A Business-Driven IT Services Improvement Model

Alberto S. Lima, J. Neuman de Souza, A.C. Callado
Federal University of Ceará
Fortaleza, Brazil
{albertosampaio, neuman, arthur}@ufc.br

J. Augusto Oliveira, Jacques Sauvé, Antão Moura
Federal University of Campina Grande
Campina Grande, Brazil
{zedeguga, jacques, antao}@dsc.ufcg.edu.br

Abstract**—** Under current approaches, service performance is generally evaluated using technical metrics, for the following two basic reasons: 1) They are easily understood by technical people and 2) They are typically easy to measure directly. The actual impact on the business of low value and quality are not apparent. Service metrics are objectively measured, however, subjective criteria - those that depend on the subject (person) being polled - are not easily brought into the picture. Uncertainty is not typically considered in the measurement process. Service metrics are gathered strictly on an operational level without any effective information available at a strategic level. Within this scope of work, we propose a model in order to quantify an IT service aggregated value and a hierarchical quality indicator within a time snapshot, which can be used to help managers in activities relating to continual service improvement. We carried out a case-study in a real environment of a Brazilian Bank whereby the results indicate that our non-intrusive model is useful and can be adopted by corporations in addition to their actual continual service improvement rules.

Keywords- IT QoS, business value, fuzzy logic, IT service improvement, ITSM, Business-driven IT Management.

I. Introduction

This paper discusses IT service management. Specifically, we are interested in *continual service improvement (CSI)*, which is one of the IT management processes defined in Information Technology Infrastructure Library (ITIL). Under the current approaches, service quality is generally evaluated using technical metrics, for two basic reasons: 1) They are easily understood by technical people and 2) They are typically easy to measure directly. Examples are service response time, time to close a trouble ticket, and so on.

We believe that current approaches to capture service performance for the purpose of continual service improvement suffer from the following drawbacks:

- The actual impact on the business due to low quality is not apparent. **Subjective** criteria - those dependent on the subject (person) being polled - are not easily brought into the picture.
- **Uncertainty** is not typically considered in the measurement process. To make matters worse, uncertainty comes from several sources: *stochastic* uncertainty means that metric values change to the natural stochastic nature of physical processes; *epistemic* uncertainty comes from the fact that we simply do not know the value of certain parameters used in the measurement process, and therefore these must be estimated.
- **Metrics aggregation** at hierarchical levels is very important in IT management since hundreds of services and thousands of metrics are typically involved. The problem of aggregating metrics is that they can have different units, can be numerical or categorical, can be spread over several orders of magnitude (numerical treatment problem), can be objective or subjective, can include technical and business metrics and can include uncertainty that has not yet been properly dealt with.
- Service quality metrics are gathered strictly on an operational level, without any information available on a **strategic level**, which is a level that could, for example, be incorporated on a Balanced Scored Card used by top management.

In this work, we extended our idea presented in [1], providing a contribution to the Continual Service Improvement process by enhancing the "Check" phase of its Plan-Do-Check-Act (PDCA) cycle [2] in a business-driven IT Management (BDIM) approach view [3]. The remainder of the paper is organized as follows: section 2 presents related works, whereby we show *fuzzy logic*, quality, value-driven works [4] [5], and BDIM approaches which refer to information technology service management (ITSM) and quality of service (*QoS*). In sections 3 and 4, we address our model description for continual service improvement. Section 5 describes a real case study with data analysis, using our model and we offer conclusions and suggestions for future works in section 6.

II. Related Works

Whilst thinking about IT service quality evaluation needs, one can notice some aspects related to software engineering scenarios whereby the infrastructure set includes the application level at IT governance [6] [7]. Within this scope, there are some successful works that influenced our strategy: [8], [9], [10], [11], [12] and [13].

Business value concept is discussed in the frameworks [14], [15] and [16]. All three frameworks address value creation and delivery but provide no quantitative assessment approach and do not use subjectivity, the concept of quality as an indicative value. These works improved BDIM research but they did not attempt to focus on estimating IT service's value within a given period in order to improve IT services. There

978-1-4244-9221-3/11/$26.00 ©2011 IEEE

were some BDIM relevant proposals in [17] and [18], but the scope focused upon quantitative measurable metrics, while subjectivity and uncertainty in IT service improvement and design were not 'work' focused. In [19], there was a metric dependency study to evaluate the *QoS* impact on process quality which had focused upon measurable metrics that relate to functional elements of a single process activity, as well as services and implementing services. Subjective IT service metrics within processes were not taken into consideration, as well as uncertainty in some activities and IT services business value.

The value network analysis (VNA) [20] is an approach that seeks to quantify the value of intangible information whereby regarding these items as assets, and marketable as deliveries. In [21] we had an approach which used VNA and ITIL associated principles in order to illustrate service provider relationships. Our approach does not conflict with the proposed concept; moreover, we believe that our model can be customized for use in addition to VNA.

In [22], an analysis based on public observable information was performed in order to analyze service systems in terms of value delivery and to discover a method in which to increase this value. The work addressed value in economic terms whereby focusing on service delivery to external audiences.

III. Model Description

We proposed a design change in traditional KPIs (Key Performance Indicators) and KQIs (Key Quality Indicators) design, in addition to a general approach, allowing a fuzzy inference to estimate a quantitative IT service quality percent as presented in [1]. Figure 1 illustrates the sequence to use our model. Figure 2 shows our model overview, with its inputs, outputs and methods. Drill-down operations allow further displacement of a higher layer to a lower layer, in order to investigate the cause-effect information. Higher layers are more important to business executives, while lower layers are important for managers. Our model basic inputs are metrics (KPIs) collected at the operational layer (IT Services).

3.1. Model requirements

We tried to answer the following question in relation to requirements elicitation: "What attributes must a model have to solve value modeling deficiencies found in the literature regarding continuous improvement of IT services"?

The Model should be formal

The model should be expressed through a non ambiguous language. As a consequence of this, people with different profiles should reach similar conclusions when making a value analysis based on the same scenario.

The Model should propose an evaluation method

The model should provide a consistent method for estimating an IT service total transferred amount, within a particular context.

The model should involve a partial relation order on a scenario set

The model methods for IT services evaluation should allow at least a partial ordering context set based on value [4].

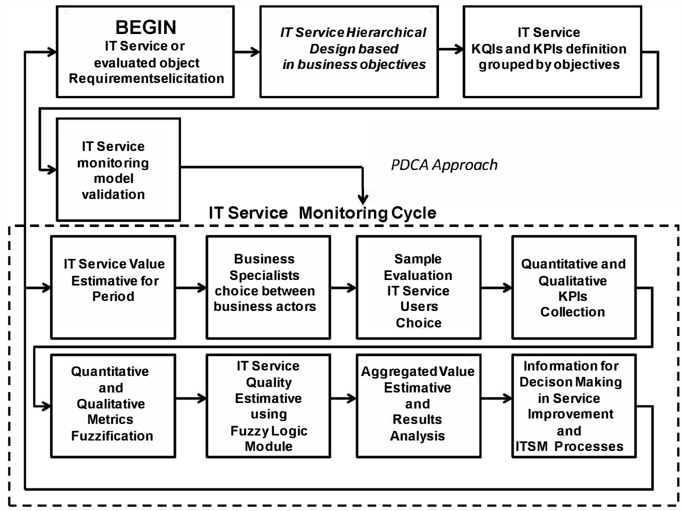

Figure 1 – Sequence for continual service improvement.

The Model should capture values at different hierarchical levels

The model should be made applicable to all levels of the IT service monitoring hierarchical structure.

The model should capture values in different business scenarios

The model must be adaptable in order to capture particularities from different organizations, operating within different market segments.

The model should capture IT services, activities or process value

The model should allow us to estimate IT services aggregated value as a priority, but in a complementary way, whereby it can be used to estimate an aggregated value by means of process and business activities.

The model should have a low intrusion level in relation to the IT environment

The used model should not interfere too deeply in company processes nor include many new variables within the work context.

The model should have operational capacity

The model should capture metrics at the operational level, aggregating them to various hierarchical levels that involve CSI (Continual Service Improvement) monitoring.

The model should provide inputs for strategic models

The model should provide outputs that can be utilized in strategic monitoring tools (e.g. BSC-Balanced Score Card).

3.2. Model items

In order to address the requirements presented in section 3.1, we have designed and implemented some components in order to enhance our model. In this section we present, define and show some details of these components.

A definition for Value

Business value is any benefit effectively deliverable to an addressee with the ability to satisfy the requirement of the addressee, meet an expectation, desire or wish of the addressee, or become an enhancement/advantage [4].

A definition for quality

Quality is a subjective concept which differs in perception from one individual to another. Several factors such as culture, perceived models, product or service type, needs and expectations directly influence definition of quality.

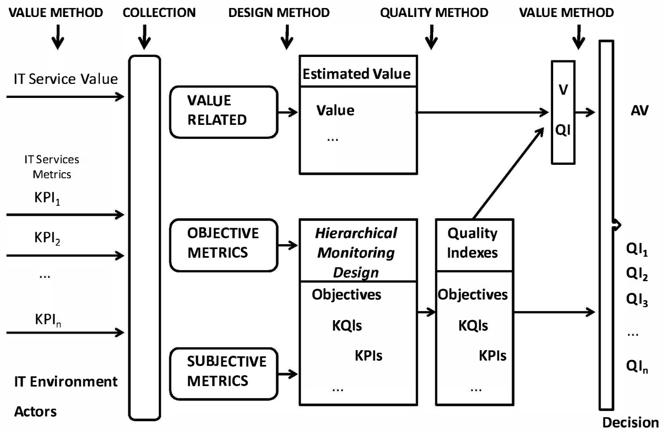

Figure 2. Our CSI Model.

Connection between value and quality concepts

From the client's viewpoint, quality is associated with recognition of product value and utility, while in some cases linked to price [23]. In relation to services, there are several **definitions for quality**, such as: "Conformance to customer requirements", "Value for money", "Fitness for use", "Aggregated value that similar products not possess", "Do it right the first time ", "Products or services with effectiveness". Companies must understand how a customer perceives value for money [22]. We can use, as an example, the value-based pricing approach which operates the software pricing process, based on perceived customer value in relation to received benefits [22].

Value entities

Our model entities and associations are value items presented in [4].

Value behaviors

Value behaviors comprise of a set of atomic and instantaneous operations performed by an actor [4], and are expressed by notation *an operation ([list of parameters])*. The primitive operations of our model are described in [4].

3.3. Valuating an IT service

IT services value and aggregated value estimative method

We consider four assumptions in our model for real ITSM context:

1. Members of the IT Steering committee are familiar with the business strategy that is commonly communicated through mission, vision, values, objectives, indicators and aims of the ongoing strategic plan.
2. Committee members are acquainted with IT services because information has been previously presented in electronic/hard-copy format or orally defended before the IT Steering Committee.
3. Evaluated IT services are within a production environment.
4. The value premise of our model is relative to how much value IT services can aggregate to business in a given period.

The first step of our valuation method consists of a two-phase interspersed sequence as shown in Figure 3. At this stage, we calculate all IT services set value to serve as a reference and input to our valuation method second step.

Step 1: value estimative for an IT services set

The first phase of our valuation method is a two-round dynamics valuation in which the IT Steering Committee members assign values to IT services under analysis. At the end of the second round, the projects have numeric values assigned to them in one of two possible fashions:

- A single IT service tagged with its correspondent value;
- An IT services group - gathering a set of IT services - tagged with a single value.

In order to start the valuation process, the IT Steering Committee members are provided with a set of bills labeled with *Fibonnacci* numbers starting from 3 (3, 5, 8, 13, 21…).

The number of bills given to each Committee member must be equal to the number of IT services under valuation. This set up makes it possible for the members of the committee to valuate every proposal under analysis. In addition, the increasing distance between numbers in the *Fibonnacci* series leaves members free from the doubt of deciding between proposals very closely valuated (i.e. 3.96 versus 3.98).

Valuation – first phase: In the first phase IT committee members freely distribute their bills throughout IT services under analysis. In this case "freely" means that an IT service can receive any number of bills and that an IT service group can be evaluated together by a value that sums up any number of bills. When a valuation refers to an IT services group, the member must stipulate the relative weight of each IT service within the group. Relative weight is a number between zero and one that expresses how important an IT service is, when compared with the other components of the group. All weights of an IT services group must add up to one. For each valuation, the member must provide a reason that supports it. One or two short paragraphs should be used to provide the reasoning. Both valuation and reasoning must be kept anonymous during the process.

Reasoning – second phase - In this phase a mediator reads out each valuation and reasoning provided by the relative committee member. Again the author of both the valuation and reasoning must be kept anonymous. The reading is an opportunity for committee members to extend their comprehension and perceptions on project proposal and unity, possibly reconsidering some valuations assigned during the first round. Practice has proved that publication of reasoning improves valuation accuracy and guides members towards a common consensus [24].

Valuation – third phase - In the second and last round of valuation, committee members repeat phase 1. However, there is no need to present the reasoning for each valuation during this phase.

Computation – fourth phase - The final value of an IT service valuation in the first phase, is the sum of its assigned values during the second valuation round. If a joint IT services group receives a higher value than all its unitary components, then the group must be maintained. In this case, the final value of an IT service group is the sum of values assigned to the group plus the values assigned to each of its components when valuated as a unitary IT service.

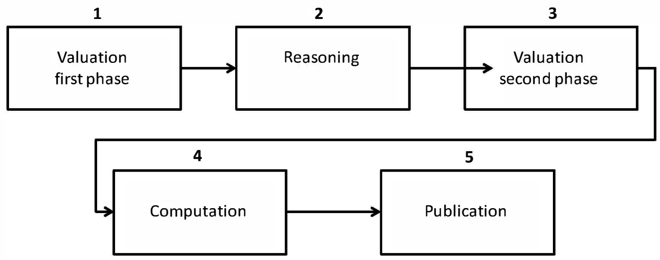

Figure 3. – valuation method first step.

Publication – fifth phase – In the final phase, IT services/IT services groups are ranked according to their value and presented in order to the Committee members. Due to space restrictions, we won't show the complete formalization of our first step method which is available in [25].

Step 2: IT service aggregated value in a period

Top level executives need to have metrics expressed in business terms for easy understanding. Using a general quality percentage as a mitigating factor, in order to estimate an IT service value, is a reasonable and useful monitoring solution to managers because there is a strong link established between the IT service value and quality concepts found in literature and drill-drown is desirable to a value-based approach at strategic levels. IT service quality quantification process results are arranged at different IT service evaluation hierarchical levels. A quality percent is calculated for each IT service and its subjacent metrics [1]. The aggregated value estimative in our model (Aggregated Value - *AV*) is given by use of the quality percent index achieved by the service during a given period (Quality Index - QI) as a mitigating factor in its value, multiplied by result of valuation method first step, $AV = QI \ x \ V$. This is very important information required to support the decision making process in relation to various activities related to continual service improvement, in ITSM.

Formalization - Let:

G = $\{g_1, g_2, g_3, \ldots, g_{|G|}\}$, IT services groups (one or more IT services), defined after first valuation method step.

Q = $\{q_1, q_2, q_3, \ldots, q_{|Q|}\}$, IT services quality percents set in an evaluation period, using our model's quality estimation method [1].

Vg =$\{vg_1, vg_2, vg_3, \ldots, vg_{|G|}\}$, IT services group set (including unitary groups), obtained in first step of our valuation method.

We want :

For each IT service group (unitary or not), $g_i \in$ R:

$\mathbf{g_i} = \{r_W,\ldots,r_Z\}$ be each IT services group $g_i \in$ R where

$\mathbf{W_i} = \{w_W,\ldots,w_Z\}$ are the weight set of each service r_i in group, obtained in first value estimative method step, and $\sum_{i=w}^{z} w_i = 1$. We want to calculate these IT services group quality percent, using individual quality percents, obtained for each service individually, in our quality evaluation method execution.

We want to obtain the set:

Qg =$\{qg_1, qg_2, qg_3, \ldots, qg_{|G|}\}$, where

$$qg_i = \frac{\sum_{i=w}^{z}(q_i * w_i)}{|g_i|}$$

The IT services group aggregated value set is:

AVg =$\{avg_1, avg_2, avg_3, \ldots, avg_{|G|}\}$, where

$$avg_i = \mathrm{vg_i} \times \mathrm{qg_i}$$

We can consider that we are executing an operation to reduce [4] IT services group value for the evaluation period, as illustrated in the following notation (if $qg_i < 100\%$) :

$$a.reduce(e), where \quad e = \mathrm{vg_i} - avg_i$$

Triangular Fuzzy Numbers				Linguistic Terms			
Ñ	a	m	b				
Ñ1	0	0	1	High Impact	No Relevance	Insufficient	Violation
Ñ2	0	1	2	Medium Impact	Low Relevance	Low	Low
Ñ3	1	2	3	Low Impact	Relevant	Regular	Medium
Ñ4	2	3	4	Expected Impact	Very Relevant	Good	High
Ñ5	3	4	4	No Impact	Imprescindible	Excelent	Superation

Table 1. Triangular fuzzy numbers and some linguistic terms for IT service evaluation [1].

IT services quality evaluation method

It is essential to use valid and accurate metrics which represent attributes that we wish to observe and quantify. We recommend for use in our model, technology, process and services metrics [1], with focus on service monitoring activities [1]. We can associate linguistic terms (Table 1) to fuzzify collected values, depending on organization's services design strategy. Due space restrictions, our complete monitoring hierarchical design and quality estimative method theory is shown in [1].

IV. AN ILLUSTRATIVE EXAMPLE

Using our model, consider IT services A, B, C and D under valuation by three members of the IT committee. After being informed about the context and details related to IT services, the IT committee members valuate the IT services in the first round as follows:

<table>
<tr><th>IT service / member</th><th>1</th><th>2</th><th>3</th><th>Value</th></tr>
<tr><td>A</td><td>3</td><td>13</td><td>13</td><td>29</td></tr>
<tr><td>B</td><td rowspan="2">8+13=21
$d_B = 0.8$
dc = 0.2</td><td>5</td><td>3</td><td rowspan="2">33.6</td></tr>
<tr><td>C</td><td>3</td><td rowspan="2">5+3=8
$d_C = 0.2$
$d_D = 0.8$</td></tr>
<tr><td>D</td><td>5</td><td>8</td><td>19.4</td></tr>
</table>

Table 2. valuation and computation for the first round.

The IT service A was valuated as a unitary service by all committee members. In this case the computation is straight forward and the total value is the sum of each valuation. 3 + 13 + 13 = 29. There is no set of valuations referring to IT services B and C as unitary services that out values the value 21, assigned by a committee member 1 to **BC** as an IT services group. Therefore, **B** and **C** will remain as an IT services group and value for **BC** group must also accumulate all the values assigned by members 2 and 3 to **BC** IT services:

21 + 5 + 3 + 3 + 8 X 0.2 = 33.6. The term 0.2 in the sum corresponds to the *domination* (importance) of IT service C compared to IT services group **CD**, according to member 3's judgment. The IT services group attribution **CD** valuated with 8 by member 3 is out valued by other valuations assigned to C and D as unitary IT services (3, 8 and 5). In this case, D should be maintained as a unitary IT service and its total value must again accumulate all the valuations assigned to its proposal: 5 + 8 + 8 X 0.8 = 19.4. Now the mediator reads the reasoning provided by members when they assigned each value showed in Table 2. After the reading, some members took the arguments into account and reformed part of their first-round valuation. At this moment, the followings values (see Table 3) were assigned in the second and final valuation round.

Note that members 1 and 2 changed their valuation to IT service **C** in the last round. Member 3 in turn decided now to valuate **B** and **C** as unitary IT services and assigned a higher value to IT service **A**, leaving IT service **D** without value attribution (value = 0). Now the result of valuation process can be published (Values in Table 4).

<table>
<tr><th>IT service / member</th><th>1</th><th>2</th><th>3</th><th>Value</th></tr>
<tr><td>A</td><td>5</td><td>5</td><td>13+8</td><td>31</td></tr>
<tr><td>B</td><td rowspan="2">8+13=21
$d_B = 0.8$
$d_C = 0.2$</td><td>8</td><td>3</td><td rowspan="2">40</td></tr>
<tr><td>C</td><td>3</td><td>5</td></tr>
<tr><td>D</td><td>5</td><td>13</td><td></td><td>18</td></tr>
</table>

Table 3: Valuation and computation for the second round

IT services aggregate value estimative method second step occurs after the IT services quality estimative method step. Assuming that our model quality estimative method [1] generated quality percentages listed in Table 4, we calculated the following results for each IT service group (unitary or not) aggregated value in period, also shown in Table 4 (*AV=VxQI*).

IT service/ IT services group	Value	Quality percent	Aggregated Value
BC	40	0.6	24
A	31	0.8	24.8
D	18	0.94	16.92

Table 4. Valuation method results.

IT services group **BC**, whose value to business was quantified in the initial period as superior to all other IT services (Table 3), lost its leading position due to its low quality general performance. This position can be regained at a later evaluation, whereby factors that led to this result at operational level, can be identified and corrected by ITSM managers. Figure 4 shows us an IT services value-based monitoring evolution hypothetical example, which can be generated through our model use in a given period, beginning with the initial value shown in Table 2. Note that IT services group **BC** aggregated value performance, which dropped in the first evaluation period, may lead managers to a need a drill-down analysis. Thankfully, this is only made possible through our model hierarchical monitoring design. This design can show objectives, KQIs and KPIs quality indicators for each evaluated IT service, allowing the identification of factors that may be influencing this value decline. ITSM managers have information to subsidize decisions about improvement of activities, beginning at the specific point that could have generated such low quality. Important analysis, obtained through value and quality indicators generated by our model will allow managers various decision options on service lifecycle management (SLM) activities related to the CSI process as shown in the next sections.

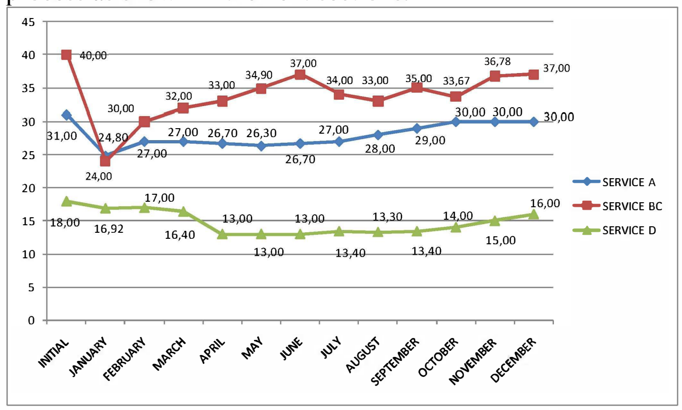

Figure 4. IT services aggregated value monitoring example.

V. CASE STUDY AND RESULTS

We applied our model's non-intrusive monitoring hierarchical design on Bank of Northeast of Brazil (BNB), federal-owned company, with headquarters in Fortaleza, Ceará, Brazil, which has 5895 employees. BNB IT department has 259 employees and 219 contract employees. We used negative cases analysis technique [26] in our case study, as follow:

1. **Null Hypothesis**: Managers have no preference regarding our model use nor IT services current evaluation method. **Measurement requirements:** manager preference regarding the current evaluation form and model. **Alternative hypothesis**: different preferences regarding our model use and current evaluation method. **Measurement requirement**: managers preference.
2. **Null Hypothesis**: Managers do not consider our model useful. **Alternative hypothesis**: the model is useful. **Measurement requirement**: model utility.
3. **Null hypothesis**: Managers do not consider the model satisfactorily complete. **Alternative hypothesis**: the model is complete. **Measurement requirement**: model completeness.
4. **Null hypothesis**: Managers do not consider that model has enough accuracy and precision. **Alternative hypothesis**: the model has enough accuracy. **Measurement requirement**: model accuracy.
5. **Null hypothesis**: Managers do not consider model effective. **Alternative hypothesis**: the model is effective. **Measurement requirement**: model efectiveness.

6. **Null hypothesis**: Managers do not consider that model upgrades (with reliability and objectivity) actual CSI strategy. **Alternative hypothesis**: the model upgrades actual CSI strategy. **Measurement requirement**: model upgrading.
7. **Null hypothesis:** Managers do not consider that model can treat intangible value items. **Alternative hypothesis:** model can treat intangible value items. **Measurement requirement:** model intangible treatment.

Impact Classification	NO IMPACT	EXPECTED IMPACT	LOW IMPACT	MEDIUM IMPACT	HIGH IMPACT
SLI - SERVICE LEVEL INDEX					
Calculated SLI %	Greater than 95%	95%	90.00 to 94.99	80.01 to 89.99	Less than 80.00
Penaltie %	0	0	0.05%	0.10%	0.20%
AI - ABANDONMENT INDEX					
Calculated AI %	Less than 5%	5%	5.01 to 7.00	7.01 to 10.00	Greater than 10.00
Penaltie %	0	0	0.05%	0.10%	0.20%
CRI - CALLS RESOLVED IN FIRST CONTACT INDEX					
Calculated CRI %	Greater than 60%	60%	45.00 to 59.99	40.00 to 44.99	Less than 40.00
Penaltie %	0	0	0.05%	0.10%	0.20%
CSI - CUSTOMER SATISFACTION INDEX					
Calculated CSI %	Greater than 80%	80%	77.00 to 79.99	75.00 to 76.99	Less than 75.00
Penaltie %	0	0	0.50%	1%	2%
FLAAI - First Level Average Attendance Index					
Calculated FLAAI %	unreachable	100%	95.00 to 99.99	90.00 to 94.99	Less than 90.00
Penaltie %	0	0	0.05%	0.10%	0.20%
SLAAI - Second Level Average Attendance Index					
Calculated SLAAI %	unreachable	100%	95.00 to 99.99	90.00 to 94.99	Less than 90.00
Penaltie %	0	0	0.05%	0.10%	0.20%
SDI - Shipping Demand Index - third level					
Calculated SDI %	Less than 12%	12%	12.01 to 13.99	14.00 to 15.00	Greater than 15.00
Penaltie %	0	0	0.05%	0.10%	0.20%
ADI - Accepted Demand Index - second level					
Calculated ADI %	unreachable	100%	90,00 to 99,99	80,00 to 89,99	Less than 80,00
Penaltie %	0	0	0.05%	0.10%	0.20%

Table 5 – Common KPIs, business impact and penalties in a Bank's service desk.

We conducted validity estimation levels in a case study, according to [26] recommendations to construction validity, internal validity, external validity and conclusion validity and observed [27] and [28] recommendations to questionnaires design and preparation. We identified 10 objectives for the service desk, obtained from contract texts, corporate intranet pages and other documents as illustrated in Table 8. Business quality standard reference [1] for the service desk was estimated by applying an evaluation with 11 business specialists, which included IT and business areas. We considered current SLA thresholds, shown in Table 5, as quality reference to business. We conducted the first step of method execution for estimating 14 IT services values (including service desk).

Table 6 shows IT services valuation results after the first round. The Service desk was in tenth place with a value of 1144. Before we began the second round, all committee member valuations and reasoning were presented without identification. In the second valuation round, we obtained results as presented in Table 7. Note that the service desk value has decreased, due to consensus reached between evaluators when reading other committee members reasoning.

ID	*IT SERVICES*	*VALUE*
3	BRAZILIAN PAYMENT SYSTEM (SPB)	8449
11	CREDIT INTEGRATED SYSTEM (SIAC)	7627
2	BANKING AUTOMATION	7032
5	INTERNET BANKING	6412
6	WAN	3766.2
7	LAN	3216.9
12	CREDIT PROPOSALS INTEGRATED SYSTEM (SINC)	2945
8	DATABASE	1844.9
4	CHECK COMPENSATION	1689
1	SERVICE DESK	1144
13	BUSINESS PROCESS MANAGEMENT SYSTEM	1110
14	DATA WAREHOUSING	598
9	IT CONTRACT ADMINISTRATION	169
10	TELEFONY CONTRACT ADMINISTRATION	68

Table 6. IT services ranking after first valuation round.

ID	*IT SERVICES*	*VALUE*
3	BRAZILIAN PAYMENT SYSTEM (SPB)	9729
2	BANKING AUTOMATION	8129
11	CREDIT INTEGRATED SYSTEM (SIAC)	6515.3
6	WAN	4372.3
5	INTERNET BANKING	4202
7	LAN	3548.5
12	CREDIT PROPOSALS INTEGRATED SYSTEM (SINC)	2793.7
8	DATABASE	2666.2
4	CHECK COMPENSATION	1780
13	BUSINESS PROCESS MANAGEMENT SYSTEM	919
1	SERVICE DESK	419
14	DATA WAREHOUSING	260
9	IT CONTRACT ADMINISTRATION	107.5
10	TELEFONY CONTRACT ADMINISTRATION	66.5

Table 7. IT services ranking after second valuation round.

The Service desk was ranked in relation to other IT service values, obtaining eleventh position. For subjective metrics collection, when executing the quality estimative method, we used 42 user questionnaires to evaluate the service desk, using our proceedings cited in [1]. Technological KPIs were collected using the *Unicenter Service Desk* tool.

1	Answer, record and resolve issues or incidents, quick solutions, from phone, web and fax in the first level, redirecting to the second level incidents that require specialized knowledge to be solved
2	Solve, guide or monitor incidents related to services supported on the second level, redirecting to the third level incidents that require technical knowledge to be solved
3	To monitor the degree of customer satisfaction in the process of technology with the services provided
4	Maintain the Quality in Service Level Operation
5	To coordinate technical and administrative assistance to the First Level
6	To coordinate technical and administrative assistance to the Second Level
7	Monitoring of the Service and Quality - Monitoring the quality of services provided to customers several areas of the process of technology
8	Provide Operational Support
9	Provide Administrative Support
10	To maintain a good Administrative and Quality Management, generating information, analyzing and suggesting changes.

Table 8. Service desk identified objectives.

We used Table 1 linguistic terms and Table 5 thresholds as a metrics fuzzification reference for estimating the IT service quality standard reference, as well as the user evaluation process. We calculated the estimated service desk quality percentage to all hierarchical monitoring design levels. Details about KPIs fuzzification are shown in [1]. The Service desk had an estimated quality index [1] as shown in Figure 5 (objective 11), whereby obtaining an overall quality figure of about 83.8%. Figure 6 illustrates comparative values achieved by a service desk objective. Service desk objectives which had lower performance evaluation were operational and administrative support. We identified some possible service desk improvement requirements using a drill-down result analysis: increase attention on service desk written texts; use larger IT resources in meeting demands; training attendants in ITIL; improve telephony calls care; daily satisfaction survey could be improved and improve interpersonal and emotional balance during first and second level sessions. BNB service desk value during this period was estimated in the first valuation phase of our model as 419 (see Table 7). Based on this initial value, after applying quality estimative method, we have calculated its aggregated value, which was $avg_i = vg_i \times qg_i$

$$Avg_{service\ desk} = 419 \times 83.8\% = 351.12\ (351)$$

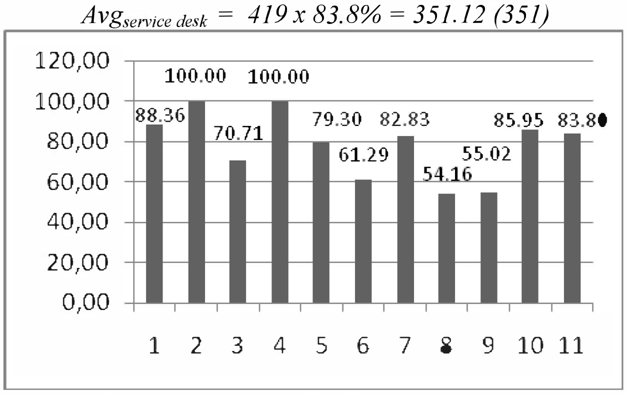

Figure 5. Service desk objectives result comparison.

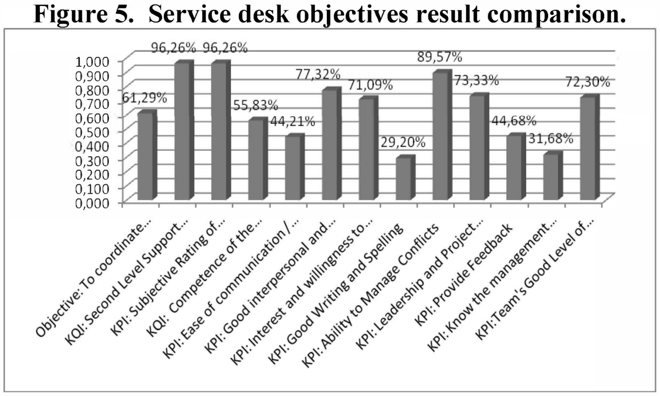

Figure 6. A service desk objective quality results.

We conducted interviews with ITSM managers and practitioners in order to obtain good result analysis and validation of our hypothesis. We presented our BNB's case study results and our model in detail, before going through questions and verifications. Results indicate that our model met proposed requirements and that we validated the alternative hypothesis with all positive responses results greater than 66%. The main results of our model and applicability indicatives, obtained through these interviews and questionnaires are presented in Tables 9 and 10.

QUESTION	RESULTS	RESPONSES %
Greater difficulties to analyze our model	High mathematical methods learning curve	100
	Much input data	30
	Understand that there is no fuzzy logic knowledge need to use our model, when automating calculus in a software tool.	20
Alternatives for dealing with difficulties	Process automation in a software tool	100
	Training program	60
	Consulting services	40
Metrics hierarchical design organization in our model is a good proposal	Agree	90
	Disagree	10
Model Utility	Is useful	100

Table 9. Results summary.

EVALUATED ASPECT	RESULT
An objective-driven hierarchical metrics monitoring design, for IT services evaluation.	Adequate, since identified objectives are representative to IT service quality estimative.
Use same quantitative approach to tabulate objective and subjective IT service related metrics.	Our model tabulating way is satisfactory, but the metrics quantity should the minimal, between IT service, process, and management related metrics.
Model utility.	Our model is useful.
Process automation, using a software tool.	Our model should be automated in a decision-making software tool, to help managers in CSI needs identification.
Subjectivity and uncertainty treatment in IT services CSI related activities.	The model has qualities to facilitate KPIs thresholds establishment, and linguistic terms use during an IT service evaluation process, simplifying metrics treatment.
Using model for IT services continuous improvement activities.	The additional use of our model to current monitoring way can have a great potential and should be considered in strategic approaches. The possible improvement needs identification can lead managers to review ITSM aspects that go unnoticed to current techniques.
Hierarchical level quality percentages use in autonomic activities or systems at operational level.	Our model lower levels quality percents could be used as input to autonomic systems, to enable tuning.
Using IT service aggregated value and objective quality percentages, as input metrics to business tools based in BSC.	Our model provided quantitative values are likely to be used as input metrics for a BSC, to have appropriate and aligned IT business metrics.
Precision and accuracy.	Model is sufficiently accurate and has a satisfactory accuracy in relation to its proposal. Linguistic terms variation allows other terminology ways to verify service performance.

Table 10. Key points raised in interviews with results.

VI. CONCLUSION AND FUTURE WORKS

This paper presented a model to improve IT services using a BDIM [3] feedback monitoring strategy. Our model applicability domain includes any business scenarios where there are real technical and human conditions to perform activities guided by ITSM and ITIL principles. Our model method set allows proper use but does not guarantee success in metrics choice, in order to reflect all IT service quality aspects or make sure that involved actors really have acquired an evaluation profile.

We carried out an experiment in a real corporate environment, performing an evaluation of a service desk managed by the internal IT department of a Brazilian Bank. Results indicate that our model can define and treat the service's quality attributes and can capture human factors such as uncertainty and subjectivity, whereby minimizing an IT services threshold definition, business tasks and service objectives mapping, and KQIs and KPIs business relevance degree estimates. This is possible because we can evaluate all of the characteristics above, using the same fuzzy inference approach. Our model can be immediately adopted by companies which practice IT governance, but we need to automate procedures as a tool for achieving effective results. Our non-intrusive proposed approach allows an easy deployment, complementing IT service management practices, enabling a more effective link between business strategy and IT services operation. Quantitative value and hierarchical quality indexes generated with our model's adoption can be used to link and improve strategic and operational IT management related activities. Model outputs can be used to input a strategic planning tool (ex. Balanced Score Card), moreover, each hierarchical quality level index can be used to improve ITSM related activities such as service design, change management and capacity management (e.g., to input tuning regulation systems).

Research efforts leading to broader validation campaigns are ongoing. We feel that future works should focus on applying our model to evaluate another IT service management domain, such as cloud computing, e-commerce, web services, information security management, etc. We plan to automate our model in an ITSM complementary tool for CSI management. Another interesting plan of action is to address details of the step-by-step solution procedure, in particular, to estimate economic value to IT services or to capture actor's attitudes to risk.

ACKNOWLEDGMENT

We thank *Stelio Gama Lira Jr.*, IT Director, *Kilvia Botelho Queiroz* and *Eliseu Castelo Branco Jr.*, Bank of Northeast of Brazil managers, for participating in initial campaign's validation experiment, as well as having involved all ITSM staff to help our case study.

REFERENCES

[1] LIMA, ALBERTO S., DE SOUZA, J. N., OLIVEIRA, J. A., SAUVÉ, J., MOURA, J. A. B., Towards Business-Driven Continual Service Improvement, Proceedings of the 5th IEEE / IFIP International Workshop on BDIM. IEEE Communications Society, 2010.

[2] OGC (Office of Government Commerce), ITIL V3 PUBLICATIONS, "Service Strategy", "Continual Service Improvement", "Service Design" "Service Operation", 2007.

[3] MOURA, A., BARTOLINI, C., SAUVÉ, J.; Business-Driven IT Management - Upping the Ante of IT, IEEE Communication Magazine, Vol 46, No. 10, Oct 2008, pp 148-153. URL: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4644133.

[4] OLIVEIRA, J. A., MOURA, J. A. B., BARTOLINI, C., HICKEY, M., Value-based IT Decision Support - Towards a formal business value model for steering IT-business alignment, 4th IEEE/IFIP International Workshop on BDIM, 2009.

[5] OLIVEIRA, J. A., SAUVÉ, J., BARTOLINI, C., MOURA, J. A. B., HICKEY, M., QUEIROZ M., Value-driven IT Service Portfolio Selection under Uncertainty, 2010 IEEE / IFIP International Network Operations and Management Systems (NOMS), 2010.

[6] Governance Institute (ITGI) CObIT 4.1 Edition, Executive Overview 2007, p.6., URL: http://www.isaca.org.

[7] WEIL, P., ROSS, J., IT Governance: How Top Performers Manage IT Decision Rights for Superior Results, Harvard Business S. Press, 2006.

[8] BELCHIOR, A. D., A Fuzzy Model for Software Quality Evaluation, PhD Thesis, Systems Engineering and Computer Science Department, Federal University of Rio de Janeiro - COPPE, RJ, 1997.

[9] ALBUQUERQUE, A. B., E-commerce Web Sites' Quality, Master Thesis, University of Fortaleza, CE, 2001.

[10] ZADEH, L. A., Fuzzy Logic, IEEE Transaction Comput., vol. 25., 1998.

[11] OLIVEIRA, K. R., AdeQuaS: Software Quality Assessment Fuzzy Tool, Master Thesis, University of Fortaleza, CE, 2002.

[12] BRANCO JR, E. C., A Model to Software Project Management Quality Evaluation, Master Thesis, University of Fortaleza, CE, 2001.

[13] ROCHA, A. R. C., A Model for Quality Evaluation of Specifications, PhD Thesis, Software Engineering and Computer Science Department, Pontifícia Universidade Católica (PUC), Rio de Janeiro, RJ, 1983.

[14] PORTER, M. E, Competitive Strategy: Techniques for Analyzing Industries and Competitors, Free Press, 1983.

[15] BARNEY, J.B., WRIGHT, M., KETCHEN Jr., D.J., The resource-based view of the firm: Ten years after 1991, Journal of Management; 27 (6), pp.625–641, 2001.

[16] DIAO, Y., BHATTACHARYA, K., Estimating business value of IT services through process complexity analysis, 2008 IEEE / IFIP International Network Operations and Management Systems (NOMS), 2008.

[17] MARQUES, F. T., SAUVÉ, J. P., MOURA, J. A. B., SLA design and service provisioning for outsourced services. Journal of Network and Systems Management, Volume 17 , Issue 1-2:73, 2006.

[18] MARQUES, F. T., SAUVÉ, J. P., MOURA, J. A. B. Business-Driven Design of Infrastructures for IT Services, 2006.

[19] MAYERL,C.,HUNER,K. M., GASPAR, C.M.,ABECK,S., Definition of Metric Dependencies for Monitoring the Impact of Quality of Services on Quality Processes, IEE, 2007.

[20] ALEE, V., Value Network Analysis and value conversion of tangible and intangible assets, Journal of Intellectual Capital, Volume 9, No. 1, pp. 5-24, 2008.

[21] LEE, L. L., ITIL and Value Network Analysis, Optimice Pty Ltd, 2009, white paper.

[22] HARMON ,R., RAFFO , D., FAULK ,S., Value-Based Pricing for New Software Products: Strategy Insights for Developers, in www.cpd.ogi.edu/MST/CapstoneSPR2005/VBSP.pdf.

[23] WIKIPEDIA, quality concept, in http://pt.wikipedia.org/wiki/qualidade.

[24] LINSTONE, H. A. , TUROFF, M., The Delphi Method:Techniques and Applications, 2002, in http://is.njit.edu/pubs/delphibook/.

[25] OLIVEIRA, J. A., A formal method to evaluate business value and its IT application , PhD Thesis, Federal University of Campina Grande, 2010.

[26] RUNESON, P., HÖST, M., Guidelines for conducting and reporting case study research in software engineering, Springer: Empir Software Eng. ,14:31-164,DOI 10.1007, 2009.

[27] WOHLIN C., RUNERSON P., HOST, M., OHLSSON, B. R., WESSLÉN, A. , Experimentation in Software Engineering - An introduction. Kluwer Academic Publishers, 2000.

[28] KITCHENHAM, B.,PFLEEGER, S. L. , Principles of Survey Research Part 4: Questionnaire Evaluation. ACM SIGSOFT. Software Engineering Notes, Volume 27, no 3,Issue 20:23, 2002.