SOFTENG 2017

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SOFTENG 2017

Forward

The Third International Conference on Advances and Trends in Software Engineering (SOFTENG 2017), held between April 23-27, 2017 in Venice, Italy, continued a series of events focusing on challenging aspects in the field of software engineering.

Software engineering exhibits challenging dimensions in the light of new applications, devices and services. Mobility, user-centric development, smart-devices, e-services, ambient environments, e-health and wearable/implantable devices pose specific challenges for specifying software requirements and developing reliable and safe software. Specific software interfaces, agile organization and software dependability require particular approaches for software security, maintainability, and sustainability.

The conference had the following tracks:

- Software designing and production
- Software testing and validation
- Software reuse
- Software reliability, robustness, safety

We take here the opportunity to warmly thank all the members of the SOFTENG 2017 technical program committee, as well as all the reviewers. The creation of such a high quality conference program would not have been possible without their involvement. We also kindly thank all the authors that dedicated much of their time and effort to contribute to SOFTENG 2017. We truly believe that, thanks to all these efforts, the final conference program consisted of top quality contributions.

We also gratefully thank the members of the SOFTENG 2017 organizing committee for their help in handling the logistics and for their work that made this professional meeting a success.

We hope that SOFTENG 2017 was a successful international forum for the exchange of ideas and results between academia and industry and to promote further progress in the field of software engineering. We also hope that Venice, Italy provided a pleasant environment during the conference and everyone saved some time to enjoy the unique charm of the city.

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Improving a Travel Management Procedure: an Italian Experience

Antonello Calabró*, Eda Marchetti*, Giorgio Oronzo Spagnolo*
Pierangela Cempini†, Luca Mancini†, Serena Paoletti†

*Software Engineering Area
†Administrative Staff
Institute of Information Science and Technologies"A. Faedo"
Italian National Research Council (CNR)
via G. Moruzzi, 1 - Pisa, Italy
Email: firstnames.lastname@isti.cnr.it

***Abstract*—Recently, a lot of attention has been dedicated by the Public Administrations to reduce/optimize the costs of travel management. Indeed, automatic support may increase the quality of the proposed services, drastically decreasing the time required for document production and validation, and promoting the integration with different PA (Public Administration) systems and services. However, due to the critical nature of the exchanged data, the interaction with the customers (personnel and citizens), the complexity of the considered procedures, the quality aspect becomes a crucial point to be considered during the development of automatic supports. In this paper, we focus on the quality aspects of the PA travel management automation, and we present the evaluation of a prototype implementation of a framework for automating the travel management process adopted inside an Italian PA. The experience highlighted important challenges in the application of automatic facilities for the travel management and nd allowed the detection of inconsistencies and improvements of the process itself.**

Keywords–usiness process; Monitoring; Adequacy Criteria; Learning assessmentusiness process; Monitoring; Adequacy Criteria; Learning assessmentB

I. INTRODUCTION

Automatic support is currently consolidated practices for increasing the quality of services provided by administrations and drastically decreasing the time required for documents production and validation. In line with this policy, the Italian Public Administrations (PAs) are currently moving towards the "digital maturity", i.e., massive adoption of Information and Communication Technologies) facilities to increase the quality and efficiency of their internal procedures, integrating the different PA services and speeding up the overall PA management [1]. However, due to the critical nature of the exchanged data, the interaction with the customers (personnel and citizens), the complexity of the considered procedures, the quality aspect becomes a crucial point to be considered during the development of automatic supports. In this paper we focus on the PA travel management automation, which has been recognized as one of the PA hot topics for cost reduction, according to a recent research of the School of Management in collaboration with AirPlus [2]. In particular, this analysis evidenced that only one third of the considered PAs has an accurate, organized, quality satisfactory travel management system. Most of the times, only a partial automation is provided and the single employees are forced to organize their travels with the help of on-line travel services.

The main issues of the existing facilities have been identified into the persistency of: an hard copy collection of travel documentations; an inaccurate, incomplete or erroneous collection of travel data; a manual checking and validation of the produced travel documentation by the administrative personnel. A more satisfactory travel management system could, on one hand drastically reduce the time and effort necessary for the procedure completion, and from the hand, provide optimized travel schedule, conventions with public transports accommodations and digitalization of travel documentation. A preliminary analysis of the impact of the adoption of proper automatic support for the travel management on the PAs overall costs can be summarized as:

- n evident increase of the quality of the filled modules due to the reduction in the number of errors and inconsistencies inside them;
- an accurate collection and cataloguing of data, avoiding loss of documentations;
- a reduction of the time required for checking and validating the different costs and expenses;
- automatic and periodic statistical travel reports useful for the stipulation of conventions with travel or accommodation companies;
- an accurate and more organized annual budget analysis useful for a faithful schedule and planning of PA costs;
- an integration with the different PA systems and services, with an important decrease in the cost and effort necessary by the administrative staff to process the documentation, record travel data information and complete the overall travel refund.

On the basis of the above considerations, and continuing a preliminary work presented in [3], this paper presents the procedural steps followed from requirements elicitation to the definition of a specific quality model and the relative customized software measurement plans for its internal travel management system of an Italian PA: the Institute of Information Science and Technologies "A. Faedo" (ISTI) of the Italian National Research Council (CNR) in Pisa [1]. In collaboration with the administrative staff of such institute, we analyzed the possible quality improvements starting from three points

[1] http://www.isti.cnr.it/

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of view: the technical position, related to the quality of the systems itself; the view of the user, which is more related to the usability experienced and the quality level obtained in the fulfilment of his/her tasks; and finally, the view of the PA personnel, which is interested in the maximization of the revenues in management.

Thanks to our previous experience in different context domains, [3], [4], [5], [6], [7], we followed a storytelling approach [8] [9] to collect through interviews the most important requirements, quality attributes, interesting behaviors and critical activities of the travel management process. Then, using the basic guidelines of the Business Process Management [10], we developed a Business Process Model (BPM) representing the steps that have to be performed by the different participants (people, teams distributed organizations or systems) during the execution of the travel management process. This approach allowed us to focus on important quality aspects and an easy model for the travel refund process. Concise definitions have been used both during discussions with the ISTI administration and for the preliminary validation of the executable framework, called COSO (COmpilazione miSsiOni) [11], implementing the process itself. n particular, to simplify the quality attributes measurement, track activities evolution and the information exchange, monitoring capabilities have also been included in the developed framework.

Recently BPM modeling has been adopted in many sectors, such as financial services, business services and construction, manufacturing, public sector and healthcare, retail and wholesale, and telecommunications. Especially in the public administration, many governments are taking advantage of the multiple benefit that BPM software solutions offer [12]. There are various examples of successful BPM adoption in public administrations like for instance those experienced in Germany, Switzerland, Austria [13] and Sweden [14]. In particular, the authors in [15] describe the BPM System for benchmarking, monitoring, simulation and redesigning processes, that will be deployed into the Greek government agencies. However, despite the importance of the topic, there is very little attention paid on the definition of precise quality aspects useful both for guiding the development and subsequent assessment of such system.

The experience of this paper highlighted that the identification of the proper quality attributes, as well as the BPM elements can be a key factor for the final results. It also revealed important challenges in the application of automatic facilities for the travel management in a specific PA context and and revealed the detection of inconsistencies and improvements of the process itself.

Summarizing, the contribution of this paper is: the BPM modeling of the natural language rules of the CNR manual for travel management process, the definition of a quality model focused on productivity, efficient time management, usability and performance aspects, and the feedbacks and results of the preliminary assessment of the COSO framework.

In the rest of the paper, some background concepts are presented in Section II, while in Section III, the procedure followed for deriving BPM is presented. The set of quality attributes used for the COSO assessment is schematized in Section IV, while the main COSO components are introduced in Section V. Preliminary assessment results are collected in Section VI and discussion and conclusions follow in Section VII.

II. BACKGROUND

In this section, we briefly provide some details about the CNR travel management procedure. The formalism chosen to represent this procedure is the Business Process Model and Notation (BPMN) [16], which is the de facto standard for process modeling. It is indeed a rich and expressive but also complex language to be used for the tasks associated with process modeling [17]. Usually, the BPMN refers to any structured collection of related activities or tasks that are carried out to accomplish the intended objectives of an organization. Tasks within a business process may represent steps that can be performed manually by a human or automatically by an IT system [18].

As any other PA, ISTI and more in general the CNR, has a well-defined collection of travel policies and procedures. According to CNR rules, the travel expenses have to be previously authorized using a specific authorization module. Once travel has been completed, the expenses have to be reported into a specific refund module, supported by appropriate documentation and legitimated by the administrative staff. Variations from the established policies represent exceptional cases and have to be approved by the authorized department approver (Director). One of the main traveler's responsibility is to be familiar with, and strictly follow, the policies and procedures specified in the manual. It is out of the scope of this paper to provide a detailed rules list; in the following we only mention the most important ones. Additional information regarding travel authorization, reimbursement process as well as accounting practices and procedures is available in [19].

Authorization: The travel should be authorized by the Director, and an authorization module should be produced at least five working days before departure. Travelers should provide their personal details, the motivation of the travel, the location, and an estimated amount of the total travel cost.

Transportation: Class depends on the category of travelers and varies from national to international transportation.

Accommodation: Type of allowed accommodation depends on the category of travelers.

Reimbursing Travel Related Expenses: Rules vary in case of national or international travels an reported through specific module.

Meal expenses: Only two meals are allowed and the total meal expenses for day are limited by specific boundaries.

Documentation: Original receipts for all expenses must be submitted to administrative staff and PDF copy provided.

Mileage Reimbursement Rate: Reimbursements for mileage are made following specific mileage reimbursement rate in effect at the time of the trip.

Reimbursable Expenses: Reimbursable travel expenses also include: airline baggage fees, automobile rentals and meeting/-conference fees.

However, the Italian legislation about PA travel management is continuously modifying and due to its natural language specification, it often rises misunderstandings and misinterpretations. Being informed and knowledgeable about the travelers management evolution is one of the most difficult

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points for the travelers. Therefore, the documentation provided both for travel authorization and travel refund are often full of errors and inconsistencies.

III. Model Creation

In this section, we briefly present the method used requirement elicitation. The requirements have been then translated into the Business Process Models of the ISTI travel management process, called ISTI Travel Model (ITM). In order to develop the ITM, we followed a storytelling methodology [8], [9]. Therefore, through interviews with ISTI personnel and domain experts, we collected the most interesting behaviors and critical activities of the travel management process.

The method is summarized in Figure 1, where three main stakeholders are: the *Tellers*, who are asked to describe their activities explicitly through stories; the *Facilitators*, who provide support to story tellers for producing coherent stories and to modelers for the definition of the first abstraction of the models; *Modelers*, who are the process analysts defining the graphical models on the bases of information collected from the tellers and facilitators. Following the storytelling methodology three specific phases, each one involving all the roles, have been executed as briefly described in the rest of this section.

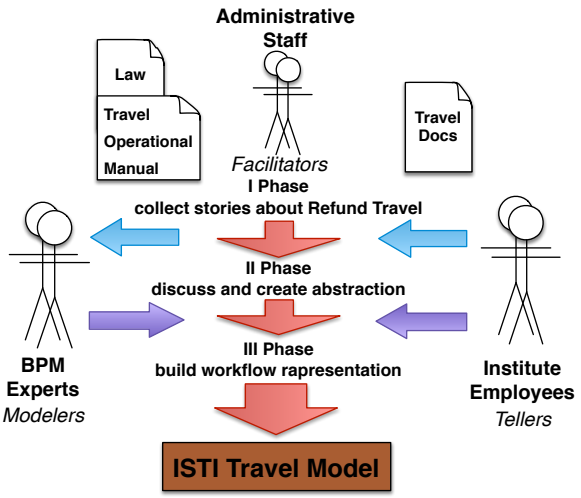

Figure 1. Methodology to create the model

At the end of the three phases of the storytelling methodology, we have produced one high-level model that describes the main process of the ITM and sixteen lower level models that describe in details the sub-processes. For simplicity, we report in Figure 2 just the high-level model of the ITM concerning reimbursement of travel related expense.

As in the Figure 2, the actors interact with the COSO framework according to the following procedure: (1) The employee authenticates himself/hersef though COSO and starts a request of travel refund expenses; (2) Using an Identity Provider (IdP is responsible for providing identifiers for users looking to interact with a system) COSO identifies the users; (3) GEKO [20], the ISTI internal Internet service managing administrative projects funding, sends to COSO the data related to the selected travel; (4) the employee fills/uploads and accepts travel data and documents. The COSO framework aids the employee in the module completion implementing the rules and policies of the CNR travel management procedure concerning the accomodations, transportation, meal expenses; (5) Finally, the refund request is printed and sent to the SIGLA framework [21], which is the official CNR system for the management of the accounting and financial reporting.

IV. Quality aspects

Nowadays, modern societies and administrations take more and more in consideration quality aspects of their business process and try to improve them by the adoption of automatic support. The International Organization for Standardization (ISO) in its definition for quality, namely "(the) degree to which an inherent characteristic (a distinguishing feature) fulfils requirements (a need or expectation that is stated, generally implied or obligatory)" [22]. Thus, an important aspect becomes the possibility of evaluating both the user satisfaction and the quality of the proposed service in terms of parameters that can be obtained by directly measuring the business process. Considering in particular the PAs business processes, they involve several collaborative activities shared among different, possibly many, offices, personnel, companies. Moreover, the introduction of laws/regulations concerning the improvement of automatic documentations management as well as the necessity of costs reduction provide new challenges for the enactment and automation of PA business process such as productivity, timeless, and usability and performance.

In this section, considering the specificity of the ISTI travel business management, the information collected in the phase 2 of the storytelling methodology (see Section III), and the set of attributes expressed in the ISO/IEC 25010 standard [23], a customized set of quality attributes has been selected and adapted for assessing the COSO framework.

In the following subsections, the quality model is briefly presented considering the attributes divided into five target perspectives: business, security, performance, configuration and enhancement.

1) Business Perspective: The attributes considered according to the business perspective are:

Suitability: Degree to which the system provides a set of functions that meet the ISTI personnel requirements (both from administrative and user perspective). It is measured in the number of requirements implemented into the specifications.

Accessibility: Degree to which the system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use. Two measures are associated to this attribute: the number of functions a user with a physical handicap can access; the number of different categories of ISTI personnel mapped into the system.

Learnability: Degree to which the system can be used by the ISTI personnel to learn the rules of the CNR travel management procedure. It is measured in terms of the completeness of user documentation and /or help facilities.

User error protection: Degree to which the system protects users against making errors. It is measured in terms of the number of rules of the CNR travel management procedure implemented in the system.

Adaptability: Degree to which the system can effectively and efficiently be adapted to different or evolving rules of

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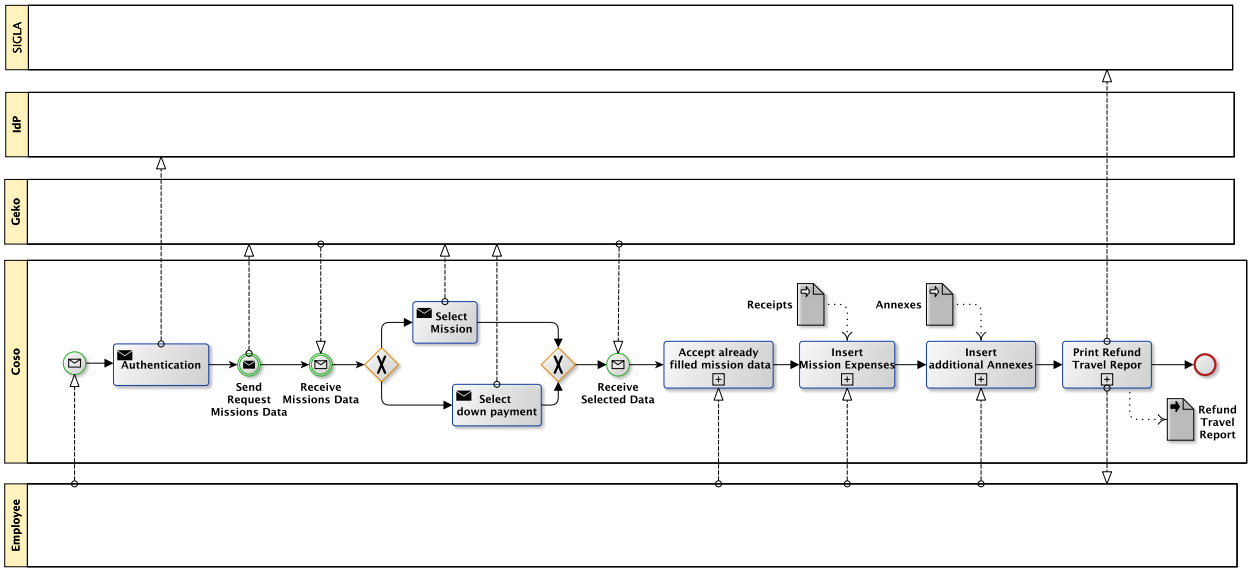

Figure 2. COSO high-level Model

CNR travel management procedure. It is measured in terms of number of implemented rules per functionality in the system.

Modularity: Degree to which new features or customization can be added to the system. It is measured in terms of the average number of dependencies between system components.

2) Security Perspective: The attributes considered according to the security perspective are related to the degree to which the system protects travel information. Therefore, the ISTI personnel or other interacting systems should have the degree of data access appropriate to their types and levels of authorization. It is evaluated in terms of:

Confidentiality: The system ensures that data are accessible only by the ISTI authorized personnel. It is evaluated in terms of the possibility to control system accesses.

Integrity: The system prevents unauthorized access or modifications. It is measured in terms of the possibility to avoid data corruption.

Non-repudiation: Degree to which actions or events can be proven to have taken place. It is measured in terms of the possibility to use digital signature.

Accountability: Degree to which the actions of an entity can be traced. It is measured in terms of the possibility to use audit trail.

Authenticity: The system can prove the identity of a subject or resource. It is measured in terms of the use of the possibility to authenticate the identity of a subject or resource.

3) Performance Perspective: The attributes considered according to the performance perspective are related to the resources and the behaviour of the system. In particular, the considered attributes are:

Time behaviour: Time necessary to compile the modules for the travel authorization or refund. It is measured in terms of the mean time necessary for a module completion.

Capacity: Maximum amount of simultaneous accesses to the system. It is measured in terms of how many online requests can be processed per unit of time.

4) Configuration Perspective: The attributes considered according to the configuration perspective are related to the structure of the system. In particular, the considered attributes are:

Compatibility: Degree to which the system can exchange its results with other available systems or components. It is evaluated in terms of how flexible is the system in data sharing.

Interoperability: Degree to which the system can use (or produce) information from (for) other systems. It is evaluated in terms of supported data exchanged format.

5) Enhancement Perspective: Additional quality attributes, not included in the considered standard, have been defined for the framework assessment. In particular:

Traceability: Degree to which the system can keep track of a given set or type of information to a given degree. Specifically the system should log and trace activities execution according to user defined specific rules. It is measured in terms of number of tracking and storage facilities included into the system.

Customizable data collection: Degree to which the system can provide statistical analysis on the basis of travel data collection. It is measured in terms of the number of user defined statistical analysis the system can produce.

V. FRAMEWORK

For completeness, in this section we provide a short description of the automation of the CNR travel management procedure, thought the COSO framework, is provided. More details can be found in [3]. As described shown in Figure 3, the framework collaborates with the three main software products of ISTI that are SIGLA [21], for the management of the accounting and financial reporting, GEKO [20] for the management of funding and Identity Provider to manage authentication. However, during the development and validation stages, the prototype has been forced to work as a stand-alone framework. In Figure 4, additional architecture details of the COSO component are shown. To improve the

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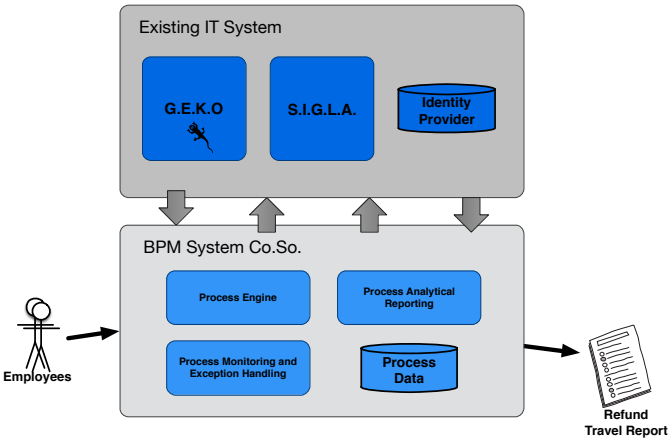

Figure 3. Overview of the high level architecture

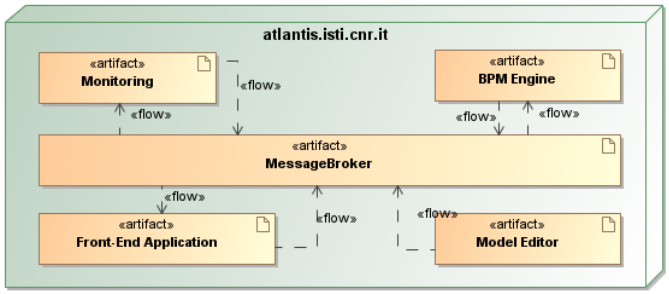

Figure 4. Overview of the architecture

adaptability, modularity and learnability of the proposal, five main components have been identified:

- the **editor**: it provides facilities both for creating and modifying the models representing the business process.
- the **front-end**: it is composed of several web-forms and help facilities. It provides both documentations and suggestions to the user and contributes to decrease the number of errors in module fulfilling.
- the **monitoring**: it keeps track of models execution and collects specific travel data useful for statistical analysis.
- the **message broker**: it deals with the communication between different components.
- the **BPM engine**: it executes the BP model relative the CNR travel management process.

VI. Assessment

According to the quality attributes defined in Section IV, the following sections recap how and where these attributes have been addressed. For the assessment, the specification described in section III and its current prototype implementation into the COSO framework [11] have been considered.

A. Business Perspective Assessment

Suitability: During the three phases of the storytelling methodology a set of functional and non functional requirements has been collected. In the model creation, these requirements have been mapped and realized into one or more activities or tasks of the BP model. Consequently, all the identified requirements have been implemented into the specifications.

Accessibility: The current implementation of COSO prototype provided a set of facilities specifically designed for administrative and research staff. Additional categories of ISTI personnel, such as external or associated staff, have still to be included in the implementation. The percentage of different categories of ISTI personnel mapped into the system is currently around 70%. Specific facilities for users with physical handicaps are currently under development and, therefore, this measure was not evaluated.

Learnability: A set of user documentation and help facilities has been defined in collaboration with Administrative Staff to make easier the learning of the rules of the CNR travel management procedure. In particular, for each of the activities and tasks of the derived BP model the front end of COSO framework provides a help menu reporting meaningful example, rules description and specific constraints.

User error protection: The BP model implements all the rules and policies defined in CNR travel management procedure [19]. Moreover, the front-end application of COSO framework has been developed to prevent rules violation or common users mistake.

Adaptability: During the BP model derivation, the process has been stiletted into more sub-processes, each one associated to a (or a restricted group of) requirement(s) so to simplify the maintenance or upgrading of the the framework. Moreover, the editor associated to the COSO framework allows to update the models in case of new requirements or rules.

Modularity: The development of the COSO framework followed the Model-View-Controller paradigm. The stand alone components as well as the use of messages paradigm and REST invocations guarantee the independency between system components.

B. Security Perspective Assessment

The attributes related to the security perspective, i.e confidentiality, integrity, non-repudiation, authenticity, are covered by the ISTI authentication system, and ISTI intranet in general, on which the users must authenticate themselves before. In particular, ISTI implements the authentication procedures, policies and the architecture required by the GARR consortium (Rete italiana dell'istruzione e della ricerca - Italian network for the research and instruction) [24], which is the top Italian Guarantor for the research networks, in order to protect data from any intruders. Moreover, to better focus on these quality aspects, as depicted in Figure 2, in the BP model a specific task has been entirely dedicated to the security aspects.

C. Performance Perspective Assessment

Time behaviour: We are currently collecting data for the complete evaluation of this attribute. However, the introduction of an automatic framework provided a drastic reduction in the time required for checking and validating the different costs and expenses. Before the introduction of the COSO framework the process was manually completed. Preliminary results evidenced that the time behaviour can be reduced to one third of the mean time required for a completion of a travel authorization and refund (currently estimated into 3 and 1.5 hours respectively). Moreover, the possibility of simultaneous accesses of from different users reduced the interactions and communications between the ISTI personnel and the Administrative staff.

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Capacity: We do not have a statistical significant number or data to estimate this attribute. However, considering that inside ISTI the average number of travel authorizations and refunds per years is around 1500 this can represent a considerable budget and effort reduction for the overall institute.

D. Configuration Perspective Assessment

From the configuration perspective, the automatic framework provides the integration with GEKO, the ISTI internal internet service managing administrative projects funding, and SIGLA, the official CNR system for the management of the accounting and financial reporting. This decreases considerably the cost and effort necessary by the administrative staff to process the documentation, exchange personnel information and modules, record travel data, and complete the overall travel refund.

Finally, considering the enhancement perspective the monitoring component included in the framework, allows to log, trace and store activities execution according to specific rules defined in collaboration with ISTI administrative staff. The purpose is to improve costs management and predictions; establish a better distribution of ISTI budget and possibly establish specific (accommodation/transportation) conventions. In addition, monitoring component includes the possibility to defined customizable rules and store the relative data so to improve user defined statistical analysis. This guarantees a satisfied level of the enhancement quality attribute implementation.

VII. Discussion and Conclusion

This paper presented the procedure adopted for the BPM modeling of the natural language rules of the ISTI-CNR travel management manual and the definition of a quality model useful for the development and assessment of its automatic implementation. Preliminary feedbacks and results have been collected during the evaluation of the COSO framework. The lessons learned by this experience are: the model must be flexible enough to accommodate modifications and situations that are not explicitly described by the regulations; the model must be simple and intuitive to make easier its understanding; quality aspects are difficult to be defined and formalized by not software engineering expert and many times a mediator is necessary. As a future work, we will continue the COSO implementation and the collection of assessment results.

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