	If value is until 5% over target, then only verify isolated cases. If value is more than 5% over target, then review root cause and strategies in place.	If value is until 5% over target, then only verify isolated cases. If value is more than 5% over target, then review implemented strategy.
Interpretation Responsible	IT Security responsible for antivirus	IT Security responsible for antivirus
Interpretation Moment	At the end of each month, starting one month after the End User team completes the strategy	At the end of each month, starting one month after the End User team completes the strategy
Interpretation Periodicity	Every month, the current value is compared to the target and to the previous month as a reference. At the end of the year, the total value is compared to the total value for the previous year.	Every month, the current value is compared to the target and to the previous month, as a reference to verify if the strategy was successful.

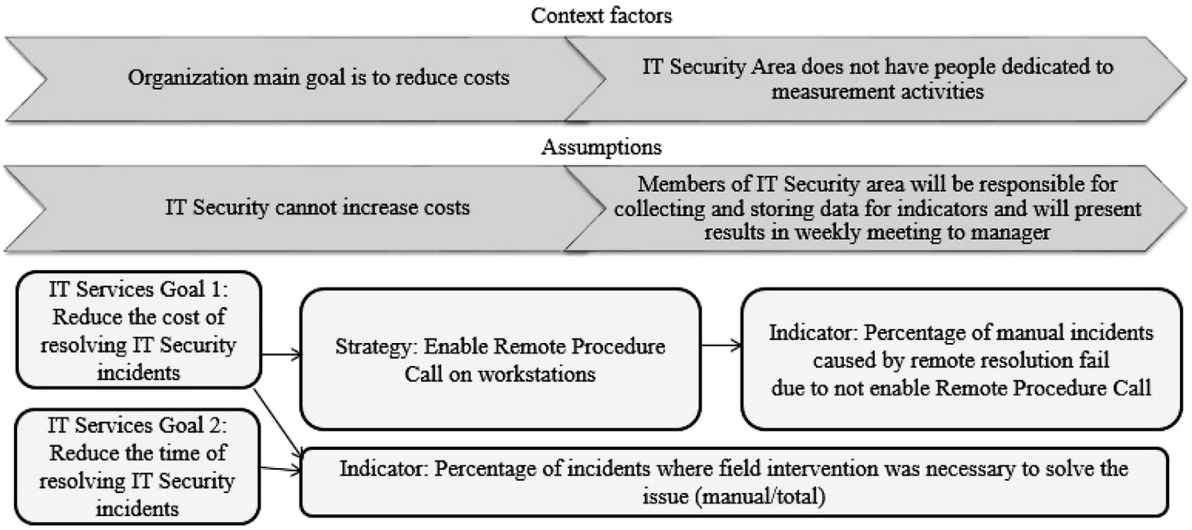

Fig. 4. GQM + Strategies Grid.

coordinator, SINIS also contributed to make clear for the team the relation between goals, strategies and indicators. He stated that after the case study, the IT Security team was more dedicated to measurement activities because members understood the relationship between what they should measure, what they should do (i.e., the strategies), and the relation with the IT service goals. He also reported that some concepts used in SINIS to define goals, strategies, indicators and interpretation models were new to him and the team. He stated that learning about these concepts and documenting goals, strategies and indicators by using SINIS templates helped them better understand what should be done, why it should be done and how it should be done. Moreover, he informed that the team was motivated to keep using SINIS and that the SINIS description and supporting instruments are good specifications that make it possible to execute the activities. The coordinator feedback showed us that, according to him, it was possible to execute SINIS activities based on their descriptions, SINIS produced what it is supposed to deliver, and the use of SINIS provided several benefits for the IT Security department. When asked about the effort demanded to perform SINIS, the coordinator expressed some concern regarding the amount of time required to perform SINIS activities. However, he also said that he believes that the effort tends to decrease as the team becomes more familiar to SINIS. At the end, he said that, taking the obtained results into account, he found the effort to apply SINIS justifiable and acceptable.

We can understand the obtained results as initial evidences that SINIS is feasible (it was possible to execute SINIS by following its description, it produced a set of IT service-related goals, strategies and indicators aligned to organizational goals, and it required efforts considered acceptable) and useful (its use provided benefits for the IT Security department). However, the study presents limitations (discussed in Section 5.4) that prevents results generalization. Thus, although the study provided initial evidences about SINIS feasibility and usefulness, they cannot be generalized.

In addition to answer the research question, after applying SINIS we also evaluated it in terms of its requirements (presented in Section 3).

- Requirement R1 is about identifying goals and indicators at multiple levels. Goals were cascaded from the organization (business goals) to the IT Security department (IT service goals) and derived operational actions (strategies). Indicators were defined to monitor IT Security goals and the strategies defined to achieve them.
- Requirement R2 is about fostering alignment between indicators and goals. According to the IT Security coordinator, defining IT service goals and associating indicators to them was the main benefit of applying SINIS, as they reviewed the existing indicators and discarded indicators not aligned to any goal.
- Requirement R3 is about providing instruments to support SINIS execution. Templates, examples and checklists were used during

Table 12
Lessons Learned.

SINIS Characteristic	Lesson Learned	Improvement
Use of different sources to allow reusing elements (e.g., goals and indicators)	(−) SINIS suggests that indicators can be identified by consulting the COBIT Goals Cascade set of indicators or a list of IT service indicators provided in [49]. However, we noticed that searching a catalog can be ineffective for organizations that have a set of indicators being used.	Provide guidelines about how to select or improve indicators used by the organization.
	(−) Search in different sources can be difficult because sources do not follow a common conceptualization and categorization.	Create a unique catalog of IT service goals, strategies and indicators using RMSO conceptualization and categorize these elements according to maturity models' processes, COBIT and ITIL processes, aiming to make easier search and reuse.
	(+) Consulting the indicators from COBIT Goals Cascade and from [49] provided insights for the team refine their own indicators.	–
Use of causal analysis	(−) Using causal analysis is a good way to find out issues to be addressed by the strategies to be defined to achieve IT service goals. By identifying the aspects that the strategies should focus on, an organization can be prevented from working on many possible (and sometimes inefficient) initiatives. However, SINIS does not support choosing the most suitable causal analysis technique to a given situation. Thus, the decision about which technique to use depends on the knowledge of who is applying SINIS.	Provide some guidelines about which causal analysis techniques better applies to some situations.
SINIS supporting instruments	(−) SINIS templates, checklists and examples were helpful to apply SINIS. However, more information might be needed for personnel not very familiar with IT service processes or measurement. Also, due to the lack of a supporting tool, some activities demanded much time.	Develop a supporting tool and other mechanisms to facilitate SINIS use.
	(+) SINIS provides templates to be filled during activities execution and also examples of filled templates. Having available examples to read during each activity helped the team to easily understand what needed to be filled in the provided templates.	–
Establishment of numeric targets to indicators	(−) SINIS suggests that numeric targets are established for the defined indicators. Targets were established looking at past experiences and considering the manager expectations. There was no information or analysis about the processes capacity to meet the established targets.	Include in SINIS the use of Statistical Process Control to establish more realistic targets and evaluate if the processes are able to achieve them.
	(+) Establish numeric targets for the indicators was good for having a way to measure if strategies are performing as expected.	–
Explicit relations among goals, strategies and indicators	(+) SINIS helps align goals (what is to be achieved), strategies (how to achieve goals) and indicators (how to monitor goals achievement and strategies success). By doing that, team members became more aware about why they should work on the established strategies and provide measurement data.	–
Measurable Strategies	(+) SINIS guides the use of measurement plans to connect indicators to goals and strategies. When applying the measurement plans for measuring the strategies, the IT service manager was able to gather information to evaluate the strategies and, indirectly, also the performance of the team members performing the strategies. This served as a more transparent and non-subjective performance evaluation that was considered less subjected to complaints and discussions.	–

SINIS execution and were considered by the study participants useful to learn how to execute SINIS and to properly record the produced results.

- Requirement R4 is about reusing indicators. Even not reusing indicators from the lists of indicators provided by SINIS, these lists provided insights that helped the IT Security department to reuse and refine some of its own indicators. Moreover, SINIS helped to reduce the time and effort to identify indicators, since in the study the team defined for the first time IT Security goals before thinking about indicators. Thus, indicators identification was strictly focused on measuring goals achievement, instead of involving lengthy unfocused discussions as in the past.
- Requirement R5 is about adopting a consistent terminology. SINIS instruments use terms of the conceptualization provided by a measurement ontology. Once the terms were explained to the participants, they did not have any doubt and we observed no difficulty about the terms meaning during the study.

5.3.2. Lessons learned

The case study allowed us to learn some lessons. In Table 12 we classify a lesson as positive (+) when it refers to SINIS aspects that supported successful results. On the other hand, we classified a lesson as negative (−) when it refers to aspects that need to be addressed in future improvements of SINIS.

5.4. Threats to validity to the case study results

The validity of a study denotes the trustworthiness of the results, and to what extent the results are not biased by researchers' subjective point of view [44]. In this section, we discuss threats involved in the case study. Every study has threats. They should be addressed as much as possible and be considered together with the results obtained in the study. Next, we present the main threats involved in this study by following the classification proposed in [44], namely: construct, internal, external and reliability.

Construct Validity: this aspect of validity is related to the constructs involved in the study. The main threat in this context is the same discussed in Section 3.1, i.e., indicators we used to evaluate SINIS may not be able to fully represent properties they operationalize. Moreover, there is a threat about constructs discussed in interview questions or

presented in SINIS supporting instruments are not interpreted in the same way by the researcher and study participants. For example, in SINIS' context, the "*strategy*" term has a very particular meaning (like in GQM + Strategies) and the terminology adopted to talk about measurement is very domain-specific. This could lead to misunderstandings. To minimize this threat, the terminology adopted in SINIS and indicators used to evaluate SINIS were explained to study participants and doubts were clarified. Additionally, data collected during the interview were validated by the interviewee.

Internal Validity: this aspect of validity is concerned with the relationship between results and the applied treatment. The main threat in this context is related to the researcher who conducted study. The participation of this researcher can have affected study results, since she has knowledge about SINIS (she is one of its creators) and she works in the organization where the study was conducted. Although she does not work in the department where the study was performed, she has knowledge about the organization's business goals and processes. Thus, we cannot state that same results could be obtained if the researcher had not guided the execution of SINIS activities. Trying to minimize this threat, the researcher limited her interference to guide the participants through the execution of SINIS activities and to suggest the use of SINIS provided checklists, templates and examples to support activities execution. Another threat refers to time constraints faced by the IT Security team during the case study. Since the IT Security team had a tight deadline imposed by the director to present a single-page report with a dashboard including the most relevant indicators, it did not have enough time to fully cascade, during the case study, all the identified IT service goals in strategy. To minimize the effects of time constraints on the study, the researcher asked the participants to select a subset of the identified IT service goals and all SINIS activities were performed to them. By doing that, the study participants experienced all SINIS activities.

External Validity: this aspect of validity is concerned with to what extent it is possible to generalize results. Main threats to external validity in this study are: (i) researcher participation; (ii) use of SINIS in a single department of a single organization; (iii) feedback obtained from only one participant of the study. Concerning (i), as discussed in the context of internal validity, the researcher participation may have influenced results. Thus, it is not possible to generalize results for cases without the researcher intervention. As for (ii), the use of SINIS in a single department provides results that can only be considered for other departments similar to the IT Security department of Organization A. Regarding (iiii), perceptions about SINIS use were taken from only one participant. To minimize this threat, the selected the participant who could summarize perceptions from the IT Security manager and team, since he interacts and communicates with both. Considering these threats, study results can only be generalized to departments similar to the IT Security department of the Organization A that are interested in identifying IT service goals, strategies and indicators aligned to business goals, and where the researcher conducts SINIS use.

Reliability Validity: this aspect is concerned with to what extent data and analysis depend on specific researchers. The researcher participation also represents a threat to reliability validity. The researcher only guided the execution of SINIS activities, i.e., she did not execute the SINIS activities herself, in order to minimize her influence (as a researcher) in SINIS' context of use in produced data, as previously discussed. During SINIS execution, interviews and meetings were performed to gather necessary data to perform SINIS activities. All interviews and meetings were recorded, transcribed, and transcripts were validated by participants and a researcher. Another reliability threat is related to the interview to gather feedback about SINIS use. The interview conducted was not totally structured and the interviewee was let to freely talk about his perceptions about SINIS. To minimize the threat of not getting the necessary information to evaluate SINIS, we defined a set of supporting questions to be used depending on answers provided from the interviewee. The analysis of the interview data was made by only one researcher, which represents another threat to reliability validity.

In summary, considering all mentioned threats and the fact we have performed a single case study, we can only present some insights regarding SINIS use and generalization is limited. Thus, obtained results cannot be considered conclusive, but preliminary evidences of SINIS feasibility and usefulness.

6. Conclusions, related work and implications

6.1. Conclusions

Being part of the largest economic sector in the world [47], IT services have been growing by adopting an IT management service-oriented approach to support applications, infrastructure and processes [39]. IT services must be aligned to organizational needs and goals and must be able to contribute to goals achievement. Although the IT service literature states that relevant indicators must be used to verify goals achievement and support decision-making [19], there is a lack of clear guidance about how to define proper indicators aligned to organizational needs and goals [27] [33]. Therefore, IT service departments can spend time and effort measuring without being sure about what the measurement results represent [52].

This paper presented SINIS, a method that extends GQM + Strategies to help organizations identifying goals, strategies and indicators for IT services in alignment with business goals. SINIS consists of a systematic process and instruments (checklists, templates and examples) to support the process execution.

SINIS was used in a case study in the IT Security department of a large global organization. The IT Security team was able to build the GQM + Strategies Grid and discard useless indicators. Team members became more devoted to measurement and strategies, and now understand relationships between goals, strategies and indicators. SINIS instruments contributed to cover the lack of practical examples and guidance to apply GQM + Strategies [6]. The obtained results cannot be considered conclusive, but they show initial evidence that SINIS can be used to identify goals, strategies and indicators for IT services.

SINIS was developed through incremental learning cycles. Each cycle consisted of a study that produced useful knowledge for developing SINIS. In addition to SINIS itself, which is the main contribution of this work, other contributions were produced: (i) a set of measures suitable for IT service measurement [49]; (ii) aspects to be considered when identifying IT service indicators [48]; (ii) knowledge related to analysis of impacts among IT service-related processes [50]; (iii) relevant knowledge about using GQM + Strategies in the IT service domain [51]; and (iv) knowledge involving the use of causal analysis techniques to identify aspects to be addressed when defining strategies to achieve IT service goals [54].

6.2. Related works

As previously discussed, COBIT Goals Cascade and GQM + Strategies are the main basis for SINIS. Thus, there are some similarities between SINIS and these works, but there are also some differences. COBIT Goals Cascade provides a catalog of goals and indicators which can be reused by IT service organizations. COBIT Goals Cascade recommends that each organization should build its own goals cascade, compare it with COBIT Goals Cascade, and then refine it [25]. However, COBIT Goals Cascade does not provide any mechanism to drive this process. As COBIT Goals Cascade, SINIS recommends that goals are cascaded from higher to lower levels. SINIS suggests accessing the COBIT Goal Cascade catalog for reuse and covers the lack of mechanism by providing procedures, checklists, templates and examples that can be used by organizations to define its own goals and indicators. GQM + Strategies recommends that goals, measures and strategies should be aligned and modeled in a grid to make goals and strategies explicit for an

organization and to provide a clear correlation of all measurement initiatives [6]. However, GQM + Strategies does not detail how to identify processes or issues to be considered in strategies or how to define proper strategies and measures [35]. Similar to GQM + Strategies, SINIS uses a grid to represent goals, strategies and indicators. However, different from GQM + Strategies, SINIS recommends analysis of critical processes and causal analysis a way to define proper strategies and indicators to monitor them.

At the best of our knowledge, besides SINIS, there is no other approach that extends GQM + Strategies to the IT service domain providing a systematic process, checklists, templates and examples. However, there are some research efforts which apply GQM + Strategies and discuss some of the gaps addressed by SINIS. Moreover, there are proposals which, although not devoted to IT services, can be used in this context. For example, López et al. [34], Basili et al. [7] and Kaneko et al. [28] provide lessons learned, results and experiences from applying the GQM + Strategies approach in industry, but they do not suggest any kind of method or procedures to be used when applying GQM + Strategies. Asghari [2] uses action research and proposes an elicitation approach called Goal Strategy Elicitation to support collecting information for goals and strategies to apply GQM + Strategies. That author considers that there is a need to conduct more empirical research on GQM + Strategies, as the approach has been evaluated in few cases thus far.

Concerning research efforts related to identification of indicators for measuring IT services, a framework for measuring IT services is presented by Lepmets et al. [32] and later validated in industry [33], but only a catalog is provided, not a method to define and select indicators aligned to goals. Moreover, the authors state that alignment between business goals and IT services needs to be studied in the industry and could provide additional support for their framework. Jäntti et al. [27] present a support system for IT service measurement. According to the authors, in addition to a well-designed and easy-to-use measuring tool, there is a need for a systematic measurement process, and measures need to be based on business goals. To answer this need, the authors suggest a summarized framework based on ITIL [39], but emphasize that the study focused on implementing the measurement system and that the framework was not validated in real cases.

6.3. Implications

The contributions of this work have implications for both, practice and research. In this section, we discuss some of these implications.

6.3.1. Implications for practice

In the context of practice, SINIS can be used to help IT service organizations or departments to identify IT service goals, strategies and indicators aligned to business goals. By doing that, they will be able to measure only what really matters and obtain useful information for decision making. The use of proper indicators allows monitoring strategies and verifying if they produce the expected results. By monitoring a strategy through effective indicators, it is possible to keep it running, when indicators show that it is producing the expected results; to adjust it, when indicators show that the results are not so good; or abort it, when indicators show that the strategy will not be able to produce what it is expected. Moreover, when strategies are established to achieve IT service goals, it is possible to verify if IT service goals will be achieved by the established strategies. This way, it is possible to review goals and strategies according to information provided by indicators used to monitor them. Additionally, when IT service goals are aligned to business goals, it is possible to analyze how the strategies established to achieve IT service goals contribute to business goals achievement. As a result, the alignment between the IT service area and the organization as a whole is improved.

SINIS is meant to be applied by IT service managers or similar roles. The IT service manager can execute SINIS to identify and cascade goals, strategies and indicators and have the big picture about how his team is going to work in a certain period (next year, for example) to achieve business goals. However, it is important to notice that the execution of some SINIS activities can involve other participants. For example, if a causal analysis is needed, may be necessary to involve people directly related to the processes to be analyzed. Moreover, it is important that the results of SINIS application (especially the final grid) are communicated to the interested parties.

Although the expected role to execute SINIS is the IT service manager, SINIS can be also executed by other IT service professionals or even by the project team to have a structured view about which projects, activities, initiatives or practical operational actions (i.e., strategies) can be taken to achieve goals. The structured view of alignment between goals, strategies and indicators can be useful to justify a new project by indicating that it is able to produce results for achieving business goals.

For being able to apply SINIS, we suggest that the user is familiar with IT-related service processes and measurement; however, no knowledge of the approaches used as foundations for SINIS (e.g., COBIT Goals Cascade and Balanced Scorecard) is required. We believe that the process description and the supporting instruments (checklists, templates and examples) allow a person that had never executed SINIS to apply it. However, since, so far, we have not performed any study without the intervention of the researchers, we do not have evidence that the process description and supporting instruments are enough for one to apply SINIS successfully.

The current version of SINIS was applied in an IT service department of a global large organization. The method was designed to be used by IT service departments that could be both a service provider organization (as in the case study) or the organization to which service is provided. In this last case, the organization can apply SINIS to align the provided services to the organization's goals as well as to monitor the provided services. However, we have not explored the use of SINIS in this context yet.

Although we have not experienced it yet, we believe that there is no offside that prevents applying SINIS in a small size organization. Activities can spend more effort for large organizations that probably have more goals, strategies and indicators, or less for small organizations with less goals, strategies and indicators.

SINIS is a proposal strongly related to the industry. However, there are still some steps to be followed aiming at transferring it to the practice. In order to scale SINIS to practice in field, new studies in industry are necessary, particularly without researchers' participation. By conducting new studies, we will be able to evaluate SINIS use in different scenarios, identify and make the necessary improvements to transfer it to the practice. Taking this into account, we plan to perform new case studies to better evaluate SINIS and get feedback for improving it. Moreover, aiming at improvements to foster the use of SINIS in practice, as future works, we plan to develop a tool to support SINIS use and an online catalog to make the list of IT service measures identified in [52] available for automatic search.

6.3.2. Implications for research

Implications of this work are mainly related to the GQM + Strategies [6]. The first one regards the use of that approach in the IT Service domain. GQM + Strategies is an approach that supports identifying goals, defining strategies (i.e., initiatives, such as projects or other actions) to achieve the goals, and identifying measures/indicators to monitor strategies and goals. It was conceived in the Software Engineering area and it is focused on software development. We have explored its use in a different domain by providing a method based on GQM + Strategies structure to be used in the IT Service domain. Another implication related to GQM + Strategies is that SINIS can be considered an extension of that approach as we provide guidelines about how to elicit strategies and instruments (checklists, templates and examples) to support executing each activity. The use of SINIS can bring new issues

to be explored regarding the use of GQM + Strategies in the IT Service domain. Moreover, the guidelines, checklists, templates and examples represent useful knowledge to apply GQM + Strategies in the IT Service domain and, from their use, new knowledge and needs to be addressed in future researches can arise.

We have explored the extension of the GQM + Strategies to apply it in IT service measurement initiatives, but it is possible to notice that SINIS focuses on the planning phase of a measurement program. Thus, SINIS supports identifying IT service-related goals, strategies and indicators aligned to business goals, but does not address goals and strategies monitoring. In this context, some research questions can be explored in future works, such as: How should goals, strategies and indicators be monitored to verify goals achievement? How should changes in context factors, assumptions and goals should be managed in the context of the defined strategies? New research questions can also be explored when planning IT service-related goals, strategies and indicators: After identifying and aligning goals, strategies and indicators to achieve business goals, how to verify if the identified elements really are the necessary ones for achieving business goals? Are interpretation models enough to monitor, control and report information about goals and strategies? Considering that IT service processes can conflict with one another [50], how conflicts between IT service goals and strategies can be avoided or minimized? Summarizing, our work is just a first step in research to apply GQM + Strategies principles to the IT Service domain. There is still a promising road ahead.

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