Metrics to Support It Service Maturity Models
A Case Study

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Abstract: *Background*: Maturity models for IT service require proper identification of critical business process and definition of relevant metrics to support decision-making, but there is no clear direction about what should be those critical business processes and metrics. *Aims*: This is part of a research in progress concerning the identification of adequate metrics to be used by organizations deploying IT service maturity models. We have conducted a systematic mapping study to answer: (i) What metrics are being suggested for IT service quality improvement projects? and (ii) How do they relate to IT service maturity models processes? In this paper, we aim to answer new research questions: (iii) What kind of relationship exist between processes that appear in derived metrics that include more than one process? (iv) Which of literature suggested metrics are being used by organizations? *Method*: We have conducted a case study in industry. *Results*: From relationship found between mapping study metrics, we had analysed those ones used by organization that had available data, but we could not evidence a correlation between them, even being related. However, as a result of this analysis, we had confirmed the need to evaluate IT services through multiple metrics or define metrics in a way that the same metric be able to present different aspects about IT services management, in order to provide a comprehensive approach about the organization scenario.

1 INTRODUCTION

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 (TSO, 2011). Guidance on how to develop and improve IT service maturity practices is a key factor to improve service performance and customer satisfaction (Forrester et al., 2010). CMMI-SVC (Forrester et al., 2010) and MR-MPS-SV (Softex, 2012a) models had been created to attend this need. These models require appropriate metrics to be identified in order to monitor various processes executed for service delivering to customers. Thus, selection of sub-processes to be measured must be aligned with organizational goals in order to measurements results are able to deliver relevant information for decision making and business support. However, there is no clear direction or strict suggestion about which business processes and metrics should be considered.

We previously executed a systematic mapping study to identify papers presenting metrics that could be used to assess IT service quality within the context of IT service maturity models (Trinkenreich et al., 2015). Although some papers suggested the applicability of some of these metrics to IT industry we were not able to see any details about how they had been used, neither any analysis about how metrics that involve more than one maturity model process area (instead of isolated ones) impact IT services quality.

Therefore, this article aims to investigate the applicability of such metrics in a real context. Moreover, we aim to understand the relationship between the metrics related to more than one IT service process by verifying in industry how the metrics suggested in literature are being used. To accomplish that, we present a case study in a mining global large company

This paper is structured as follows: literature review on IT service maturity models and metrics (section 2), case study (section 3) and our conclusions (section 4).

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2 IT SERVICE MATURITY MODELS AND METRICS

Through essential elements of effective processes and an evolutionary path for improvement, maturity models provide guidelines on how to design processes, as an application of principles to meet endless process improvement cycle (Forrester et al., 2010).

CMMI-SVC (Forrester et al., 2010) is a maturity model based on CMMI concepts and practices, and other standards and service models such as ITIL (TSO, 2011), ISO/IEC 20000 (ISO/IEC, 2011), COBIT (Information Systems Audit et al., 2012), and ITSCMM (Niessink et al., 2005). CMMI-SVC model has been created for service providers and covers necessary steps to create, deliver and manage services. Of the 24 process areas of CMMI-SVC, only 7 are CMMI-SVC specific: Service Delivery (SD), Capacity & Availability Management (CAM), Incident Resolution & Prevention (IRP), Service Continuity (SCON), Service System Development (SSD), Service System Transition (SST) and Strategic Service Management (STSM).

MPS.BR Program (Santos et al., 2009) is an initiative funded by Brazilian government that aims to make it possible for micro, small and medium-sized Brazilian companies to invest in process improvement and software quality. Since 2004, more than 600 companies have already been evaluated by the reference model for software process improvement, MR-MPS-SW (Softex, 2012b) (Kalinowski et al., 2014). In 2012, reference model for IT services improvement MR-MPS-SV (Softex, 2012a) was created to provide a maturity model more suitable for micro, small and medium-sized Brazilian companies, but also compatible with the internationally accepted quality standards (including ISO/IEC 20000) and taking advantage of existing expertise in already available standards and maturity models. MR-MPS-SV (Softex, 2012a) has 24 processes, of which 12 are specific and based on ISO/IEC 20000 quality of services standard: Service Delivery (ETS), Incident Management (GIN), Service Level Management (GNS), Problem Management (GPL), Change Management (GMU), Service System Development (DSS), Budget and Accounting Services (OCS), Capacity Management (GCA), Service Continuity and Availability (GCD), Release Management (GLI), Information Security Management (GSI) and Service Reports (RLS).

Quality assessments are not just service outputs, they also involve service delivery process evaluation (Parasuraman et al., 1985). Measurement plays a key role in process quality improvement initiatives. Through process and products data collection and analysis, measurements can quantitatively demonstrate their quality and decision making support. Being able to control and predict processes future behavior allows the supplier to increase probability of achieving expected IT service quality.

Initial levels of both presented maturity models use measurement in a traditional way: metrics are generally collected and analyzed comparing planned and executed and allowing corrective actions to be taken in future executions. At highest maturity models levels (CMMI-SVC levels 4/5, MR-MPS-SV levels A/B), aiming to meet quantitative management, measurement is associated to statistical methods and other quantitative techniques (Forrester et al., 2010) (Softex, 2012a).

In general, effective service measurements are planned based on a few vital and meaningful indicators that are quantitative, economical and proper to support desired results. With many measures, an organization can lose focus on improving results because it may become too intent on measurement. Thus, we must define what metrics and indicators are suitable to support services quality monitoring and customer satisfaction objectives (TSO, 2011). The identification of such metrics is not an easy task.

Other authors had also studied this matter. For example, Lepmets et al. (Lepmets et al., 2011) present a framework of quality metrics for IT service, by conducting studies in industry, derived from ITIL, ISO/IEC 20000 and SERVQUAL. This framework is later extended through a systematic review (Lepmets et al., 2012) and (Lepmets et al., 2013), but no relationship between IT service quality metrics to services maturity models process areas are proposed.

3 CASE STUDY

A case study method is an exploratory research technique used to highlight and explore aspects, which may guide providing directions for the question. This methodology is relevant for information system when researcher can study the information system in a natural environment, answering ‘‘how’’ and ‘‘why’’ questions and when there had been no much previously conducted formal research. As only one company is being evaluated in this case study, but many process areas (multiple units of analysis), this paper represents an embedded single-case design case study (Recker

2013).

3.1 Case Study Planning

This case study objective is part of a major research about validating results of mapping study previous work in industry, in order to identify and better understand metrics found in literature.

Our research questions had been originally defined in a previous work (Trinkenreich et al., 2015): (i) What metrics are being suggested for IT service quality improvement projects? (ii) How do they relate to IT service maturity models processes? Those questions had been answered in literature by results of systematic mapping. From the content of all 16 selected papers, we were able to identify 133 metrics, 80 were about specific IT service maturity models' processes. Some found metrics are related to more than one process area. More details and discussion can be found in (Trinkenreich et al., 2015), some metrics related to the case study are listed in the following subsections.

Research questions that we aim to answer through this case study are: (iii) What kind of relationship exist between processes that appear in derived metrics that include more than one process, (iv) Which of literature suggested metrics are being used by organizations?

In order to execute case study, we have followed a set of steps depicted in Figure 1.

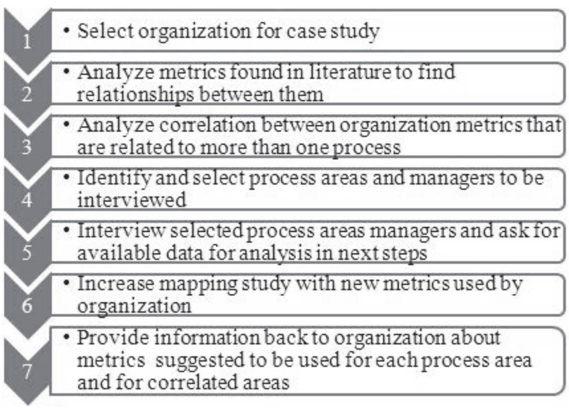

Figure 1: Case study stages.

3.2 Case Study Execution

As a first step, we identified an organization to perform the case study: Organization A is a large global organization headquartered in Brazil. It operates in over 30 countries and has offices, operations, exploration and joint ventures across five continents. The case study was performed on its IT services application and infrastructure department.

The IT Services Department provide IT services for all other departments of the organization following ITIL library practices [TSO, 2011], but it is not certified by any software or services maturity model. Main subareas of IT Services Department are Infrastructure, Hosting, Applications, Security, Networking and End User Computing. All subareas spend lots of effort to perform its services measurement in order to attend performance indicators, which had been created from strategic organizational goals. Performance indicators are derived in measurable goals that employees of IT Services Department need to annually reach, and the monitoring of related actions in course is performed monthly. Performance indicators are created relating to different subareas, in order to motivate the work within and between teams and improve service quality as a whole. Thus, team members not only care about their areas processes, but also support other areas. In addition to project goals and cost savings, there are also goals related to compliance incidents and availability of applications considered critical to business.

The researcher that conducted the study case works in Hosting subarea of IT Services Department of Organization A. She is focused on improving quality of services and, for that, conducts reviews of capacity, availability, implemented changes, and opened incidents with outsourcing support teams. IT Services Department also includes an ITIL Office subarea, with Service Delivery, Incidents, Problems, Changes and Service Continuity teams, cross serving all other subareas already cited here.

Second step was analyzing metrics found in literature to find relationships between them. During the mapping study execution, we found many metrics related to more than one process area, like: "Incident numbers can grow because of a Data Center unavailability", "Unavailability can decrease because team had found root cause for a recurrent issue", "Incident numbers can increase because an executed change that had failed". Although we did not conduct any further investigation at the moment, we have included in scope of this case study a cross metrics evaluation and a metric correlation analysis.

In order to answer research question (iii), we have analyzed all metrics to find out what kind of relationship can exist between them, checking what happens to a second metric (if it increases or decreases) when a first metric value increases. Then, we could find other process areas about which there is not a large amount of metrics in literature, but relates to many other process areas' metrics (for example Service Continuity and Change Management). Table 1 shows the metrics with more influence to others. The third column depicts what happens to the second metric when the first metric increases.

Third and fourth steps had been conducted in parallel. To allow us answering research question (iv), we had identified areas and respective managers to be interviewed. Most of identified metrics in literature were about Service Delivery, Incidents, Problems, Changes and Continuity.

We have interviewed managers of ITIL Office to analyze how each of those areas of Organization A interact with others, as explained in each following paragraphs and also resumed in Figure 2.

Incident and Service Delivery managers are the same manager, who is responsible of making sure that Service Desk (first support level for all IT Service Department subareas) receives users requests and process according defined flow, provides solution using support scripts or, when is not possible to solve the issue or attend the request, opening Incident tickets for next levels support.

Problem manager is responsible for tracking all problems record lifecycle, including problem record opening, categorization, root cause identification and closing. It does not include root cause solution implementation, as it is scope of Change management, and this is how Problem and Changes relate with each other.

Change manager is responsible for keeping configuration database up to date and tracking all changes in steady state applications, network and infrastructure. An unsuccessful change can cause issue in the environment and then users can call Service Desk and Incidents can be opened. This way is another relation that can exist between Change and Incident areas.

Service Continuity manager is responsible for controlling by opening crisis rooms to return availability of high critical applications. This team controls not all applications because high cost involved. A crisis room is opened in this company when there is an unavailability of a high impact application. When a crisis room is opened, all technical teams connect to a conference room and get there working together until the issue is solved and application is back again. This process had been created to minimize impact to applications considered critical to business and as faster it can solve the issue, fewer incidents are opened by users. This is how Service Continuity and Incident areas relate with each other. Also, every time a crisis room is closed, it generated a new problem record to be opened and this is how Service Continuity and Problem areas relate with each other.

Managers of the five ITIL Office teams selected for case study have more than 10 years working at Organization A, are committed to provide and improve quality of services to users. They had highlighted that impacts caused by processes intersections are unknown and still need to be measured and controlled, in order to verify if, how and where can processes be improved. Incident manager had informed that he can observe some applications that are running in production for quite a long time (years, for example), with a high amount of incidents continuously being opened by users reporting errors, and also with lots of changes in

Table 1: IT service metrics with more relationships found to other metrics.

First metric	Second metric	Impact
Service availability	Amount of incidents that caused business impact because of performance issues; MTBSI – mean time between system incidents; MTBF – mean time between system failures; Business impact caused by IT service outages; Number of service interruptions per month, per application, per configuration item; Duration of service interruptions per month, per application, per configuration item; Amount of services outages caused by capacity and availability issues	Decreases
Service availability	Number of avoided incidents per day	Increases
Percentage of change requests not tested because of due date	Percentage of successful change requests; Service availability; Number of avoided incidents per day; MTBSI – mean time between system incidents	Decreases
Percentage of successful change requests	Mean time between versions; Amount of IT services versions	Increases
Percentage of successful change requests	Amount of incidents caused by change requests; Amount of changes that had caused incidents and problems; Duration of service interruptions per month, per application, per configuration item; Service availability	Decreases
Percentage of change requests not tested because of due date	Amount of incidents caused by change requests; Amount of changes that had caused incidents and problems; Amount of change requests after a transition to production (considering a certain period)	Increases

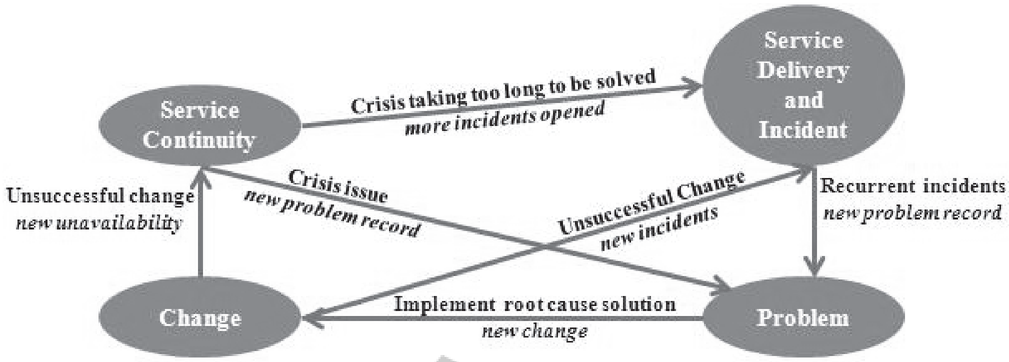

Figure 2: Interrelations between areas selected for case study from Organization A.

code being executed on it. He and the Change manager are interested in understanding if there is any cause-effect between Incidents and Changes for each of those applications, and how can they measure that. They aim to find if this is happening because Changes are being executed to release new functionalities and are causing Incident increase, if Changes are being executed to fix bugs and are introducing new errors, if there is any standard of Incidents variation being related to changes execution, or not. If there is any kind of standard, after how much time (one hour, one day, two days, a week) after implementing a Change that Incidents start to grow.

Managers had been interested in being interviewed as they need to always keep improving measurements and it had showed a good interaction between academy and industry on this subject.

In order to aggregate information for research question (iii), we have taken two process areas metrics that we could find relationship and company had available data to analyze if a correlation test could be used to find correlation between them. Organization A does not document whether each Incident is caused by a Change. Both Incident and Change managers said this is a big challenge to understand how Changes impact Incidents and how Incidents impact Changes, Therefore, we have collected data about amount of executed Changes (deploy of new code solution) and opened Incidents for 1 year for 9 web applications that are hosted in the same Microsoft Sharepoint infrastructure.

Aiming to apply descriptive statistical methods, we have defined a null hypothesis stating that there is no correlation between executed Changes and opened Incidents. Like that we are saying that executed changes do not increase or decrease amount of opened incidents.

As we aim to reject null hypothesis showing that it can be a relation between Changes and Incidents for Microsoft Sharepoint applications. First we suppose that Changes can impact Incidents, what means that the execution of Changes deploying new code solution (either for new functionalities or to fix reported errors) can cause trouble applications and it can make users to dial to support and open Incidents. The objective of that is to propose a way to help Organization A on finding root cause for having a large amount of Incidents opened by users for applications that are hosted on this platform and so improve service quality. In order to do that, we had compared values from changes in one period to incidents in next period, because we suppose that a Change happens first, and after some time, the impact occurs and then Incident happens.

So, in order to analyze correlation, we had first aggregated amounts of Changes and Incidents that had been occurred for those Microsoft Sharepoint applications per month (Table 2). In order to select proper correlation test, we had to first find if distribution data was normal. As we had 12 observations (months), Shapiro-Wilk test was applied to confirm that distribution data was normal (p-values > 0,05) for both Changes (p-value = 0,432) and Incidents (p-value = 0,793) and so we were able to use Pearson correlation test to compare incidents and changes. We had observed that data are not strongly correlated and we cannot reject null hypothesis (Pearson r = -0,1200, p = 0,71).

Then we had aggregated amounts of Changes and Incidents per week, instead of month, in order to get more granular data (Table 3). As the amount of observations was larger now, with 53 weeks, we had applied Kolmogorov-Smirnov test to confirm that distribution data was still normal (p-values > 0,05) for both Changes (p-value = 0,261) and Incidents (p-value = 0,614) and so again we could use Pearson correlation test to compare incidents and changes. Again, we had observed again that data are not strongly correlated and we cannot reject null hypothesis (Pearson r = -0,078, p = 0,57).

Distribution data for Changes was not normal (p-value < 0,05) distribution data for Incidents was normal (p-value > 0,05), but very close to this limit. We have selected Spearman correlation test, because it can also be applied to distribution data that is not normal. Once more, we had also observed that data are not strongly correlated and we still cannot reject null hypothesis (Spearman = -0,0741).

We could not find correlation between Changes and Incidents when considering total applications, but managers had informed that they still can notice errors and cases of unavailability after some changes that need to be further investigated.

Fifth, still related to answer research question (iv), we have interviewed managers of five IT service process areas (Incident, Problem, Service Delivery, Change and Service Continuity), asking what metrics do they use today and if they wish to get some other results by measurement that is not being done yet.

Incident manager had informed that taken measurements are “First Call Resolution”, “Incident Resolution on Time”, “Incidents - Backlog per Vendor and Support Group, per Status, per Aging and per Priority” and “Incidents Closed on Target, Total Closed and % on Target per Vendor and Support Group”.

Service delivery manager had explained that in order to count to the SLA result, the incident should be in the Closed status. All measurements start when incident is assigned to a Support Group. There are two sets of SLA: TTO (Time To Own, the same as response time) and TTR (Time To Resolve). Some vendors don´t have contract for TTO, but even like that the company measures them either. For TTO, it stops the calculation when incident status goes to In Progress or Resolved. If an incident status is directly changed from Assigned to Pending, the clock does not stop. TTO is calculated only one time per incident and per vendor. If the incident is reassigned/reopened to the same service target, it does not start measuring again. For TTR, it stops the clock only in Resolved status. The clock pauses in Pending status, independent of the reason used for being on this status. For service targets where the clock runs only in business days and in a limited time, both TTO and TTR calculate only in the defined working hours.

Problem manager had informed that taken measurements are “Amount of problems with missed root cause due date”, “Amount of problems that had inconclusive root cause”, “Amount of open problems for high impact applications” and “MTBP - Mean Time Between Problems”.

Service Continuity manager had informed that taken measurements are “Application Availability”, “Application Performance”, “Application User Experience” (which is a derived metric 35% * System Performance + 65% * System Availability), “TTE - Time to Escalate an Incident to Crisis”, “Amount Time in Crisis” and “MTBC - Mean Time Between Crisis”. “Application Availability” is automatically collected by a monitoring platform with machines installed in each location of the company, simulating an user access to application. “Amount Time in Crisis” and “MTBC - Mean Time Between Crisis” are calculated using crisis reports, that have start and end information.

Change manager informed that uses those measures: “Rate of denied x approved changes”, “Rate of successful x unsuccessful executed changes”, “Mean Time Between Corrective Changes”, “Amount of Emergency changes”.

Sixth, we were able to answer research question

Table 2: Amount of opened incidents reporting applications errors and executed code changes per month.

Months	Ago 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	Jun 2014	Jul 2014	Aug 2014
Changes	9	8	9	3	9	6	7	13	10	7	8	9	-
Incidents	-	189	171	143	160	162	149	110	136	90	100	101	127

Table 3: Amount of opened incidents reporting applications errors and executed code changes per week.

Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Changes	4	4	6	6	5	3	1	4	2	1	0	2	0	1	2	6	3	0	1
Incidents	62	48	37	45	41	44	30	27	45	27	32	41	39	68	59	24	9	10	26
Weeks	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Changes	2	2	0	1	2	2	3	4	5	3	3	1	1	8	5	2	4	1	4
Incidents	46	46	34	24	44	49	33	10	33	42	21	18	28	52	30	9	25	24	19
Weeks	39	40	41	42	43	44	45	46	47	48	49	50	51	21	53	-	-	-	-
Changes	0	6	5	5	8	9	8	3	5	2	5	7	4	3	5	-	-	-	-
Incidents	21	30	20	24	22	26	24	19	23	17	16	21	34	50	2	-	-	-	-

(iv) in the context of this case study. We had increased the mapping study metrics list with new metrics informed by this company and marked those ones that were returned by literature and are really used. Organization A uses 19 metrics for IT services, as we can see in Table 4. First column lists the metric found in the case study, the second column indicates whether it was also found in the mapping study results, while last two columns indicate CMMI-SVC and MPS-SV related processes. Most of them (68%) had been found in literature and only one metric used by Organization A correlates different process areas ("TTE - Time to Escalate an Incident to Crisis" which is about Incident and Service Continuity areas).

Finally, as the seventh step, we had returned to interviewed managers with suggestion of new metrics they could use for each process area and for intersections between areas (obtained by systematic mapping and categorization by process areas that we had previously done (Trinkenreich et al., 2015)), in order to help them on selection of new metrics to improve management and control of IT services Department quality and attend business goals.

Table 4: Metrics used by Case Study organization.

Metric used in Industry	Literature?	CMMI-SVC	MPS-SV
First Call Resolution	Yes	IRP	GIN
Incident Resolution on Time	Yes	IRP	GIN
Incidents - Backlog per Vendor and Support Group	Yes	IRP	GIN
Incidents - Backlog per Status, per Aging and per Priority	Yes	IRP	GIN
Total and % Incidents Closed on Target per Vendor and Support Group	Yes	IRP	GIN
Amount of problems with missed root cause due date	Yes	IRP	GPL
Amount of problems that had inconclusive root cause	Yes	IRP	GPL
Amount of open problems for high impact applications	Yes	IRP	GPL
MTBP - Mean Time Between Problems	No	IRP	GPL
Application Availability	Yes	GCD	SCON
Application Performance	No	GCD	SCON
Application User Experience	No	GCD	SCON
TTE - Time to Escalate an Incident to Crisis	Yes	GCD/GIN	SCON/GIN
Amount Time in Crisis	No	GCD	SCON
MTBC - Mean Time Between Crisis	No	GCD	SCON
Rate of denied x approved changes	Yes	CM	GMU
Rate of successful x unsuccessful executed changes	Yes	CM	GMU
MTBCC - Mean Time Between Corrective Changes	No	CM	GMU
Amount of Emergency changes	Yes	CM	GMU

Interviewed managers had analyzed the list of metrics we have retrieved from literature through systematic mapping and reported interesting on start using some of them. We had also suggested managers to start using metrics to correlate more than one process area. Metrics that we had found in literature to attend process area intersections (already discussed in Figure 2) were "Amount of incidents caused by changes" and ´ Rate of problem increase comparing to incidents".

Besides those suggestions retrieved from literature, there are intersections that we had not found correlated metrics in literature. For those, we have discussed and agreed, based on analysis of goal question metrics, about some new metrics creation together with interviewed managers: "Amount of problems that had root cause related to failed changes", "Rate of crisis occurred with root cause X root cause unknown", "Amount of incidents for issues during crisis" and "Amount of crisis caused by changes". Table 5 presents all metrics that Organization A managers had reported that plan to start using as a result of this case study.

Incident manager had informed that he needs to adjust the process of tickets fulfillment by Service Desk in order to get information and generate data for further measurements. For example, to measure "Amount of incidents caused by issues about growth rate", a root cause analysis needs to be done and filled in the incident record in order to get incidents caused by growth rate. Today, technical teams solve the incident without imputing data about root cause. Another example that needs information to be carefully filled in incidents is for metric used in Correlation test "Amount of changes that had caused incidents". If root cause (in this case, the change record number) is not filled for each incident, it is not possible to get a proper list of changes that had caused incidents to be opened after executed.

Therefore, besides this lesson learned about the importance of designing processes focused on data generation and collection for measurements, we could get other lessons from this case study either. Measurement process area of service maturity models can be used by organizations which main business is not IT, in order to help them on meeting performance indicators. Also we have seen that metrics that correlate more than one process area can support finding impacts that one can cause in other which could not be seen with metrics for only single areas, and with this information, organizations can work on process improvements and prepare themselves to mitigate risks about those impacts. Another interesting point that authors had realized is that performance indicators that correlate more than one area can encourage people between different teams to work together. For example, “TTE - Time to Escalate an Incident to Crisis”. For this number to decrease, both Incident and Service Continuity teams must work together in a process of teamwork.

4 FINAL CONSIDERATIONS

This paper had presented a case study that aimed to identify adequate metrics to be used by organizations deploying IT service maturity models, whether there as correlation between metrics that are related to more than one process, and how are IT service metrics being used in a real organization.

Mapping study had returned several metrics relating more than one process area, showing some kind of influence between them. Changes and new releases that cause incidents are examples of correlation and intrinsic cause-effect relationships between Change, Release and Incident areas. Increase and decrease analysis is a first step to study cause-effect between metrics, and Pearson and Spearman correlation tests can be used for a deeper investigation to understand how long after an event one metric can affect another. We have demonstrated an example about Changes and Incidents. A Change can influence Incidents after hours, days or other periods. Also, we had found that is necessary to have granular and detailed data in order to select proper grouping for correlation tests.

If an organization can realize the importance of measurements to control and improve the quality of its services, it needs to design its processes thinking about how processes will generate data to be collected for measurements, always doing cost balancing and being aligned with business needs.

Even not having IT as its main business, an organization that measures provided IT services and has documented performance indicators to meet, avoid having the IT Services Department being undervalued by internal or external clients, and also justifies investments on it. Maturity models practices and goals can help as evolutionary way to implement Measurement, even if the organization is not interested on being certified on them.

Selecting metrics to control quality of IT service is not easy. Metrics need to be useful to justify measurement costs, need to be aligned with business goals, and can permeate different areas with different processes and people. This can seem more difficult to manage, but results can show increase of teamwork and deeper understanding of relationships between different process areas, that can find and remove possible bottlenecks that would not be known with only the use of single areas metrics.

As future work, we plan to extend case study for other organizations, detail how to collect and analyse IT service metrics, investigate correlations between areas to have a deeper understanding about how one process impact another, and provide a method to create cross related metrics.

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REFERENCES

Forrester, E., Buteau, B., Shrum, S., 2010. *CMMI For Services, Guidelines for Superior Service*. CMMI-SVC Version 1.3, - 2nd Edition. SEI. Addison-Wesley Professional.

Information Systems Audit, et al., 2012. *COBIT Five: A Business Framework for the Governance and Management of Enterprise IT*. USA.

ISO/IEC, 2011. ISO/IEC 20.000-1: *Information Technology – Service Management – Part 1: Service management system requirements*. International Standard Organization/International Electrotechnical Commission, Switzerland.

Kalinowski, M.,Weber, K. C., Franco, N., Barroso, E., Duarte, V., Zanetti, D., Santos, G., 2014. *Results of 10 Years of Software Process Improvement in Brazil Based on the MPS-SW Model.* 9th Int. Conf. on the Quality in Information and Communications Technology (QUATIC), Guimarães, Portugal, 2014.

Lepmets, M., Cater-Steel, A., Gacenga, F., Ras, E., 2012. *“Extending the IT Service Quality Measurement Framework through a Systematic Literature Review”*, SRII Global Conference.

Lepmets, M., Mesquida, A., Cater-Steel, A., Mas, A., Ras, E., 2013. *“The Evaluation of the IT Service Quality Measurement Framework in Industry“*, Global Journal of Flexible Systems Management - Volume 15.

Lepmets, M., Ras, E., Renault, A., 2011. “*A Quality Measurement Framework for IT Services”, SRII Global Conference.*

Niessink, F., Clerc, V., Tijdink, T., Vliet, H., 2005 - *The IT Service Capability Maturity Model - IT Service CMM*, version 1.0RC1.

Parasuraman, A. Zeithaml, L. Berry, 1985. *.A conceptual model of service quality and its implications for future research*. Journal of Marketing, vol. 49, pp. 41-50.

Recker, J., 2013. "*Scientific Research in Information Systems - A Beginner's Guide"*. Springer, ISBN 978-3-642-30048-6.
Santos, G. Weber, K. C. Rocha, A., 2009. *Software Process Improvement in Brazil: Evolving the MPS Model and Consolidating the MPS.BR Program*. XXXV Conferência Latinoamericana de Informática – CLEI 2009, Pelotas, Brasil.
Softex, 2012a. *MPS.BR – Guia Geral MPS de Serviços* (in Portuguese and Spanish). Available at www.softex.br.
Softex, 2012b. *MPS.BR – Guia Geral MPS de Software* (in Portuguese and Spanish). Available at www.softex.br.
Trinkenreich, B., Santos, G., Barcellos, M., 2015 *"Metrics to Support IT Service Maturity Models – A Systematic Mapping Study"*, 17th International Conference on Enterprise Information Systems (ICEIS), Barcelona, Spain.
TSO (The Stationery Office), 2011. *An Introductory Overview of ITIL*. available http://www.tsoshop.co.uk.
Wohlin, C., Runeson, P., Höst, M., Regnell, B., Wesslén, 2012. *Experimentation in Software Engineering,* Springer, ISBN: 978-3642290435.