Metrics to Support IT Service Maturity Models
A Systematic Mapping Study

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Keywords: Measurement, Key Performance Indicator, IT Service Quality, Maturity Models, Systematic Mapping Study.

Abstract: *Background*: Maturity models for IT service such as CMMI-SVC and MR-MPS-SV requires identification of critical business process and definition of relevant metrics to support decision-making, but there is no clear direction or strict suggestion about which should be those processes and metrics. *Aims*: We aim to identify adequate metrics to be used by organizations deploying IT service maturity models and the relationship between those metrics and processes of IT service maturity models or standards. Research questions are: (i) Which metrics are being suggested for IT service quality improvement projects? (ii) How do they relate to IT service maturity models processes? *Method*: We have defined and executed a systematic mapping review protocol. A specialist on systematic mapping review and IT service maturity models evaluated the protocol and its results. *Results*: Of 114 relevant studies, 13 addressed the research questions. All of them presented quality metrics, but none presented tools or techniques for metrics identification. *Conclusions*: We identified 133 metrics, 80 related to specific processes areas of service maturity models. Even being a broad result, not all models aspects were considered in this study.

1 INTRODUCTION

Service is about delivering value to customers by facilitating results they want to achieve without taking costs and risk ownership (Davenport, 2013). 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 (Capability Maturity Model Integration for Services) (Forrester et al., 2010) and MR-MPS-SV (Reference Model for IT Services Improvement) (Softex, 2012a) models have 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 processes to be measured must be aligned with organizational goals in order for measurement results to be 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.

This paper describes the main results of a study carried out aiming to identify in the literature metrics used to monitor IT service quality that are appropriate to meet IT service maturity models requirements. The paper is structured as follows: background on quality and IT service measurement, and similar studies (Section 2), systematic mapping planning (Section 3), systematic mapping results (Section 4) and final considerations (Section 5).

2 BACKGROUND

Service quality is an abstract concept due to the nature of the term “service,” which is intangible, non-homogeneous and its consumption and production are inseparable (Parasuraman et al., 1985). In order to be able to offer quality, the supplier must continually assess the way service is being provided and what the customer expects in the

Trinkenreich B., Santos G. and Perini Barcellos M..
Metrics to Support IT Service Maturity Models - A Systematic Mapping Study.
DOI: 10.5220/0005376003300337
In *Proceedings of the 17th International Conference on Enterprise Information Systems* (ICEIS-2015), pages 330-337
ISBN: 978-989-758-097-0

future. A customer will be unsatisfied with IT service providers who occasionally exceed expectations, but at other times disappoint. Providing consistent quality is important, but is also one of the most difficult aspects of the service industry (ISO/IEC 20000, 2011).

As production and consumption of many services are inseparable, quality is delivered during service delivery, making customer reporting of high relevance for quality evaluation (Parasuraman et al., 1985). Quality assessments are not just service outputs; they also involve service delivery process evaluation (Parasuraman et al., 1985).

Although methods such as GQM (Solingen and Berghout, 1999) support measurement planning, it is still necessary to select metrics properly to be collected and analysed for decision-making. However, such methods do not suggest what to measure, they only reinforce that metrics should be aligned with the organization's goals. Thus, we must define which metrics and indicators are suitable for monitoring service quality and customer satisfaction.

2.1 IT Service Maturity Models

Maturity models focus on improving organizations' processes with to the assumption that product or system quality is highly influenced by the quality of process used to develop/maintain it. 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 the endless cycle of process improvement (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 (ISACA, 2012), ITSCMM (Niessink et al., 2005). CMMI-SVC was created for service providers and covers the necessary steps to create, deliver and manage services. Maturity levels are used to describe a recommended evolutionary path for organizations that aim to improve service delivery processes. Table 1 shows 5 maturity levels, from level 1, where processes are *ad hoc* or chaotic. Initial levels consider creation and description of process and work plans whereas the higher levels demonstrate processes that are quantitatively and continuously controlled and improved. From 24 CMMI-SVC process areas, only 7 are CMMI-SVC specific (*italic* in Table 1).

MPS.BR Program (Kalinowski et al., 2014) is an initiative funded by the Brazilian government that seeks 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 assessed on the reference model for software process improvement, MR-MPS-SW (Softex, 2012b) (source: www.softex.br/mps.br). In 2012, the 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 internationally accepted quality standards that take advantage of existing expertise in other standards and maturity models.

Table 1: CMMI-SVC process areas by maturity level (Forrester et al., 2010).

Level	Process Areas
5	Organizational Performance Management (OPM), Casual Analysis & Resolution (CAR)
4	Organization Process Performance (OPP), Quantitative Work Management (QWM)
3	Organizational Process Focus (OPF), Organizational Process Definition (OPD), Organizational Training (OT), Integrated Work Management (IWM), Decision Analysis & Resolution (DAR), Risk Management (RSKM), *Incident Resolution & Prevention (IRP), Strategic Service Management (STSM), Service System Transition (SST), Capacity & Availability Management (CAM), Service System Development (SSD), Service Continuity (SCON)*
2	Requirements Management (REQM), Work Planning (WP), Work Monitoring & Control (WMC), Supplier Agreement Management (SAM), Measurement & Analysis (MA), Process & Product Quality Assurance (PPQA), *Service Delivery (SD)*, Configuration Management (CM)

Table 2: MR-MPS-SV processes (Softex, 2012a).

Level	Processes
A	(*no new processes are added*)
B	(*no new processes are added*)
C	Decision Management (GDE), Risk Management (GRI), *Capacity Management (GCA), Service Continuity and Availability (GCD), Release Management (GLI), Information Security Management (GSI), Service Reports (RLS)*
D	*Service System Development (DSS), Budget and Accounting Services (OCS)*
E	Process Establishment (DFP), Process Assessment and Improvement (AMP), *Change Management (GMU),* Human Resources Management (GRH)
F	Measurement (MED), Acquisition (AQU), Configuration Management (GCO), Quality Assurance (GQA), Work Portfolio Management (GPT), *Problem Management (GPL)*
G	Requirements Management (GRE), Work Management (GTR), *Service Delivery (ETS), Incident Management (GIN), Service Level Management (GNS)*

Table 2 depicts MR-MPS-SV (Softex, 2012a) 7

maturity levels (from G to A, the highest) comprising 24 processes, of which 12 are based on ISO/IEC 20000 quality of services standard and therefore have no equivalent in MR-MPS-SW (shown in *italic* in Table 2).Initial levels of both presented maturity models use measurement in a traditional way. At this point, metrics are generally collected and analysed by comparing planned and executed values, which allow 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 with statistical process control techniques (Forrester et al., 2010) (Softex, 2012a).

2.2 Similar and Related Studies

A challenge faced by organizations is about selecting metrics to help them monitor provided service quality aspects, support service management improvement, and positively affect customers' quality perception. The identification of such metrics is not an easy task. Liu et al., (2011) present a case study about an IT service management framework of an ITIL-based company. The authors discuss key performance indicators (KPI) evaluation, service level agreement, an improvement for this framework and IT service management processes (Liu et al, 2011). However, those KPI are only evaluated based on ITIL processes of a specific company. Lepmets et al., (2011) present a quality metrics framework for IT services derived from ITIL, ISO/IEC 20000 and SERVQUAL, by conducting studies in industry. The framework is later extended through a systematic review (Lepmets et al., 2012); (Lepmets et al., 2013), but no relationship between IT service quality metrics to services maturity models process areas are proposed.

3 SYSTEMATIC MAPPING PLANNING

Initially we conducted an informal literature review about metrics and indicators for IT service quality and service maturity models in order to obtain knowledge about IT service domain. We noticed the importance of having a comprehensive view of how to quantify and measure service quality, in order to map metrics to be used by IT service maturity models and their processes areas.

The goal of systematic mappings is to collect and evaluate evidence on a particular topic, but also find results less dependent on researcher's own case, allowing research replication and results comparison (Kitchenham and Charters, 2007). The systematic mapping scope consists of identifying papers presenting metrics that could be used to assess IT service quality within the context of IT service maturity models. A protocol based on systematic reviews (Kitchenham and Charters, 2007) was used to guide the systematic mapping execution, but due to space limitations, it is not fully detailed.

To assist systematic mapping analysis, research questions were defined (see Table 3) and later used for generating the data collection form. Publication selection was done in three steps. First: search string execution and results cataloguing. Second: titles and abstracts reading and applying inclusion (IC) and exclusion (EC) criteria (Table 4) to the publications selected in the first step. Third: full text reading (publications selected in the second step) and verification if they really meet defined criteria.

Table 3: Research questions.

#	Main Questions	#	Secondary Questions
1	Which metrics are suitable for IT service quality improvement initiatives?	1.1	What are the metrics origins?
		1.2	Is there any evidence of practical applications for the metrics?
		1.3	What software tool for planning, collection, analysis and dissemination of metrics is described?
2	What is the relationship between found metrics and IT service maturity models processes?	2.1	What models of quality improvement services are mentioned?
		2.2	Is there any technical reference used to identify metrics?
		2.3	Is there any Statistical Process Control application detailed for the metrics?

Table 4: Inclusion and exclusion criteria.

IC1	The publication main contribution proposes or describes the use of indicators or metrics to assess quality and/or performance and/or IT service maturity.
IC2	Techniques, methods, processes and/or tools related to metrics identification to assess quality and/or performance and/or maturity of IT service are addressed by the publication.
EC1	The publication is not derived from peer reviewed conferences and journals.
EC2	The publication is not a book chapter not subject to peer-review (such as not originated from conference papers) or other non-scientific publications (such as whitepapers).

Search string was: ("IT service" OR "IT services") AND (maturity OR quality OR performance OR qos) AND (itil OR cobit OR "ISO/IEC 20000" OR itsm OR cmmi-svc OR "CMMI for Services" OR mps-sv OR mr-mps-sv) AND (TITLE-ABS-KEY (measurement OR metric OR metrics OR measure OR measures OR

measuring OR kpi OR "Key Performance Indicator")). Scopus (www.scopus.com) search engine was selected due to its reliable and replicable results and due to index most control papers.

An expert on maturity models, IT service and systematic mappings evaluated protocol about: search string ability to identify relevant papers, including control papers; research questions scope and extent in relation to research objectives; adequacy of control papers; ability of data collection form on identifying important aspects related to the systematic mapping objective.

4 SYSTEMATIC MAPPING EXECUTION

In August 2014, the search expression was executed on Scopus search engine, returning 114 publications. The second step returned 45 publications. After the third step, 13 remained. We did not filter any venue while executing the search string. All publications returned are properly indexed by Scopus engine.

Table 5 presents the selected publications, Papers in bold are the control ones. It is worth noting the almost complete absence of venues related to Software Quality, Software Engineering or Experimental Software Engineering (but PROFES, EuroSPI and QUATIC).

As a quality assurance procedure, a specialist analysed all selection steps, and inclusion and exclusion criteria application. Aiming to dispel doubts and avoid judgments of subjectivity, research questions (both primary and secondary) as well as inclusion and exclusion criteria evolved during study. Protocol described in section 4 already reflects these decisions. We also evaluated the papers presented in Table 5 regarding their overall quality and soundness. Although this is partially accomplished through the application of both exclusion criteria (EC1 and EC2) that guarantee all papers were peer-reviewed, we also critically read all the papers to assure that proper methodological aspects were applied.

Finally, the decision of whether or not to keep papers in systematic mapping scope in each of selection steps (Tables 3 and 4) and data collection from papers was evaluated. After this step, data collected was summarized. Metrics similarities were analysed considering their name, description and formula. Most papers had not presented description and formula and for those cases, we analysed only the metric name and defined a unique name to represent similar or identical metrics, consolidating in only one metric.

Table 5: Selected papers after complete reading.

#	Title, Authors, Publication Year, Source
1	DSS Based IT Service Support Process Reengineering Using ITIL: A Case Study - Valverde, R., Malleswara, T. - Journal Intelligent Decision Technologies (2014)
2	**The Evaluation of the IT Service Quality Measurement Framework in Industry – Lepmets, M., Mesquida, A., Cater-Steel, A., Mas, A., Ras, E. - Global Institute of Flexible Systems Management (2014)**
3	Application Management Services Analytics - Li, W., Li, T., Liu, R., Yang, J., Lee, J. - Service Operations and Logistics, and Informatics International Conference
4	Toward a model of effective monitoring of IT application development and maintenance suppliers in multisourced environments - Herz, T., Hamel, F., Uebernickel, F., Brenner, W. - International Journal of Accounting Information Systems (2013)
5	Proposal of a new model for ITIL framework based on comparison with ISO/IEC 20000 standard - Tanovic, A., Orucevic, F. - World Scientific and Engineering Academy and Society (2012)
6	**Extending the IT Service Quality Measurement Framework through a Systematic Literature Review - Lepmets, M., Cater-Steel, A., Gacenga, F., Ras, E. - SRII Global Conference (2012)**
7	A Quality Measurement Framework for IT Services - Lepmets, M., Ras, E., Renault, A. - SRII Global Conference (2011)
8	Measuring Service Solution Quality in Services Outsourcing Projects using Value Driver Tree Approach - Akkiraju, R., Zhou, R. - SRII Global Conference (2011)
9	**Case Study on IT Service Management Process Evaluation Framework Based on ITIL-Liu, M., Gao, A., Luo, W., Wan, J. - International Conference on Business Management and Electronic Information (2011)**
10	SLA Perspective in Security Management for Cloud Computing - Chaves, S., Westphall, C., Lamin, F. - International Conference on Networking and Services (2010)
11	Business-impact analysis and simulation of critical incidents in IT service management - Bartolini, C., Stefanelli, C., Tortonesi, M. - International Symposium on Integrated Network Management (2009)
12	Measurement of Service Effectiveness and Establishment of Baselines - Donko, D., Traljic, I. - World Scientific and Engineering Academy and Society (2009)
13	The most applicable KPIs of Problem Management Process in Organizations - Sharifi, M., Ayat, M., Ibrahim, S., Sahibuddin, S. - International Journal of Simulation Systems, Science & Technology (2009)

Table 6: Identified metrics.

Metrics	CMMI-SVC	MPS-SV
Amount of incidents that had caused business impact due to performance issues	CAM IRP	GIN GCA
Percentage of exactness of capacity forecast; Amount of capacity adjustments cases; Amount of resolution hours due to capacity shortage cases; Amount of money for capacity reserves	CAM	GCA
Service availability	CAM	GCD
Amount of incidents caused by growth rate issues	CAM IRP	GIN CM
Response time for a change request; Successful/failed change requests; Not tested changes because of due date; Emergency/normal ; Rejected/accepted; Major x minor; Released/pending changes; Average interactions with Change Management process	CM	GMU
Frequency of configuration updates, Percentage of configuration correctness, Mean time between versions	CM	GCO
Amount of IT service versions	CM	GLI
Amount of changes that had caused incidents and problems	CM IRP	GMU GIN GPL
Amount of change requests after a transition to production (considering a certain period)	CM SST	GMU GLI
Amount of incidents caused by change requests	CM IRP	GMU GIN
Amount of avoided incidents per day; Mean time between incidents; Mean time to restore system; Amount of recurrent, escalated and redirected incidents; Average time to register an incident by phone and system; Average time to categorize, prioritize, start solving action, complete action, solve an incident; Amount of incidents per SLA meet, application, period of day, month, support person and support level, resolution way (local/remote), status, priority; Average response time per support level; Percentage of correctness incident description; Percentage of existence of service desk support script	IRP	GIN
Amount of time to find/solve root cause; Rate of closed/on-going problems; Rate of recurrent/new problems; Amount of time between issue start and problem open; Amount of problems solved by known errors; Average cost to solve a problem; Amount of problems per status, month, application, configuration item, with/without root cause, repeated/new, overdue/on time	IRP	GPL
Rate of problem number increase comparing to incidents; Recurrent incidents with/without an associated problem record to investigate it	IRP	GIN GPL
Rate of onshore x offshore allocated resources for projects; Amount of previous projects executed successfully for the same client; Rate of delivered projects with/without cost optimization	IWM	GPT
Frequency of organization policies update; Amount of CMMI maturity or capacity level matches; Amount of process evaluations; Amount of identified weaknesses; Rate of improvement initiatives completed/pending; Number of cases where process is being circumvented	OPF	AMP
Frequency and amount of time hours for people training; Rate of employees who finished the training; Number of trainings per year	OT	GRH
Amount of systems maintenance correctness after training	OT SSD	GRH DSS
Amount of time, frequency and duration used for verification activities	PPQA	GQA
Amount of identified risks per severity, per area, per application, per status; Average impact of risks; Rate of deviations from the expected real goals; Amount of reduced deviations; Frequency of backup execution; Amount of hours to execute backup routines	RSKM	GRI
Amount of identified issues during security tests amount	RSKM	GRI GSI
Service outages caused by capacity and availability issues	SCON CAM	GCA GCD
Metrics	CMMI-SVC	MPS-SV
Frequency of SLA monitoring; Grades of SLA satisfaction level; Amount of services covered by SLA and OLA; Amount of delivered services in accordance with SLA; Average of time for SLA change request approval; Amount of fines paid because of SLA failures; Amount of SLAs under review; Number of identified contract breaches	SAM	GNS
MTBF – mean time between system failures; Business impact caused by IT service outages; Service interruptions number and duration per month, application, configuration item; Business processes with/without continuity agreements; Number of disaster practices, shortcomings and gaps per month, application, configuration item; Number of implemented preventive metrics	SCON	GCD
Deployments duration; Release backouts; Automatic/manual release distribution; Failed/succeed release component acceptance tests; New services released to production per application, month	SST	GLI
Grades received on user satisfaction about received IT service; Support calls received/abandoned per day; Support calls average time per day, month and person; Business impact caused by late service deliveries; Service request time per user, month, application; User complaint response time; Service requests on time/late, with correct/wrong description, completed/pending	SD	ETS
Retention rate of specific key employees	WMC	GRH
Projects delivered in/not accordance of scope, time, resources and budget; Learned lessons by project; Projects per defined risk status	WMC	GTR
Amount of incidents caused by new releases transitioned to production	SST IRP	GLI GIN
Application defect density and complexity; Requirement defects found per project phase; Service documentation update frequency; Hours spent on rework, review, inspection and tests; Cost and Defects per application function point; correction time effort, project phase, severity; Function points delivered by developer per day; Application components per business results; Time per each application development phase; Failed/accepted acceptance tests; Reduced/increased time for maintenance; Planned/unplanned new services	SSD	DSS

4.1 Results

From the content of the 13 papers in the systematic mapping scope, it was possible to find more than 300 individual metrics. After performing repeated significance metrics aggregation and removing metrics unrelated to any process maturity models area, neither CMMI-SVC (Forrester et al., 2010) nor MR-MPS-SV (Softex, 2012a), this number dropped to 133. Metrics unrelated to any process maturity models areas are for example: Financial (Actual price paid for received service), Service importance to business (Utilization rate of IT service functions), Climate (Employees know how provided service contributes to better performance). Answering the two main research questions, Table 6 presents the identified metrics and the processes to which they relate. Some metrics are related to more than one process area. We aggregated metrics after reading and understanding their intended use, and its possible association to service maturity models objectives and goals.

We classified around 24% of metrics as related to incidents. This may indicate trends on summarizing IT service measurement in incidents, possibly leaving other areas without proper attention. Around 11% of metrics were classified as related to Service System Development. For the development/software version of target maturity models, the implementation concept is related to software products and its component's coding. On the other hand, for the service version, implementation relates to configuration and delivery of all required elements to provide service, including software development or not. Even then, a relevant number of metrics were related to coding performance and defects. As we searched for IT service, it shows academy and industry trends to consider software development and maintenance as services. Around 9% of metrics were classified as related to Change Management, which in system development is also a relevant area about maintaining applications that affect other areas that need to be studied further. Around 8% of metrics were classified as related to Service Delivery, whose goals are to ensure that there are policies, guidelines and documented approaches for service delivery and operation. It ensures that all required elements (infrastructure, resources, etc.) for service provision are available and that service supply system automated or not, is ready for operation and has periodic maintenance to keep delivery of agreed services continuity. Around 7% of metrics were classified as related to Service Continuity, which many times can be measured directly by monitoring applications and generating a reliable result and is usually one of indicators that service providers need to meet to be in accordance with service level agreements they have in contracts with customers.

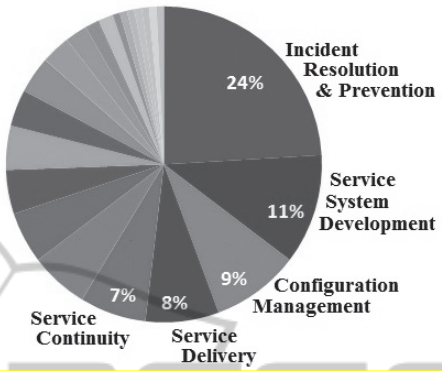

Figure 1: Top5 CMMI-SVC areas with more metrics found by systematic mapping.

Following, we briefly present some results related to systematic mapping secondary questions. Regarding "What are the metrics origin?," the literature is the most frequent source (papers # 2, 5, 6, 7, 8, 10, 11, 12 and 13 on Table 5). In relation to "Is there any evidence of practical applications for the metrics?", we found that most of the papers indicate usage of metrics in industry (# 1, 2, 3, 4, 5, 8, 9 and 11 on Table 5) and so we can say there is already some applicability evaluation in organizations. During publications analysis, we looked for "What software tool for planning, collection, analysis and dissemination of metrics is described?" Some tools like IBM AMS Analytics (#3 on Table 5) and two decision support systems were found (#1 and 11 on Table 5). With regards to "What models of quality improvement services are mentioned?," we found CMMI, ISO/IEC 15939, 20.000 and 25.020, VAL IT, SERVQUAL, PSM and GQM. We also looked if "Is there any technical reference used to identify metrics?" and, even though there are others, ITIL (TSO, 2011) is fully cited in all publications, showing the high relevance of this source in IT service management field. Finally, due to its relevance to higher maturity levels, we sought to identify if "Is there any Statistical Process Control application detailed for the metrics?." Only one example was obtained (#3 of Table 5), in which authors present a system that makes advanced analysis to help manage operations. This system would be beneficial in predicting incidents volume to support future resource requirements and service performance expectations,

making a team fair sizing, without hurting SLAs.

4.2 Threats to Validity

This systematic mapping has construct and conclusion threats (Wohlin et al., 2012) that can influence the validity of the results.

Construct Threats: Services maturity models that are this study's focus (CMMI-SVC (Forrester et al., 2010) and MR-MPS-SV (Softex, 2012a)) are relatively recent (created in 2009 and 2012, respectively). Therefore, there is still little research about them in the literature. The search scope was turned into these models origin, which is the formal origin of IT service quality. It was not possible to find metrics for all maturity models process areas, and publications indicating metrics or indicators for IT service quality do not relate them to IT service maturity models process areas. Because of that, the authors interpreted, based on almost intrinsic relationship between metrics characteristics and various IT service maturity models process areas, considering their relevant aspects (Incident, Service Delivery, Capacity, Availability, Continuity, etc.) and proceeding with association.

We could not consider only papers presenting experimental evidence about proposed metrics usage. In order to minimize this threat, the authors recorded practices and applications evidence level for considered metrics in general results analysis.

Due its relevance and comprehensiveness, Scopus search database was chosen as the search source. However, Scopus did not index one of the four control papers. Thus, the paper "Extending the IT Service Quality Measurement Framework through the Systematic Literature Review", which is indexed only by Springer (link.springer.com), was added to the selected publications, aiming to reduce the. Even with this Scopus limitation.

Conclusion Threats: After applying criteria selection and exclusion, only 39% of the papers selected by the search string remained as part of systematic mapping scope. The full text of some papers was not available for reading. To avoid premature elimination and reduce this threat, an email was sent to the papers authors asking for the papers. As a result, in the third step it was possible to access the full text of 84% of the selected papers.

The search period was limited to the last six years. This decision was made because the oldest control paper year was from 2010 and CMMI-SVC (Forrester et al., 2010) maturity model was created in 2009. Making 2009 the cut-off year, 114 papers were found. Moreover, this threat is minimized because one selected paper presents a list of other selected papers by a systematic mapping describing IT service metrics with only one paper prior to 2009. Therefore, we believe that the impact of limiting papers to 2009 on is low to this study's results.

4.3 Further Work and Remarks

By analyzing the identified metrics, we noticed that they could indicate cause-effect correlation between process areas. For instance, the metric "Amount of incidents caused by changes" considers the relation between the Incidents and Changes areas. This relation is starting to be deeply studied, as we can see in the last Business Processing Intelligence Challenge 2014 (www.win.tue.nl/bpi/2014/challenge), which asked participants to propose a method to find the impact of changes on Service Desk workload of a fictitious organization by process mining analysis.

This paper is part of ongoing research. Our next step is to evaluate the mapping study results and usage in industry. The first case study (Trinkenreich and Santos, 2015) was performed in a global large company, including a quantitative study based on experimental correlation test to understand cause-effect between Changes and Incidents, identification of how IT service metrics are being used in this real organization and whether metrics had been found in literature. To understand cause-effect between different areas can help organizations to improve service quality as a whole, instead of only measuring independent indicators of each area.

We expect that a list of metrics like the one this paper provides can help organizations in metrics selection. They can use the list as a start point and chose metrics according to the process area to be measured, speeding up the metrics selection activity.

In the context of metrics selection, we understand that another limitation is the absence of information about how to collect and analyse metrics. The selected papers do not present any information in this sense. Thus, in response to that limitation, we plan to create a metrics catalogue containing the metrics and their operational definitions, which guide, among others, on how to collect and analyse the metrics.

5 FINAL CONSIDERATIONS

This paper presented a mapping study that aimed to identify metrics used to monitor IT service quality

that are suitable for service maturity models.

Monitoring and Process Control (GP2.8) is a CMMI-SVC common practice (Forrester et al., 2010) that indicates 103 service metrics examples for all process areas, while only 37 of them are related to CMMI-SVC specific process areas. The systematic mapping identified 133 service metrics, 80 of them suitable for CMMI-SVC specific processes areas. This result demonstrates that there are improvement opportunities in suggested metrics of CMMI-SVC (Forrester et al., 2010).

As future work, we plan to extend the systematic mapping to other research databases. Moreover, we plan to detail the metrics collection, analysis, and how to maintain association between organization goals and metrics. We also plan to conduct other case studies in the industry and study correlations between processes areas, aiming to get a deeper understanding of how one process affects another.

ACKNOWLEDGEMENTS

Authors would like to thank the financial support granted by FAPERJ (project E-26/110.438/2014) and CNPq (Process Number 461777/2014-2).

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