novática
Revista de la Asociación de Técnicos de Informática

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Legal depósit: B 15.154-1975 -- ISSN: 0211-2124; CODEN NOVAEC
Cover Page: "Mineral, Vegetable, Animal" - Concha Arias Pérez / © ATI
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Special English Edition 2013-2014
Annual Selection of Articles

summary

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Using Process Mining in ITSM

Abstract: *When it comes to information systems, ranging from copiers to surgical equipment or enterprise management systems, all the information about the processes executed using those systems are frequently stored in logs. Specifically for IT Service Management processes (ITSM), it is quite common for the information systems used to execute and control those processes to keep structured logs that maintain enough information to ensure traceability of the related activities. It would be interesting to use all that information to get an accurate idea of ??how the process looks like in reality, to verify if the real process flow matches the previous design, and to analyze the process to improve it in order to become more effective and efficient. This is the main goal of process mining. This paper explores the different capabilities of process mining and its applicability in the IT Service Management area.*

Keywords: *Change Management, ITSM, Process Management Tools, Process Mining, Service Desk, Services.*

Author

Antonio Valle-Salas is Managing Partner of G2 and a specialist consultant in ITSM (Information Technology Service Management) and IT Governance. He graduated as a Technical Engineer in Management Informatics from UPC (*Universitat Politécnica de Catalunya*) and holds a number of methodology certifications such as ITIL Service Manager from EXIN (Examination Institute for Information Science), Certified Information Systems Auditor (CISA) from ISACA, and COBIT Based IT Governance Foundations from IT Governance Network, plus more technical certifications in the HP Openview family of management tools. He is a regular collaborator with itSMF (IT Service Management Forum) Spain and its Catalan chapter, and combines consulting and project implementation activities with frequent collaborations in educational activities in a university setting (such as UPC or the *Universitat Pompeu Fabra*) and in the world of publishing in which he has collaborated on such publications as IT Governance: a Pocket Guide, Metrics in IT Service Organizations, *Gestión de Servicios TI. Una introducción a ITIL*, and the translations into Spanish of the books ITIL V2 Service Support and ITIL V2 Service Delivery.

1. Roles and Responsibilities in ITSM Models

All models, standards or frameworks used in the ITSM industry are process oriented. This is because process orientation helps structure the related tasks and allows the organization to formalize the great variety of activities performed daily: which activities to execute and when, who should carry them out, who owns what responsibilities over those tasks, which tools or information systems to use and what are the expected objectives and outcomes of the process.

One model commonly used to represent the different components of the process is the ITOCO model [1] Figure 1 that represents the fundamental elements of a process: Inputs, Outputs, Tasks, Control parameters and Outcomes.

This model allows us to differentiate between three different roles needed for the correct execution of any process: process *operators*, who are responsible for executing the different tasks; process *managers*, who warrantee that the process execution meets the specifications and ensure that both inputs and outputs match the expectations (within the specified control parameters); and process *owners,* who use a governance perspective to define the process, its outcomes and the applicable controls and policies, as well as being responsible to obtain and allocate the resources needed for the right execution of the process.

The *process manager*'s job is the execution of the control activities (also called the control process) over the managed process, acting on the deviations or the quality variations of the results, and managing the allocated resources to obtain the best possible results. Therefore, this role requires a combination of skills from diverse professional disciplines such as auditing, consulting and, chiefly, continuous improvement.

2. ITSM Process Management

The ITSM industry has traditionally used a number of methodological tools to enable the process manager do the job:

- Definition of metrics and indicators (usually standardized from the adopted frameworks).
- Usage of Balanced Scorecards to show and follow those indicators.
- Definition of management reports (daily, weekly, monthly).
- Usage of various kinds of customer and/or user satisfaction surveys.
- Performance of internal or external compliance audits.

These tools allow the process manager to gain knowledge about the behavior of the processes she is in charge of, and to make decisions to set the correct course of tasks and activities. However these tools are commonly rather rigid whereas the process manager needs a deeper analysis of the process behaviour.

Still, there are two key aspects of any continuous improvement model: to know what the current situation is - as the starting point for the improvement trip - and to understand what the impact of the improvement initiatives will be on the process and its current situation. Both aspects are represented in Figure 2.

At these initial stages many questions arise regarding the daily activities of the process manager, namely:

- Which is the most common flow?
- What happens in some specific type of request?
- How long are the different cases at each state of the flow?
- Can we improve the flow?
- Where is the flow stuck?
- Which are the most repeated activities?
- Are there any bottlenecks?
- Are the process operators following the defined process?
- Is there segregation of duties in place?

Moreover, in ITSM we usually find that most processes defined using frameworks do not fully match the real needs of daily operations; a standard and rigid approach to processes does not meet the needs of those activities in which the next steps are not known in advance [2].

One clear case of this type of processes in ITSM is the problem management process. Here, to be able to execute the diagnostics and identification of root causes, the operator

> "The role of the process manager requires a combination of skills from diverse professional disciplines such as auditing, consulting and, chiefly, continuous improvement"

will have to decide the next step according to the results of the previous analysis. Thus, problem management is, by nature, a non-structured process whose behavior will totally differ from a strict process such as request management.

3. Process Mining & ITSM

The first and most delicate task when using process mining techniques is obtaining a log of good quality, representative of the process we want to analyze, and with enough attributes to enable filtering and driving subsequent analysis steps as shown in **Figure 3**.

Fortunately enough, most ITSM process management tools have logs that allow the actions executed by the various process actors to be traced. These logs (e.g. **Figure 4**) are usually between maturity levels IV and V on the scale proposed by the Process Mining Manifesto [3].

The following steps of discovery and representation are those in which the use of process mining techniques provides immediate value.

The designed processes are usually different to the real execution of activities. This is caused by various factors, amongst which we find too generalist process designs (to try to cover non-structured processes), flexibility of the management tools (that are frequently configured to allow free flows instead of closed flows) and process operator's creativity (they are not always comfortable with a strict process definition).

For this reason, both the *process owner* and the p*rocess manager* usually have an idealized view of the process, and so are deeply surprised the first time they see a graphic representation of the process from the analysis of the real and complete information.

For instance, as mentioned in USMBOK [4], the different types of request a user can log into a call center will be covered by a single concept of *Service Request* that will then follow a different flow or *Pathway* as shown in **Figure 5**. This flow will be "fitted" within a common flow in the corresponding module of the management tool used by the Service Desk team.

In order to fit this wide spectrum of different types of requests into a relatively general flow we usually avoid a closed definition of the process and its stages (in the form of a deterministic automat) but we allow an open flow as shown in **Figure 6** in which any operator decides at any given time the next state or stage of the corresponding life cycle [2].

That is why, when we try to discover and represent these types of activities, we find what in process mining jargon is called "spaghetti model" as shown in **Figure 7**. In this model, even with a reduced number of cases, the high volume and heterogeneous transactions between states makes the diagram of little (if any) use.

Therefore, to facilitate analysis, we need to use some techniques to divide the problem into smaller parts [5]. We can use clustering, or simply filtering the original log, in order to select the type of pathway we want to analyze.

Previous to the discovery and representation tasks, it is recommended that the log is enriched with any available information that will later allow segmenting the data set according to the various dimensions of analysis.

For instance, in this case we will need to have an attribute indicating the request type or pathway to be able to break down the model by requests, segmenting the data set

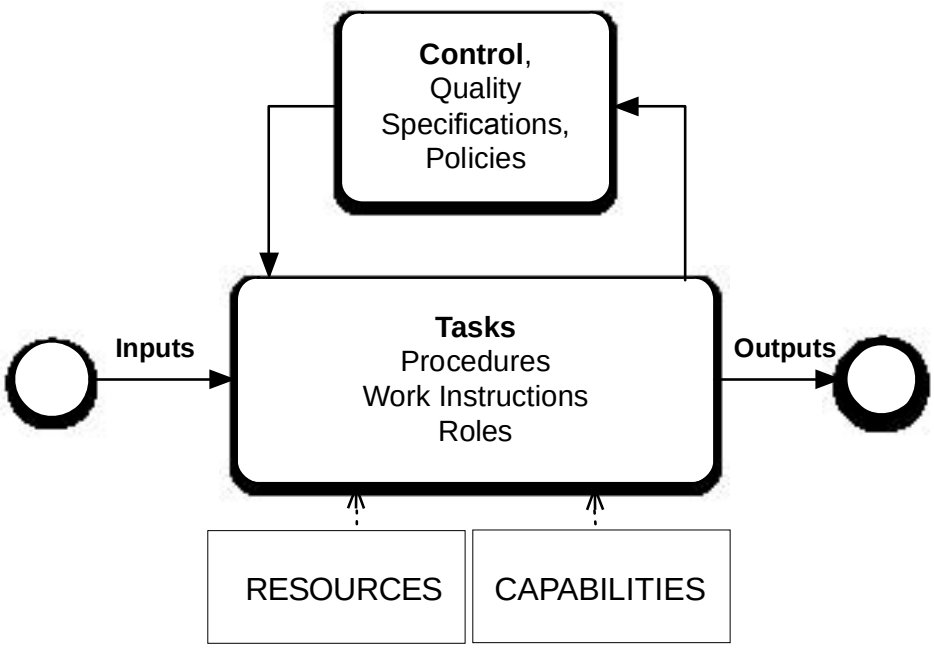

Figure 1. The ITOCO Model.

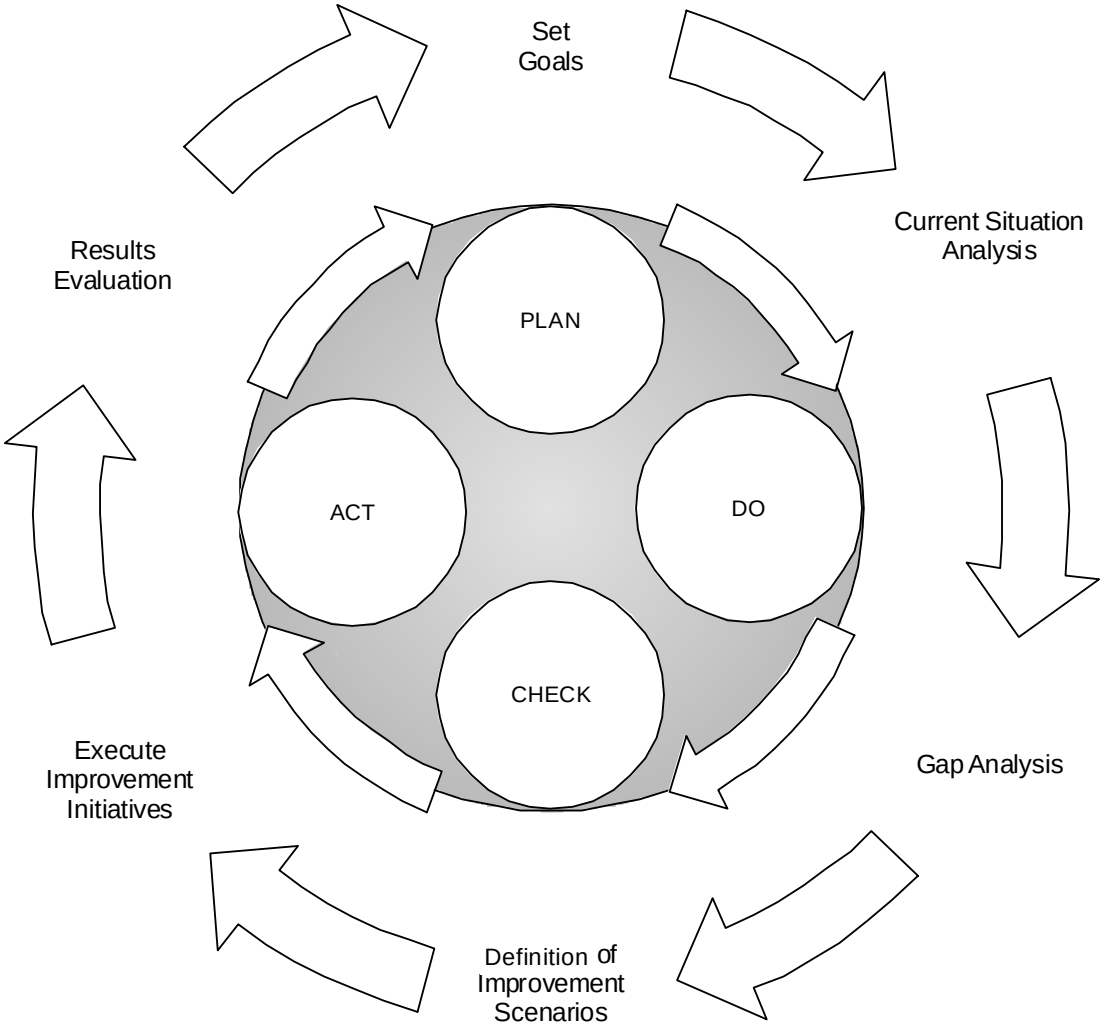

Figure 2. Continuous Improvement Cycle.

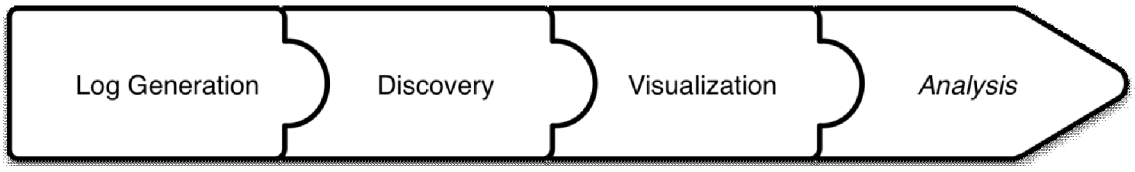

Figure 3. Sequence of Process Mining Steps.

Case ID	Activity	Complete Timestamp	Resource	Category	Priority
214371	Registered	2012/04/16 13:59:51.000	Operator 136	Request for Information	Medium - 35
214371	Reassigned	2012/05/02 09:25:19.000	Operator 30	Request for Information	Medium - 35
214371	Solved / Validation Pending	2012/05/07 10:52:29.000	Operator 16	Request for Information	Medium - 35
214371	Closed	2012/05/08 09:29:39.000	Operator 136	Request for Information	Medium - 35
216141	Registered	2012/04/27 13:59:16.000	Operator 136	Request for Information	Medium - 35
216141	En espera	2012/04/30 14:06:43.000	Operator 16	Request for Information	Medium - 35
216141	Solved / Validation Pending	2012/05/04 10:16:39.000	Operator 16	Request for Information	Medium - 35
216141	Registered	2012/05/07 09:56:05.000	Operator 136	Request for Information	Medium - 35
216141	Solved / Validation Pending	2012/05/07 10:15:24.000	Operator 16	Request for Information	Medium - 35
216141	Closed	2012/05/07 10:35:34.000	Operator 136	Request for Information	Medium - 35

Figure 4. Sample Log.

> "The first and most delicate task when using process mining techniques is obtaining a log of good quality, representative of the process we want to analyze"

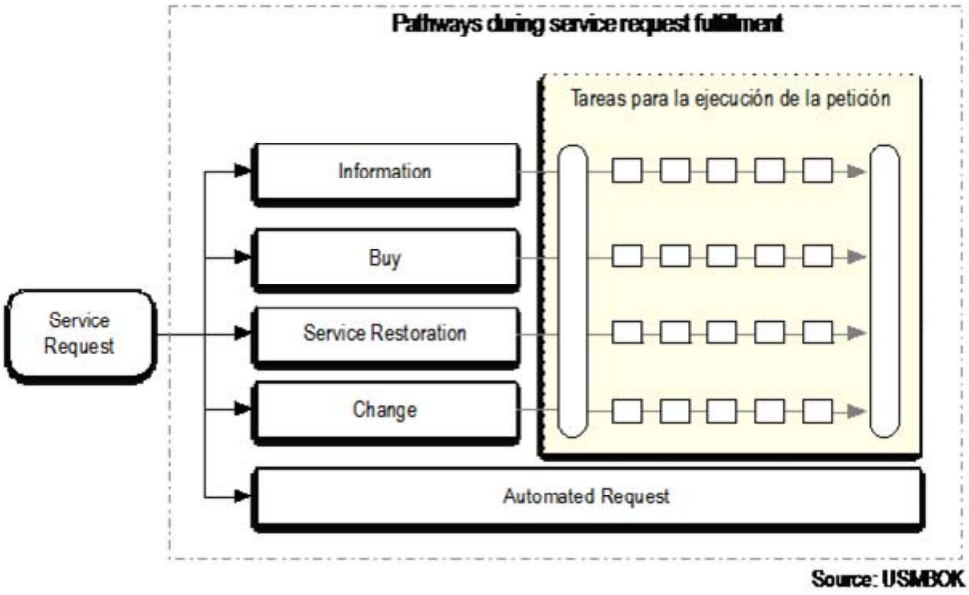

Figure 5. Pathways, According to USMBOK.

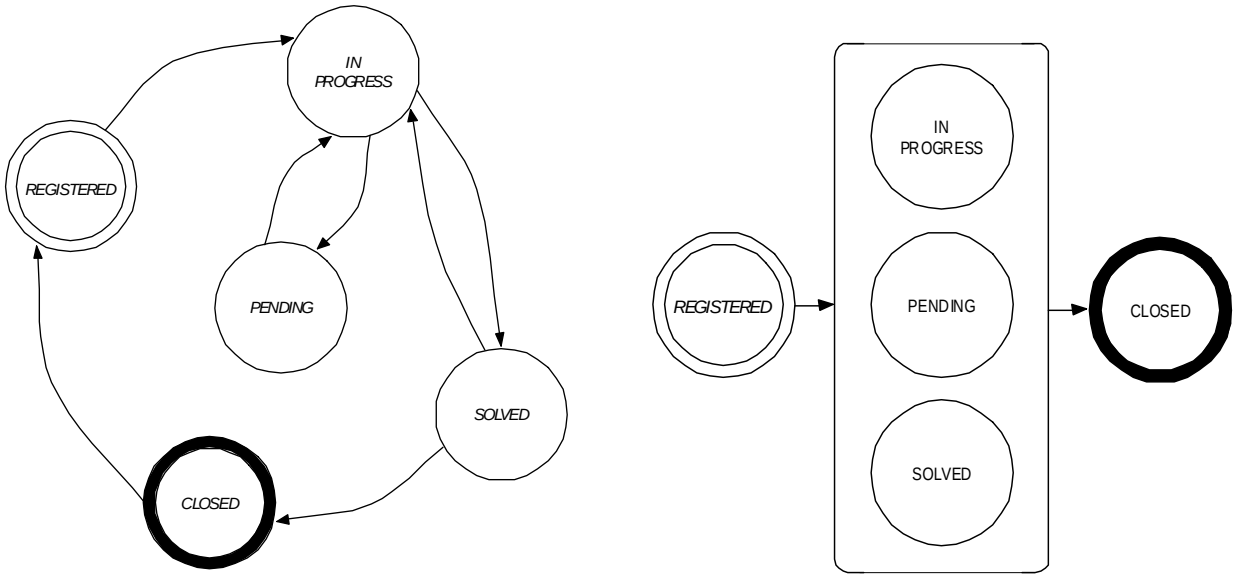

Figure 6. Strict Flow vs. Relaxed Flow.

Figure 7. Spaghetti Model.

and carrying on the analysis of a specific kind of request (see **Figure 8**).

On the other hand, we need to remember that process mining techniques are independent of the process activity. Instead, they focus in analyzing the changes of state.

At this point, we can be creative and think about the process flow as any "change of state within our information system", so we can use these techniques to analyze any other transitions such as the task assignment flow amongst different actors, the escalation flow amongst different specialist groups or (even lesser related to the common understanding of a process) ticket priority changes and re classifications (see **Figure 9**).

Finally, at the analysis stage it is time to answering questions about the process behaviour. To do this we have a broad array of tools:

■ Enrich the visual representation: for example in **Figure 9** we can observe that longer transactions between operators are represented in a thicker line, or in **Figure 8** we show most frequent states in darker color.

■ Graphs and histograms: to represent volume or time-related information. Typical situations of this kind of analysis are graphic representations of the number of open cases over time (backlog evolution) and histograms showing the distribution of duration and/or events per case.

■ In more analytic fields, we can obtain a

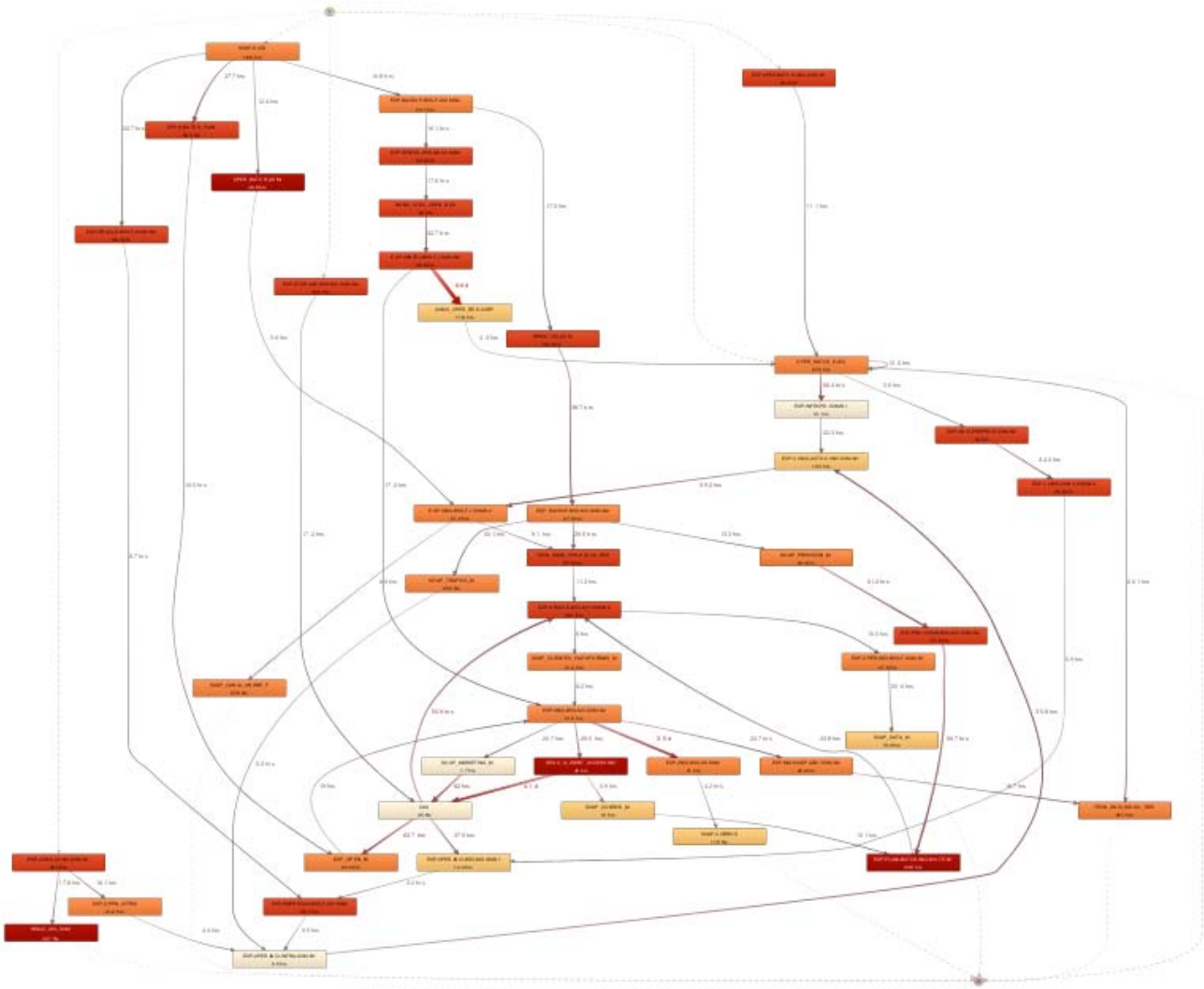

Figure 8. Filtered Spaghetti Model.

> "To facilitate analysis we need to use some techniques to divide the problem into smaller parts"

diagram showing a Márkov Chain for our process (see **Figure 10**). It will depict the probability for a particular transition to happen, to help answer questions like "what is the probability that a closed ticket will be re-opened?" We can also complement this information with case attributes: affected item, contact person, request type, organization etc. so that the model for analysis is richer.

So far we have covered methodological tools and mechanisms intended for quantitative and statistical analysis of processes and their behaviour. However, there is another side of the analysis focusing in the specific area of execution, answering questions such as "are there clear patterns of behavior in my process?", "is the process execution meeting previous definitions or corporate policies?" [6].
To answer the first question we will use the concept of "variant". We can describe a variant as the set of cases executed following the same trace of sequence of events. Thus, it is possible that some types of requests are always completed in a common pattern. We will easily check this by analyzing the variants of our process as shown in **Figure 11** (right side), where we see 79% of cases following the same flow: Registered à Completed / Validation à Closed.

To answer the second questions about process conformance we must have a formal model of the process to compare with its real execution. Once we have this piece, we can carry out different approaches to the problem of validation of conformance, as described by Anne Rozinat in her paper *Conformance Checking of Processes Based on Monitoring Real Behavior* [7]:

- Fitness analysis: answers the question "is the observed process complying with the process flow specified in the model?"
- Appropriateness analysis: answers the question "does the process model describe the observed process appropriately?"

Nevertheless, calculating some fitness index to a particular model will not be enough when doing analysis or audits; in those situations we will need ways to do complex consultations of the log [8]. To be able to know in which situations activity A is executed before activity B, or when did operator X executes activities A and B, will be of great importance to unveil violations of business rules or policies that govern the execution of the process.

If these techniques are applied to ITSM processes, we can provide an interesting application to ensure segregation of duties in change management for those organizations needing to comply with SOX or similar regulations. Next step would be continuously monitoring of these rules [9].

4. Conclusions

Process mining is presented as a set of tools that facilitate to a large degree process owners' and process managers' tasks, from acquiring knowledge about the real behaviour of the process to audits and continuous improvement. They allow many analyses that would be practically impossible or extremely costly to perform using traditional strategies like reporting, dashboarding or measuring indicators.

Although, generally speaking, one of the biggest difficulties we find in process mining is the lack of information or logs to analyze, in the specific area of IT service management

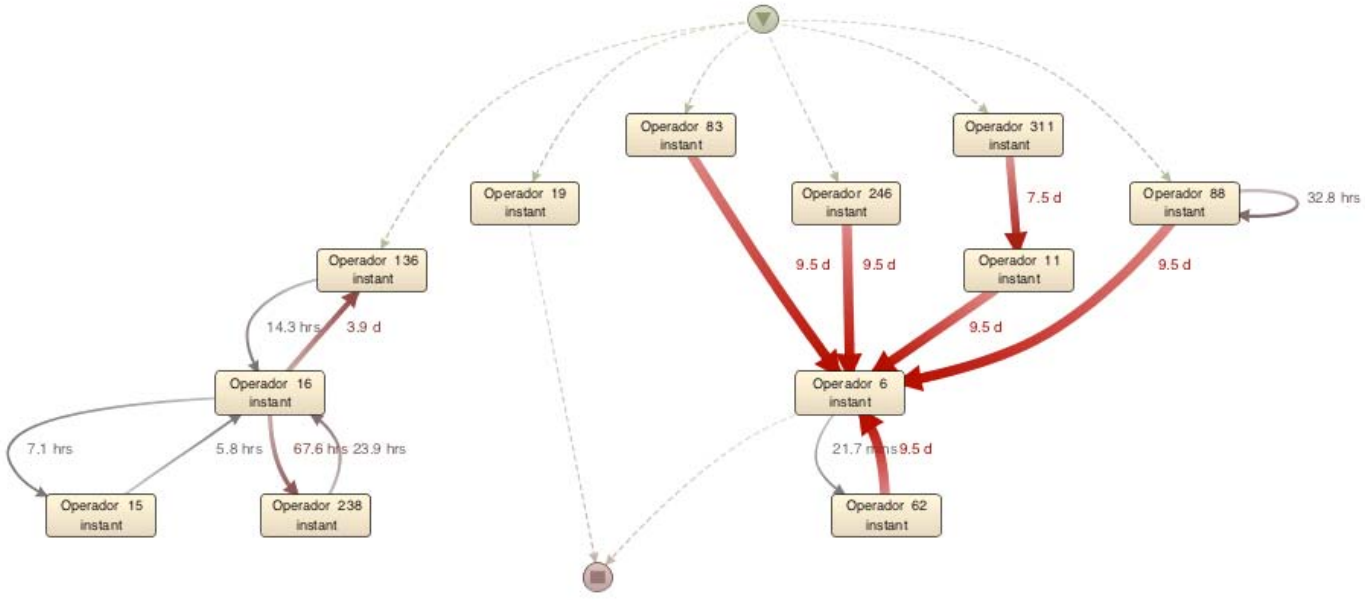

Figure 9. Social Map: How Cases Flow through the Different Process Operators.

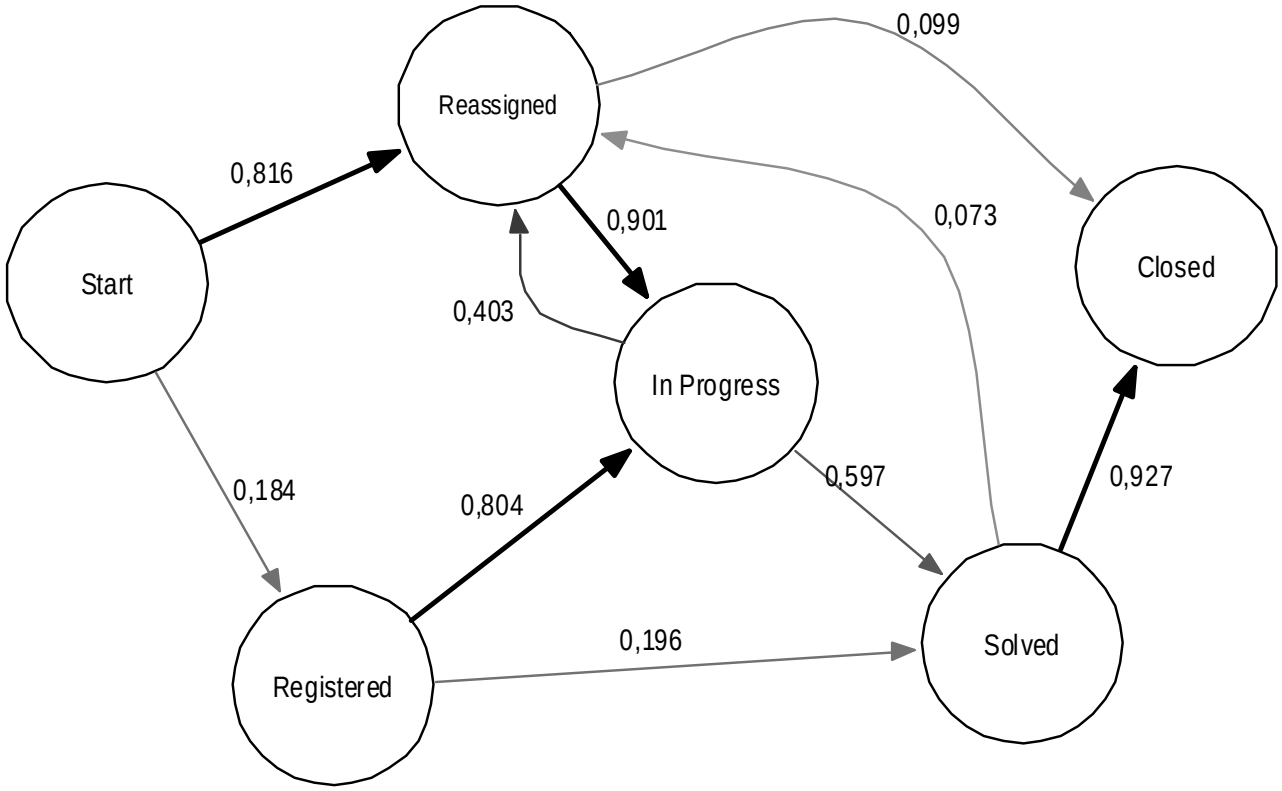

Figure 10. Simplified Márkov Chain.

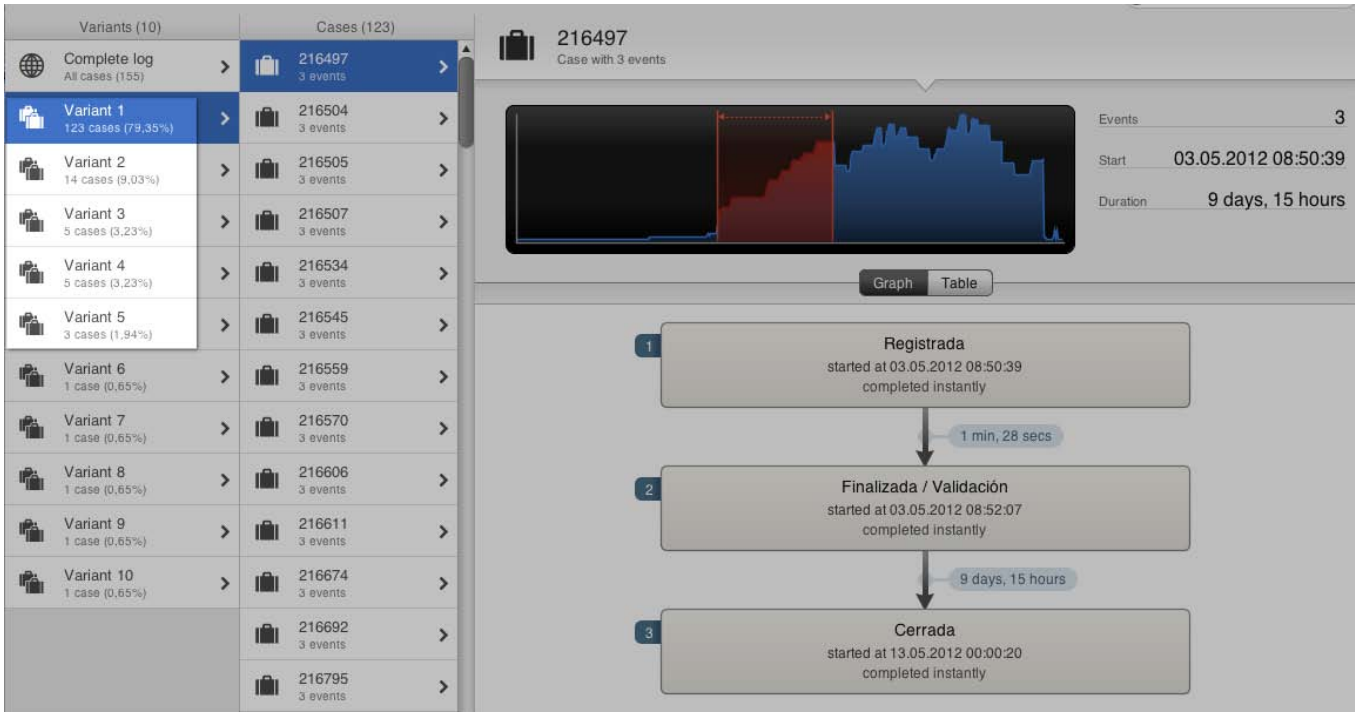

Figure 11. Process Variants.

this is not a problem. Here ITSM process management tools keep logs that can be used for process mining and can define auditable fields to be traced giving us different perspectives or dimensions of analysis.

Therefore, process mining stands out as a powerful and adequate tool to support ITSM practices in its permanent quest for improvement opportunities, both for processes and services of the management system.

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