Inventorying Systems: An Action Research

Vanessa Soares[1], Rejane Figueiredo[1], Elaine Venson[1], Laís de Araújo[1]
and Rafael Queiroz[2]
[1]*ITRAC – Information Technology, Research and Application Center, University of Brasília, Brasília, Brazil*
[2]*TU Darmstadt, Main University, Darmstadt, Germany*

Keywords: Inventory, Maintenance, Documentation, Legacy Systems, Action Research.

Abstract: Maintainability, characterized by ease of understanding, is strongly related to the availability of correct and update information about the system and the ease of maintenance staff in understanding it. The Brazilian public administration has many legacy systems in maintenance whose documentation is non-existent or incomplete. The main purpose of this work was to identify the inventorying attributes that have to be recorded to support systems maintenance. The methodology applied was action research whose cycles allowed identifying the attributes required by each one of the stakeholders, civil servants and providers to inventory the systems, as well as how to register and access their attributes. As a result, the set of attributes produced by the interaction between researchers and stakeholders was considered essential to the infrastructure and systems areas, managers, and providers.

1 INTRODUCTION

Systems maintenance is held to be one of the costliest stages of Software Engineering and a major part of the effort is spent in understanding the system. The ease in understanding it is strongly related to the availability of information on the system and to how easily it is understood by the maintenance team (Anquetil et al., 2007; Cozzetti et al., 2006).

Some works focus on the documentation for software maintenance (Souza et al., 2006); some offer support tools, such as the one that uses tools based on the Wiki as a repository (Salvaneschi, 2011), or on categorizing software applications (McMillan et al., 2011). Some other concentrate on knowledge management, with the use of different techniques such as post-mortem analysis and post-partum analysis (Anquetil et al., 2007; Klint and Verhoef, 2002).

However, Ben-Menachem and Marliss (2004; 2005) point the importance of understanding and managing software assets in a collective way and within the corporate domain. The authors point that a system inventory is not simply a list of programs by host for release or license management, but rather a repository containing software items' information to support both management and program evolution.

Standards exist in this context that provide support on the inventorying of systems. The ISO/IEC 14764 (2005) standard deals with one of the primary processes of the ISO/IEC 12207 (2008) standard, namely Software Maintenance and provides guidance on the planning, execution, control, evaluation and closing of the maintenance process. From these standards, the ISO/IEC 15289 (2015) aims to provide requirements for identifying and planning the specific information items (information products) to be developed and revised during systems and software life cycles and service processes.

Brazilian Public Administration (BPA) has many legacy systems in maintenance whose documentation is either non-existent or incomplete. On top of that one also has the issue that a good part of systems development and maintenance is outsourced (Brazil, 2012a).

The inventorying of systems in Brazilian public organizations is a requirement of prevailing legislation (Brazil, 2014; 2012b) both during systems development and maintenance, and in the closing stages, and in the contractual transition of suppliers.

In spite of defining the guidelines, the norms do

Soares, V., Figueiredo, R., Venson, E., Araújo, L. and Queiroz, R.
Inventorying Systems: An Action Research.
DOI: 10.5220/0006336602960303
In *Proceedings of the 19th International Conference on Enterprise Information Systems (ICEIS 2017) - Volume 1*, pages 296-303
ISBN: 978-989-758-247-9

not specify the information that should be inventoried. In this context, the research question is: which inventory items should be used to build the register of the legacy systems? The purpose of this work was to identify the inventorying attributes that will be registered to support the legacy system maintenance of a Brazilian public organization, named here as Ministry.

The methodology applied was action research, from which a strategy was defined and executed to determine the items in systems inventorying, considering the needs of the many units contained in the Ministry, as well as those of the suppliers involved. The data was collected in interviews, meetings, and through participant observation.

This article is structured in sections. Section 2 has a survey on Systems Inventorying. Section 3 presents the standard on information items. Section 4 lays the plan for action research. Section 5 describes the stages in action research. Section 6 presents the process for the identification of the inventorying attributes. Section 7 provides an analysis of the results. Section 8 presents the conclusions.

2 INVENTORYING OF SYSTEMS

Most organizations find it difficult to gather and supply information for the management of their software items. As most IT professionals understand that the goal of the work to manage software configuration is summed in individually managing the software versions that have been and/or will be delivered, it is common that these organizations have no repository with data on what the existing systems are, and their location, and who are the parties responsible for them, or even the relation of dependency that exist amongst them (Salvaneschi, 2011; Ben-Menachem and Marliss, 2004; Ben-Menachem and Marliss, 2005).

Systems documentation is linked to the creation of formal documents, with specific formats, geared to the development and maintenance processes of software systems. There is a discussion nowadays on other options to record such data into documents, such as the use of Wiki-based tools, as proposed by Salvaneschi (2011). According to Salvaneschi (2011) all the evolution documents whose goal is to provide support to maintenance staff, are stored in a Wiki-based tool.

One way to store information on systems is with the construction of a system inventory that holds, in a direct and concise way, their main technical and management data. Ben-Menachem and Marliss (2004) approach IT asset management, a process that churns a massive volume of data and information that has to be converted into data that is meaningful for the organizations. Ben-Menachem and Marliss (2004) also point at the importance of the relationship between the assets for the control of the organization. IT assets should include all the system objects, or artifacts, such as specifications, work plans, source code, and documentation.

Klint and Verhoef (2002) discuss the importance of knowledge management to do business and manage the hard and software infrastructures that support the business processes. Klint and Verhoef (2002) also investigate how the principles of knowledge management can be applied, to allow the continuous creation, consolidation, conservation, and updating of the knowledge of the software assets in the infrastructure. System inventorying is one of the solutions put forward for the creation of knowledge.

Systems inventorying starts with the extraction of data from the source code, to produce a structured and detailed list of the assets. Ben-Menachem and Marliss (2005), present a methodology that allows the optimization of software items as assets, based on an enterprise software inventory, and the streamlining of IT asset valuing, to allocate development and evolution priorities.

3 ISO/IEC 15289:2015

The ISO/IEC 15289 (2015) standard – Systems and Software Engineering – content of life-cycle information items (documentation) is based on ISO/IEC 12207(2008) and specifies the goal and contents of the documentation for the entire lifecycle of the systems, of the software, and of the information items in service management.

According to ISO/IEC 15289 (2015) both a project as an organization or service should keep the relevant records on the information items required.

Such records hold structured data in a permanent and legible way and can be generated from any process in the life cycle, task or activity, including data on requirements, policies, source code, orders, issues, and historical data. These records should be kept for record recovery, repositories or databases.

A number of record types is found, amongst which the configuration register (record of assets, record of changes) that are dealt with in this paper as system inventory. From the context of this work we can point at the configuration record (asset record,

change record). With it, one can see the relevance of system inventorying and the ways to organize it, making it useful for a project or organization, through the many moments of a system's life cycle.

4 MATERIALS AND METHODS

The goal of this paper was to identify the attributes of the configuration items in legacy systems to build a systems inventory, and from this experience propose a process to update this inventory. A strategy was devised and executed to inventory legacy systems as set in the standards (ISO/IEC, 2008; 2015) and the processes for Systems Configuration Management and Software Documentation Management, as contained in ISO/IEC 12207 (2008).

Having identified the attributes, we sought to present the entire set to the stakeholders, as well as evaluate the adequacy of each attribute.

The object of this study is a Brazilian public organization, named here simply as Ministry. The approach is qualitative and we used the action research technique.

Action research is done by the research members and by those involved in the problem, in a participatory manner (Petersen, 2014). According to (Petersen, 2014), the stages adopted in action research included: *Diagnosis*, focused on the description and understanding of the problem; *Action Planning*, to identify alternatives on how to solve the problem and eventually point the best alternative; *Action Taking*, where the action planned is then implemented; *Reflection*, where the results of the action are gathered and studied.

The Diagnosis stage was carried out in meetings and informal interviews with those involved, leading to the definition of the problem: a lack of documentation for the systems and the negative effect on the maintenance activity of the systems.

The Action Planning and Action Taking stages had interactive cycles with the research members and the members of the organization involved. Three cycles were needed to yield a stable instrument. The process of data collection entailed document research and interviews. The last step, Reflection, included the evaluation and led to the instrument being validated in the organization.

4.1 Characterization of the Ministry

The Ministry uses part of the Information Technology Infrastructure Library (ITIL) to support the management of their IT services. Development demands and change requests (correction or evolution aimed) are dealt with as services and have to comply with the procedures for the management of demands for services as placed by third parties, both for systems development and maintenance.

The Ministry customized the Open-Source Ticket Request System (OTRS) tool to manage IT services, amongst which the management of systems maintenance chores. They were going through a period of supplier transition, with systems inventory being an important element to produce an alternation of suppliers that could take place with the least impact possible on the provision of the services for systems maintenance.

The Ministry has a coordination office, the General Office for Information Technology (CGTI) in charge of planning, conducting, and monitoring the IT services in the body. It consists of a Projects and Processes Division (DIPRO), a Systems Development Division (DISIS), and a Division for IT Services Infrastructure (INFRA). The Ministry does not have a large number of employees, each division being represented by only one head employee and some analysts.

DISIS maintained a spreadsheet with a minimum set of information items, based on a management view of the systems under their control. Even that the fields that were deemed as minimal by the Ministry, many were empty or had outdated information. On the other hand, systems analysts of the suppliers had another set of spreadsheets and text documents with no shared information. With the supplier transition it was necessary to execute a detailed survey of the data, rating and providing it to the different stakeholders.

5 ACTION RESEARCH

5.1 Diagnosis

The Diagnosis stage had many meetings and interviews with the analysts concerned, developers, managers, and some users, apart from the analysis of secondary sources such as documents and legacy systems. This survey allowed us to forward to high management a diagnosis report, showing the precarious condition of the documentation of their systems. The lack of some basic information was unknown to the managers, such as that of libraries and system development environments.

5.2 Action Planning and Action Taking

Four cycles were defined for the next *Action Planning* and *Action Taking* stages in action research: Data Spreadsheet for the Ministry's Configuration Items; Wiki Tool; Adequacy of the OTRS Tool; and Evaluation of the Inventory's Attribute Usefulness. The first three cycles are shown in Figure 1.

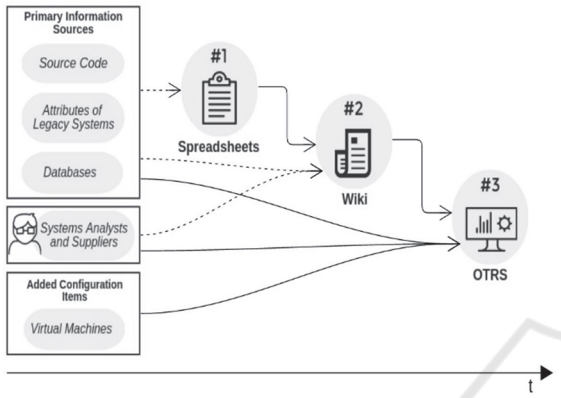

Figure 1: Planning of Inventory Process with the first three cycles and the information sources.

5.2.1 Systems Data Spreadsheet

In Cycle 1 we planned collecting the maximum information items from the existing systems and recording the data on the Spreadsheet then in use in the DISIS. For that, a survey was done of all the Ministry's systems, with the updating of all the data then held for each system where many times the only information found was that provided by the analysts in charge (of the suppliers), apart from their status, if active or idle.

Of the 54 legacy systems identified, 35 were picked to have their data updated and recorded. All the other systems were replicated or were inactive.

5.2.2 Wiki Tool

In Cycle 2, similar to the proposal of a Semantic Wiki (Gonçalves et al., 2010), a collaborative creation of knowledge took place, where a Wiki was defined and refined with documentation items from the different views and needs of the many parties involved.

This solution was necessary to define which system items would be registered, pursuant to the needs of each of those involved, something that demanded intense interactions between those in the Ministry and the suppliers, as led by the researchers.

5.2.3 Customizing the OTRS Tool

From the coming to life of the Wiki contents by the DISIS and the registration of the data, we considered the guidelines set in standard (ISO/IEC, 2015) that provide on the access to information and also considered some needs of the Ministry, such as: visibility of information; traceability amongst the data assets; ease of inventory maintenance.

The OTRS is a Web based ticketing system used in Customer Service, Help Desks, and IT Service Management. The service tool was adopted by the Ministry to manage IT services. With this, we decided to replace the Wiki solution by the OTRS one. With this, Cycle 3 got under way: customizing the OTRS tool to concentrate the register for all the systems' data and the remaining configuration items, especially the databases and virtual machines, which are directly related to the systems.

It was in such a scenario that the lines of this new solution started to appear. Meetings were held to refine and validate it. After an agreement had been reached, the customization solution, with its defined attributes, was placed in development by the infrastructure team and after that it was implemented.

5.2.4 Evaluation of the Inventory's Attribute

The attributes of the inventory were surveyed according to the needs of the stakeholders with the use of the standard (ISO/IEC, 2015) as a parameter. Following the definition of the attributes of the inventory and the customization of the tool we started Cycle 4 where we managed to gauge the actual usefulness of the attribute of each configuration as registered in the Inventory.

This evaluation was necessary to verify the adequacy of the information on the items as registered in the Inventory and whether it had contributed to the work of maintenance and IT management in the Ministry.

5.3 Reflection

At the end of six months at work the Ministry already had nearly 90% of their systems accounted for as well as all the databases and blade servers also registered. Apart from this, a set of minimum configuration items was produced, adequate to the needs of the Ministry.

In Cycle 1, related to the collection of systems' data and other configuration items in a spreadsheet, we found it rather difficult to keep this spreadsheet

updated, given that editing the data was the responsibility of just one person, due to the limitations of the tool itself. However, using it was necessary and allowed a quick survey of the information in the systems and of the other configuration items that are directly related to them, such as the databases and the virtual machines.

The use of the Wiki tool in Cycle 2 proved more adequate to the specific needs of the body and received a greater number of adepts of its use. Due to the possibility of a more harmonious structuring of the data, it served as an object to identify the items and of how it could be organized in the inventory. However, the Wiki would be another data storage technology, not associated to the services management tool, not allowing different roles to access it, and under the due control of the Ministry.

In Cycle 3 it was chosen to customize the services management tool then in use, allowing the inventorying work to continue and, later, the management of traceability amongst the assets.

In many moments the absence and a high rate of rotation amongst the civil servants of the Ministry contributed to the dispersion of information and the delay in data collection. Despite that, the creation of the Inventory in an interactive manner allowed responding to the demands voiced by the stakeholders, the Ministry and the suppliers.

6 INVENTORYING

The collection of data for inventorying started with the active systems of the body, that is, the systems that were then in use and the databases then under test, with the need after that, to also register the remaining configuration items as well as the inactive systems.

When the OTRS tool was customized, it was necessary to transfer the collected data. With the completion of the initial inventory, a need was identified to also register the virtual machines (VMs) with the OTRS tool. For that, a form was provided with the VMs of three environments (production, homologation, and testing) for each system active in the body, which allowed registering the associations between the systems and the VMs. This way it was possible to identify the traceability amongst the body's assets in the OTRS tool. The work lasted some three weeks.

All the configuration items directly related to the systems were inventoried and the work was revised, with only the registration of indirectly related items remaining, such as the blade servers and the frames. The inventorying these last two items has been postponed and will be done at a later stage by the Ministry.

6.1 Attributes Identification

The attributes of each configuration items (systems, databases, and virtual machines) were identified after the proposal of Ben-Menachem and Marliss (2004), based on the management and technical perspectives. The needs of information of the Ministry were taken into account, such as the presence of physical and functional features, the versions of the tools, etc. These attributes contain the source and provision as contained in the standard (ISO/IEC, 2015) for each one of them.

As for the systems, it is possible to identify items on a management level such as the state of system implementation, its business value, the administrators in charge, what the documentation repository is, and technical items such as the language, the version of the system's language, whether the architecture used is that named as standard, and the Entity and Relationship Model (MER).

The attributes identified for the databases (DBs) totaled 15 attributes and contained especially management data. The attributes surveyed for the VMs, differently from the remainder, have a larger volume of technical data such as, for example, the machine's operating system and version, network, and number of processor cores, amongst other information necessary to guide the use of these machines during the work of systems' maintenance and development in the body.

6.2 Attributes Utility Evaluation

The set of attributes related to each configuration item was submitted to the evaluation, which consisted of a measure of the usefulness of each attribute for each IT role in the body. The replies could range from indispensable to dispensable. The attributes rated as indispensable for any one of the roles interviewed are named essential for the inventory.

Due to the low number of Ministry employees, the data was collected from the 5 professionals, namely: head of the DIPRO, head of the DISIS, DISIS analyst, INFRA analyst, and maintenance members.

The data was gathered according to such perspective in order to obtain data that could better reflect the actual usefulness of such attributes, for

each professional of the body.

6.2.1 Attributes of the Systems

The set of attributes that was surveyed for systems is the most voluminous set, with a total 27 attributes. From this total, 17 are markedly management, 6 are technical, and 4 include both perspectives. Figure 2 shows the number of points received by each attribute, according to each professional interviewed where 1 means the attribute is *indispensable* and 0 means it is *dispensable*.

View	Attributes	A	B	C	D	E	Total
Management	Name	1	1	0	1	1	4
	State of Implementation	1	1	1	0	0	3
	State of Incident	0	0	0	0	0	0
	Initials	1	1	0	1	1	4
	Business Area	1	1	1	0	0	3
	Type of Access	0	1	1	0	0	2
	Manager Holder System	1	1	0	0	1	3
	Manager Holder System (extension line)	1	1	0	0	1	3
	Manager Replacement System	1	1	0	0	1	3
	Manager Replacement System (extension line)	1	1	0	0	1	3
	Custodian	1	1	0	0	1	3
	Custodian (extension line)	1	1	0	0	1	3
	Functional Size	0	1	1	0	0	2
	Security Asset?	1	0	1	0	0	2
	The DISIS performs support?	0	1	0	0	0	1
	Business Value	0	1	0	0	0	1
	Observations	0	1	1	1	0	3
Technical	ERM (URL)	0	1	1	1	0	3
	Data Dictionary (URL)	0	1	1	1	0	3
	Documentation (URL)	0	1	1	1	0	3
	Language	0	0	1	1	0	2
	Language Version	0	0	1	1	0	2
	Architecture Standard	0	0	1	1	0	2
Both	Production (URL)	0	1	0	1	1	3
	Homologation (URL)	0	1	0	1	1	3
	Test (URL)	0	1	0	1	1	3
	Repository (URL)	0	1	0	1	1	3

A – DIPRO Head
B – DISIS Head
C – DISIS Analyst
D – Maintaner
E – INFRA Analyst

Figure 2: System Attribute Scores.

The DIPRO head considers 11 attributes indispensable for one's work routine in the body, all of them related to the management angle; the other 16 were rated as dispensable, being resorted to only in the event of an incident. The DISIS head considers 22 attributes indispensable, amongst which 15 from a management perspective, 3 from a technical angle, and 4 with both. The 5 remaining attributes were considered as dispensable, that is, not used during one's work routine. It was possible to evaluate that, in general terms, almost half of these attributes, around 49%, are deemed as indispensable, with only 12% as dispensable. The technical attributes for Systems are indispensable for the DISIS analysts and for the maintainers, while for the infrastructure analysts these are dispensable for the execution of their work.

6.2.2 Attributes for Database (DB)

The attributes surveyed for databases totaled 15, and 8 of them were of a management kind, 5 were technical, and 2 had both perspectives. The score for each attribute can be seen in Figure 3.

As regards the management perspective, it was found that the DISIS head considers 7 of the 8 attributes as dispensable, using them only in the event of an incident, for the purpose of an investigation. Amongst the attributes related to a management view, only 1 was rated as indispensable by the DISIS head.

View	Attributes	A	B	C	D	E	Total
Management	Name	0	1	0	1	1	3
	State of Implementation	0	0	0	0	1	1
	State of Incident	0	0	0	0	0	0
	Owner	0	0	0	0	1	1
	Extension Owner	0	0	0	0	1	1
	Custodian	0	0	0	0	1	1
	Extension Custodian	0	0	0	0	1	1
	Security Asset?	0	0	0	0	0	0
Technical	Database Version	0	0	0	0	1	1
	Data Source (URL)	0	1	0	1	1	3
	Schema Name	0	0	0	1	1	2
	User (login)	0	0	0	1	1	2
	Password	0	0	0	1	1	2
Both	Environment	0	1	0	1	1	3
	Database Type	0	0	0	1	1	2

A – DIPRO Head
B – DISIS Head
C – DISIS Analyst
D – Maintaner
E – INFRA Analyst

Figure 3: DB Attribute Scores.

The infrastructure analyst considers 6 management attributes as indispensable, and 2 are not used by this professional. For the maintainer there are 7 indispensable attributes and one that is dispensable.

The technical attributes are widely used by the infrastructure analysts and by the maintainers. They had 5 and 4 attributes considered as indispensable, respectively. The DISIS head, in one's turn, considers only 1 technical attribute as indispensable for one's work.

The attributes that are both of management and technical kind are only 2 and are considered as indispensable for both the infrastructure analysts as

for the maintenance agents.

The DIPRO head and the DISIS analysts considered all the attributes as dispensable as they do not deal with the body's database.

6.2.3 Attributes for Virtual Machines (VMs)

Virtual Machines, as much as the databases, are configuration items under the responsibility of the infrastructure team. This way, the infrastructure analysts are the one that use the attributes of this item the most. In second place lie the maintainers who make wide use of some attributes when performing their work in the body's systems.

The total score each attribute had as indispensable can be seen in Figure 4.

View	Attributes	A	B	C	D	E	Total
Management	Name	0	1	0	0	1	**2**
	State of Implementation	0	0	0	0	1	**1**
	State of Incident	0	0	0	0	0	**0**
	Owner	0	0	0	0	1	**1**
	Owner (extension line)	0	0	0	0	1	**1**
	Custodian	0	0	0	0	1	**1**
	Custodian (extension line)	0	0	0	0	1	**1**
	Security Asset?	0	0	0	0	0	**0**
Technical	Operation System	0	0	0	1	1	**2**
	Version	0	0	0	1	1	**2**
	IP	0	1	0	1	1	**3**
	Network	0	0	0	0	1	**1**
	Processor Number	0	0	0	0	1	**1**
	Memory	0	0	0	0	1	**1**
	Disc/Size	0	0	0	0	1	**1**
	Server and Application Version	0	0	0	0	1	**1**
Both	Environment	0	1	0	1	1	**3**

A – DIPRO Head
B – DISIS Head
C – DISIS Analyst
D – Maintaner
E – INFRA Analyst

Figure 4: VM Attribute Scores.

As regards the management attributes, the infrastructure analysts consider them all as indispensable. The DISIS head, in one's turn, frequently uses only 1 of the attributes, the other 7 being deemed as dispensable. All of the management attributes are deemed as dispensable by the maintenance agents.

The 8 technical attributes are indispensable for the infrastructure analysts. The maintainers consider only 4 of these attributes as indispensable. The DISIS head, who has a management profile, considers only 1 attribute as indispensable, with the remaining 7 being used only in the event of an incident, in an investigative task.

Only one attribute was rated both as management and technical. The attribute was deemed as indispensable for the DISIS head, for the maintainer and for the infrastructure analyst, as seen in Figure 4.

The DIPRO head and the DISIS analysts considered all the attributes as dispensable as they do not deal with the body's database.

7 ANALYSIS OF THE RESULTS

It was possible to identify and validate, with the use of action research, a set of inventorying attributes for the legacy systems, with the technical and management needs as premises. The identification was done based on the needs of the different stakeholders. Attributes were identified for the legacy systems, databases, and virtual machines.

With the evaluation of the attributes done in Cycle 4, it was possible to observe some unused items during the evaluation period, for example, the **State of Incident** attribute, found in all configuration items. For the DIPRO head, however, this information will be used to monitor the operating impact in the event of an incident, i.e., an indispensable attribute that should remain in the inventory.

Still along this line, there is the attribute that should advise whether the item is a **Security Asset.** This attribute was requested by the head of the Division of Information Security of the Ministry for the management of the security assets of the body, being an indispensable attribute for that division.

When asking about the need of additional information the DIPRO head requested a system's attribute that would contain the URL for system monitoring.

As regard the virtual machines, a management need to link them to the databases was identified. All remarks found will be assessed and forwarded to the Ministry's Services Management area.

In general terms, it is possible to observe that most of the attributes is being used by at least one of the stakeholders. The inventory reflects the needs of the IT professionals of the Ministry, providing support to both the systems' maintenance process and for the work of IT management, as pointed by Ben-Menachem and Marliss (2004; 2005), reaching the technical and management goals.

8 CONCLUSIONS

The team of researchers was able to take part, advise

and execute inventorying strategies for a public body that was going through a period of supplier transition and relied strongly on the information on the legacy systems as held by the suppliers that were on their way out.

With the use of action research we found that the main needs related to the creation of the inventory, and the definition of which items it would contain, according to the different needs of those involved (from roles in the *Ministry* and those of the many suppliers), and also to how store, access, and maintain them.

With simple strategies such as the use of a Wiki to register the data during the collection and after that with the customization of a tool that was already in use in the body, the inventorying of the legacy systems took place. The redocumenting of the legacy systems and the mapping of their inter-relationships was done from the perspective of each one of those involved, taking into account the different roles of the *Ministry* and of the suppliers.

With this work it was possible to define a set of inventorying attributes that would meet both the management and the technical perspectives of the body, as proposed in the works of Ben-Menachem and Marliss (2004). With the evaluation of the attributes for each configuration item in the inventory it was possible to conclude that all the attributes in use are essential for the inventory and that they meet the needs of all the stakeholders, whether holders of a management or technical view.

For the Ministry, what is sought is to periodically evaluate and update, and keep the inventory always in line with the needs of information on the configuration items of the Ministry, avoiding the re-establishing of a chaotic work scenario, as regards management, the maintenance and the evolution of legacy systems.

The process to identify inventorying attributes for legacy systems, and databases, and virtual machines, with the use of action research, and the set of defined attributes can help other organizations in the processes to inventory their legacy systems.

REFERENCES

Anquetil, N., de Oliveira, K. M., de Sousa, K. D., & Dias, M. G. B., 2007. Software maintenance seen as a knowledge management issue. Information and Software Technology, 49 (5), 515–529.

Ben-Menachem, M., & Marliss, G. S., 2004. Inventorying information technology systems: supporting the paradigm of change. IEEE software, 21 (5), 34 – 43.

Ben-Menachem, M., & Marliss, G. S., 2005. IT Assets Control by Importance and Exception: Supporting the Paradigm of Change. IEEE Software, 22 (4), 94 – 102.

Brazil. 2012a. Informações Gerenciais de Contratações Públicas de Bens e Serviços de Tecnologia da Informação. Available in: <http://www.comprasnet.gov.br/ajuda/Manuais/0401_A_12_informativo%20comprasnet_ComprasTI.pdf>.

Brazil, 2012b. Inventário e Mapeamento de Ativos de Informação nos Aspectos Relativos à Segurança da Informação e Comunicações nos órgãos e entidades da Administração Pública Federal. Presidência da República, Casa Militar. Available in: < http://dsic.planalto.gov.br/documentos/nc_10_ativos.pdf >.

Brazil, Ministério do Planejamento, Orçamento e Gestão, 2014. Secretaria de Logística e Tecnologia da Informação. Instrução Normativa No. 04. de 11 de setembro de 2014. Available in: <https://www.cti.ufu.br/sites/cti.ufu.br/files/IN_SLTI_04-12Set2014.pdf>.

Cozzetti, S., de Souza, B., Anquetil, N., & de Oliveira, K. M., 2006. Which documentation for software maintenance?. Journal of the Brazilian Computer Society, 12(3), 31-44.

Gonçalves, J. J., Lima, F., & da Nóbrega, G. M., 2010. Construção e manutenção de um Repositório de Experiência Docente baseado em Wiki Semântico. In Anais do Simpósio Brasileiro de Informática na Educação.

ISO/IEC, 2008. International Standard ISO/IEC/12207. Information technology – Software life cycle processes," International Organization for Standardization/International Electro-Technical Commission.

ISO/IEC, 2006. International Standard ISO/IEC/14764. Software Engineering - Software Life Cycle Processes - Maintenance. International Organization for Standardization/International Electro-Technical Commission.

ISO/IEC, 2015. International Standard ISO/IEC/15289. Systems and software engineering – Content of life-cycle information items (documentation) International Organization for Standardization/International Electro-Technical Commission.

Klint, P., & Verhoef, C., 2002. Enabling the creation of knowledge about software assets. Data & Knowledge Engineering, 41 (2-3), 141 – 158.

McMillan, C., Linares-Vasquez, M., Poshyvanyk, D., & Grechanik, M., 2011. Categorizing software applications for maintenance. in: 2011 IEEE 27th IEEE International Conference on Software Maintenance (ICSM), pp. 343-352.

Salvaneschi, P., 2011. The evolution of Information Systems a case study on document management, in: 2011 IEEE 27th IEEE International Conference on Software Maintenance (ICSM), pp. 428-437.

Petersen, K., Gencel, C., Asghari, N., Baca, D., & Betz, S., 2014. Action research as a model for industry-academia collaboration in the software engineering context, in: 2014 ACM Proceedings of the 2014 international workshop on Long-term industrial collaboration on software engineering, pp. 55-62.