A General Framework for the Continual Evolution Methods; Adaptation to the Continual Evolution of Organization's Business Processes

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Two contributions to Continual Evolution: CEFOP, a method for Business Process Continuous Improvement and As-IS/As-IF, a methodological framework for Continual Evolution Methods Engineering

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To my boyfriend: Thanks for all your support. For assuring me that everything was OK when I wasn't feeling optimistic and slowing me down when I was over processing.

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Abstract

Nowadays businesses are living in an ever-changing environment fuelled in large part by technological and societal breakthroughs. This dynamism demands organizations to continually strive to provide faster, better, or more innovative products and/or services to stay competitive in the market. Companies must be able to constantly and dynamically change their internal structure, products, processes, collaboration patterns, etc. This continual need to change makes company live in a cycle of continuous improvement, varying from incremental- small steps of continuous improvement to radical change, breakthrough and innovate on a large scale. We are using the term continual evolution to refer to the constant need organisations face, from improvement to innovation.

In this CIFRE PhD issued from a collaboration between the LIG-SIGMA team and the startup Net Invaders[1] based in Aix-en-Provence, we are proposing CEFOP, a method targeting process participants empowerment in planning business process improvement. Participants' engagement reduces external interventions and accelerates the integration of changes in their activities. CEFOP combines participative and evidence-based approaches (process mining) to facilitate participation and assure involvement. The method is additionally enriched with collective decision-making strategies inciting to collectively create the vision of change and imagine the most convenient scenario for change transformation. The method is constructed using the assembly-based approach by reusing and adapting existing methodological fragments.

A second result of this PhD is the proposition of the framework As-IS/As-IF, which aims to facilitate the construction of continual evolution methods within method engineers. This framework characterizes the As-IS state of a system and identifies the most convenient evolution scenario, called As-IF system. This contribution proposes a product meta model and a process model, to be adapted by method engineers when constructing new methods to a given context.

[1] https://www.net-invaders.com/agence-web/

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Chapter 1. Introduction

1.1. Context

Nowadays businesses are living in an ever-changing environment, fueled in large part by technological and societal breakthroughs. This dynamism demands organizations to continually strive to provide faster, better, or more innovative products and/or services to stay competitive in the market. Companies must be able to change their internal structure constantly and dynamically, products, processes, collaboration patterns, etc.

This Ph.D. is part of the ProMiNi[2] project, a collaboration between the SIGMA[3] team and Net Invaders[4], a startup based in Aix-en-Provence, France, and specialized in the development and maintenance of e-commerce sites. The company is rapidly growing; increasing the number of customers and employees and diversifying the range of products and services proposed to its customers. This business growth demands to constantly seek to provide more efficient and innovative services, hence improve their internal processes. The response to these changes must be dynamic, to this intent, Net Invaders launched ProMiNi, aiming to construct a business improvement method that: 1. guides a rapid changing of business processes, 2. provides reliable results, and 3. doesn't rely on external intervention. These criteria will permit them to keep their competitive advantage in this ever-changing business environment, effectively respond to the need to change, and reduce the financial cost of external intervention.

To achieve the three fixed criteria for the business improvement method, Net Invaders oriented their approach toward employees' empowerment. Their engagement in the business process improvement will reduce external intervention and accelerates the integration of the change in their activities. Change initiatives are effortful and the risk of non-successful is high; two out of three initiatives fail [1]. Employees' empowerment will increase the chance of succeeding [2] since their involvement enhance change acceptance and absorption, and reduces the risk of going back to old habits [2] [3].

1.2. Net Invaders Presentation

[2] Process Mining Net Invaders: https://en.net-invaders.com/

[3] http://www.liglab.fr/fr/la-recherche/axes-et-equipes-de-recherche/sigma

[4] https://www.net-invaders.com/agence-web/

Net Invaders start-up was founded in 2015 in Aix-en-Provence as a collaboration between three partners. Initially, the company started its activity by proposing NiSmart, a service dedicated to the construction of professional websites. In NiSmart, the company proposes a vast set of graphical templates to be adapted to the customer needs and easily modified and evolved in time.

With the increase of activity and business growth, the company enriched its catalog of commercialized services with two new propositions, NiShop and Market Invaders, Fig.1. NiShop is an e-store solution for vendors to facilitate their online sales. This service proposes an ergonomic and responsive back-office interface that assists vendors in managing the content of their site. The second solution, Market Invaders, is a multi-channel e-commerce platform aiming to simplify the usage of marketplaces such as eBay, Amazon, Cdiscount, etc. This product is a SaaS (Software as a Service) that permits vendors to sell online all their merchandise in different marketplaces in a few clicks through a unique application.

Today the company has oriented its business strategy toward the consolidation and the expansion of these current solutions rather than the diversification of its catalog. Accordingly, the goal of the ProMiNi project is to facilitate the continual improvement of business processes of the company and empower employees in changing and adapting their participation and work routines.

Fig.1: The three main products commercialized by Net Invaders.

The first step in this project was to define Net Invaders process landscape and map all the processes of the organization and their interdependencies,[4]. The processes within the organization, as stated in Porter's value chain[5], are categorized into core, support, and management processes.

1.1. Core group all those processes creating value for the organization; These processes produce goods and/or services for which customers are willing to pay.

1.2. Support processes are those that capacitate the execution of core processes, such as procurement, human resource or information technology management, etc.

1.3. Management processes provide directions, rules, and practices to guide both core and support processes. They cover strategic planning, compliance and risk management, as well as partners' management.

In our intervention, we are focusing in the evolution of the core processes, also referred to as business processes. Fig. 2 illustrates the core processes of the company, grouped according to Porter value chain [5] and categorized, based on the APCQ process framework [6]**.** This categorization structures Net Invaders architecture, by grouping all processes related to software development activity in ***purchased solutions*** and ***SaaS solutions*** gathers all activities performed when proposing the service of Software as a Solution, Market Invaders.

We intervened on three of these processes, selected by the stakeholders of the organization; 1) Framing and 2) Maintaining of Purchased Solutions and 3) Initiating Service Delivery of SaaS Solutions.

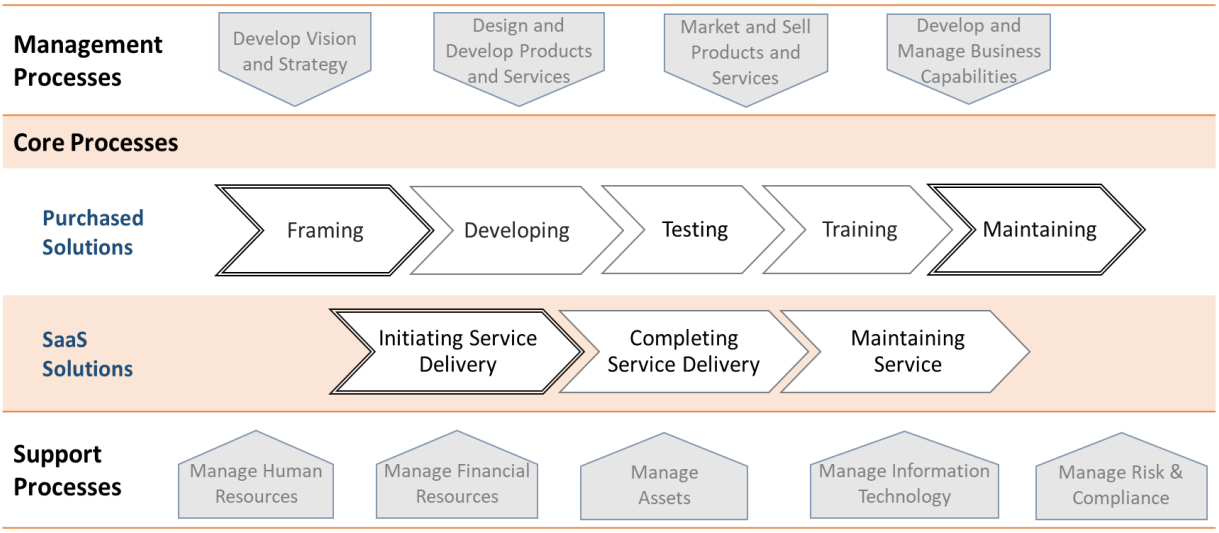

Fig. 2: The process landscape of Net Invaders start-up.

These processes are double-boarded processes in Fig. 2. In this manuscript, we are using the last process as a case study, whereas some of the interventions and outcomes on the other two processes are briefly described in Appendix II.

Case Study- Initiating Service Delivery process (ISD)

Initiating Service Delivery process (ISD) groups all business activities performed from the moment that a vendor expresses an interest in the solution Market Invaders, up to his decision to either subscribe or reject the solution. The process covers account creation, trial period management and contract subscription. These activities give vendors the possibility to test the solution, apprehend its usage and increase his chance to subscribe to Market Invaders.

The ISD process is triggered by the trial subscription request that vendors submit through the SaaS website. The vendor completes an online form and sends it through the interface. Once the subscription request is received, the client manager validates the trial request. To this intent, a meeting to present the solution presentation is scheduled with the vendor, during which the vendor's needs and trial's conditions are established. Each vendor gets a designated time to test the SaaS solution.

Trial terms defined, the developer creates and activates vendor's account, gives him access in the system and prepares his working environments. This configuration also covers the association of the account with the group of marketplaces where the vendor desires to sell his goods. When the account is ready, the vendor can pursuit the testing of the solution.

During the trial, vendors can create their catalogs of commercialized goods and additionally start generating and publishing Ads on different marketplaces. An Ad represents an online advertisement for a product or a good commercialized by a vendor on a given marketplace. All Ads publications requested by vendors during the trial period are performed in a testing environment, so buyers can't access them or place an order over these advertisements.

The trial period expired, the client manager contacts the vendor to gather their feedbacks over the solution and identify if further testing is needed. Depending on these feedbacks, the process can pursuit either:

- By extending the trial period, so that the vendor can further test and explore the solution.
- Successfully: the vendor decides to subscribe to the solution; he chooses a fitting subscription category, signs an agreement, and starts using the solution and get invoiced for this service.

- Unsuccessfully: vendor retracts from using the solution, in this case the developer deactivates his account, revoke his access to the SaaS solution and delete all Ads created or published during the testing.

This process is under the ownership of the chief commercial officer (CCO), who is responsible for the customer experience while testing the solution. Table 1shows the ISD business process profile and summarizes its main characteristics.

Table 1: The profile of Initial Service Delivery business process

<table>
<tr><td colspan="2">Name of process: Initial Service Delivery (ISD)</td></tr>
<tr><td colspan="2">Vision: This process aims to provide a trial to vendors on the SaaS solution. This trial permits vendors to apprehend the service and subscribe to the solution.</td></tr>
<tr><td colspan="2">Process Owner: Net Invaders Chief Commercial Officer (CCO)</td></tr>
<tr><td>Customer of process:
The vendor aiming to test the SaaS solution</td><td>Expectation of the customer:
Understand and operate the SaaS solution (service)</td></tr>
<tr><td colspan="2">Outcomes:
Provide an excellent customer experience so that vendors and engage him in the usage of the solution
Apprehend and better use the solution in the future</td></tr>
<tr><td colspan="2">Trigger:
A trial request submitted by a new vendor</td></tr>
<tr><td colspan="2">Tasks:
Validate request
Prepare Vendors Environment
Test solution
Conclude Trial</td></tr>
<tr><td>Inbound Interfaces:</td><td>Outbound Interfaces:
Complete Service Delivery</td></tr>
<tr><td colspan="2">Required resources:
Human resources: Client manager, Developer
Information: Procedure documentation, User guideline, Vendor Trial Agreement, etc.
Work Environment Requirement: SaaS Solution, Solution Development Repository.</td></tr>
<tr><td colspan="2">Process performance measures:
Subscriptions and Declines per month
Rate of success (Subscription/ Requests)
Cycle time (Trial time)</td></tr>
</table>

1.3. Research questions

This thesis started with the scope to propose a business process improvement method that can be deployed continually, so that small and medium companies, including Net

Invaders, can quickly and effectively reply to change. Business Process Management - BPM, approaches cover and manage the changing of a business process when aiming to improve their performance, conformance, security, etc. Each process improvement goes through five steps [4]:1) identifying and discovering the process to be improved, 2) analysing and diagnosing the existing problems, 3) redesigning the change to be deployed for improvement, 4) implementing this change over the business process, and 4) monitoring and ensuring that the change is standardized in the working routine, Fig. 3.

The first three steps of this lifecycle share similar intentions as the Plan step in PDCA[7], the well-known four steps continuous improvement cycle. The scope of this step, in the context of business process improvement, can be resumed to characterize the current state of the process and define the change to be implemented for improvement.

The scope of the ProMiNi project is to empower process participants in reaching both these intentions. Today the existing state of art proposes different approaches that incite and motivate actors' involvement in business process improvement. Several participative methods are introduced to facilitate intervention through the usage of serious games, gamification, virtual reality, etc. These techniques aim to lower the entrance barrier for participants, by reducing the required skills and knowledge to cover the steps of process improvement[8]. All this work creates today a strong base for

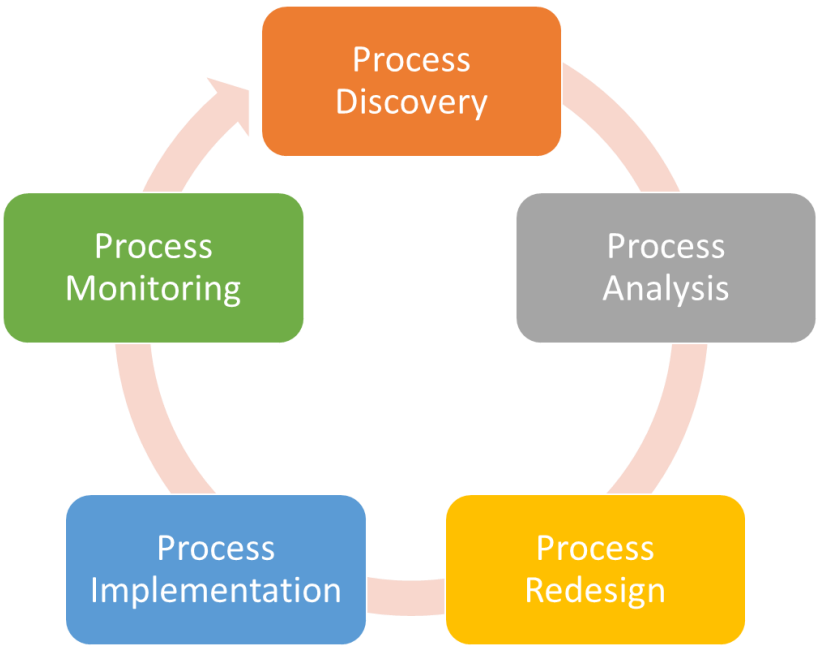

Fig. 3: Business Process Management cycle

covering the steps of process improvement and participant's empowerment; however, this goal is not fully achieved since:

1) management hesitates to delegate the responsibility of business process improvement to its participants fearful that they will lack objectivity in identifying the best scenario for improvement

2) actors are reticent to engage in continuous improvement fearful that their points of view and efforts will not be part of decision making.

Our scope in ProMiNi is to go over these blocking points and construct a method that fully empowers process participants in the business process improvement. To this intent, we targeted two problems when constructing a business process improvement method:

1. ***Lack of objective participation:*** Companies are more and more promoting the empowerment of their employees since it represents a way to reduce the cost of business process improvement and enhance change acceptance. Nevertheless, this involvement can negatively impact the quality of the improvement; Process participants are prone to subjectivity since they are brought to analyze and change their working routines. This element brings prejudice when it comes to assure the quality of the outcomes of a business process improvement and can negatively affect the future of the business, due to an incorrect response to the change. This drawback does not motivate companies to fully dress the improvement responsibility to their actors.

   To provide a solution to this issue, we propose to combine participative techniques with evidence-based techniques such as Process Mining[9] [10]. These techniques generate their results by mining traces left during process execution which will ensure an objective involvement for process participants.

2. ***Lack of collective decision making:*** Today, the vision of the change is defined by managers based on the company strategy and communicated following a top-down philosophy[3]. They delineate the direction and expected improvement, detailing the steps for the change deployment and the expected results out of each. To succeed in business process improvement, all actors impacted by the change must understand and share a common vision [3], this will motivate them to take actions in the right

direction and facilitate the alignment of their individuals' needs and interests to those of the organization. Following this top-down approach in decision making prevents sharing and adhering to the same change since sometimes the interests of involved parties differ and might even be conflicting; for example, *managers want to change* as *process participants feel comfortable in the current way of working*.

To incite process participants' empowerment, ProMiNi proposes to collectively construct the change vision combining both: top-down approach, currently followed, with the bottom-up approach where process participants are pro-actively asked to share their point of view describing how they imagine that the process should be changed. The different scenario of change and their impacts are collectively reviewed so that the better fitting way of changing the process is collectively defined. This will increase participants' comprehension of the need to change and endorse it.

To resume, the research questions we aim to respond with this Ph.D. when developing a method for process participants' empowerment in business process improvement are:

Research Question 1: *How to objectify process participants' intervention in business process improvement?*

Research Question 2: *How to collectively create the vision of change and imagine the most convenient changing scenario?*

1.4. From Process Improvement to Continual Evolution

This Ph.D. was developed within the SIGMA team; which research is oriented toward the construction of methods covering continuous improvement or innovation in socio-technical ecosystems. ADInnov[11], ISEA[12], and ISEACAP[13] are some of the methods introduced by the team covering respectively; 1)ADInnov- instilling innovation in social-technical ecosystems, 2) ISEA- the continuous improvement of business process and 3) ISECAP- the continuous improvement of absorptive capacity of companies involved in innovation projects.

With our work, we target the construction of CEFOP, a method guiding the continuous improvement of business processes by empowering and objectifying its participants. This proposition provides guidance and instruction to plan the improvement of business processes. Today, companies are living on a cycle of continuous improvement– learn–

innovate [14], where the need to change varies from incremental- small steps of continuous improvement to radical- breakthrough and innovation by changing on a large scale [15]. We are using the term **continual evolution** to refer to the constant need organizations face, from improvement to innovation, Fig. 4. Continual evolution demands to extend employees' empowerment to cover improvement and innovation continually, installing so within the organization the philosophy of *"no endpoint"* [16].

When constructing CEFOP, we are taking into consideration that business processes, as well as other systems, will need to improve and innovate during their lifecycle, so the method must offer the possibility to imagine improvement and innovation scenarios. We introduce the term, **As-IF**, to refer to a change scenario imagined when trying to evolve a system.

Method engineering proposes different approaches for constructing a method; design it "from scratch" [17][18], assemble it by reusing existing method fragments [19], extend an existing method [17][18], or instantiating or adapting a model[20], [21]. CEFOP proposes to combine, adapt, and reuse, evidence-based and participative methodological fragments to guarantee objective participation. So naturally, we are choosing the assembled-based approach to construct our proposition. This approach will additionally allow the assembling of fragments deriving from both continuous improvement and innovation context.

Method engineers are today presented with a vast variety of methods, each proposing their steps and methodological fragments, to guide improvement or

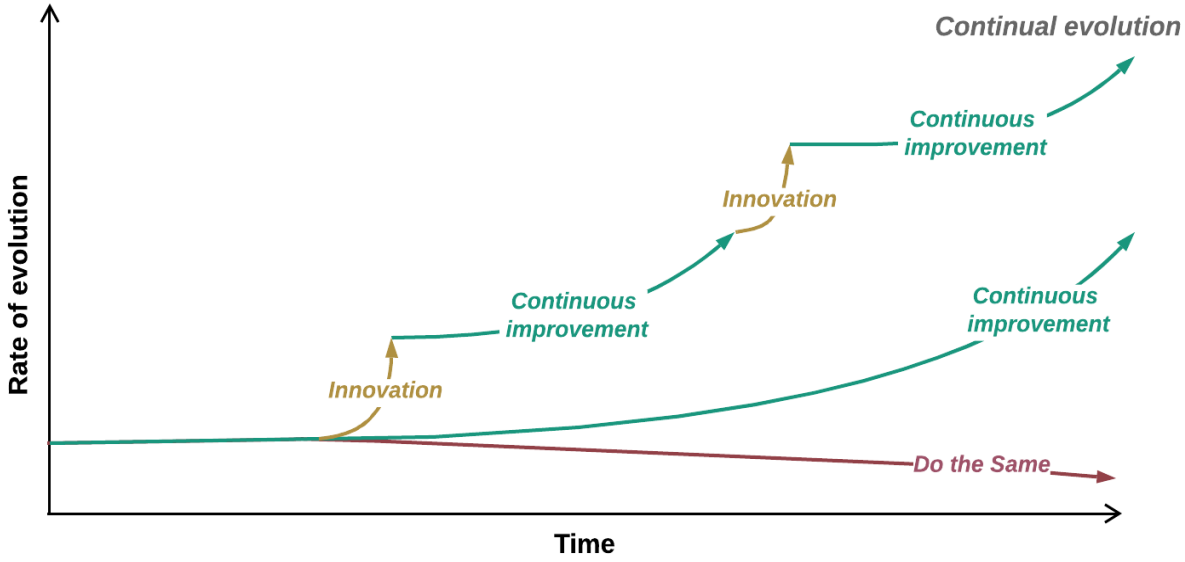

Fig. 4: Continual evolution, the rate of evolutions compared to continuous improvement and innovation.

innovation. This diversity complicates the construction of a new method for the continual evolution since the adaptation or reuse of existing methods fragments demands to understand the approach proposed by each method and the intent and scope of the proposed fragments.

To facilitate the construction of continual evolution methods for method engineers, the gaps between improvement and innovation cycles must be reduced and their processes, steps to be followed, and expected outcomes formalized. This uniformity is the focus of our third research question:

Research Question 3: How to guide method engineers in the design of a new method planning the continual evolution of a system?

- *Which are the steps to follow and the products to expect when creating the vision of change?*
- *How to identify the most convenient evolution scenario, called the As-IF system?*

1.5. Research Results and Journey

As discussed, the outcomes of our research project can be resumed in two topics; 1) the empowerment of process participants in business process improvement answering so to the first and second research questions and 2) the proposition of a guideline for method engineers to facilitate the construction of continual evolution methods, answering to the third research question. Accordingly, two main results are presented in this Ph.D.:

1. CEFOP: a method to empower process participants in the continuous improvement of business processes

CEFOP (**C**ontinual **E**volution **f**or **O**rganizational **P**rocesses) [22] guides and structures the continuous improvement of business processes within small and medium companies, such as Net Invaders. This proposition, as defined by OMG[5], is formalized with:

- **A Product meta-model** describing the elements required to characterize the business process,

[5] https://www.omg.org/spec/MOF

- **A Process model** detailing the steps to follow to derive the above elements and imagine the improvement of the business processes.
- **The Methodological fragments;** instruments and tools, supporting the process model in deriving the concepts of the product meta-model.

The focus of this contribution is to incite: 1) process participants empowerment, by making participants' intervention more objective and 2) collective decision making and definition of the change vision. For this, the method:

A. Combines participative and evidence-based methodological fragments and consolidates the derived products**.** CEFOP includes within its structure:

Ludic and participative methodological fragments, to increase the involvement of process participants and minimize the barrier of knowledge or skills required for participating in the improvement of business processes.

Evidence-based methodological fragments to guarantee the objectivity of the artifacts generated in each step of business process improvement.

Consolidation methodological fragments that guide participants in merging the products generated from the participative and evidence-based steps. The consolidated artifacts are more solid and reliable for the improvement. Additionally, this consolidation permits the confrontation of participants' perceptions with what is really happening, increasing so their acceptance of the need to change.

B. Explores each participant's point of view and collectively defines the best scenario for improvement and vision of the change defining. CEFOP develops the point of interest of all involved stakeholders and guides them to collectively define the most convenient scenario for the improvement. For this, we are proposing roadmaps of steps illustrated in Fig. 5, where the change vision is defined by 1) initially characterizing the current state of the business process, referred to as the As-IS process, and then 2) imagine all suggested ways of changing the business process; each suggestion leads to different As-IF scenario replying to *"What if"* questions, and lastly 3) collectively choose the most convenient scenario of change to be deployed and obtaining the new improved version of the business process, that will become the new As-IS process.

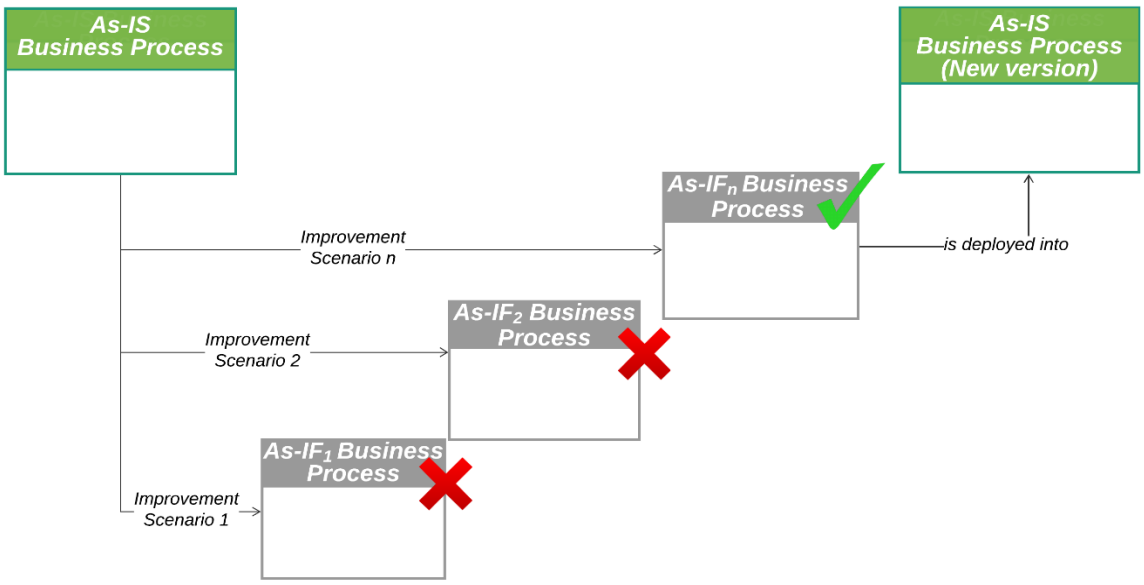

Fig. 5: The roadmap proposed in CEFOP to collectively identify the improvement to be deployed over the business process.

2. **As-IS/As-IF framework: A guide for method engineers to design continual evolution methods.**

The scope of this second contribution is to provide a guide for method engineers to help them in the construction of continual evolution methods. The proposed framework, As-IS/As-IF, structures the plan step of the PDCA cycle, Fig. 6, by translating it two main intentions to be attained: Characterize the As-IS system and Imagine the As-IF system, the most convenient scenario for the evolution. This framework is composed of two adaptable prototypes:

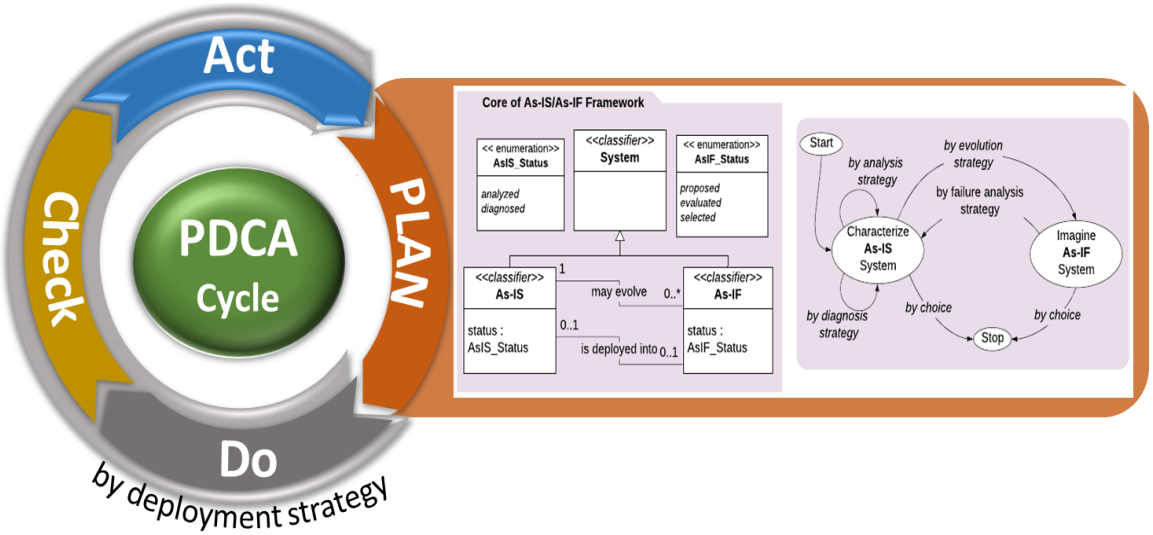

Fig. 6: As-IS/As-IF framework positioning toward the PDCA cycle and a fragment of 1. product meta-model and 2. process model.

1. **A Product meta-model** describing the set of elements required to characterize the As-IS system and imagine the As-IF systems.
2. **An intentional Process model** structuring the goals to achieve to derive all the above elements and plan the improvement of the As-IS system.

Our research journey to obtain these two results is resumed in Fig. 7. Initially, our Ph.D. research aimed to reply to the two first research questions: *1. How to objectify process participants' intervention in business process improvement?* and *2. How to collectively create the vision of change and imagine the most convenient scenario for evolution?*. Correspondingly, the review of the state of art concentrated on business process management methods. The outcome of this work was the proposal of the method CEFOP in RCIS 2017[22].

Later, we introduced As-IS/As-IF [23], a conceptual framework responding to our third research question; *How to guide method engineer in constructing a method planning the continual evolution of a system?* This contribution is derived from a more extended research context, where we reviewed continuous improvement or innovation methodologies, including the methods ADInnov and ISEAcap, results of InnoServ and ACIC project in SIGMA team.

As-IS/As-IF framework proposes a guide for method engineers to facilitate the construction of methods dedicated to the continual evolution of a system. We used the framework to restructure ADInnov and CEFOP methods, which resulted in second enriched versions for both methods.

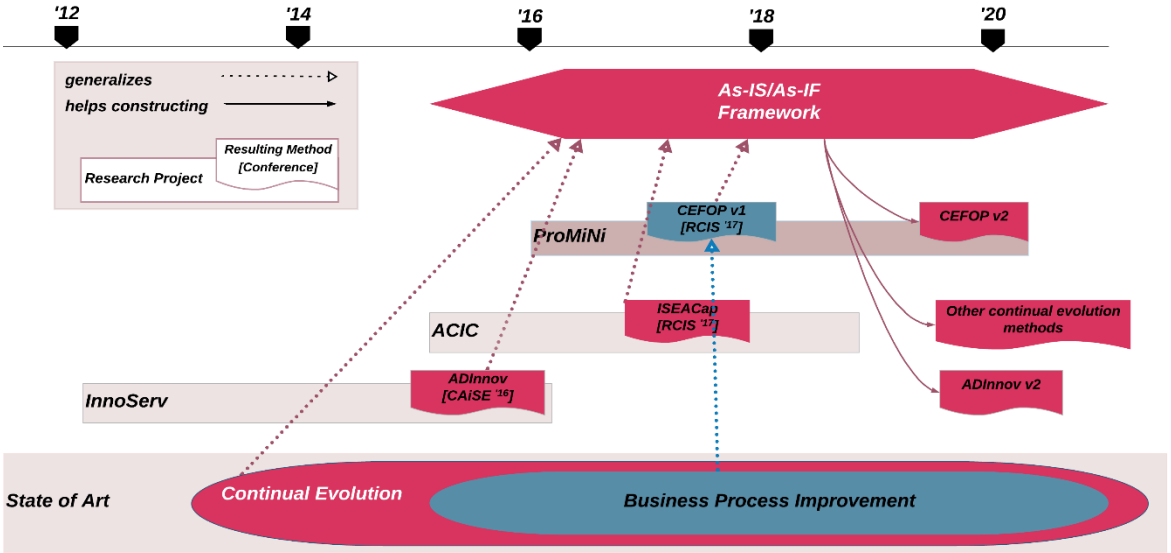

Fig. 7: The research journey:
■ *Phase 1: Continual evolution of a business process* ■ *Phase 2: Continual evolution of a system*

In this manuscript, we are describing the second version of CEFOP by detailing the final version of the product meta-model and the process model derived from its adaptation from the As-IS/As-IF framework.

1.6. Structure of the Manuscript

This document is composed of three parts, grouping six chapters, as follow:

Part I: State of Art

Chapter 2: State of Art Overview

This chapter reviews some of the existing methodologies proposed today to guide continuous improvement or innovation of a system. This overview details their proposed approach, focusing especially on their steps and expected results. The second part of the chapter zooms in the discipline of Business Process Management, overviewing some of the methods proposed in this discipline and illustrating some of their methodological fragments.

Chapter 3: Applicative State of Art

In this section, we illustrate the usage of existing approaches and methodological fragments to improve the ISD process. This review details the organized workshops and the obtained outcomes when modelling and assessing the performance of the case study process.

Part II- Contribution

This part of the manuscript describes both contributions: the method CEFOP and the framework As-IS/As-IF.

Chapter 4: CEFOP Approach and Instrumentalization

We introduce the approach proposed by CEFOP to model the business process and assess process performance and illustrate the consolidation methodological fragment proposed to consolidate the process model and process measures development. The steps proposed by the method and the tools supporting them are presented and illustrated over the ISD process.

Chapter 5: CEFOP Formalization

The chapter introduces CEFOP formalism, to plan the continual evolution of a business process. The method is formalized by a product meta-model and a

process model which describe the artifacts handled by CEFOP during business process improvement and the approaches proposed for their elicitation.

Chapter 5: As-IS/As-IF Framework

This chapter introduces the proposed structure to plan the continual evolution of a system. The framework is formalized by a product meta-model and an intentional process model. Both models' adaptations are detailed and illustrated over CEFOP and ADInnov methods.

Part III: Conclusions

Chapter 6: Conclusions and Future Works

This chapter proposes a summary of the work performed in this Ph.D. detailing our conclusions and the future perspectives for this research.

Part I – State of art

This part of the manuscript is structured in two chapters: the first one overviews the state of the art and the second one illustrates the usage of the existing methodological fragments over the ISD business process.

Chapter 2 is an overview of existing methods guiding continual evolution. We start this overview by going over some of the principal methodologies covering continuous improvement and innovation and overviewing their approaches and cycle of steps. Each review describes the system in the target of the evolution, the proposed methodology, and illustrate some of methodological fragments used to generate the artifacts manipulated when planning an improvement or innovation.

Later, we focus our analysis mainly on methods guiding business process continuous improvement. This analysis goes more in-depth over the approaches and the methodological fragments proposed by each of these methods to discover, analyze, or redesign a business process.

Chapter 3, in contrast to the previous, doesn't focus on methodological fragments review but illustrates their usage in our real case study business process improvement. We are using two different approaches, participative and analytic, to model and develop the performance of the ISD process and review and evaluate the obtained artifacts by both these approaches on three criteria: completeness, objectivity, and comprehensiveness.

Chapter 2. State of Art

2.1. Introduction

Every organization faces the need to evolve and adapt to the changing environment in which they live. To respond to these needs, continuous improvement projects are deployed to manage the lifecycle of a system. The stakeholders piloting these projects have different backgrounds and cover different roles, as can be business manager, system owner or participants, system analyst, or methodologist. For example, the team guiding a business process management project can be composed of the Chief of Operation Officer from the management, the owner of the process within the organization and its participants, as well as a process methodologist and analyst[4].

Most of the time, SME enterprises don't have an operational excellence division in their structure, so they are obliged to outsource the function of analyst and methodologist. The intervention of the analyst targets to outline the system to be changed, analyze, and redesign. He oversees the structuring of the change, how it is deployed, and monitors and controls its absorption in the working routine. The methodologist assists the analyst by providing knowledge on the best or more suitable methods or methodological fragments to use on different stages of the system lifecycle management.

Deming [24] introduces a four-step cycle, also referred to as the PDCA cycle to manage the continuous improvement, Fig. 8. The presented four steps are Plan, Do, Check, and Act, referring respectively to:

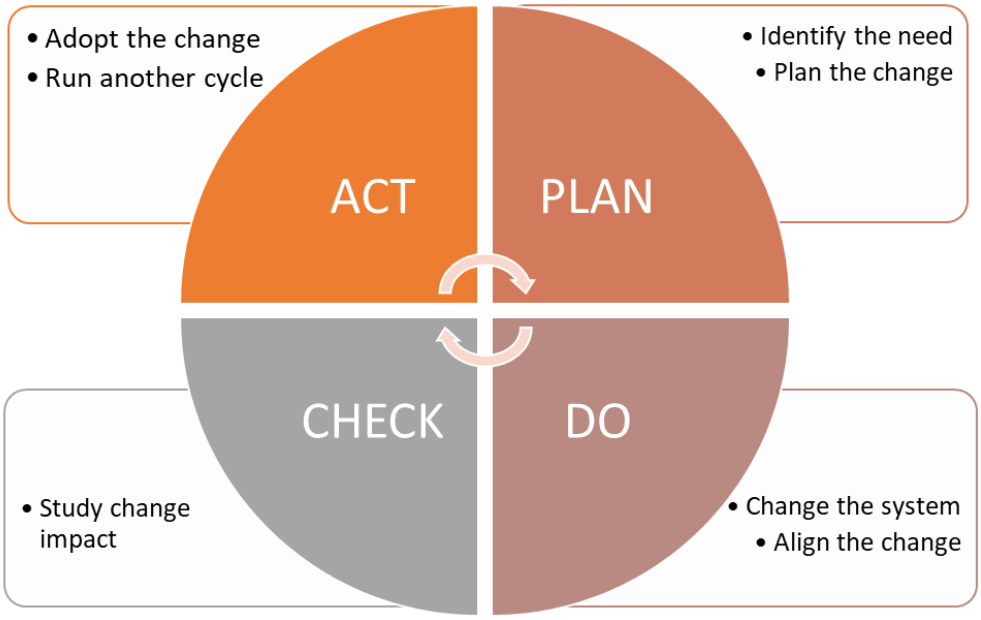

Fig. 8: The Deming PDCA Cycle.

- **Plan** defines the need to change, which is the blocking points existing in the system and identifies the change to be deployed over the system as a solution.
- **Do** covers the change defining. The proposed solution is structured over the system and if necessary, the change is readjusted and realigned.
- **Check** monitors the impact of the implemented solution. The scope is to collect information and check if this solution is effective or not.
- **ACT** concludes by deciding on either to adopt the change in the whole system or retake another cycle of improvement and explore new solutions.

The PDCA cycle settles the base upon which most of the continuous improvement or innovation methods construct their process for evolving a given system. The change implemented by these methods can differ from transactional, small improvements put in place up to enhance a system, up to transformational where the system is completely innovated and changed [24].

As previously discussed in Section 1.4, today organizations live under continual evolution where the need to change is never-ending and in time it shifts from improvement to innovation. So, a methodologist should be able to guide suitable advising on both continuous improvement and innovation methods.

In the following sections, we start by briefly overviewing some existing methods covering continuous improvement or innovation of specific systems and later focus on business process improvement methods and their methodological fragments proposal.

2.2. Continual Evolution

A method sits on the highest level of abstraction and it refers to a collection of problem-solving approaches governed by a set of principles and a common philosophy. As discussed above, the methods covering continual evolution target different needs to change varying from small improvements of a system up to radically changing and innovating it. Fig. 9: Continual evolution methods and methodologies Fig. 9 illustrates the position of some exiting methods and approaches proposed today, based on the scope of change aimed to implement being that transactional (improvement) or transformational (innovation).

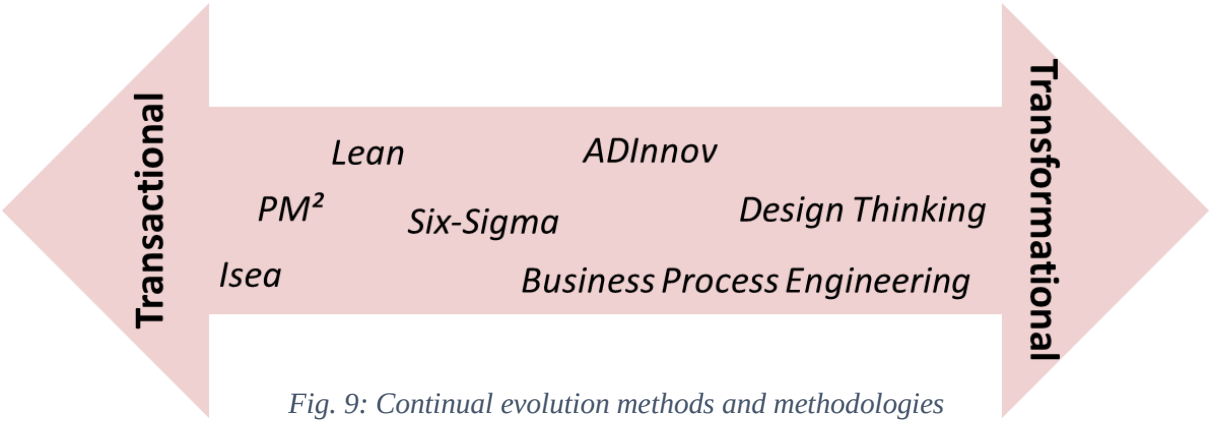

Fig. 9: Continual evolution methods and methodologies

2.2.1. **Lean Manufacturing**

The approach Lean was inspired by Japanese management methods, aiming to continuously improve products, processes, and services through small incremental changes [25]. The main philosophy of Lean is to increase the efficiency and quality delivered to the customer by removing wastage and inefficiencies[26]. For this, the methodology reviews 1. manufacturing chains to reduce the time requested for delivering a product or service, the resource consumption, and errors occurrences, and 2. processes to simplify them by reducing workload and increase productivity. The methodology proposes 5 steps to cover a cycle of continuous improvement, which are:

Identify Value: to identify the steps in the process or production chain that bring value to the customer and the ones that don't.

Map the Value Stream: models the value streams in the organization and identifying the wastages or ineffective operations that must be removed to maximize the added value for the customer.

Create Flow: ensures that the flow of production, services, or processes continues once the wastage is removed.

Establish Pull: standardizing and systematically reviewing the flow to reduce wastage or loops in the value stream. The performed operations are made visible so that a quick reaction and correction can be deployed if required.

Seek perfection: transforms the business culture and aims at continuous improvement, so that optimizing the value provided to the client remains at the heart of each and everyone's concerns.

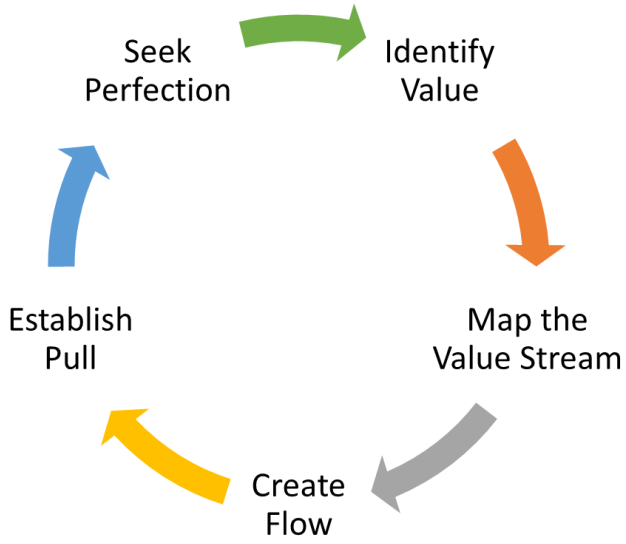

Fig. 10: Lean 5-step cycle for continuous improvement.

Lean methodology is today adopted in several methods covering continuous improvement, each developing its own set of methodological fragments to eliminate waste and inefficiencies in given contexts. Some of these propositions are Kanban[27], a process visualization approach, facilitating team interaction and collaboration, to better manage and operate their process and reduce the time to deliver a product or service; Kaizen[28], a strategy inciting proactive participation from employees to continually improve the manufacturing process; 5S [29] helping work standardization and productivity enhancement through guidance on how to manage and organize a clean, efficient and safe manner environment, etc.

2.2.2. **Design thinking**

Design Thinking is an iterative solution-based approach, seeking to identify a solution for complex problems and generate innovation[30]. The method follows a user-centered approach, where the needs of the customer are analyzed by multi-disciplinary teams, so that they are better understood, and a better fitting solution is proposed. Design Thinking proposes a flexible sequence of process steps and iterations in its problem-solving approach[31], in which six principal activities can be identified:

Understand: the method starts by collecting existing information to explore the problem and understand the concerned context.

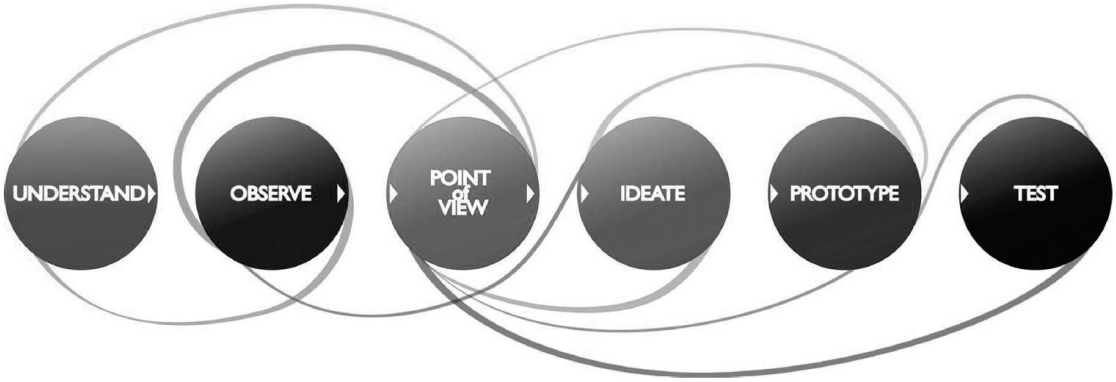

Fig. 11: Design Thinking six-step cycle for innovation.

Observe: once the problem is identified, insights over the user's needs must be retrieved. This collection can be performed through observations, interviews with the customer or immersion in the physical environment.

Point of View: groups together all the information and insights gathered in the two previous steps. They are synthesized into a core problem, shared with all the team guiding the problem resolution project. To this intent, a visual representation of all collected insight is created, facilitating the exchange of research results and the identification of 'pain points' to be addressed for improvement.

Ideation: the team starts to generate ideas to address the issues elicited in the previous step. Brainstorming sections are organized to incite people to think out of the box and elicit ideas for possible solutions that will be further developed.

Prototype: aims to produce an inexpressive and low scale version of the products or features proposed during the Ideation step. Each prototype is shared with small groups of people outside the project team to identify the best fitting solution for the user's needs.

Test: covers the testing of the best solutions, that emerged from prototyping, on a larger scale or people and final users. This step can result in redefining the problems and the understanding of the user's needs.

Design thinking is quite a used approach today though it comes with a large set of methodological fragments that are proposed for each of the steps and depending on the context. For example; Touch Point Dashboard[32] is proposed to map and visualize the customer journey so that team member can easily exchange their point of views and Brain Storming[33][34] and Worst Possible Idea[33] to incite the free-thinking of involved parties and expand the resolution space.

2.2.3. **ADInnov**

ADInnov[11] (Analysis, Diagnosis, and Innovation) method is part of the ANR research project InnoServ[6], and aims to understand and support innovations in complex socio-technical ecosystems such as the ecosystem around fragile people at home. The method states two intentions to be attained: Characterize As-IS Ecosystem and Imagine As-IF Ecosystem, through analysis, diagnosis, innovation, roadmap, and deployment strategies, Fig. 12. ADInnov process is formalized using the intentional map formalism[35], where circles represent intentions and arrows represent strategies to put in place for their attainment.

By analysis strategy aims to elicit the components characterizing the ecosystem. Some of the components composing the ecosystem around a fragile person, Fig. 13, are; ***target***-the legal or physical person (e.g. *fragile person*) who beneficiates from the ecosystem services and on whom an ***actor*** operates under its own business (e.g. *nurse*, *physician*, etc.). Each actor covers a ***function*** corresponding to a skill or responsibility and is involved in the realization of concrete service. ***Responsibility networks*** are defined to manage the ecosystem complexity, they are views of the ecosystem determined by their proximity with the target. Three responsibility networks were identified in the InnoServ project: *Regulation* - laws and rules concerning home care of fragile people, *Coordination* - home care organization, and *Execution*- direct interaction with fragile people at home. A point of view relates to a cross-cutting issue in the responsibility network that determines a point of interest of a provided service (*financial, medical, social, strategic, technological, legal, etc.*).

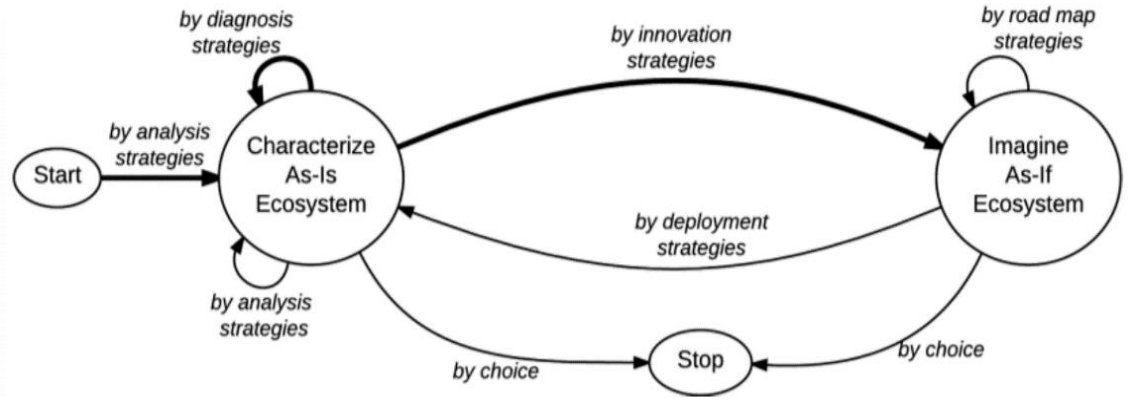

Fig. 12: ADInnov cycle for ecosystem innovation.

[6] https://goo.gl/8HHZYQ

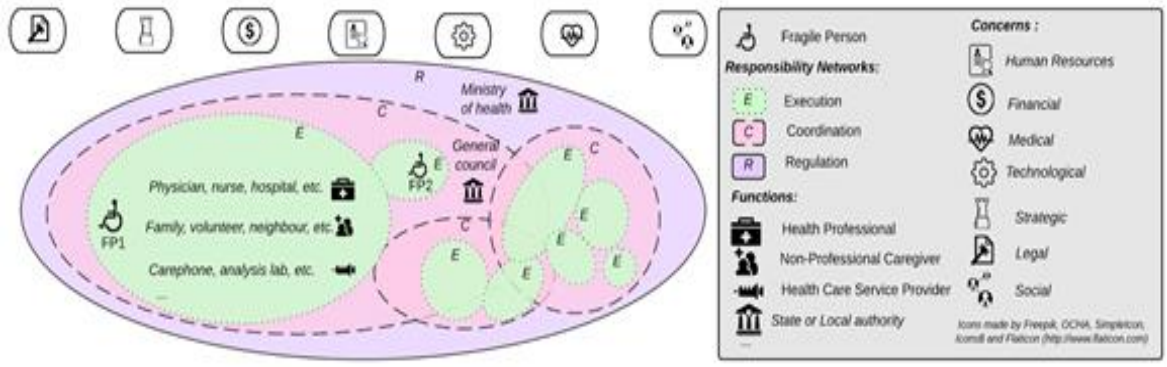

Fig. 13: Some of the components identified in the ecosystem around a fragile person, in InnoServ.

The ecosystem proposes ***services*** (e.g. *health professionals*) that relate to the providing of technical and intellectual capacities or useful work over the targetted fragile person. A service is attached to a responsibility network (RN) and is composed of one or several ***concrete services*** treating a point of view and performed by one or more functions (e.g., the service *Recognize the caregiver work* can be done from a legal point of view (*recognizing the caregiver status*) and from a financial point of view (*establishing a salary for caregivers*)).

By diagnosis strategy reveals blocking points, each corresponding to a concrete issue in the context of a responsibility network or a point of view (e.g., in the *Execution RN*: *There is a problem of unavailability as well as lack of required actors for caregiving*). The latter is translated into one or more refined ***goals*** (e.g. *have available actors in the fragile person's house*) and ***constraints*** expressing the fact that some components can't evolve (i.e. *the fragile person is not supposed to evolve*).

By innovation strategy aims to propose ***changes*** that will make possible to reach the identified goals, as, innovation services are induced in the form of new services (e.g. *a digital service of piloting*), new functions *(orchestrator, coordinator*), or new actors (*pools of competencies)*. The *pools of competencies* gather actors with the same function to balance the ecosystem workload, an *orchestrator* manages one or more *fragile persons* and uses the resources of one or more *pool of competencies* whereas a *coordinator* is responsible for organizing, coordinating, and managing the *pools of competencies,* assigning the orchestrators and arbitrating their requests. The impact of these changes on the achievement of goals leads to their ***evaluation*** to identify their relevance. The changes evaluation is made possible by imagining one or more **As-IF *ecosystems***, each corresponding to an As-IS in which one or more changes are embarked and evaluated. One of the As-IF systems can then be

chosen as the new system to be deployed as defined in its roadmaps which introduces one or more ***Operational Changes*** corresponding to the implementation of the change in the As-Is system.

To come up with all these components, detect the blocking points or propose evolutions in the ecosystem, different method fragments are used by ADInnov, such as a) serious games[7] to analyze the information flow between functions; b) post-it's to analyze service dependency or c) CAUTIC[36] method workshops to evaluate innovation changes.

2.3. Business Process Management

Business process management groups all methods and technologies proposed to guide different operations that business processes might request. The target of these methods can vary from business process improvement, redesign, automatization, etc., and their guidance cover operations such as process modeling, analysis, redesigning, monitoring [37][38]

As this discipline covers continuous evolution, the cycle of steps is based on PDCA. Different methods have revisited this cycle to propose their own set of steps and stages[39]. One well-known adaptation is the business process improvement cycle presented by Dumas, La Rosa, Mendling, and Reijers[4]. They propose six-steps for process improvement, triggered by process identification, Fig. 14: Business process management cycleFig. 14, which is removed from the cycle and considered as a one-time step. The remaining five steps; discovery, analysis, redesign, implementation, and monitoring, are cyclic and performed continuously. This proposition performs process modeling in two steps process identification and discovery; where process identification groups the defining of the process architecture and business analysis, and discovery, the outlining and modeling of the business process.

In contrast to PDCA cycle, this cycle introduces an analysis step before process redesign and monitoring, which proposes process performance measuring and diagnosis to identify possible root-causes to be improved in the To-Be process. The remaining three steps, redesign, implementation, and monitoring, follow the original cycle.

[7] http://www.lego.com/fr-fr/seriousplay/

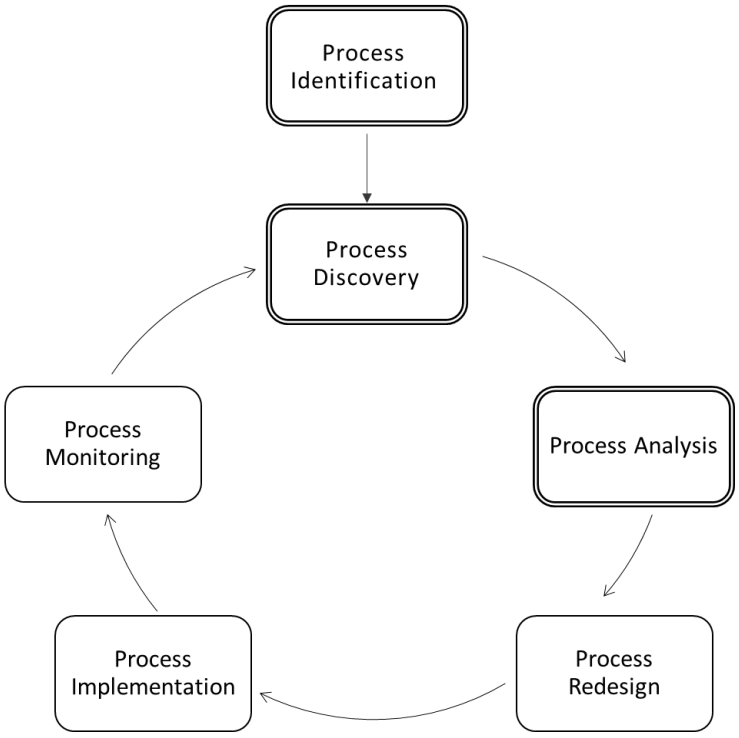

Fig. 14: Business process management cycle where double-boarded steps are targeted by CEFOP.

CEFOP covers the planning of business process improvement aiming to analyze and diagnose the existing state of the business process ad imagining the best improvement scenario to be implemented. So, in correlation with this business process improvement cycle, our scopes target the first three steps of the cycle: process identification, discovery, and analysis. In the following sections, we are overviewing some of the most well-known methods covering business process improvement by particularly zooming on 1) the targeted problem and the followed philosophy and 2) their proposed methodological fragments and the intervention of stakeholders in these three steps.

2.3.1. **Business Process Methods Overview**

In business process management, the targeted problem for resolution, as discussed in continual evolution, can stretch from small improvement up to complete transformation of the process. A method can either target to modify or reorganize the transactions performed during the business process execution or to completely transform and redesign the workflow[4]. Besides the targeted problem-solving scope, we can categorize BPM methods also on the approach and philosophy they follow during their steps. This grouping identifies two opposing approaches when aiming to resolve the targeted problem: the creative or analytic approach. Within creative approaches, we can group all those methods proposing participative techniques to gather process

knowledge from participants or other actors of the organization whereas methods based on analytic philosophy rely on business or process data and analytics.

Fig. 15 illustrates the positioning of some well-known BPM methods to the axes targeting problem type and followed approach. Methods as ISEA[12], CoDesign[8], and Design-Led Innovations[40], strongly emphasize the participation of process actors to either improve the process or innovate and completely transform it. In the opposite quadrant are situated methods, such as, Lean Six Sigma[41], PM²[42], BPR[43], and Product Based Design[44] that are based on data analysis approach. Lean Six Sigma and PM² rely on analytics to discover the process model, identify root causes and improvement tracks; BPR and Product Based Design rely on business data analysis to identify possible transformation or innovation for the business process.

In our review of the state of art, we are focusing on the left side of the graph since at present the scope of CEFOP is business process improvement. The following sections detail some of these approaches and the methodological fragments proposed by these methods to cover the first three steps of the business improvement cycle; identity, discover and analyse the business process.

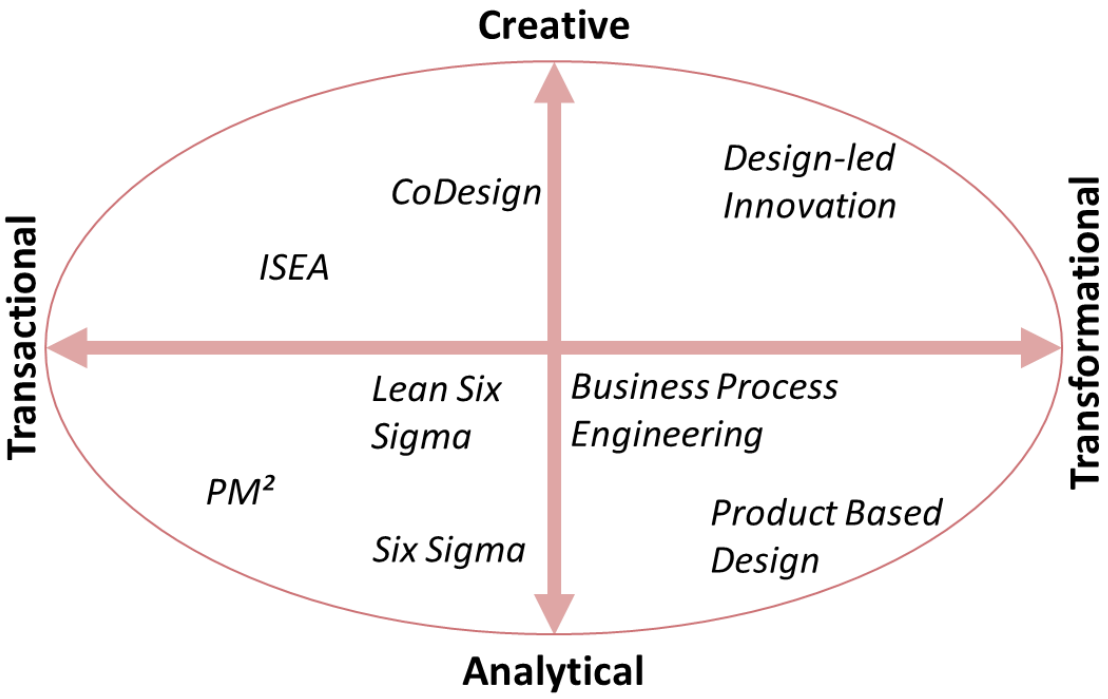

Fig. 15: Methods of Business Process Management.

2.3.2. **Six Sigma**

Total Quality Management (TQM) was one of the first methodologies proposed in the BPI discipline. It was first introduced in Motorola Production System to improve the quality of their production[45]. The major impact of this methodology was to emphasize the importance of managerial responsibility, the usage of statistics on the work process, and the organizational impact on process performance quality[4]. One of the main inconveniences of this approach was that the support targeted the achievement of a given stage of quality after which no improvement could be made. They often reach a stage after which no further quality improvements can be made.

Six Sigma, in contrast, focuses on improving the quality to a better level by continuously reducing the number of defects. The discipline introduces five cyclic stages to cover business process management, referred to as DMEMO [46] an acronym for:

Design whose goal is to identify the business process existing in the company, process architecture, and discovering the one needing intervention by analyzing the organization data or business strategy. This step concludes with the elicitation of the improvement to be implemented as a solution.

Model focuses on formalizing how the improvement will be implemented and designing the To-Be version redesigned. The operations performed during this stage are process modeling, redesign, and simulation.

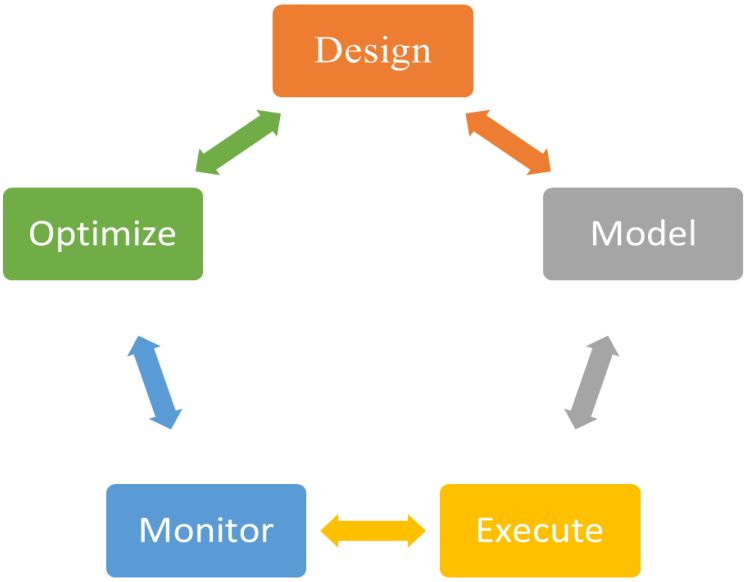

Fig. 16: DMEMO- Six Sigma business process management lifecycle.

Execute has the goal to implement within the organization the changes formalized for the To-Be process. This accommodation encompasses the training of the process participants and changing of their work routine, as well as evolving the infrastructure or the systems supporting the process execution. Other terms used in the BPM methods to refer to this step are process implementation, composition, positioning, or automation.

Monitor aims to control how the newly implemented version of the business process is performing and monitor if the business operations are under expectation. To facilitate this measuring and monitoring, the monitor stage is today more and more supported by analytical techniques and tools coming from bigdata, process mining, machine learning, artificial intelligence, etc.

Optimize focuses on evaluating process performance and detecting possible improvement aiming to increase efficiency. It covers process analysis and diagnosis, supported by prediction techniques, as well as improvement and optimization detection.

Lean Six Sigma

Lean Six Sigma method aims to improve the quality of the process output by eliminating wastage, redundancy, and loops in the process and standardizing or reducing process variability[41]. The method combines in its approach 1. LEAN philosophy[26]- introduced initially in the Toyota Production System and targeting to increase efficiency by removing wastage and 2. Six Sigma philosophy- aiming to increase the quality and efficiency of output by minimizing or removing the causes of defects through the reduction of variance in the production process.

This method adapts the SIGMA DMEMO cycle to a five-step cycle, DMAIC, Fig. 17. The cycle is an acronym for Define, Measure, Analyze, Improvement, and Control, where:

Define covers the structuring of the organization process architecture and the identification of the business process needing an improvement. Like process identification and discovery steps in the business process management cycle, the main output of this step is the model of the business process. The process analyst is charged to identify all the required components for the process modeling by interviewing process participants or/and analyzing the process related documentation.

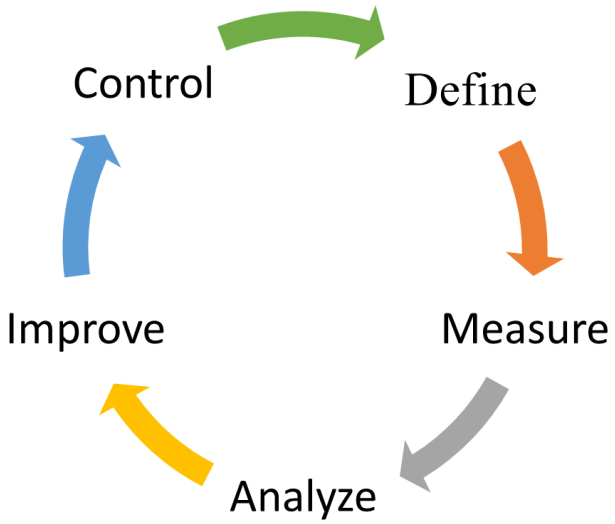

Fig. 17: The DMAIC cycle presented in Lean Six Sigma

Measure aims to asset the current performance of the business process. To this intent, the process analyst is brought to select the adequate process measures and assess process performance.

Analyze: once the process is modeled and its performance assessed, DMAIC pursues with analysis. During this step, the goal of the analyst is to identify performance measures not complying with business expectations and the root causes for this lack of performance. Several techniques of process analytics and simulation are introduced by Lean Six Sigma to assess performance and the upcoming process performance.

Improvement: the three previous steps cover the identification and analysis of the existing state of the process, whereas the improvement step focus is to transform the business process. This step covers identifying the solution to be implemented for their resolution, structuring how the change is to be deployed, and communicating the vision and the outcomes expected from the improvement.

Control: this is the last step of the DMAIC cycle and focuses on implementing the change in the business process and monitoring the process performance with two intentions 1) observe if the change sticks in the process execution routine or whether there is a resistance emerging in time and 2) observe if the new performance issues emerge with time. In case a new need for improvement is identified during this step, a new cycle can be triggered aiming to introduce a new or better resolution.

Lean Six Sigma is well-known and largely used by organizations. Today it provides a detailed guide on the methodological fragments to be used in each step[8], such as structures for interviews or documentation reviews for process modeling, techniques such as the 5 Whys, Pareto Analysis, the Scatter diagram, etc. to assess performance and identify root causes. It also proposes a rich palette of brainstorming or analyzing techniques for resolution elicitation, process redesigning, and the planning of the change implementation.

All the steps in Lean Six Sigma are performed either by the process analyst or under his guidance. To this intent, he must have a large knowledge of all these methodological fragments. The apprehension of these techniques is today structured in several training and certifications; yellow, green, and black belt. Each of these training targets a different type of intervention in the improvement, starting from getting an apprehend of the method philosophy and techniques up to being able to cover the complete DMAIC cycle of an organization.

2.3.3. **PM²**

PM² *proposes a guide for organizations in improving process performance or compliance with rules and regulations*[42]. The method proposes a six-step process, structured as a guide to performing process mining projects. The process mining discipline proposes several techniques that cover the automatic process discovery, conformance checking, and process enhancement using data produced from previous instances executions[9].

The six steps proposed by PM² are 1. Planning, 2. Extraction, 3. Data Processing, 4. Mining and Analysis, 5. Evaluation and 6. Improvement and Support, Fig. 18. Each step is guided either by a business expert or/and a process analyst.

Planning; The process analyst outlines the business process to be improved, the scope of the intervention, and the information systems supporting process execution. The scope of intervention can target either to reply to a business question concerning performance improvement or conformance checking, limited to the algorithms proposed today by Process Mining. In the case of performance improvement, the question to be answered by the method depends also on the data traced in the system, for example, does the system trace quality, cost, or resource consumption information.

[8] https://www.isixsigma.com/

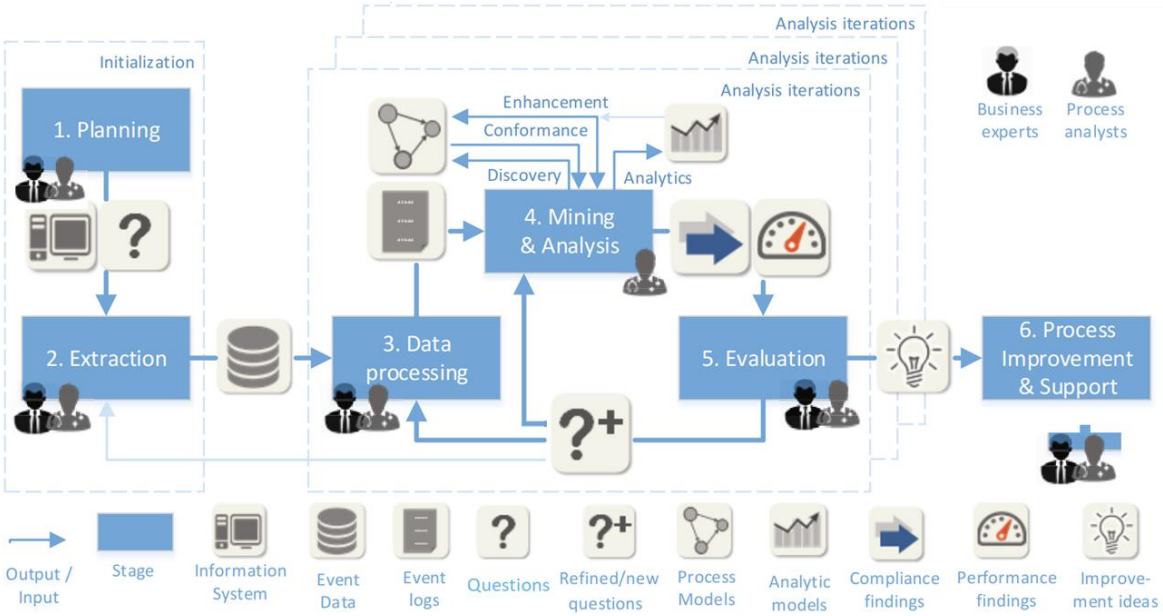

Fig. 18: PM² steps for business process improvement.

Extraction. Once the intentions of the intervention are stated, the extraction of the data to be analysed can start. During this step, the process analyst and business expert must collaborate to define the proper level of granularity and transformation for the information extraction. The business expert intervention aims to provide the requested process knowledge so that the extracted data set is complete and comprehensive; shares the same terminology used in the process execution.

Data Processing. This step focuses on constructing the event log file[9] to be later fed to a process mining algorithm for process discovery or analysis. The process analyst is charged to define the structure for data transformation and enrichment. In addition to these tasks, data filtering is performed in collaboration with the business expert to facilitate analysis, such as slicing and dicing the collected data based on process outcome, the time taken to complete the process instance, or cluster executions based on their complexity.

Mining and Analysis. This step aims to mine the data processed previously and analyse the different process metrics computed by the process mining techniques. Depending on the needs, different algorithms of process mining can be exploited to either discover the process model, check its conformance, or enhance it with quantity, cost, or resource consumption information.

[9] http://www.processmining.org/_media/presentations/event_logs_the_input_for_process_mining.pdf

Evaluation. The process analyst and business expert are brought to diagnose process performance or conformity and identify the root causes over process analytics generated in the previous stage. This evaluation aims to verify and validate the finding or propositions of the stakeholders and if necessary, to refine the question defined during Planning and trigger a new analysis.

Improvement and Support. This last stage of the method focuses on the deployment of the solution and the support and monitoring of the improved process execution.

In contrast to Lean Six Sigma, PM² focuses primarily on process modeling, measuring, and analysis, leaving improvement out of the method scope and not proposing specific techniques for this step. Thus, like Lean Six Sigma, PM² is dependent on the intervention of the process analyst. His expertise is requested to deploy each of the stages and in addition to process management expertise, he must have process mining knowledge.

2.3.4. **ISEA**

ISEA method [12] was developed and constructed within the Sigma research team of LIG, Laboratory of Informatic Grenoble. This method proposes a participative and ludic approach for process participants to model by themselves the existing business process and identify improvements.

The method revisits the DMEMO business process management cycle and restructures the Define stage by proposing a four-phase sub-cycle to characterize the As-IS business process. ISEA introduces Identification, Simulation, Evaluation, and Improvement phases that will be followed by the classical stages of process modeling, execution, and controlling, Fig. 19. These new phases aim respectively:

Identification to identify the process participants and external actors that can be either supplying process inputs or consuming the outputs. During this phase, the process borders are outlined defining the perimeter to be analyzed and the participants who will be involved.

Simulation: to identify the activities performed by process participants and the documents exchanged during process execution. This phase is organized as a participative and ludic session, where actors, dressing the role of a process participant, take turns and describe their interventions.

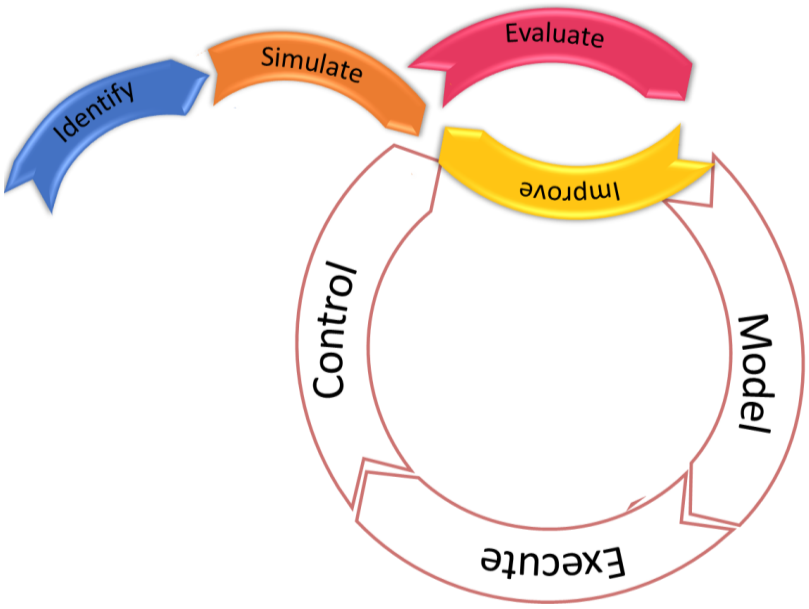

Fig. 19. The business process management cycle proposed by ISEA.

Evaluation identifies the blocking points existing in the process by making process participants play out the model described in the simulation phase. Besides identifying the blocking points, the scope during the evaluation is also to elicit possible solutions to the existing problems. These improvements are organized and road map based on their order of priority.

Improvement to play in the solution proposed during the evaluation and check if new blocking points emerge. Like in the simulation phase, participants are asked to play in the process as if a chosen improvement is deployed in the process. The result of this phase is to obtain an optimal scenario for the improvement of the business process, where all necessary changes are elicited and structured.

Like PM², the four phases proposed by ISEA cover the detection of improvements and leave deployment up to existing techniques proposed by other business process management methods. The novelty of ISEA is to propose an Improvement step before modeling, executing it, and then controlling the To-Be process. The playing-in of the solution before its implementation permits us to better identify the improvements and roadmap its deployment. Additionally, the method proposes a participative approach for the introduced phases, where each phase is structured as a participative and ludic workshop and supported by methodological fragments facilitating process participants' involvement. The role of the process analyst in all these phases is to facilitate and animate the workshops.

2.4. BPM Methodological Fragments

Above, we discussed the cycle of steps proposed by methods covering business process improvement and the principal approach they followed. In this section, we are going more in detail over the methodological fragments employed by these methods. A methodological fragment groups the approach and the supporting tool used by a method to obtain the expected artifact that, depending on the improvement step, can be the process model, the blocking points and their root causes, or the change and its operationalization redesign.

Following a similar categorization logic as for the method, we are presenting in the following section some analytic and participative methodological fragments employed to discover or analyze the business process

2.4.1. **Process Discovery**

Process discovery aims to elicit the business process components and construct the model which will facilitate the visualization of the process flow for process analysis and redesign. A general meta-model of the business process components to be elicited during an improvement initiative is shown in Fig. 20. The business process model is characterized by [4]:

- the events or conditions that trigger the execution of a process instance
- the activities performed during this process
- the decision points encountered in the process flow
- the objects manipulated during the performed activities
- the actors involved in the process, part of which is also the customer
- the outcomes delivered to the customer from the process

This list of the components used to model a business process differs from one method to another. Each proposition in business process management adapts and enriches this meta-model to elicit its own set of components. Today, the state of art is composed of several processes modeling methodological fragments which we are categorizing based on the followed approach into participative or evidence-based.

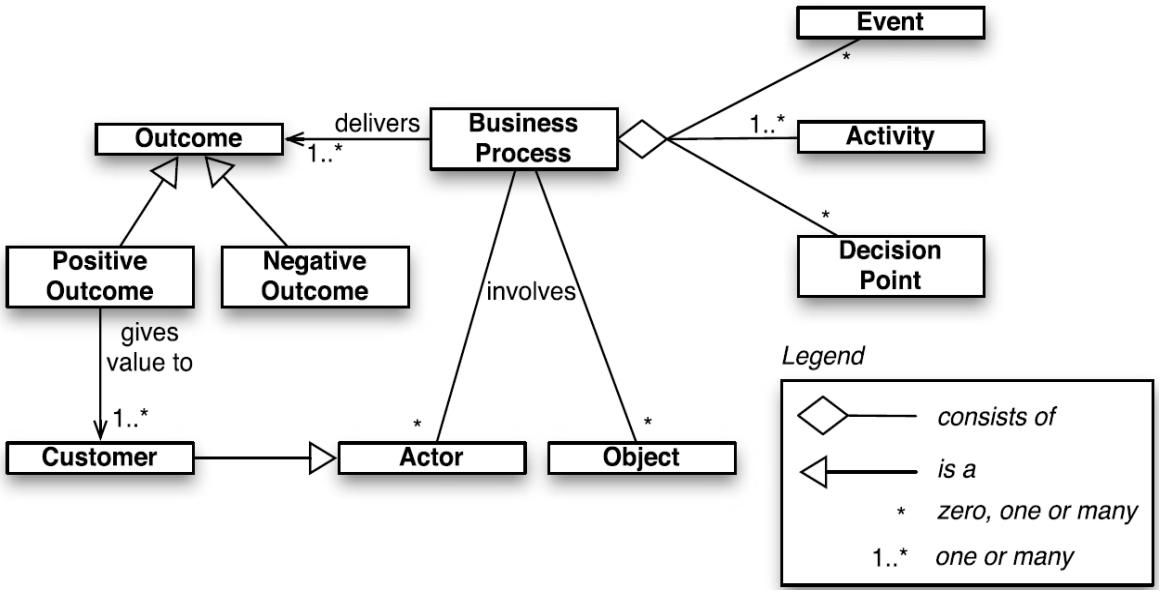

Fig. 20: This meta-model of the business process components.

2.4.1.1. **Participative Process Discovery**

The participative process discovery approach groups within it all those methodological fragments where the business process modeling relies on participants' involvement. Their contribution is incited following different tools.

In the CoDesing overview[8], the process modeling workshop is structuring using a methodological fragment guiding participants to describe their intervention using tangible objects. Whereas ISEA uses serious game techniques to model the business process where each participant describes his intervention using the post-it concept. This methodological fragment is supported by ISEasy[10] tool facilitation participants intervention. Both methodological fragments are illustrated in Fig. 21.

Some other participative fragments proposed for business process modeling are include the usage of 3D or virtual gaming.

[10] http://isea-test.methodforchange.com/

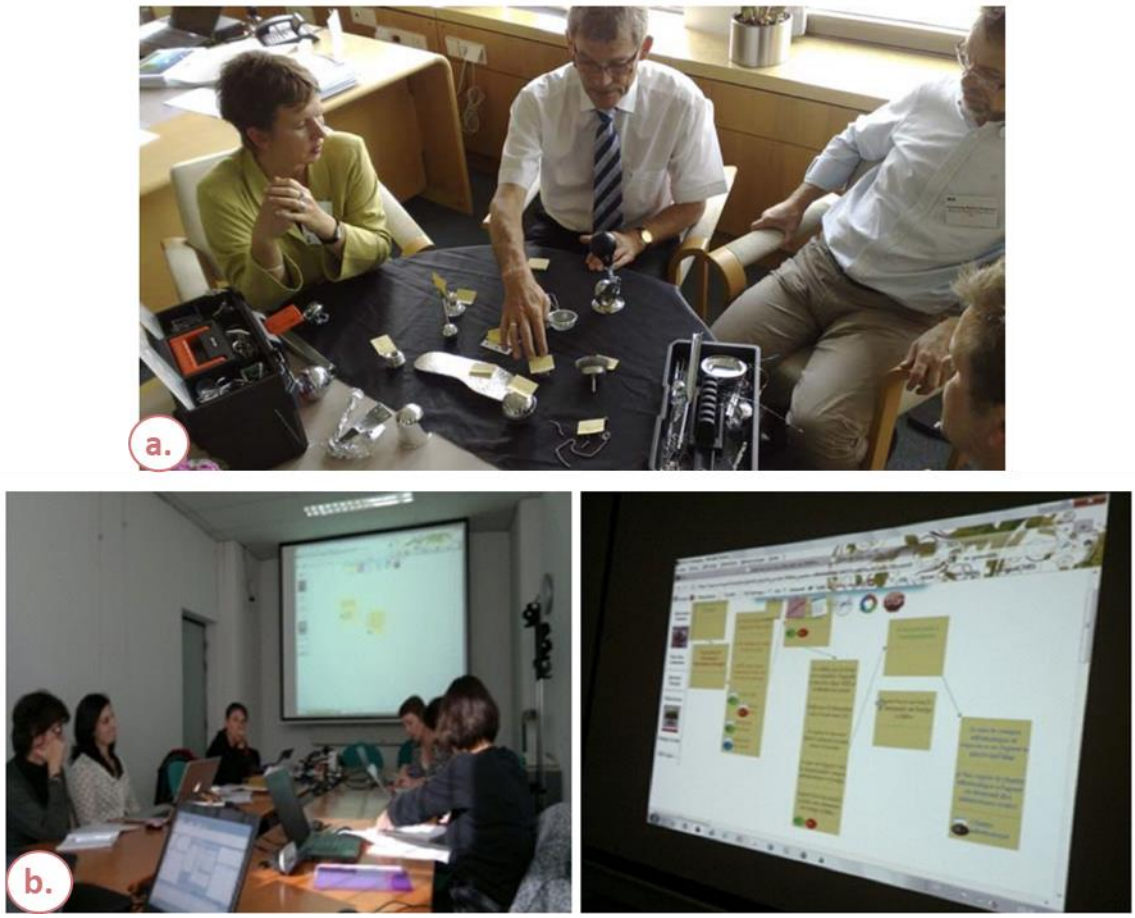

Fig. 21. Process modeling workshops using a) Isea and b)tangible methodological fragments.

2.4.1.2. Evidence-based Process Discovery

Process mining and document analysis are the two main business process modeling fragments proposed in the evidence-based approaches. This approach group all those methodological fragments where the process is modeled upon evidence left during process execution. The document analysis approach, is one of the earliest techniques proposes to examine process-related documents. Some of the main tools supporting this fragment are documents reviewing instruments used by Lean Six Sigma experts.

While the process mining discipline, introduced in the early 2000s, proposes to mine traces left from previous process execution to automatically discover the process model. PM² uses this methodological fragment to discover the model of the business process. The methods delegate the choice of the most convenient algorithm and supporting tool to the process analyst. Today, this discipline proposes a vaster range of algorithms and supporting tools, adapted to different event logs complexity or the level of process mining knowledge. Some of the most well-known tools for process mining

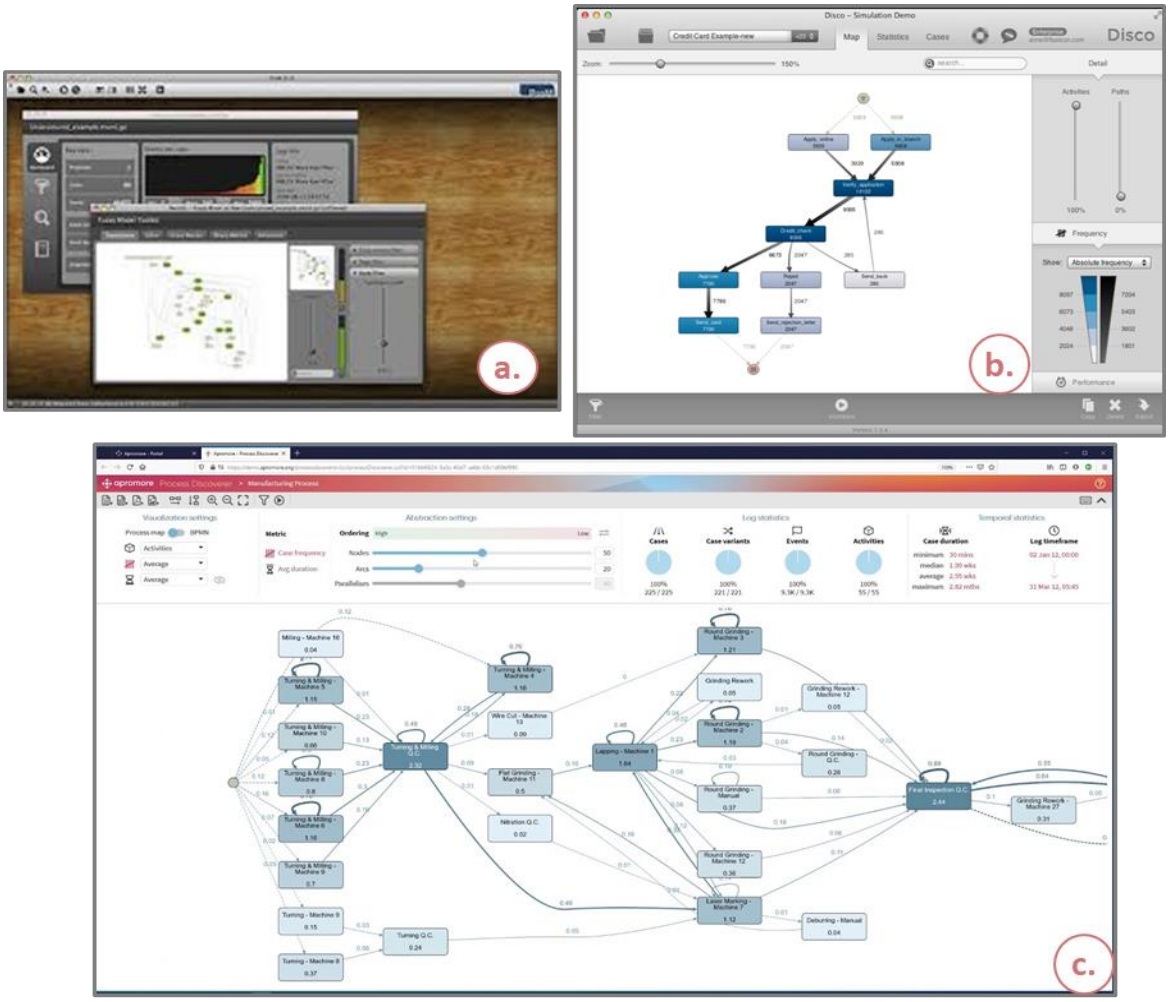

Fig. 22: Three process mining tools: a) Pro-M, b) Disco and c) Apromore

are Pro-M[11], DISCO[12], Apromore[13], Fig. 22. The first one is an open-source framework that collects all algorithms proposed in the process mining community. Whereas the other two tools are more oriented toward business analysts and have more user-friendly interfaces and process measures assessment.

2.4.2. **Process Analysis**

The second strep in the business process improvement cycle, Fig. 14, is process analysis. The scope in this step is to measure the process performance and detect the blocking points and their root causes. These artifacts can be derived following either a participative or an evidence-based approach.

[11] https://www.promtools.org/
[12] https://fluxicon.com/
[13] https://apromore.org/

2.4.2.1. **Participative Process Analysis**

The participative category groups all methodological fragments following a more creative approach, relying principally on participative techniques to analyze the process performance. Some examples of the methodological fragment proposed under this approach are a) *Stakeholders Issues*[14]- identify process stakeholder and incites them to formalize the performance issues they encounter and mind map their concerns*;* *b)5 Why-s r*oot cause analysis to identify the root of a performance issue or *Fishbone* to construct *a* cause and effects *diagram* permitting to the elicitation of a solution. All these methodological fragments are part of the lean philosophy and detailed and supported in Lean Six Sigma. Fig. 23 illustrates some examples of these methodological fragments' usages.

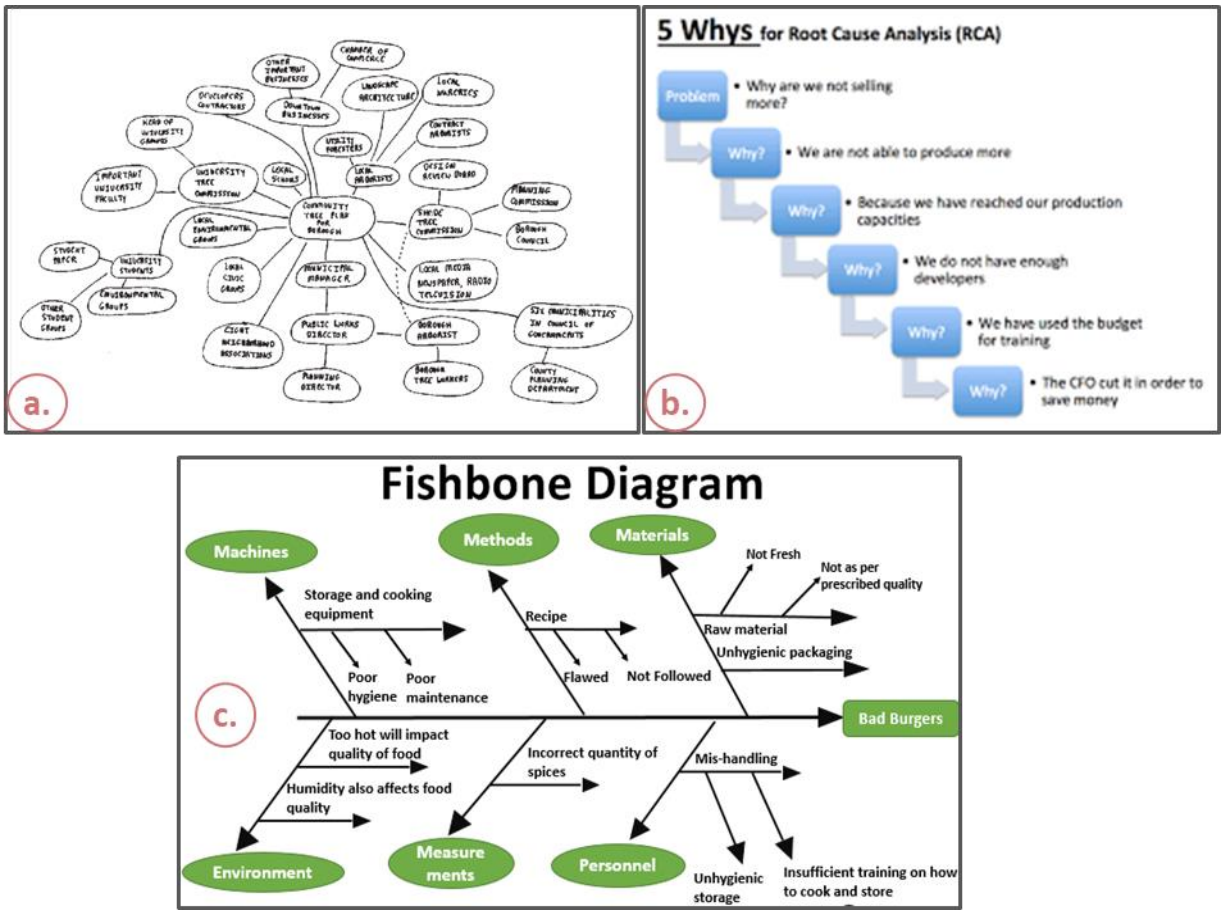

Fig. 23: Participative process analysis using a) Stakeholder Issue mapping, b) 5 Why-s and c) Fishbone diagram methodological fragments.

[14] https://www.mindtools.com/pages/article/newPPM_07.htm

2.4.2.2. Evidence-based Process Analysis

The first group, composed of fragments following an analytical approach, proposes methodological fragments as can be Pareto Analysis, Simulation, Queues, and bottleneck, etc. All these methodological fragments, proposed in Lean Six Sigma, generate their results upon evidence left during business process execution and use mathematical computation to analyze the workflow and identify congestion, waiting, loops, and/or delays. This analysis approach is today integrated also in process mining tools, which automatically compute process measures upon event log files. PM² integrates this methodological fragment and analyzes the business process using a replay algorithm[10] integrated into all three process mining tools presented above. Simulation is another methodological fragment proposed in PM² to artificially execute a process and generated traces to be analyzed to predict future process performance. Fig. 22 illustrates the time-consumption computed for each process activity where the most time-consuming ones are represented using a darker color. A more detailed guide of all process measuring proposed in process mining tools is found in [47]

2.4.3. BPM Methodological Fragment Overview

We can group the above discussed methodological fragments on the approach they follow and the improvement step in which they are used as shown in Fig. 24

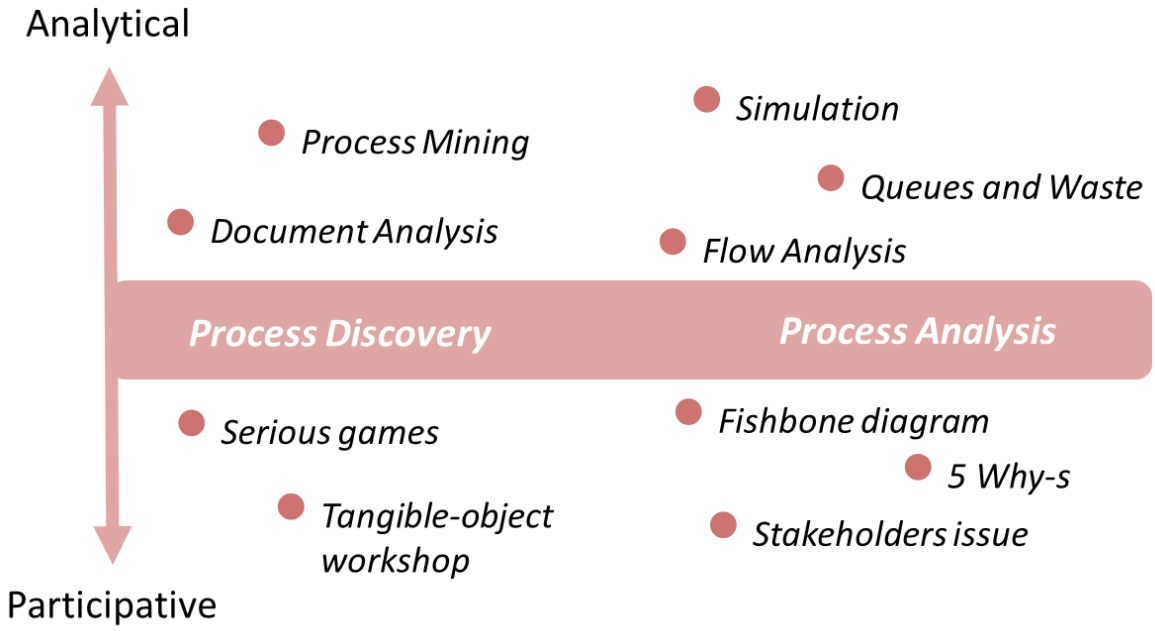

Fig. 24: Analytical and Participative techniques in continuous improvement.

Some of these methodological fragments are also reused during process redesigning steps, as for example, ISEA uses Serious game methodological fragment to construct the AS-IF business process by imagining how the process will have if a change is deployed and PM² reuses simulation fragment to artificially execute the AS-IF process and assess the impact of the change in the process performance.

2.5. Synthesis and Conclusion

This part of the manuscript overviews the existing state of the art, starting by reviewing some well-known methods covering continual evolution and then going over business process management methods, focusing on those covering business process improvement. We are focusing on the Plan step, on how to well structure it to have solid artifacts and a base upon which to change a system (deploy the Do- Check-Act steps of the Deming cycle).

Even though the scope of the evolution differs over the methods of continuous improvement and innovation, the following similarities are identified:

1. **They share similar intentions to attain.**

Both improvement and innovation cycles aim to characterize the current state of the system to be evolved (As-IS), imagine the changes to deploy (As-IF), implement the changes and obtain so a new version for the system. Lean starts with characterizing the current flow in the manufacturing environment, ADInnov the socio-technical ecosystem around a fragile person, and a BPM method a business process in a given context.

Then they proceed by trying to imagine the change to be deployed to evolve the system, either to improve the performance of the business process (Lean Six Sigma) or innovate it (Design Thinking). For this, several evolution scenarios are prototyped Design Thinking or simulated in Lean Six Sigma or PM², out of which the To-Be system is chosen for deployment.

2. **They manipulate similar concepts**

The main artifacts handled by each of these methods, as shown in Fig. 25, are:

The System Components: All elements used to model the system in the target of the evolution, where the system can refer to a manufacturing chain, business process, ecosystem, etc. For example, *some of the components of the ecosystem in ADInnov are*

the functions and the actors dressing them, as well as in ISEA the business process is composed of tasks and information systems.

The Blocking Points: The diagnosed issues in the system that need to be resolved and trigger the need to evolve the system. A blocking point can be *a not-achieved process performance measure in Lean Six Sigma or wastage, or bottleneck detected in the manufacturing chain by Lean.*

The Measures: The means used to assess the state of the system which can be quantitative, assess or value an aspect of the system, or qualitative describing a quality of the system (*satisfying, utility, the fulfillment of client's need, etc.).*

The Goals and constraints: The expectations to be fulfilled or desired behavior from the evolved system.

The *Changes*: The solutions proposed to resolve the identified blocking points and attain the fixed goals and constraints. A change describes how the current system is altered to obtain an improved or innovated new version for this system.

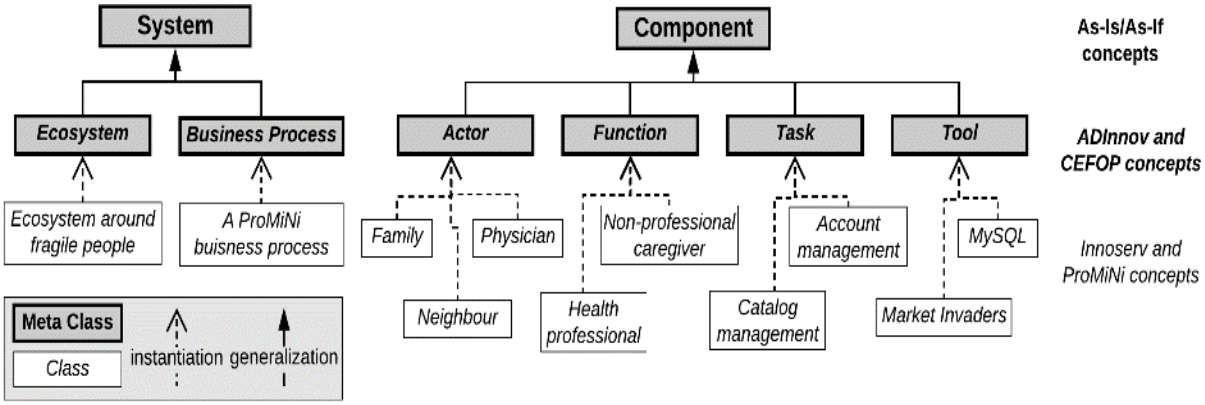

Fig. 25: The components to be elicited when planning continual evolution.

We are formalizing these similarities between continual evolution methods into the As-IS/As-IF framework, to provide a guideline for method engineers when constructing a continual evolution method for a specific system and context.

Chapter 3. Methodological Fragments Usage

3.1. Introduction

The previous chapter went over some business process improvement method and illustrated some methodological fragments used by them during different steps. In this chapter we are illustrating the usage of existing analytical and evidence-based methodological fragments to discover and analyze the ISD process, which implies model this process and assess its performance. We are using both these approaches and comparing them on the workshop complexity and the quality of the obtained artifacts.

Workshop complexity reviews all the difficulties encountered during the proceeding. One of the main intentions in our work is to minimize external intervention and increases process participant empowerment. So, both process modelling and process measures development workshops should not be complex- non-accessible to participants or demanding additional competencies and knowledge. These sessions should incite and motivate the actor's involvement.

Concerning, the quality of the artifacts, we are evaluating them on two criteria:

Comprehensiveness: The obtained artifact should be comprehensive for all involved parties in the improvement initiative, increasing so their empowerment. In our case, the model of the process and the process measures derived out of the workshops should be easily readable and understandable for all involved stakeholders; the process owner and participants, and allow them to understand all intervention in the process flow (process model) and process performance on different operational levels (process measures). This will facilitate the empowerment of the process participants and the handling of these artifacts to analyze the process or imagine possible evolution scenarios.

Completeness and Objectivity: Both artifacts should provide a complete and objective description for the process execution and its current performance, without being impacted by process participants' involvement or inattentions. The process model must reflect its real behavior including deviations or shortcuts participants take during the process execution. As well, the performance measures must cover all concerns existing in the process, no matter if they are raised by the process owners or participants and assess the real performance of the process not just the perception of involved participants.

The following sections detail the organized workshops and the outcomes obtained from each of them.

3.2. ISD Process Discovery

Process discovery step aims to identify the business process components and construct its model, to this intent, we are using the methodological fragments presented in ISEA and PM² to model the Initial Service Providing (ISD) process. These fragments represent respectively the participative and the evidence-based approach.

We choose these fragments among the others since both methods provide a detailed protocol to structure the process model proceeding and they are both supported by open source tools: ISEA fragment is supported by ISEAsy[15] to facilitate the process participants involvement and for the process mining work session, a lot of tools exist and we chose to use DISCO.

3.2.1. ISEA: Participative Process Modelling

The method ISEA organizes a participative workshop for business process modeling. This session is supported by ISEAsy, an online tool that facilitates the process of participants' intervention and provides also the possibility to automatically translate the models into formal modeling languages (BPMN[16], YAWL[17], etc.). The latter will enable the usage of the model for analysis simulation or change impact evaluation. ISEA gathers all the roles participating in the process execution, each represented by an actor, and the method facilitator, who is charged to configure the working space and assist them during the modeling session.

The modeling starts with the first role, the ones whose intervention is triggered by the process input. In the case of the ISD process, it is the vendor who triggers the process execution by filling and submitting a form to request the subscription to the SaaS solution proposed by the company. The actor playing this role is guided to describe the actions he performs and place the first yellow post-it, Fig. 26. Once he finishes describing this intervention, he passes the hand to the client manager who must proceed with the description of the process flow. Besides describing their intervention, ISEA requests actors to state also the documents used and transferred during these activities. When modeling the ISD process, we asked the actors to describe the information systems that they are using during their intervention instead of the

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[15] http://isea-test.methodforchange.com/
[16] http://www.bpmn.org/
[17] https://yawlfoundation.github.io/

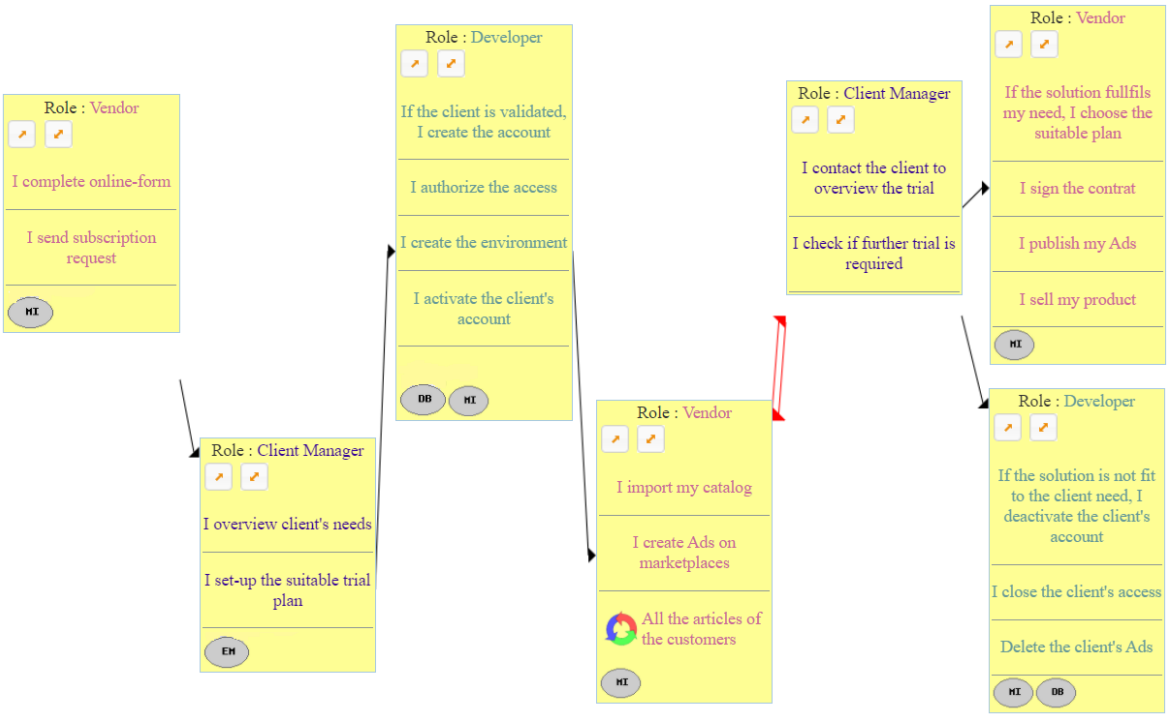


Fig. 26: The Initial Service Delivery process modeled using the ISEA method.

■ *Customer* ■ *Client Manager* ■ *Developer*

documents. For example, the vendor states that he uses Market Invader (MI) to fill and send the form.

After the first intervention of the vendor, it is up to the client manager to describe his intervention and pass the hand to the developer who will configure the vendor testing environment. The developer during his intervention beside Market Invaders (MI) information system, also uses a database management system (DB). Once the testing environment is created, the vendor is given the possibility to import his catalog and create his Ads. This activity is recurrent, up to the moment that the client manager intervenes to gather the need of the vendor and decide to either let the vendor pursuit with the testing of the solution, subscribe to the solution, or reject it.

Our intervention in the ISEA modeling workshop resumes as taking the role of the workshop facilitator, which requires no preliminary process knowledge or domain expertise

3.2.2. **PM²: Process Mining for Process Discovery**

Besides modeling the ISD process using a participative workshop, we decided also to generate a model for this process using the analytical approach proposed in PM². The methodological fragment proposed by this method relies on the usage of process mining

tools, which automatically discover the model of the process based upon traces of leftover process execution in time. In contrast to the ISEA process modeling workshop, where we only intervened as method facilitators, our assistance was more necessary when using the process mining methodological fragment.

Three out six steps proposed in PM², were followed to construct the model of the process: 1) Extraction of the traces from the information system supporting the process, 2) Data Processing to obtain the event log file to be feed to the process mining tools and 3) Mining to automatically discover the business process model. The most time and effort consuming tasks in this modeling session were the two first steps.

The ISD process as elicited during the ISEA participative modeling is supported by three systems; Market Invaders (MI), a database management system (DB), and an electronic mail management system (eM). We were able to extract traces of process execution from MI and some email exchanges from eM. MI is not a process-aware information system (PAIS), so it is not oriented toward storing evidence of process execution or tracing of user activity. To obtain the process execution traces, we explored MI databases, identify the sources of information, and to construct an ETL structure for the data extraction.

A fragment of the event logs file[48] obtained from the extraction is illustrated in Table 2, where information is anonymized. The process instance identifier, as referred to in process mining as the case id, is the vendor code that is mapped to the account in the system and the vendor database instance.

Each row in the event log refers to a trace extracted from the system where activity defines the action performed by the User on a given moment in time, marked by the timestamp.

The second issue that emerged during this modeling session is traces granularity. As stated in[10], real-life processes generate complex event logs, containing a large number of events on a very fine-grained state and multiple paths. The process model mined out of the log file extracted in the previous step is shown in Fig. 27. This tool provides a user-friendly interface that can be easily managed without requiring a lot of process mining knowledge. However, the automatically discovered model lack comprehension due to many actions and discovered paths.

Table 2: An event logs fragment of a process

Case ID	Timestamp	Activity	User

98	19/07/2016 12:08	Request Inscription	V98
98	19/07/2016 16:37	Send meeting Invitation	CM 1
98	22/07/2016 17:31	Create Customer Account on SaaS	D1
98	22/07/2016 17:33	Authorize Access	D1
98	22/07/2016 18:10	Activate Customer Account	D1
98	22/07/2016 18:28	Create Customer DB	D1
98	…..	…….	D2
98	25/07/2016 14:51	Create Product	V98
98	25/07/2016 15:03	Create Article	V98
98	25/07/2016 15:03	Add Article Photo	V98
98	….	……	V98
98	28/07/2016 12:01	Import Product Catalog	V98
98	28/07/2016 16:58	Create Articles	V98
98	….	……	V98
98	06/08/2016 00:22	Create MarketPlace1 Account	D1
98	19/09/2016 18:19	Create Ads	V98
98	…	…..	V98
98	20/08/2016 15:34	End Testing	CM 1
98	05/09/2016 11:19	Generate invoice	CM 2
98	05/09/2016 11:19	Send invoice	CM 2

DISCO uses the fuzzy miner algorithm which is one of the quickest but less solid algorithms to deal with noise. We tried to obtain a less complex model by using other mining algorithms that were available in Pro-M but without success. Even these algorithms couldn't generate a comprehensive model for process stakeholders.

The solution proposed today to deal with the complexity and traces granularity is the usage of supervised and unsupervised learning techniques which will create a level of abstraction in the traces to simplify the discovered model[49][50][51]. However, all these propositions request the intervention of a person having process knowledge to either construct the training data set, supervise mining, or validate the proposed clustering for the unsupervised mining techniques. Due to limited time and the possibility for intervention, we didn't proceed further in this modeling session.

In the case of the evidence-based ISD process modeling, business expertise was also required in the extraction phase to better detect the data related to the process.

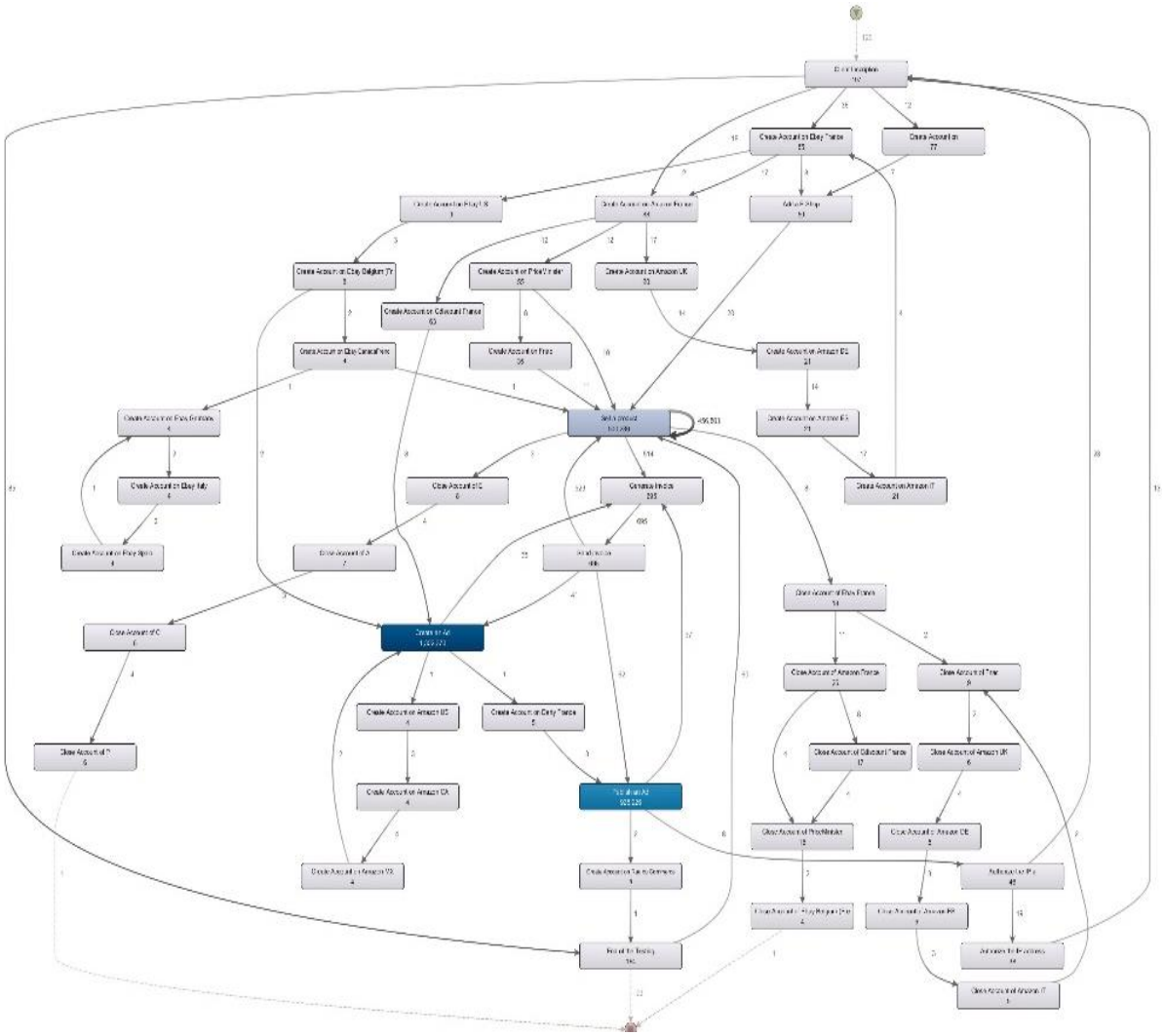


Fig. 27: The ISD process modelled using Process Mining.

3.2.3. **Process Modelling Sessions Outcomes and Discussion**

In the above sections, we undertook two process modeling sections, a participative workshop-based (ISEA) and evidence-based (PM²) modeling, aiming to identify a suitable methodological fragment to model a business process most autonomously and objectively. Table 3: The overview of the two business process modeling sessions. summarizes the encountered difficulties in the usage of these fragments and reviews the quality of the model derived out of each section.

The participative workshop-based session was rapid and productive. The proposed protocol facilitates process participant involvement and doesn't request external expertise.

The main difficulty encountered during this session is to group all process participants at the same time and in the same room to avoid the absence of a role or his replacement which can impact the model quality.

In contrast, the evidence-based modeling session was more complicated. The participation of an external process analyst is necessary to build the event logs file and that of the business expert to process and rework the process traces when it comes to data processing. Apart from processing, data extraction is time-consuming in absence of a Process-Aware Information System (PAIS) and several iterations must be taken to obtain a solid set of traces.

The analytic model, derived from process mining, is very complex, difficult to read and understand, compared to the ISEA model, due to the low level of granularity of the traces found in the logs.

Table 3: The overview of the two business process modeling sessions.

	Section Outcome		Session proceeding
	Comprehensive	**Complete & Objective**	
Workshop-based Modelling **ISEA**	*Yes*	*No*	*Difficult to group process participants in a workshop session*
Evidence-based Modelling **PM²**	*No*	*Yes*	*Several iterations to prepare the event log file* *Process and business knowledge are required*

This issue complicates its usage for process analysis or process redesign. On the other hand, the participative model is quite **comprehensive** and can be easily used by process participants in the upcoming steps.

The last criteria, we were looking for during these modeling sections was objectivity, obtaining a model that describes what is going on during process execution. While overviewing the automatically discovered model, we detected some paths that were not described in the ISEA model. For example, *vendors do Create Ads and Sell articles without subscribing to the solution*, which is a deviation that didn't emerge in the described model. During these work sessions, we noticed that participants tend to either describe the happy path or the general path, i.e. how the process is expected to execute, whereas occasional deviations are hardly reflected.

To conclude, a process model provides the base for process analysis and redesigning so it must be **comprehensive, objective,** and **complete**, which is not the case for none of the above models.

3.3. Process Analysis

Once the process is modeled, improvement pursuits with the process analysis. The goal in this phase is to identify the main issues existing in the process and their root causes. Like the approach followed for the process modeling, we have performed an analytic analysis, following a quantitative approach, and a participative analysis, following a qualitative approach.

An issue in the business process is a blocking point that exists in the current state of the business process (As-IS) that obstructs the achievement of a business objective. Each objective is further translated into tactical objectives, also referred to as short-term goals achieved once the blocking point is resolved. In business management, a well-known guide for structuring short-terms goals is SMART[52], which states that each business goal must be:

- Specific- clearly stating the area to be improved.
- Measurable- its achievement or progression can be quantified.
- Assignable- associated with a stakeholder or a business unit who is responsible and in charge of monitoring its achievement.
- Realistic- aimed to achieve realistic results given the available resources.
- Time-bound to a time-lapse within which the goal must be achieved.

To elicit the blocking point existing in the ISD process, we performed two analysis sessions, the stakeholder's issue analysis combined with the 5 Whys root-cause fragment and flow analysis.

3.3.1. Stakeholders Issue Analysis – Participative Process Analysis

The stakeholder's issue analysis gathers the perception of involved parties in the business process. The stakeholders are interviewed and incited to express the issues that they encounter during their intervention. We have interviewed the process owner and the process participants; client manager, developer, and customer following a top-down approach to collect these issues. So, the process owner starts by stating a first blocking point existing in the process they face, *"The SaaS trial takes too much time"*, Table 4. This issue was also validated by the process participants while gathering their

perception. To identify the root-causes of this blocking point, we used the 5 Whys to construct the tree diagram shown in

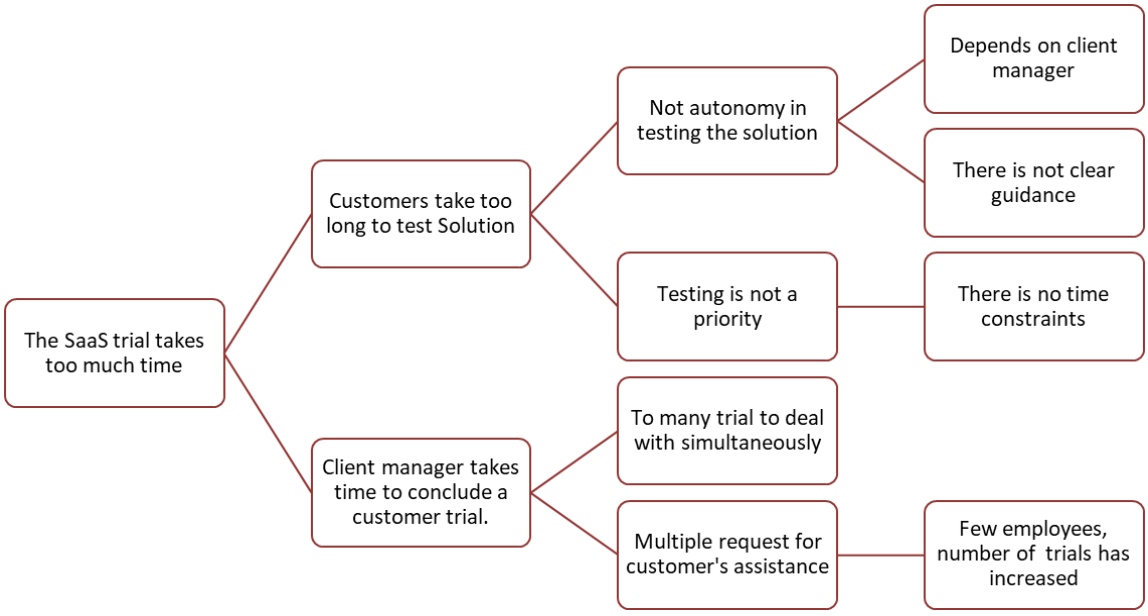


Fig. 28.

The causes elicited during this session were the lack of staff compared to the increased number of vendors requesting to test the solution and the lack of automatic constraints triggering the ending of the testing period. These two causes will then be translated into changes in the process that can be implemented to resolve the time requested by the vendor to complete the trial.

Table 4: Example of an issue of ISD process registered when using the stakeholder's analysis.

Registered Issues
Issue 1: The SaaS trial takes too much time. **Description:** Customer takes a too long period to test the solution before starting to use the service. This period exceeds the 1-month trial period provided in general. **Data and Assumption:** Customers using the service are not charged. This causes the loss of potential incomes coming from the subscriptions. Additionally, with time, customers start lacking the motivation to discover and use the solution, which causes their rejection of the service.

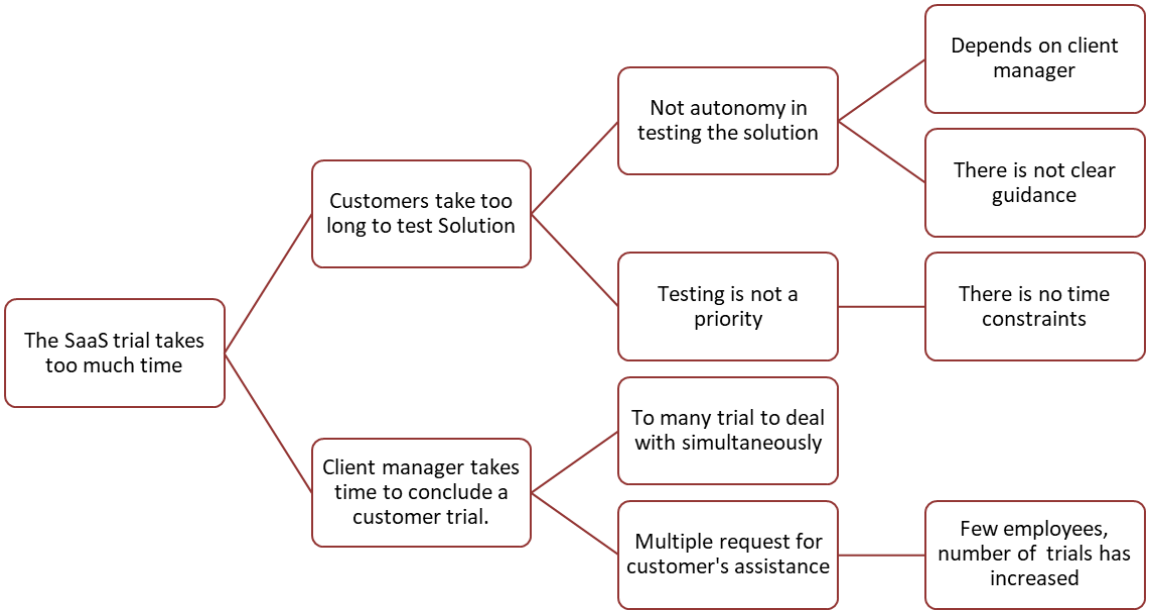


Fig. 28: The 5 Whys tree diagram constructed for the ISD process.

3.3.2. **Flow Analysis- Analytical Process Analysis**

Beside the qualitative analysis, we performed an additional process analysis experience using a quantitative analysis approach, the flow analysis. This methodological fragment proposes to assess the performance of the process, by computing different process measures. In this ISD work session, we started process performance measuring with the measure computed automatically by Disco tool and additionally implemented a business intelligence solution, Appendix I, to complete the process analysis with more business measures computed over the information present in the event logs file extracted during the analytic process modeling session, 0.

Fig. 29 illustrates the average cycle time measure, assessed for the complete ISD process execution and for three principal blocks of activities. The choice of the process measures to be computed was made by the process owner in accordance with the stakeholder issue analysis and further refined in order to identify the most time-consuming steps.

The average cycle time to complete the trial of the SaaS solution taken by the vendor is 52 days out of which 40 are spent to test the solution. This time extends the expectation of the process owner, who targets a no more than one-month trial period

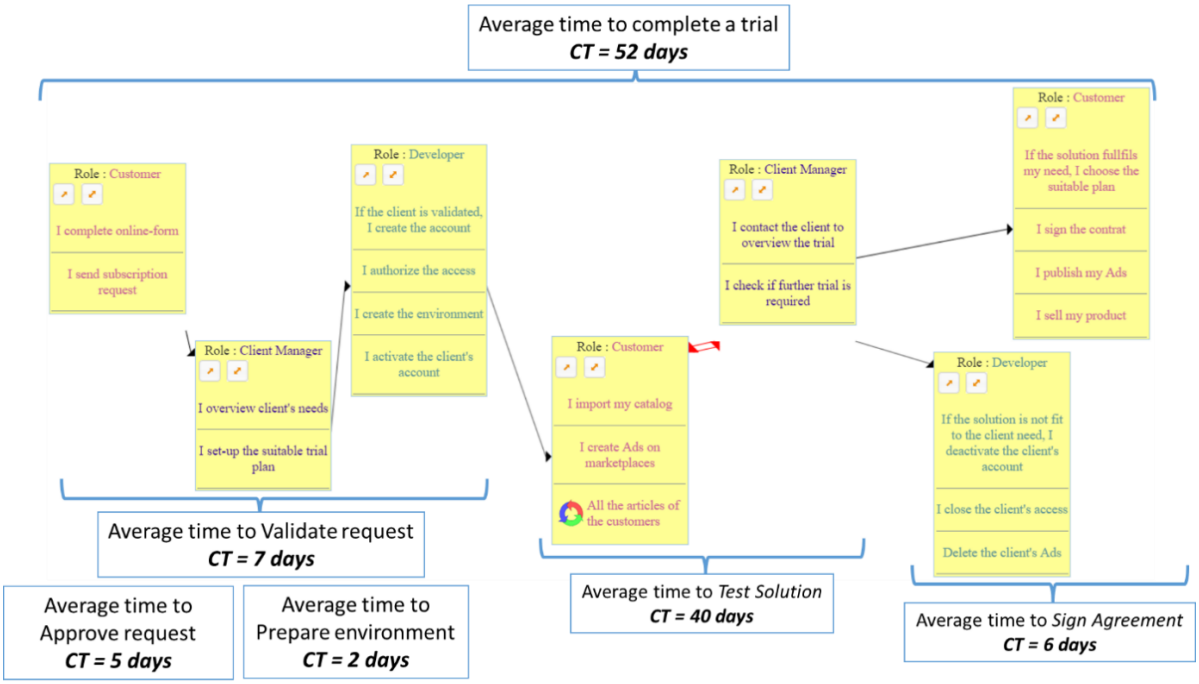


Fig. 29: The average cycle time computed for complete process execution and each of its blocks.

per vendor. To this intent the second block in the process flow must be reviewed in order to reduce the time taken to complete this part.

This objective is translated into two SMART goals that the process owner is targeting to resolve through business process improvement: *"Reduce the number of days to subscribe to the solution to less than 45 days"* and *"Reduce the number of days to test the solution to no more than 30 days"*.

3.3.3. **Process Analysis Sessions Outcomes and Discussion**

When comparing the results obtained by both process analysis sessions, the quantitative process flow analysis and the qualitative stakeholder issue analysis, we noticed that the blocking point, time consumption, is elicited in both working sessions and the need to find a solution to *lower the time taken to trial the solution* is an issue clearly needing an improvement intervention.

However, the analytical approach states clearer and more objective goals to be attained from improvement and a more objective target to be attained whereas in the stakeholder issues analysis, elicitation is related to the point of view of the stakeholder which make it subjective to the participants experience.

Another drawback in both these approaches is that both workshops followed a top-down approach, where the problems are always initially stated by the process owner and then refined or analysed by the process participants.

Table 5: The overview of the two business process analysis sessions.

	Section Outcome		Session proceeding
	Comprehensive	**Complete & Objective**	
Participative Process Analysis **Stakeholder Issue Analysis**	*Yes*	*No*	*Difficult to collect process participants feedbacks*
Analytical Process Analysis **Flow Analysis**	*Yes*	*Yes*	*Work facilitated thanks to the existence of the event log file.*

3.4. Synthesis and Conclusion

This second chapter of state of art focused on the usage of existing methodological fragments covering business process improvement. The scope of this review was to explore approaches and tools aimed to enhance employee's involvement and assure their objective participation. To this intent, we performed four working sessions; two sessions to model a real-life business process and two sessions to analyze its performance. Different approaches were followed for both steps: a participative approach where employees were involved in the artefact's generation, and analytical ones, where the artefact was derived from traces left during business process execution. As overviewed in Table 3 and Table 5:

1. The process model and the blocking points derived from participative methodological fragments are more comprehensive since participants are involved in their elicitation and formalization whereas the analytical methodological fragment can generate more complex and effort demanding models.

2. On the other hand, the result perceived during flow analysis or process mining work sessions are more objective and don't impact the subjective point of view of the involved employees. These methodological fragments allow to identify deviations in the business process model or better target the cause of the blocking points through process measure refinement on the traces level.

To deal with the drawbacks of each of these approaches and benefit from their strong points, CEFOP proposes to combine both approaches and consolidates their outputs into comprehensive, complete and objective artefacts to be exploited for business process improvement.

Part II - Contribution

This part of the manuscript details the two scientific propositions: 1) CEFOP, a method guiding the continual evolution of business processes within the organization, and 2) As-IS/As-IF, a framework guiding method engineers in the construction of continual evolution methods.

We start this part by first introducing the CEFOP approach and tools to support the process model and performance assessment consolidation. This method guides process participants in improving their business processes and is equipped with methodological fragments supporting their complete empowerment and being the backbone of the improvement. Chapter 4 describes how CEFOP combines the existing participative and analytic methodological fragments detailed in the previous chapter, and collectively consolidated these artifacts, illustrating these steps over the ISD process.

Chapter 5 focuses on CEFOP formalism, detailing the product meta-model that formalizes all the artifacts generated from the method and manipulated when planning business process improvement and the process model describing all the strategies and approaches to follow for generating the method artifacts.

The last chapter focuses on the As-IS/As-IF contribution, a framework proposed to method engineers to facilitate the construction of continual evolution methods. This contribution provides an initial structure of the process model and product meta-model that must be further adapted when constructing the target method. A set of adaptation heuristics completes this framework to facilitate its adaptation. The product meta-model and process model presented for CEFOP are second versions derived from the adaptation of this framework. This adaptation and that of ADInnov are illustrated during the presentation of the framework.

To facilitate the reading, we are using the following rule: the generalized concepts (meta-concepts) in the As-IS/As-IF framework are in **Bold**, the terms concerning the continual evolution method, including CEFOP and ADInnov are in ***bold italic***, and examples are in *italic font*.

Chapter 4.

CEFOP Approach and Instrumentalization

4.1. Introduction

The main scope in CEFOP is to construct a method that guides the continual evolution of the business process within small and medium enterprises. This evolution should rely on internal organization resources and mainly on the engagement of its actors in the transformation. Employee empowerment is critical to facilitate and succeed in the transformation of business processes. This element will permit companies to reduce the cost of external interventions and increase the change acceptance.

The state of art, as overviewed in the previous chapters, proposes several participative methods to increase the involvement of process stakeholders in a process transformation. However, this involvement lacks objectivity (section 3.4) since participants tend to describe what is expected to happen instead of what is happening during the process execution. To fill this gap, we introduce CEFOP, a method to guide the continual improvement of business processes following an approach that combines participative and analytic approaches, and consolidates the generated artifacts into more complete, objective, and comprehensive products. This proposition:

- incite the process participants' empowerment in the continual improvement. Participative methodological fragments facilitate the participation of the actors in the generation of the artifacts manipulated during the evolution.
- assure an objective generation of the business process improvement artifacts. Analytic and evidence-based methodological fragments increase the confidence and assurance in decision making.

In addition to using existing methodological fragments, CEFOP encloses in its approach a consolidation step that 1) merges the artifacts perceived from the evidence-based and participative fragments into unique artifacts for continual improvement and 2) facilitates the collective decision making by allowing:

- Process participants to realize the gap between their perception, what they describe during participative workshops, and reality, what is obtained through process execution traces analysis.
- The confrontation of different points of view and interest existing within the organization. Business process improvement impacts the strategical and operational level of the organization, from the positioning of the organization in the market to the working activity of a process participant.

The empowerment of these actors in the change process allows them to express their point of view and collectively agree on the most convenient scenario for evolution.

- The representation of a more reality conformed scenario for improvement. The artifacts used to construct the improvement scenario are objective, inducing in the detection of the best way to change the business process and having a better view of the change impact in the future. This element provides a clear view of what is to be expected once the change is deployed and motivates participants in change acceptance.

This chapter introduces the steps CEFOP proposes to model the business process and assesses its performance. We are illustrating the results obtained out of these consolidation working sessions when planning the improvement of the ISD process.

4.2. Business Process Modelling in CEFOP

Business process modeling is performed once the process to be improved or innovated is identified in the organization. CEFOP separates process identification from process modeling by considering it as an intervention initialization subprocess, Fig. 30. This initialization outlines the business process, delimitating so the area on which to focus the improvement and elicits the blocking points reported from the process owner. We have structured process identification as a simple interview to the process owner, who is brought to list:

1. process input(s) and output(s) delimiting so the scope intervention.
2. process participants (roles) involved in the process
3. information system(s) supporting its execution
4. blocking point(s) and business goal(s) triggering the improvement need

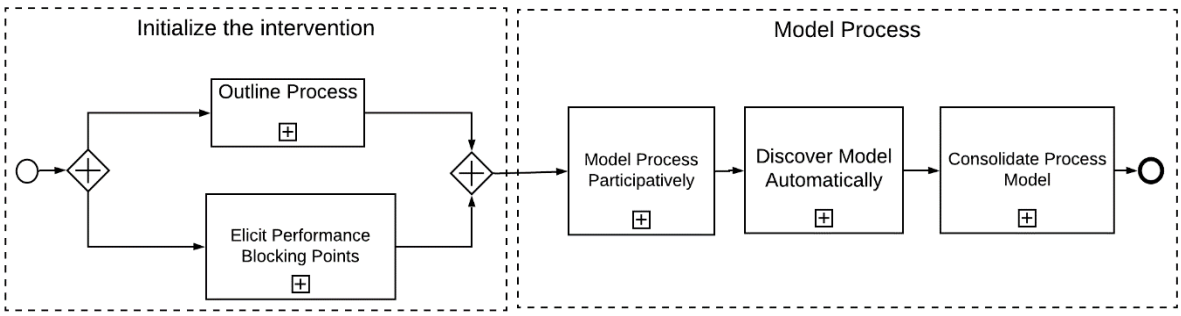


Fig. 30: The BPMN model describing CEFOP tasks to model a business process.

An example of structuring this interview is provided in Appendix II. However, CEFOP gives the liberty to the method facilitator to reorganize this session, since both the process outlining and elicited blocking points are reviewed, validated, and enriched during process model or performance assessment consolidation.

Process modeling is structured in three steps in CEFOP, where the two first Model Process Participatively and Discover Model Automatically, are based upon existing participative and analytical methodological fragments. These approaches are combined in CEFOP and their artifacts are consolidated in the third step, Consolidate Model. Table 6 describes these three steps, where:

Step 1, structured as a participative process modeling workshop, guides participants to describe their interventions and model the process based on their working experience.

Step 2 follows an analytic approach to model the process. Process mining is used to automatically discover the model upon traces left during process execution. It is structured as individual tasks to be performed either by the system or database administrators and assisted by a method facilitator having minimal process mining knowledge.

Step 3 consolidates the artifacts of the two previous steps into a complete, objective, and comprehensive business process model. This step is organized as a collective workshop where the process owner and participants exchange and validate the set of components used to model the business process.

Table 6: CEFOP three-step protocol to model the business process.

Step Description	Organization and Participants
Step 1: Participative Process Modelling	Workshop
Process participants describe their intervention in the process in ISEAsy. The protocol proposed by ISEA methodological fragment guides them in taking turns and describing their tasks and the supporting information systems. We have detailed this protocol in section 3.2.1**.**	Process Participants
Step 2: Analytic Process Modelling	Individual
The model of the process is automatically discovered following the steps proposed in PM² methodological fragment, section 0. The principal activities of the system or database administrator are:	System or Database Administrator

1. Data extraction and processing: identify the data source and set up an ETL structure to obtain the event logs file. 2. Process discovery: automatically generate the model of the process from these traces. Both these interventions request process mining expertise thus the need for a process mining expert.	Process Mining Expert
Step 3: Model Consolidation	Collective Workshop
The consolidation of the model is a workshop where process participants and owner are guided to collectively: **Consolidate the performed tasks and actions in the process:** Associate the tasks described during the participative workshops with the actions traced in the event logs files obtained in the analytic approach. **Consolidate Process Model** The previous consolidation constructs a bridge permitting to travel between the described and the automatically discovered models. This bridge allows to compare their paths and detect deviations or shortcuts, constructing so a more objective description of what happens during process execution.	Process Owner and Participants

4.2.1. **CEFOP Model Consolidation Protocol**

In contrast to participative and analytical process modeling, the model consolidation fragment is a new approach that we are introducing. To guide this step, CEFOP proposes a protocol of four steps, Table 7, which is today supported by the ISEAsy tool. The objective of this 2 hours workshop is to construct a complete, comprehensive, and objective model for the business process. Before introducing this tool-supported protocol, a paper-based model consolidation workshop was proposed and structured to validate our proposition, Appendix II. The concepts used during this process modeling session are:

- ***Role,*** like introduced in ISEA, represents process participants grouped by the function and the nature of their intervention in the process.
- ***Task*** refers to an activity described by a role during the participative modeling workshop. When using the ISEA methodological fragment it relates to a post-it placed in the model.
- ***Action*** corresponds to an activity name in the event logs file extracted in the PM² evidence-based process modeling. This activity is an elementary work unit traced by an information system supporting process execution.

- ***Deviation*** is a path followed during process execution that is present in only one of the models derived either from the participative or analytic approach.

Each step in the model consolidation workshop is assisted by the method facilitator, whose intervention consists of guiding roles and coordinating the collective steps, as well as, handling a complete task during the consolidation. Besides ISEAsy tool, participants are going to use both models derived from the ISEA and PM² methodological fragments.

Table 7: CEFOP four-step protocol for process model consolidation

Step Description	Organization and Participants
Step 1: Preparing the environment	Collective
The process owner and process participants are grouped to reconstruct the process model that they previously described in the participative session. The facilitator and the process participants overview the previously described model and the facilitator creates a task for each post-it, described during the ISEA workshop, and asks the process owner and roles to title this task.	Roles Process Owner Facilitator
Step 2: Linking the Actions	Collective
In the ISEAsy interface, each role is guided to individually: **2.1. Link actions with his role:** If a role or an actor related information is not traced in the event logs, each role must link the actions he performs with his role name. In the case when this information is present in the data set, actions are automatically grouped by role. **2.2. Link actions with described tasks:** Each role must link his actions with the tasks described during the participative process modeling. Roles are given the possibility to duplicate an action in the case when the same action is performed by the same role during two different tasks. Once roles completed actions linking, the facilitator organizes a collective review with the roles and process owner to: **2.3. Review all unlinked actions:** the facilitator, using the PM² model, narrates the execution flow, describing some actions performed before and after the unlinked action, and asks roles to rethink the action link with a role or a task. All actions left unlinked from this step are considered noise and removed from the event logs file.	Roles Process Owner Facilitator
Step 3: Automatic Process Rediscovering	Individual

Once actions are associated with tasks, the facilitator extracts the event log file from ISEAsy and: **3.1. Re-discovers the Process Model:** Using Disco, a new model of the business process is discovered where the activity tag is set on the task name, not the action. **3.2. Discover Models Deviation:** Compares the paths discovered by Disco with those described by process participants. When a gap is detected, the facilitator introduces the path ISEAsy using the deviation annotation, a red dashed arrow.	Facilitator
Step 4: Collectively Improving the Process Model	Collective Workshop
The process owner and involved roles in the workshop are brought to collectively: **4.1. Review Deviations:** For each detected deviation, the path is analyzed to find the root cause of the deviation and decide whether to**:** ▪ Validate the detected path and integrate it into the model, if the path is known and forgotten during the participative workshop. ▪ Review the association actions-task, step 2, to align both models ▪ Clean event logs file: Remove the process instances containing this path in the case when this deviation is exceptional and not to be considered in the following steps. ▪ Enrich the event logs file: A deviation can be caused also by the absence of action in the traces and trigger the need to explore a new possible data source. All non-validated deviations are removed from the consolidated model and their corresponding process instances are cleaned in the data set.	Roles Process Owner Facilitator

4.2.2. **ISD Model Consolidation Workshop**

We followed the CEFOP protocol, Table 7, to consolidate the ISD process model. The roles participating in this session are the same as in the ISEA modeling session; the vendor, developer, and client manager. As support for this session, we are using the participative model described in section 3.2.1, recalled in Fig. 31a, and the analytic discovery in 0, Fig. 31 b.

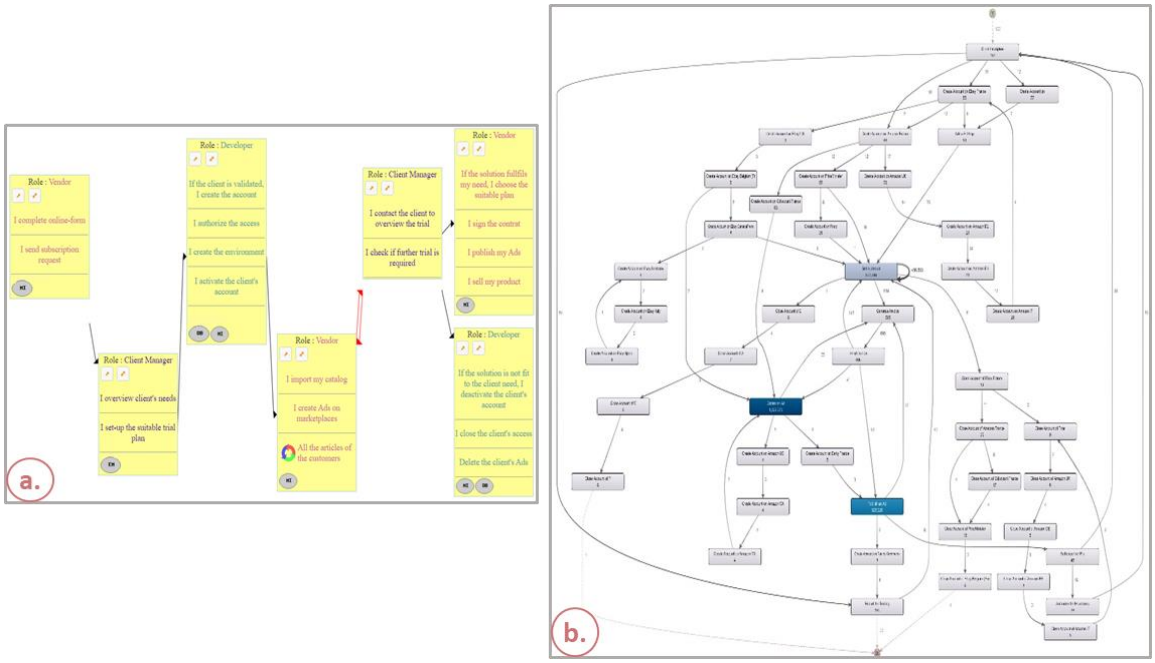


Fig. 31:The a) participative and b) mined process model for ISD business process.

4.2.2.1. **Preparing the Environment**

Same as in the ISEA tool, the facilitator starts by configuring the working environment, prepare the project, and importing the event logs file through the newly introduced functionality in ISEAsy. The facilitator represents the described participative model, Fig. 31 a, and creates a task for each of the post-it, that roles must name. Fig. 32 illustrates the reconstructed model that has the same paths as described in the previous modeling section.

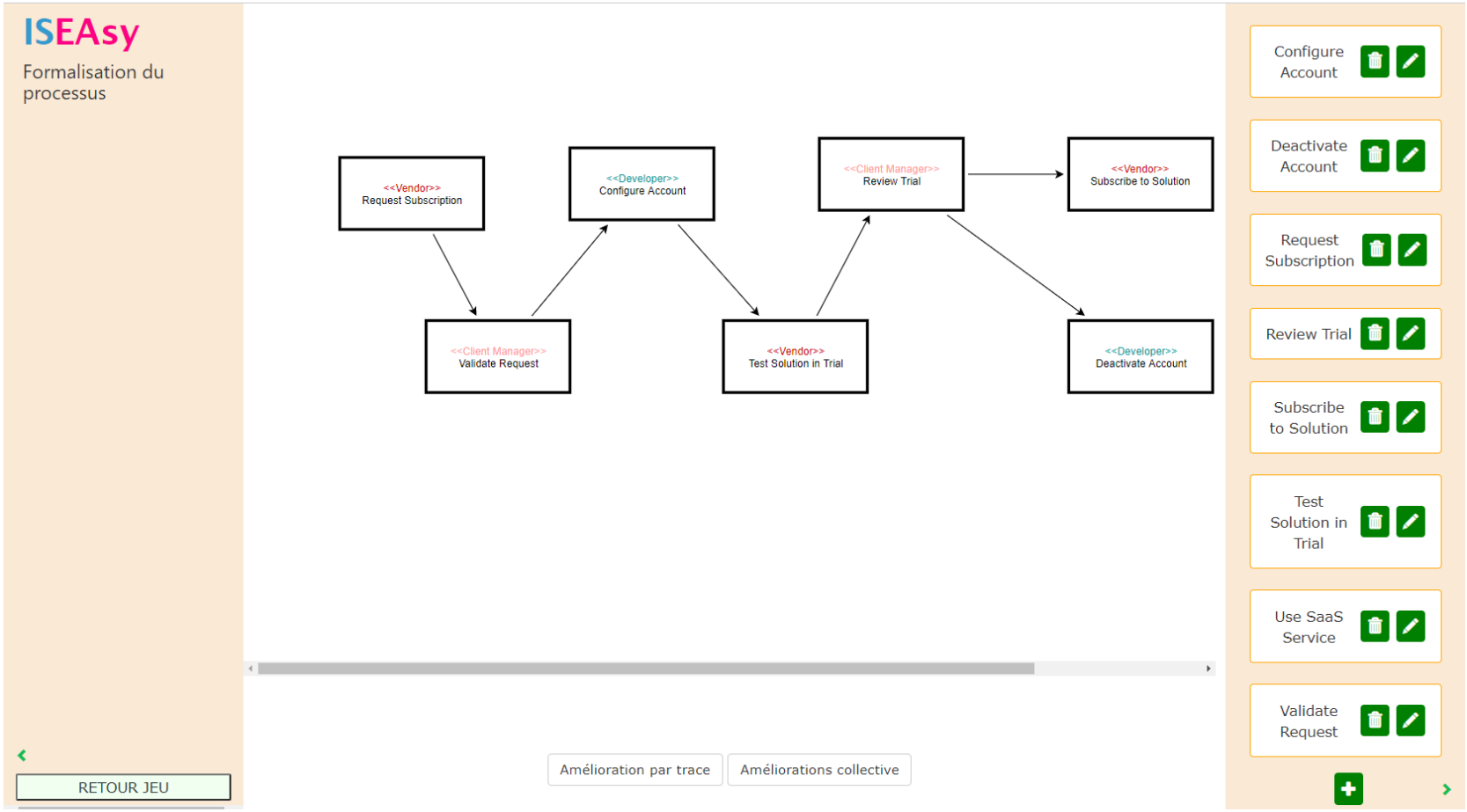


Fig. 32: The collectively reconstructed business process model.

4.2.2.2. **Linking the Actions**

The second step in consolidation protocol aims to improve the model by traces. As detailed in Table 7, this step is decomposed into three parts: linking actions with the role and then with the tasks and reviewing the unlinked actions.

In the case of ISD, the event log file contains information concerning the human resource who is performing the activity, so actions are automatically grouped by role, Fig. 33. Roles are asked to directly start by individually linking their actions with their tasks. For each action, the role is proposed, in a form of a drop-down list, with the set of tasks he described during the participative model.

Once the linking of actions with the task was completed, no actions were left unlinked, so the facilitator didn't need to organize a review workshop or event logs file cleaning.

4.2.2.3. **Automatic Process Rediscovering**

The link action-task defined in the previous step constructs a bridge that permits to travel between the described model and the discovered one. This bridge allows comparing also the paths described with the ones discovered. For this, the facilitator extracts the linked event log file from ISEAsy and uses DISCO to automatically discover the model of the process on the task level.

The discovered paths between the tasks in the ISD process are compared with the described ones and the following deviations were identified Fig. 34:

- A new path is discovered where a process instance starts with the vendor directly *testing the solution* without any actions performed prior to the *client manager* or *developer*.
- The paths of execution after the vendors completing the *testing of the solution*, pursuit either with the *subscribing to the solution* or with the *deactivation of the vendor account* and the task *Review trial* is bypassed.
- After subscribing to the solution, the vendor pursuit his activity in the trial testing environment, introducing so a path from *Subscribe to Solution* to *Test Solution in Trial*.

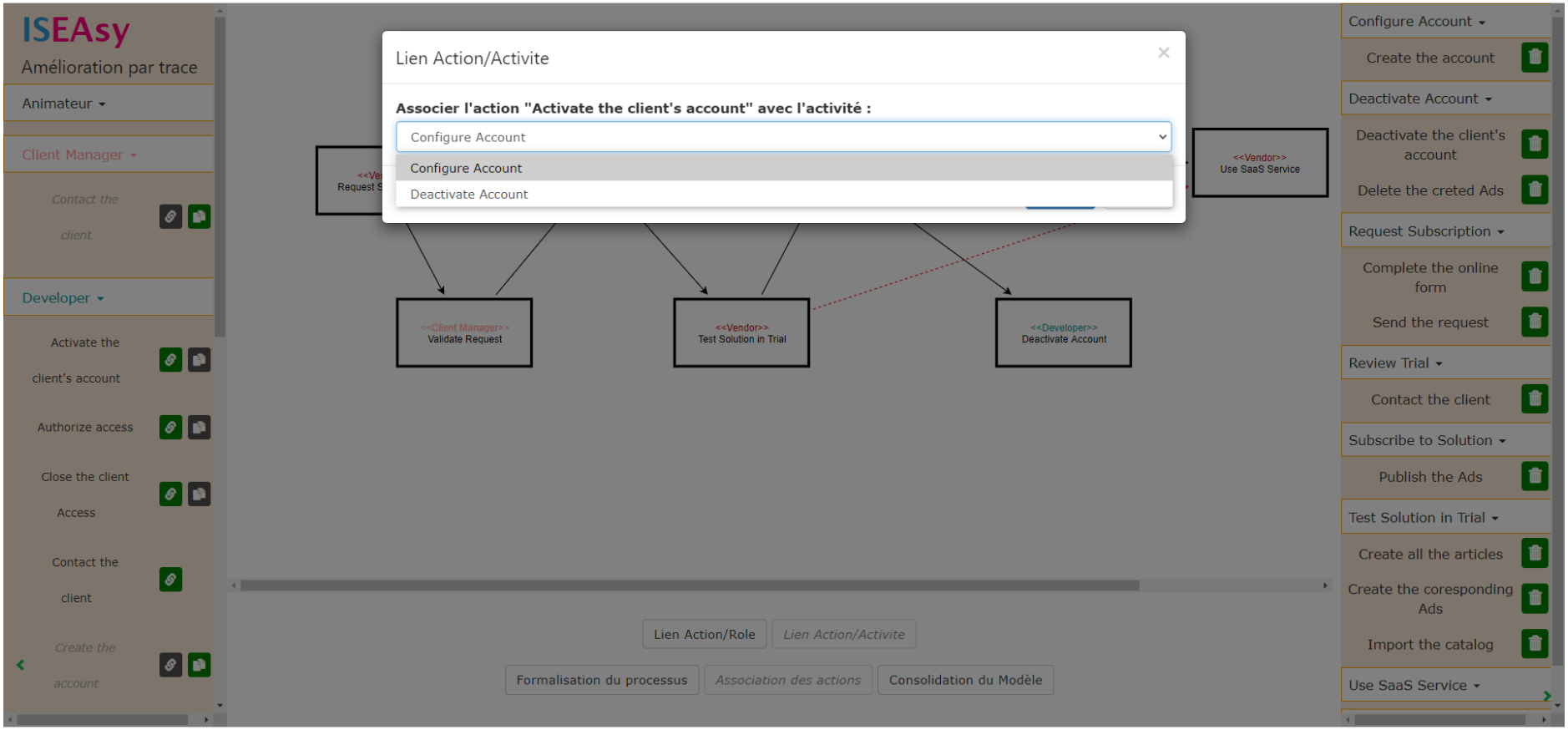


Fig. 33: Linking actions with the task in ISD process.

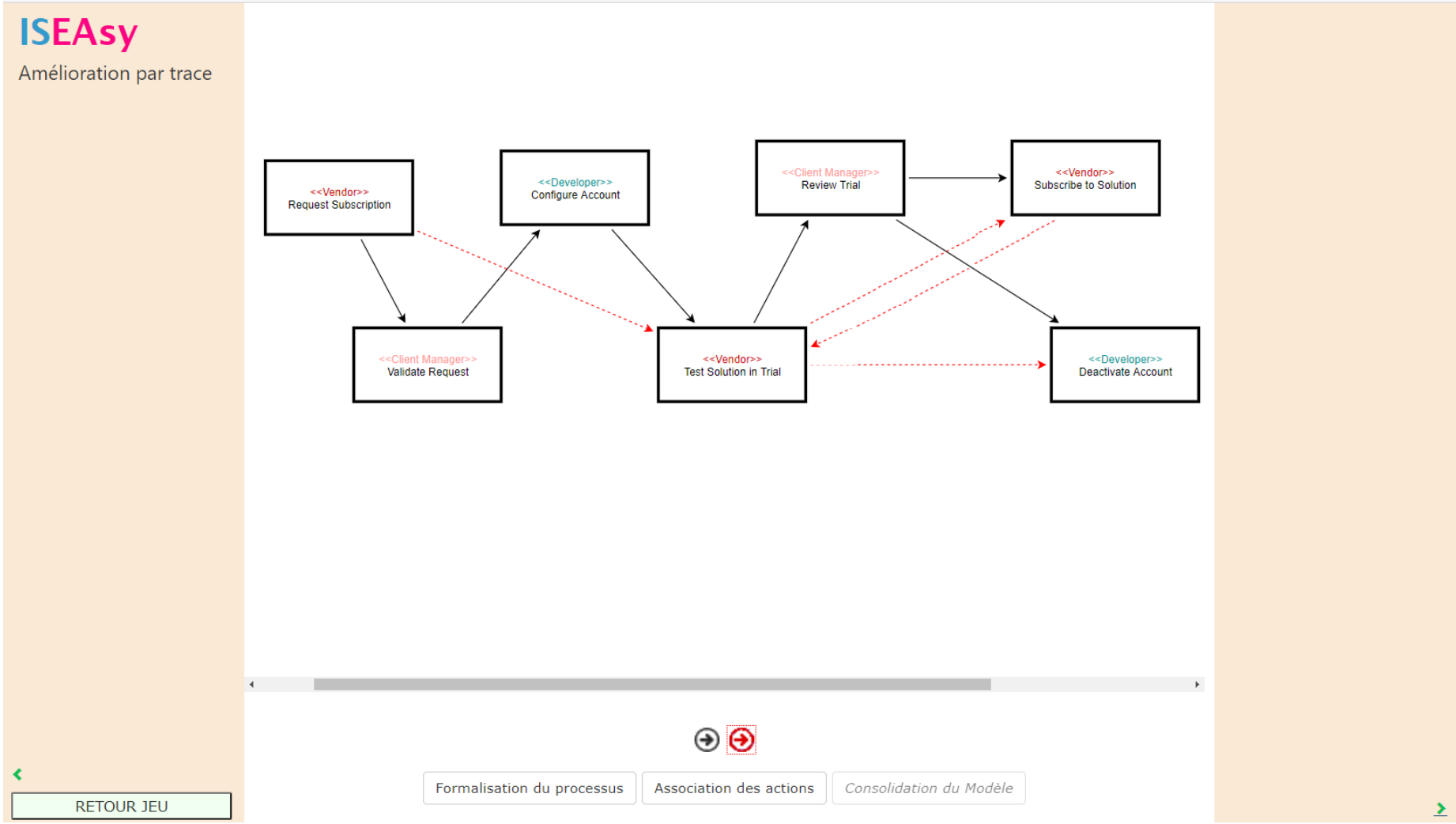


Fig. 34: The automatically discovered model of the ISD process on the task level and the detected deviations.

4.2.2.4. Collectively Improving the Process Model

The deviations detected in the ISD process are reviewed collectively by the role and the process owner. The facilitator intervenes in the discussion to clear unknown uncertain paths by describing them on the action level. Each review of a deviation concludes either with the integration of this path in the model or with its removing from the consolidated model and performing the corresponding cleaning of the event log file. The decision taken for the three deviations identified in the ISD process were:

- *Request Subscription* to T*esting solution*:
  This path is detected since the initial process was not completely supported by MI and several actions were performed locally and not reflected in the event logs. The process owner and roles decided collectively that these process instances should not be kept for the process analysis, so they were removed from the event log file.
- *Test Solution* to S*ubscribe to Solution* or *Deactivate Account*
  These paths are discovered since the task *Review trial* is not associated with any action traced in the event logs file thus not present in the automatically discover model. We are keeping the described path and discarding the detected deviation since it is due to a trace absence.
- *Subscribe to Solution* to *Test Solution in Trial*.
  This path was initially unknown for the participants in the workshop, so the facilitator had to zoom in and illustrate its execution on the action level. On this level of granularity, process participants were able to detect that the cause of the deviation was because at present vendors can *Publish Ads* and *Perform Sales*, actions exclusively performed once the subscription is done, while they are on testing period. This new path is introduced into the consolidated model so that it reflects reality, Fig. 35.

During these deviation reviews, no new data sources were detected; however, the process owner and participants expressed the desire to either enrich the tracing capability of the Market Invaders system, currently supporting several tasks, or enlarge its coverage so support all process tasks.

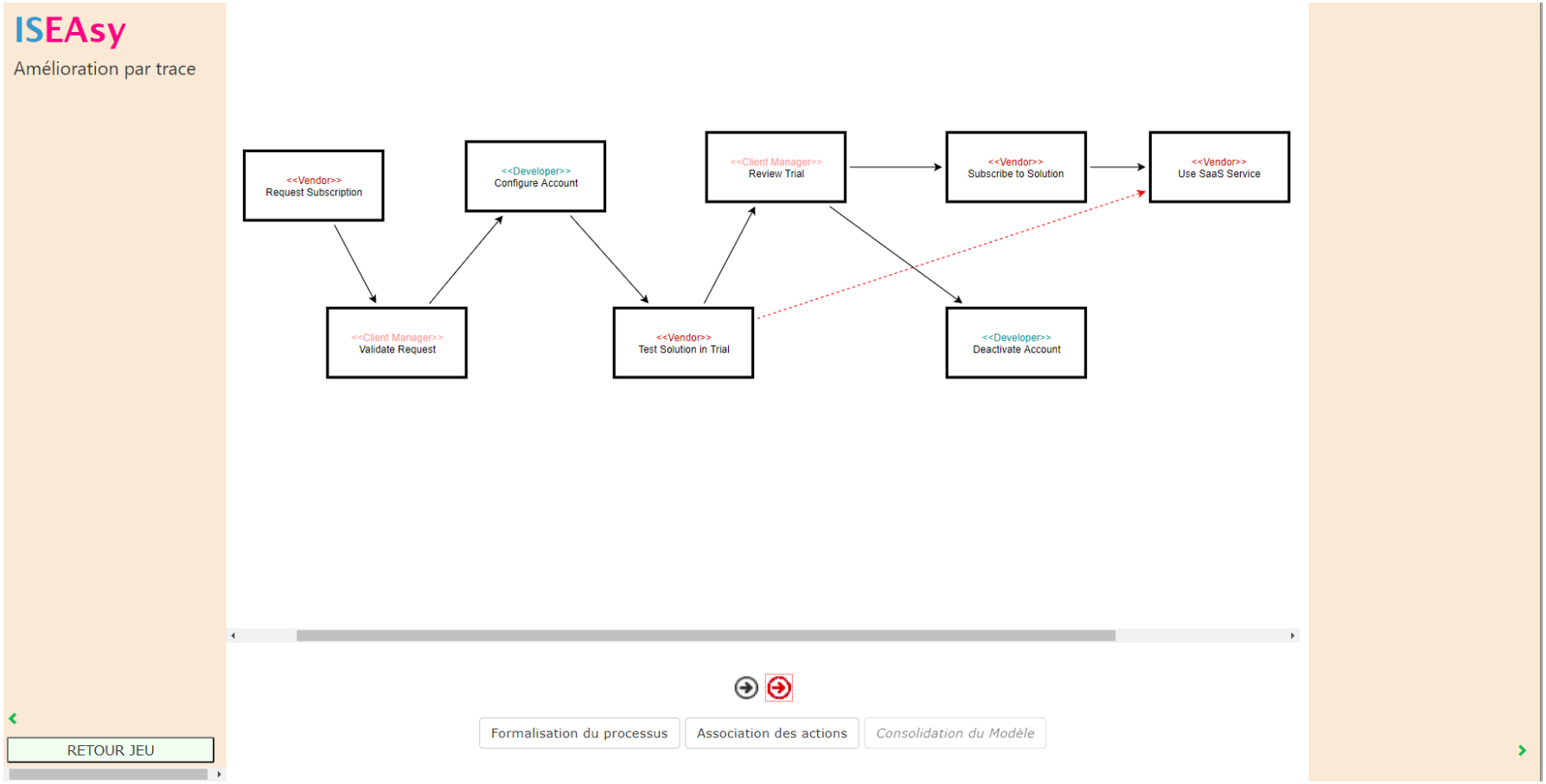


Fig. 35: The model of the ISD process obtained out of the model consolidation workshop.

4.3. Model Consolidation Outcomes and Conclusion

The model consolidation workshop is structured as a collective workshop where process participants and owners are grouped to review the set of tasks, actions, and paths composing the business process model. This consolidation is performed in four steps as structured in the protocol, Table 7, and illustrated while consolidating the ISD process model. This workshop enriches the model derived from the existing business modeling methodological fragments, which results in a process model, as shown in Fig. 36, that presents the following characteristics :

Completeness and objectivity- The consolidated ISD model describes all process components: all tasks and actions whether they are traced or not in the logs and all paths followed during process executions, including deviations and shortcuts that might be forgotten or passed by in participative workshops.

Comprehensiveness- The model is consolidated and enriched on the task level, so the simplicity and comprehension provided by ISEA methodological fragments are kept. This model proposes a more user-friendly annotation compared to BPMN.

Workshop complexity is reduced, process participants can easily interact with ISEAsy during the sessions. One of the main intentions in CEFOP is the minimize external intervention or competencies and knowledge requirement. So, the consolidation workshop is structured into small steps assisted by a facilitator whose intervention covers ISEAsy and DISCO tools.

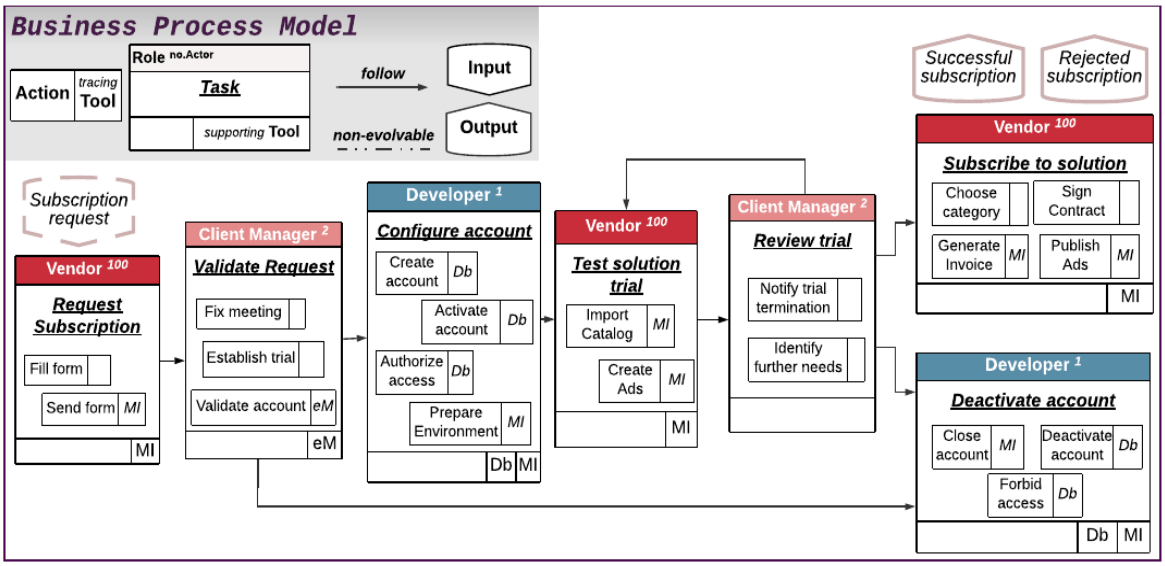


Fig. 36: The consolidated model constructed for the ISD process

Both these interventions are not dependent on process modeling or mining expertise and can be easily delegated to any actor within the organization.

In addition to process model consolidation, during this workshop, several data cleaning interventions can be triggered. This contributes to having a more process aligned event log file for future steps as can be processed performance assessments or simulation and instills into process participants a more data-driven approach.

4.4. Process Performance Assessment in CEFOP

CEFOP follows the same approach to assess the performance of a business process by combines participative and analytical existing methodological fragments and consolidates their artifacts into complete, comprehensive, and objective performance measures. Even though the approach is the same, the steps followed to attain this intention are more numerous, Fig. 37. This is because 1) the definition of the process measures can derive from performance concerns or blocking issues detected in the business process, Assess Performance Concerns by Proposal, as well as, 2) the assessment of a performance measure can trigger the Elicitation of Performance Blocking Points by grouping.

In the performance assessment workshops, we are concentrating on the methodological fragment used to measure performance covering so the six tasks in the second block. This assessment is structured as three steps, 1. Elicit and Estimate Process Measures, 2. Measure Process Performance and 3. Consolidate Process Performance. Table 8 details the protocol of these three steps.

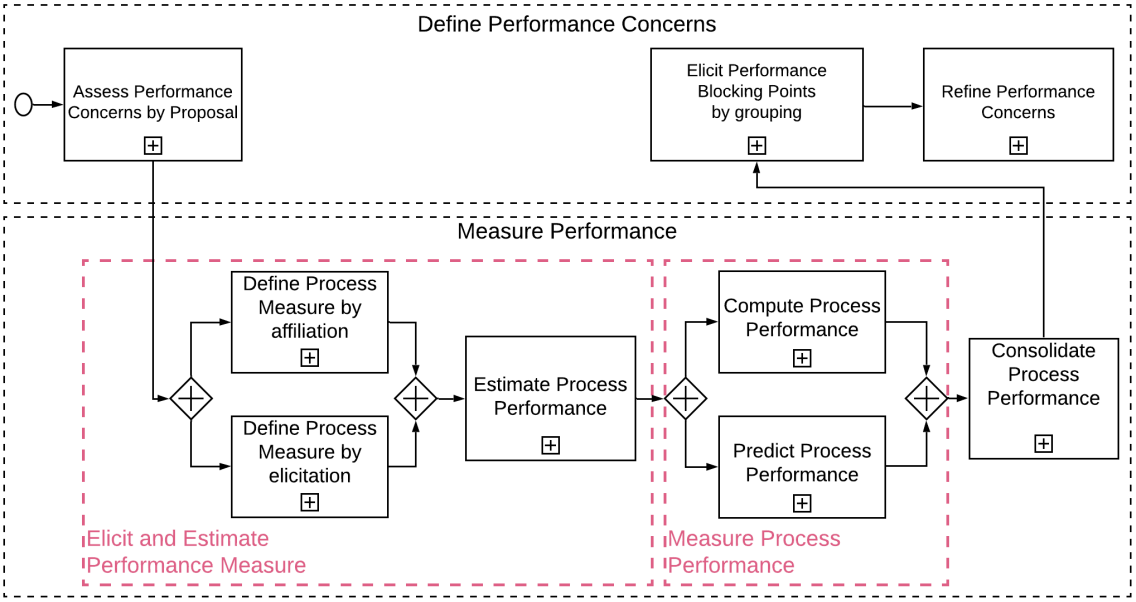


Fig. 37: The BPMN model describing CEFOP steps to assess the process performance.

Step 1. Elicit and Estimate Process Measures is structured as a workshop where process owners and participants, guided by the method facilitator, elicit the process measures to be used and estimate their values. In this step, participants are given as supporting tools:

- The consolidated model in the previous section and the associated event logs file to facilitate the definition and structuring of the process measures.
- The performance blocking points and concerns identified in the task Assess Performance Concerns by Proposal. This task in CEFOP is structured within the process owner interview performed in the Project initialization step, section 4.2.
- A guide for process measures elicitation, illustrating example of time, quantity, quality, or cost measures that can be used to measure the process performance, Appendix III.

Step 2. Measure Process Performance is an individual work session aiming to compute and predict the process measures values. This work session can be under the responsibility of a) the method facilitator, process measures are computed automatically by process mining tools and he is charged with their presentation, or b) the data analyst if it is possible to implement a more complete business intelligence solution.

Step 3. Consolidate Process Performance is a collective workshop where the process owner and participants compare the estimated values with the computed and predicted ones to identify gaps and misalignment between the two different measuring approach.

Table 8: CEFOP three-steps protocol to assess Process Performance.

Step Description	Organisation and Participant
Step 1: Performance Measure Elicitation and Estimation	Workshop
This first step focuses on eliciting the measures and estimating their values based on the process owner or participants' perception. The workshop is organized in two parts where: **1.1. Define Process Performance Measures by affiliation** The process owner is guided to translate business objectives into performance measures targeting the whole process and then	Process Owner and Participants

process participants are asked to translate each of them into measures related to their intervention. **1.2. Define Process Performance Measures by elicitation** The process owner and participants are invited to individually propose additional performance measures, based on their personal experience or need to monitor given aspects of performance. Each proposed measure must: • have a clear semantic describing its computation and the set of traceable actions used for its assessment. • be assessable upon the set of actions traced in the event log file • be estimated by the actor who is eliciting the measure	
Step 2: Process Performance Measurement	Individual
The process measures elicited in the previous steps are computed upon traces of the process execution present in the event logs file. Today, process mining tools do automatically compute several process measures. This activity is individual and can be covered by the facilitator, who is charged to collect and structure these measures. * *Depending on the company resources, this computation can be delegated to a data analyst and result in a BI interface that computes, predicts, and monitors these process measures.*	Facilitator or Data analyst*
Step 3: Performance Consolidation	Workshop
Process owner and participants are gathered collectively once the performance measurement is completed and guided to: **3.1.** Identify abnormal gaps in measures values, between the estimated computed and predicted values. **3.2.** Analyze the causes of the gaps and decide to either: • Trigger process measure review and reassessment if the computation is not validated. • Apprehend the gaps between estimation perception and reality and understanding what the real process performance is. • Apprehend the gap between present and upcoming performance and state improvement goals to avoid the emerging of performance issues in the future.	Process Owner and Participants

4.4.1. **ISD Performance Assessment and Consolidation**

We started the assessment of the performance of the ISD process in the previous chapter when illustrating the usage of existing participative and analytical methodological fragment to identify the performance issue emerged by the process stakeholder, section 3.2.1, and flow analysis using the PM2 mining approach, section

0. These workshops resulted in the identification of the issue *"The SaaS trial takes too much time"*, Fig. 38 *a* and the gathering of several processes measures values through process mining flow analysis, Fig. 38 *b.*

Following STEP 1 in our protocol, the process owner and participants were asked to translate the issue *"The SaaS trial takes too much time"* into process measures and estimate their value. This workshop resulted in four process measures, Fig. 38, where the process owner proposes to assess the "*Average time to complete trial and subscribe",* the time from the moment the vendor *"Send Request"* to when the system *"Generate Invoice*" for the first subscription.

The process participants decompose the process owner measure intro three sub-metrics, measuring respectively the average time to *Validate Request*, *Prepare Environment* or *Test Solution.* Each introduced measure is associated with an estimated value.

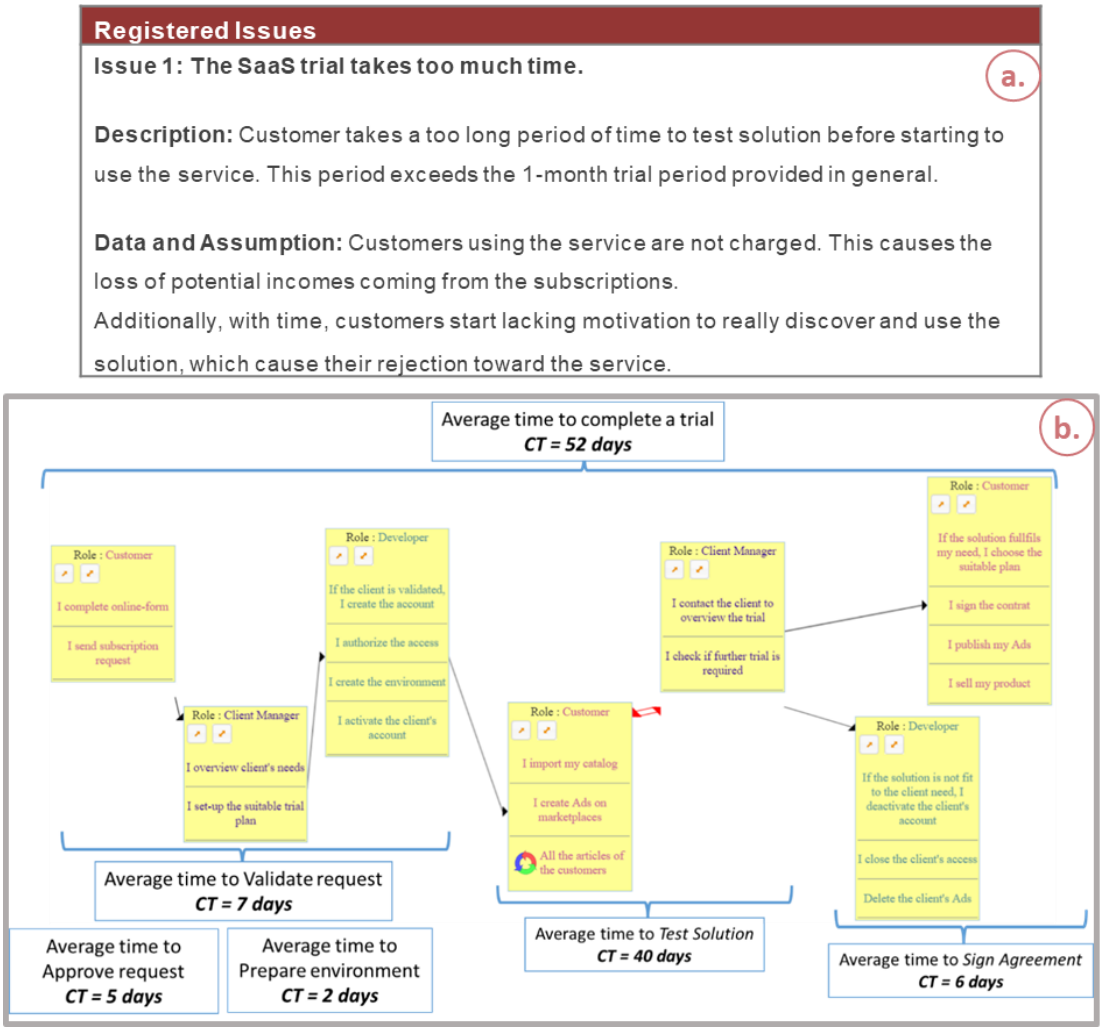


Fig. 38: The a) participative identified process issues and b) mined process measures for ISD business process

Table 9: Process measures elicited to assess ISD Performance from the issue

Nr.	Process Measure	Responsible	Related action(s)	*Estimated value*
1	Average time to complete trial and subscribe	Process Owner	Send Request Generate Invoice	45 days
2	Average time to Validate Request	Client Manager	Send Request Validate Account	7 days
3	Average time to Prepare Environment	Developer	Authorize Access Validate Account	1,5 day
4	Average time to Test Solution	Client Manager	Import Catalog Generate Invoice Deactivate Account	30 days

Once the table of measures is stated, it is up to the method facilitator to correlate this measure with the flow analysis performed by the process mining tool. Table 10 shows the values computed upon the event logs file and a prediction of the evolution of this process performance in one year. This prediction is performed considering the current growth of the business.

Table 10: The process measures estimated, computed, and predicted for the ISD process

Nr.	Process Measure	Responsible	Related action(s)	*Estimated value*	*Computed value*	*Predicted Value*
1	Average time to complete trial and subscribe	Process Owner	Send Request Generate Invoice	45 days	52 days	60 days
2	Average time to Validate Request	Client Manager	Send Request Validate Vendor Account	7 days	7 days	10 days
3	Average time to Prepare Environment	Developer	Authorize Access Validate Vendor Account	1,5 day	2 days	2 days
4	Average time to Test Solution	Client Manager	Import Catalog Generate Invoice Deactivate Account	30 days	40 days	50 days

Like the business process modeling, the assessment of the process performance must be collectively consolidated, step 3. This workshop gathers the process owner and participants, and data analyst, if involved in measures computation, to discuss the different values gathered for the same measure.

This workshop starts by identifying abnormal gaps between process measures values; estimated, computed, and predicted. For this, each measure values are reviewed and marked with a color dot illustrating:

- Green- there are no relevant gap between these values
- Yellow- a small gap is identified between values but not critical for the future of the business process
- Red- the gap between the values is very significant, the process measure is to be reviewed and probably an improvement to be planned.

Table 11: The gaps identified between estimated, computed, and predicted values for ISD

Nr.	Process Measure	Responsible	Related action(s)	*Estimated value*	*Computed value*	*Predicted Value*
1	Average time to complete trial and subscribe	Process Owner	Send Request Generate Invoice	45 days	52 days	60 days
2	Average time to Validate Request	Client Manager	Send Request Validate Vendor Account	7 days	7 days	10 days
3	Average time to Prepare Environment	Developer	Authorize Access Validate Vendor Account	1,5 day	2 days	2 days
4	Average time to Test Solution	Client Manager	Import Catalog Generate Invoice Deactivate Account	30 days	40 days	50 days

Table 11 shows that out of four measures, the average time to complete trial and test solution is critical; the gaps between estimation, computation, and prediction are important.

Once the gaps are identified, process participants and owners are asked to analyze the cause of such gaps. For each red or yellow doted measure:

1. A small description of the process measure computation is narrated either by the process owner or method facilitator.
2. A decision must be collectively taken, to whether to translate this gap into a blocking point, a performance issue to be resolved with improvement.

The decisions taken for the three ISD measures previously marked as having significant gaps, yellow and red, were:

- The average time to validate the vendor request is acceptable at present, but with the increasing number of vendors, this measure risks to become critical in the upcoming years.
- The average time taken to complete the trial or test solution is quite critical, so any improvement should be planned.

Both analyzed process measure gaps result in the need to group them as performance issues to be resolved through process improvement. The resolution of these two issues will help also the lowering of the Average time to complete the trial and subscribe to the solution.

4.5. Performance Assessment Consolidation: Outcomes and Conclusion

The consolidation of the process performances workshop shares similar intentions as the process model consolidation, to have a complete, objective, and comprehensive

artifacts. The consolidation workshop concludes with process measure valuation, Table 12, which would be later explored to detect performance concerns. Thanks to this workshop, the measures assessing process performance are:

Complete and objective: Process owner and participants are given the possibility to define measures based on performance issues elicits based on business goals or their own needs and each of these measures besides being estimated is computed upon the traces left during process execution.

Comprehensive: Each process measure proposed by the process owner is decomposed into sub-measures targeting process participants' tasks or groups of tasks to which process participants can relate more easily.

Workshop complexity: The performance assessment consolidation workshop is not fully structured, and several tasks are still to be performed manually by the method facilitator; guiding the work sections, measure reviewing, or computation. To eliminate this overcharge, this workshop should be instrumentalized, supported by a tool. Nevertheless, this workshop made process participants apprehend the real performance issues existing in their process and the need to improve it.

Table 12: The consolidated process measures assessed for the ISD process

Nr.	Process Measure	Responsible	Related action(s)	*Estimated value*	*Computed value*	*Predicted Value*
1	Average time to complete trial and subscribe	Process Owner	Send Request Generate Invoice	45 days	52 days	60 days
2	Average time to Validate Request	Client Manager	Send Request Validate Vendor Account	7 days	7 days	10 days
3	Average time to Prepare Environment	Developer	Authorize Access Validate Vendor Account	1,5 day	2 days	2 days
4	Average time to Test Solution	Client Manager	Import Catalog Generate Invoice Deactivate Account	30 days	40 days	50 days

Chapter 5. CEFOP Formalization

5.1. Introduction

CEFOP focuses on structuring the planning step of business process improvement, covering so the four initial steps in the BPM cycle[4], as shown in Fig. 39; process identification, discovery, analysis, and redesign. The scope of each of these steps is to respectively; 1) identify the process requesting a change intervention, 2) discover the components composing it and constructing the business process model, 3) analyze the blocking points and issues to be improved or resolved and their causes, and 4) redesign the process by integrating into it a possible solution.

As discussed in the state of art chapter, we group the activities performed during these four steps in two groups based on the main intentions to be attained:

- **Characterize As-IS business process**- define the current state of the business process; a) analyze it to discover the process model it and measure its current performance and b) diagnose the blocking point to be resolved.
- **Imagine As-IF business process-** explore all suggested transformations and collectively designate the best scenario for improvement by: a) proposing possible changes or solutions and imagining different evolution scenarios that can be implemented to resolve the blocking point, b) evaluating each scenario and change impact and c) selecting the best scenario to be deployed.

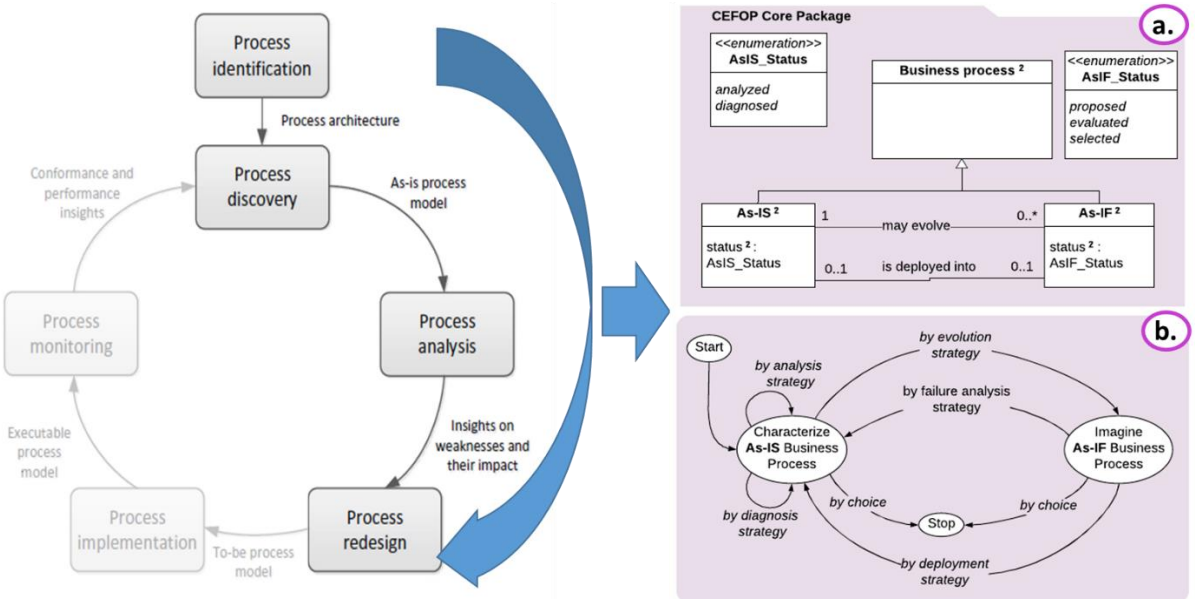


Fig. 39: The BPM cycle, highlighting the steps correlated to CEFOP, represented on the right by the core package of a) the product meta model and b) the process model

In the previous chapter, we introduced the approach proposed by CEFOP and illustrated it to model the ISD business process and assess its performance. The following sections will present CEFOP formalism; describe all artifacts generated when planning business processes improvement and presents all strategies and protocol of steps followed to generate these products.

5.2. CEFOP Method: Product Meta Model and Process Model

A method sits at the highest level of abstraction and refers to a collection of problem-solving approaches governed by a set of principles and a common philosophy. CEFOP introduces a consolidation philosophy and combines a set of; participative, objective and consolidation approaches to construct the planning of a business process improvement. We are formalizing this method with:

- A product meta-model detailing all artifacts to characterize the current state of the business process and imagine the most convenient scenario for the improvement.
- A process model describing all the strategies and approaches proposed in CEFOP to obtain the improvement artifacts.

We use the UML class diagram[18] formalism for the product meta model and the intentional map for the process model[35]. The latter formalism models in circles the intentions to be attained while planning the business process improvement and as arrows- the strategies proposed in the method to attain these intentions.

We choose the intentional map formalism to model the steps of improvements since it expresses the liberty to construct their paths that can be followed for the business process improvement. For example, the analyst can decide to characterize the As-IS process, by either:

A. Start with Identify As-IS process components, then Elicit Performance Blocking Points and Define Performance Concerns, and lastly Develop Process Measures
B. Or Start with diagnosis, Elicit Performance Blocking Points and Define Performance Concerns, and then Identify As-IS process components and Develop Process Measures

[18] https://www.omg.org/spec/UML/2.2/

An intention in the CEFOP process map is associated with a concept in the product meta-model since it represents a defined artifact when planning the improvement.

CEFOP's models are organized in 4 packages as illustrated in Fig. 40; the core, analysis, diagnosis, and evolution.

Core package: describes the two principal artifacts, As-IS and As-IF process, generated when planning the business process improvement and the roadmap introduced in CEFOP to attain these intentions. This roadmap, as previously illustrated, starts with characterizing the ***As-IS business process***, imaging several As-IFs scenarios on how this process ***may evolve*** for improvement, out of which one ***As-IF*** scenario is selected to ***be deployed into***, obtaining so an improved version for the business process, the ***new As-IS***.

The process model proposed in CEFOP to cover this roadmap has two main intentions, modeled as circles in the core intentional map, ***Characterize As-IS Process*** and ***Imagine As-IF Process***, Fig. 40. The characterization of the existing business process is attained through two strategies, arrows in the process intentional map, ***by analysis*** aiming to model the business process and assess its performance and ***by diagnosis*** to detect the performance blocking points to be resolved.

Once the current state of the business process is characterized, several As-IF scenarios are imaged following ***by evolution strategy,*** out of which either:

- a satisfying scenario for improvement is selected to be deployed and change the business process, ***by deployment strategy.***
- or an unsuccessful outcome is perceived, where it was not possible to identify a convenient scenario for improvement and we need to return and review the characterization of As-IS process, ***by failure analysis.***

The three-remaining packages in CEFOP detail respectively; the analysis, diagnosis, and evolution strategies by describing the sub-intentions to be attained and the strategies proposed for each of these steps.

Analysis package: The business process ***is specified by*** a set of ***Process Components*** that are used to model it and describing its context. CEFOP groups this artifact and the ***Process Measures*** used to assess the process performance in the analysis package. The process model, collecting these artifacts, has two main intentions: 1) Identify Process Components attained ***by specification strategy,*** and 2) Develop Process Measure ***by measurement strategy.***

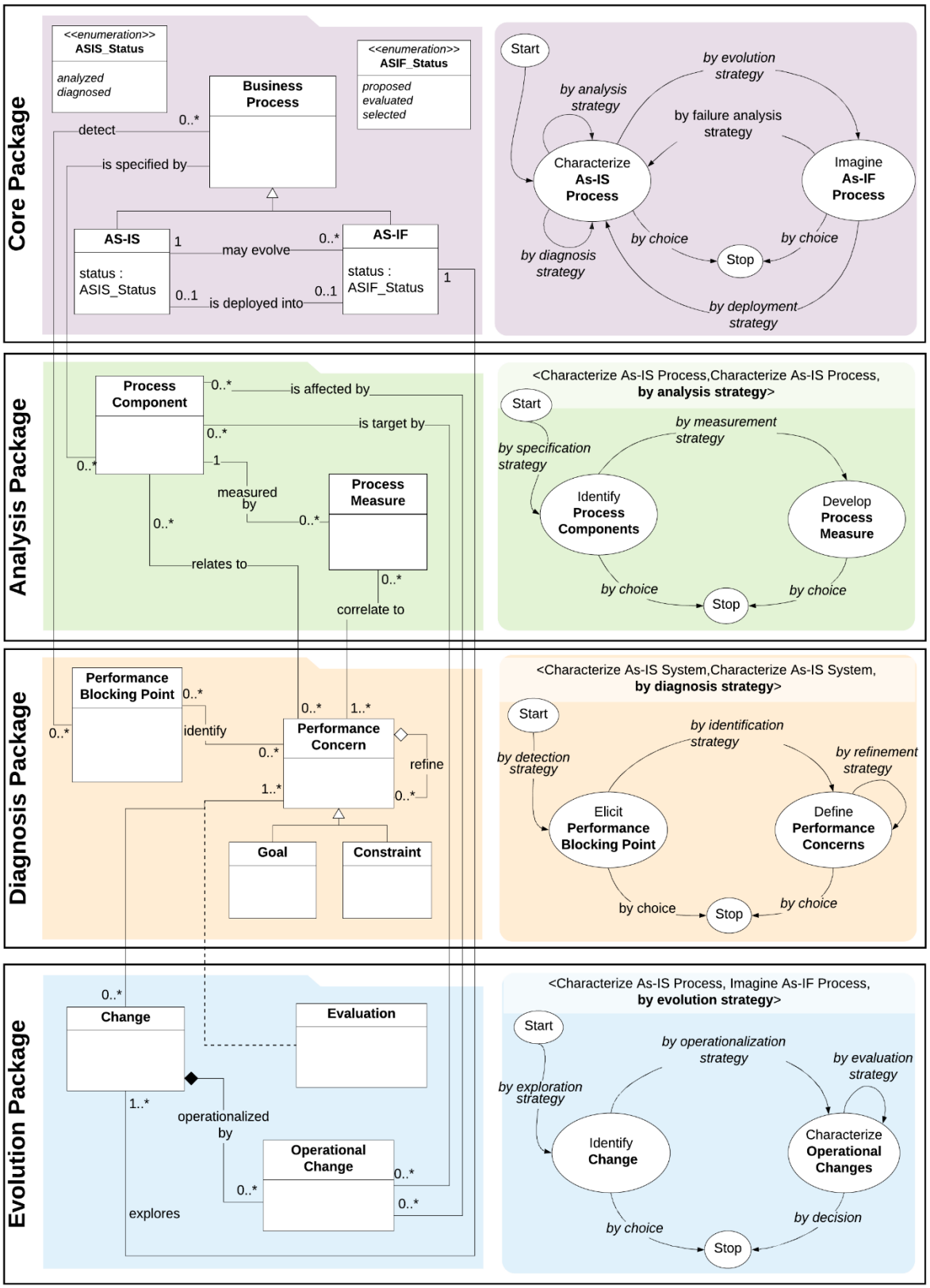


Fig. 40: CEFOP product meta-model and process model

Diagnosis package: cover the detection of ***performance blocking points*** and ***concerns*** related to them. A concern can either express a performance ***goal*** to be achieved or ***constraints***– a performance restriction to which the process must comply. Three

strategies are defined in CEFOP to generate these artifacts: 1) ***by detection strategy*** proposed to elicit performance blocking points existing in the business process that needs to be resolved through improvement, 2) ***by identification strategy*** to define concerns related to these issues and 3) ***by refinement strategy*** to decompose the main concerns, goals, and constraints into sub-goals and constraints.

Evolution package: groups the remaining products defined when planning an improvement of the business process. The product meta model in this package gathers three artifacts: ***Change***- a possible solution explored for improvement to resolve the blocking points, ***Operational Change***- the steps taken to deploy the change into the business process and ***Evaluation***- the impact of the change in the achievement of goals and non-violation of constraints. Same as the diagnosis process model, the evolution aims to attain two intentions through three strategies**:** 1) Identify Change ***by exploration strategy***, 2) Characterize Operational Changes to de undertaken to deploy each of these changes, ***by operationalization strategy*** and lastly 3) Evaluate the change impact ***by evaluation strategy*** while imagining the As-IF business process.

To express this liberty to structure and define different paths for process improvement, CEFOP introduces the ***by stop, by decision, by choice*** strategies in its process model. These strategies allow participants to collectively decide to stop the activity that they are performing and pursue a different step in the improvement or completely stop the intervention.

We are detailing in the following sections the analysis, diagnosis, and evolution packages; enrich the meta-classes of the product meta-model, and refine the sessions of the process model, and illustrating them with the followed steps and obtained artifacts for the ISD process.

5.3. CEFOP Analysis Package

In chapter4, we illustrated the usage of participative and analytical methodological fragments to model the ISD business process and assess its performances. These sections followed different approaches to obtain the business process components and performance measures. Additionally, CEFOP proposed to combine both these approaches and consolidate their artifacts to obtain a more complete, objective, and comprehensive model for the business process, section 4.34.2, and assessments for the process measure, section 4.5.

5.3.1. **Business Process Components**

CEFOP proposes to combine and consolidate the models generated through a participative and an analytic approach into a unique collectively consolidated model as shown in Fig. 41. This graphical representation of the process model is simplified so that it can be easily adapted and handled by all process participants and other actors in the organization intervening during the improvement planning. A model in CEFOP is composed of process events (input and output), activities (task and actions), roles, and tools- the information systems used during process execution.

Input and output events delimitate the business process. ***Input*** marks the starting point from where the analysis begins, for example, an incoming request from a business partner or another process, whereas, ***Output*** states the ending point, the final product(s) or service(s) delivered to the customer being that a business partner or process. The input triggering ISD process is the *Subscription Request* and the output delivered to the vendor are the services proposed when there is a Successful *Subscription* or a *Rejected Subscription.*

CEFOP introduces the concept of ***Tool*** in the business process model to refer to an information system used in the organization to support at least one intervention in the process. This component illustrates the possibility to track the user's activity during process execution. ISD execution is supported by three information systems; *MI*- the SaaS solution proposed by the company, *eM*- an electronic mail management system, and *DB*- a database management system.

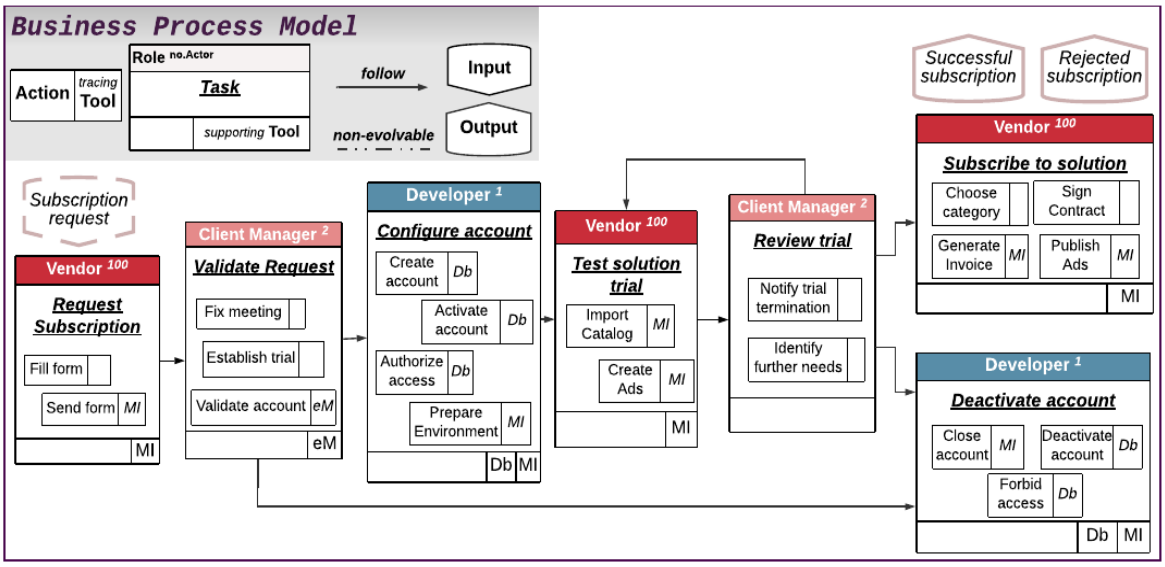


Fig. 41: The model of the Initial Service Delivery process.
■ *Vendor* ■ *Client Manager* ■ *Developer*

Tasks represent ongoing work fractions in the process, each performed by a single role or process participant. Participants' interventions follow one another creating so ***Paths*** in the process model Fig. 41. A task can either be manual or performed in an information system. Some examples of the tasks performed in ISD are *Request validation or Validate Request,* supported by *MI* or *eM* information system, or *Review trial* performed manually.

Each task is decomposed into ***Actions,*** that represent atomic work units executed within an uninterrupted time interval. Same as tasks, these elemental interventions can be manual or performed in an information system which might trace their execution in their logs. CEFOP models this relationship: is the action traced or not by an information system, as shown in Fig. 41. The task *Request Subscription* is supported by *MI* but the tools trace only the action *Send Form* and not *Fill Form*.

Role concept refers to process participants grouped on their organizational functions or as process customers or suppliers. A role is characterized by the distinct number of actors in the organization participating in this role in all analyzed process instances. Three roles participate in this process grouping each; *vendor*-100 interested sellers that have requested to subscribe to the solution, *client manager*- 2 employees of the company in charge of client relationship management and *developer*- 1 actor within the organization that intervenes as support for this process.

As discussed in 4.3, using these concepts CEFOP can construct a complete, objective, and comprehensive view of the process and its components and defines the base for the detection of the improvement and process redesign. The method chooses to construct a simplified model that is easily adapted and handled by all process participants and other actors in the organization intervening during the improvement planning.

Additionally, the method proposes to include in the consolidated model only those components that can either be targeted by an improvement or either to measure the impact of the changes. For example, if a structural change is to be proposed for ISD process, we cannot change the *Vendor* whereas the *Client Manager* or *Developer* may be evolved since the number of employees participating in this role can be altered within the organization. However, we use this concept to measure the number of requests, duration of trials, or subscription outcomes, thus this component outline is

dashed. This information would be useful during change elicitation, to distinct the components that can be impacted and altered.

5.3.1.1. Product Meta Model for Process Component

The product meta model proposed in CEFOP to formalize all these components is shown in Fig. 42: CEFOP product meta model fragment corresponding to the process components.Fig. 42. A business process is specified by the ***Process Component*** metaclass, which is specialized as a class diagram, containing a corresponding metaclass for each component. All these components instantiable up to M0 level and share three common properties; ***name, evolvable, and measurable***.

> ***Evolvable*** illustrates the ability to change or not a component during improvement. As previously discussed, this property differentiates those components that can be targeted by an improvement from the ones frozen to change.
>
> ***Measurable***, on the other hand, refers to the intention of using the component in the process measurement, for example, even though we are not able to change the role of *Vendor*, this component is used in process performance measurement, for example, to *count the incoming vendor's requests*.

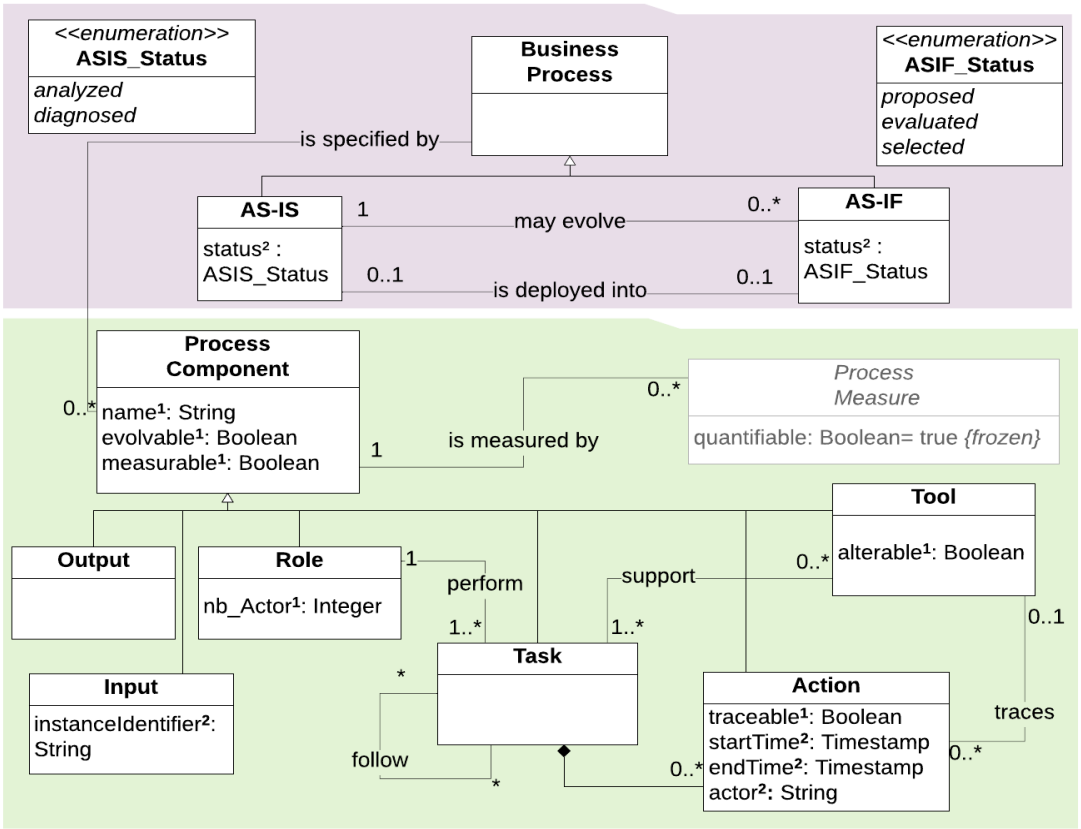


Fig. 42: CEFOP product meta model fragment corresponding to the process components.

Both evolvable and measurable properties are stated on the model level and not further valued on M0, for this these properties are indexed with the value ^{1} in the product meta-model.

Input and output meta-classes refer to the events delimitating the business process expansion. These components can evolve during the transformation process in case the need to broaden or abridge the process scope is encountered. The input event has an ***instance-identifier*** attribute, stated on M0, that discriminates each process instance. In ISD, the case identifier is the *vendor number* that distinguishes each request submitted to test the solution. The input of this process cannot be evolved since we cannot enlarge the scope of process analysis before the moment that the vendor's request is submitted whereas concerning the outputs if required, we can push our analysis beyond these borders and analyze the following steps once the subscription is signed or gather the vendors' feedbacks after rejection.

Role meta-class is characterized by the total number of the actors involved in the process, ***nb_Actors^{1},*** instantiated on the model level. CEFOP doesn't trace this property in the instance level since each action and task is performed by one actor. Evolution intervention on this component can vary from increasing or decreasing the number of employees up to engage or completely disengage their participation. Each modeled role ***performs*** at least one task in the process.

Tool meta-class formalizes the information system ***supporting*** at least one task in the process. This support can be traced in some systems, by ***tracing*** in their logs the performed actions. A tool can be central, behaving as a ***singleton,*** where the same instance of the tool supports the execution of all the process instances. The tools supporting a process differ from a basic application such as office suites up to the ones fully dedicated to supporting the process, PAIS. The choice of whether to include a tool in the model is based upon the fact if it is evolvable or measurable. CEFOP considers a tool ***evolvable*** is the information system can be changed: a) either by being replaced without blocking the process execution or b) modified by changing its functionalities and usage. To emphasize the last property, the property ***alterable*** is used to define the possibility of changing the functioning of the tool. If a tool is not evolvable, it must provide the possibility to measure at least one process measure, or else we propose to not model this artifact. For example, the *office package* and

marketplace interfaces are used to either *generate contracts* or R*eview Ads Publication*, but these tools cannot be evolved and at present, they don't provide means to measure user's activity, to this intent neither of them is modeled.

Task meta-class refers to an ongoing work fraction ***performed*** by a single role. During process execution, tasks ***follow*** each other, creating so the paths in the process. The work fraction can be either ***supported*** by at least one tool or be manual. One of the main ways of changing this concept in business process improvement is by redesigning process execution and changing the way or order tasks are performed. This change can cause the insertion of new actions or remove the performed ones. The tasks of the ISD process are all evolvable and different process measures can be deployed on those tasks that are composed by actions traced during process execution.

Action meta class structures the work units ***composing*** a task. They can either be ***traceable-*** performed in a tool and ***stored*** in the tool logs, else the action is considered as non-traceable. Since actions are basic units, their changing is limited to delete or insert new ones during process improvement. Additionally, an action is characterized by two timestamps marking the ***start time*** and ***end time*** of its execution [53] and **actor-** the user executing the action in the system**.** On the contrary to the ***traceable*** property**,** the three last attributes are instantiated on the instance level, marking the time, and the system user executing the action for each instance.

Product meta-model instantiation on ISD Process

We instantiate the process components product meta-model, described in the previous section, on M1 level to model the ISD process and on M0 level to illustrate a process instance execution for the vendor, Seller. Fig. 43 shows the details of some of the instantiated components and their valued properties. The full model of the process was previously shown in Fig. 41.

The ISD process is triggered by a *subscription request* sent by the vendor and completes either the customer successfully subscribes to the solution (*successful subscription*) or rejects the subscription (*rejected subscription).*

These three concepts are modeled as input and output events. The input, *subscription request,* is non-evolvable, but it can be used to measure process performance (*the number of requests submitted or treated, their quality, etc.)*. On the instance level, this component is also characterized by the instance identifier, which in

this case, is the name of the vendor. The output, *successful subscription*, on the other hand, is evolvable and measurable. During the analysis, this delimitation can be changed and measured.

The roles participating in this process are *the vendor*, *the client manager*, and *the developer*. The *vendor* groups the set of 100 sellers requesting to subscribe to the solution; *the client manager* groups the two actors within the organizations charged to interact with the sellers and guide them in the subscription process; and the *developer* represents the only actor within the company charged to configure and manage the customer environment.

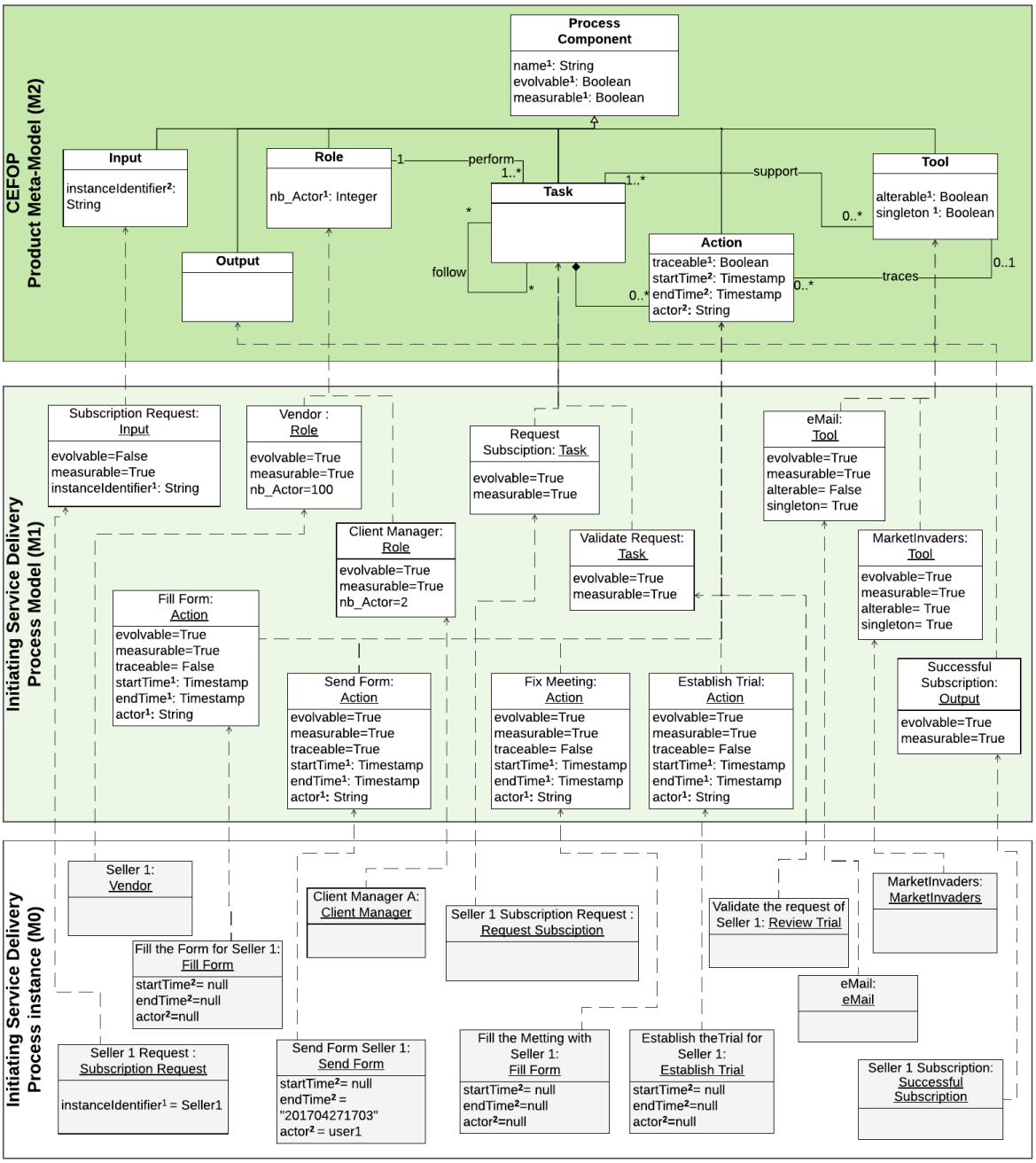


Fig. 43: The fragment of process components of CEFOP instantiated on M1 and M0

Besides the vendor that is non-evolvable (*evolvable=false)* as previously stated, the two other roles are evolvable (*evolvable=true).* All three roles are measurable (*measurable=true*).

All the tasks and actions performed during this process can be changed and measured (*evolvable =true & measurable=true*). One out of the four modeled actions in M1, is *traceable=true* since its traces are stored in the MI tool, where the other three are not traced. Being, *Send Form*, the only action that is traceable, is characterized by

an *endtime* and *actor* value on M0. The *starttime* is not traced by the MI tool, so it is declared null.

Three tools are identified as supporting the tasks of ISD process: the SaaS system Market Invaders (*MI*) and e-mail application (*eM*) which are central systems, (*singleton=true),* and MySQL Application (*Db*), an instance installed for each client (s*ingleton=false*). MI and e-mail software are evolvable *(evolvable =true),* the first is developed by the company so it can be modified if required *(alterable= true*) whereas the mail application can be replaced without impacting the process execution. On the other hand, a database system is a commercial tool that cannot be modified (*alterable=false*), but it is used for measuring purposes (*measurable=true*).

5.3.1.2. Process Map for Process Components Specification

The process model approach presented in CEFOP to model the process and obtain all components combines participative and analytic methodological fragments and a consolidating step. We introduced a 4-step protocol, *Table 6*, that illustrates CEFOP modeling approach. This protocol generates a model that is comprehensive, complete, and objective, defining so a solid artifact for performance issues diagnosis and process redesigning.

We are mapping the CEFOP modeling approach using intention map formalism, Fig. 44. During this workshop, two intentions are to be attained; ***Outline Process*** following the session <*Start, Outline the process****, by analysis strategy***> and then ***Model Process***. This second intention is attained by following three distinct strategies:

- ***by human process modeling strategy,*** relying on the usage of participative methodological fragments.
- ***by automatic process discovery strategy,*** where the process modeling is performed through the usage of evidence-based methodological fragments.

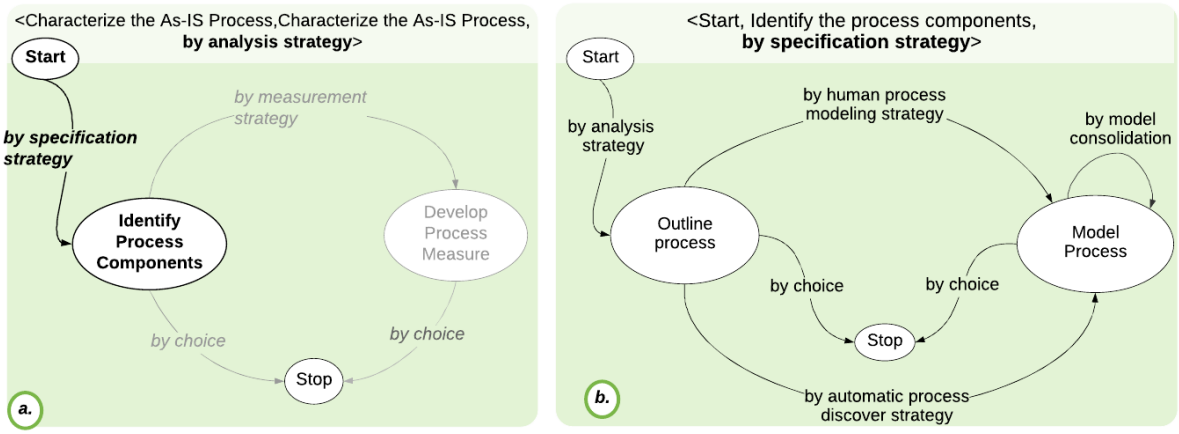


Fig. 44: The intentional map; a) of the analysis highlighting the session of process components identification and b) the refinement proposed in CEFOP method.

- ***by consolidation strategy*** which scope is to collectively consolidate the process model by reviewing and validating the process components identified in the previous strategies.

Process outlining relates to the intervention initialization step in the CEFOP modeling workshop and aims to perimeter the boundaries of the process. The intention here is to define an initial scope for the analysis by identifying the start (***input***) and end (***output***) points of the business process, the participating ***roles,*** and the supporting information system (***tool***). These components are identified ***by analysis strategy,*** which is structured as an interview with the process owner, Appendix II.

The second intention in the CEFOP process modeling is to ***model the process***, completing and consolidating the set of components used to map the process; tools, roles, paths, tasks, and actions. This intention is attained in three steps, each following a distinct strategy to model the process:

- ***by human process modeling strategy-*** models the business process using SEA methodological fragment. This approach guides process participants to describe the tasks and actions they perform during their intervention and the tools used to support these activities. The session is structured as a workshop, where the process participants are grouped by their functional role take a turn and introduce process components. The steps followed in the ISD participative modeling workshop are overviewed in section 3.2.1.
- ***by automatic process discovery strategy,*** automatically discovers the process model by mining the traces left during process execution. This section is structured following the approach proposed in PM², thus the steps followed

during the workshop are data extraction, processing, and mining. The workshop to discover the ISD model, based on this analytical methodological fragment, is illustrated in section 0

- ***by consolidation strategy***, in contrast to the two previous strategies, don't target to identify new process components but consolidate the models obtained from the previous two strategies in a unique business process model. This section is also structured as a participative workshop where roles are guided to review and validate the process components.

In contrast to the previous strategies, ***by consolidation strategy***, is introduced in CEFOP and, as presented in section 4.2.1, it is structured as a 4 step protocol, where process participants and process owner are guided to collectively:

- consolidate the set of actions and tasks performed during the intervention of each role in the process.
- consolidate the paths followed during process execution

The model consolidation workshop is supported by 1) ISEAsy: which provides an interface to facilitate actions linking with the roles and tasks and paths deviation consolidation and 2) DISCO- which assists in discovering deviation in the model. The usage of these tools during the ISD model consolidation workshop is illustrated in section 4.2.2.

5.3.2. **Business Performance Measures**

The method CEFOP assesses the performance of the process through process measures aiming to quantify given aspects of performance. We are limiting the current scope of our method to performance; however, the method can be easily enriched with process measures targeting other aspects of processes as security, conformity, etc.

Same as the approach followed for process modeling, CEFOP combines participative and evidence-based fragments to assess the performance of the business process and introduces a consolidation methodological fragment to collectively review and validate process measures assessment. To follow CEFOP performance assessment, process measures must be quantifiable, assessable following an evidence-based approach.

Table 13: The processes measures used to assess ISD performance.

Nr.	Process Measure	Responsible	Related action(s)	*Estimated value*	*Computed value*	*Predicted Value*
1	Average time to complete trial and subscribe	Process Owner	Send Request Generate Invoice	45 days	52 days	60 days
2	Average time to Validate Request	Client Manager	Send Request Validate Vendor Account	7 days	7 days	10 days
3	Average time to Prepare Environment	Developer	Authorize Access Validate Vendor Account	1,5 day	2 days	2 days
4	Average time to Test Solution	Client Manager	Import Catalog Generate Invoice Deactivate Account	30 days	40 days	50 days

The ISD process performance is assessed using time process measures, Table 13, whose values were estimated by process participants and owner, computed and predicted over traces left during the process, section 4.4.1.

At present, we are guiding participants in stating performance process measures targeting the time, quality, quantity, and cost performance dimension, where:

- **Time measure** targets the assessment of time consumption during the process execution, for example, *measure the maximal time to complete a task*.
- **Cost measure** assesses the consumption of a resource during the process execution, where resource refers to human, engaged actors, or financial, consumed material, etc. For example, a cost-performance measure in ISD is to *Assess the average working hours cost to complete the execution of a process instance.*
- **Quantity measure** focuses on estimating the number of process components or instances completed, aggregated upon different criteria; time, successful/ unsuccessful categories, etc. An example of such a measure is to *Assess the average number of trial days of the successful instances last year.*
- **Quality measure** aims to measure the presence of work unit or patterns associated with errors, special instances, positive or negative output, etc., for example, *Estimate the percentage of unsuccessfully completing of the process execution.*

Fig. 45 illustrates the symbol used to model a process measure in CEFOP, where the performance dimension is stated in the gray dot.

Fig. 45: The symbol used to model a process measure in CEFOP, characterized by either Cost, Time, Quantity, or Quality dimension.

A performance measure in CEFOP is associated with a process component, that is targeted for its measurement. The association is stated in the process measures description and provides an indication over which process part the change should intervene, or the resolution of a performance issue is to be evaluated. For example, the measures used to assess ISD performance *Average time to validate request* is associated with the task *Validate Request*, Fig. 46. This association is exploited when proposing the change, *Hire a new client manager*, to resolve the performance issue that might arise in the future when the time requested to complete this task might increase to *9 days*.

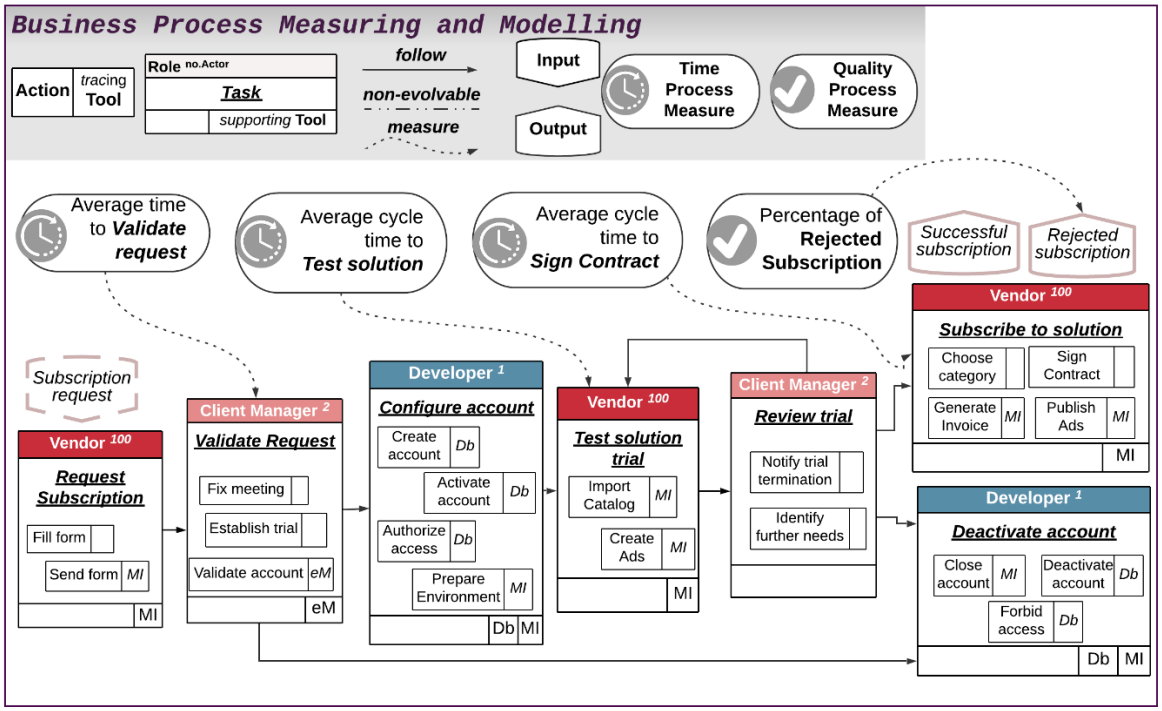


Fig. 46: Several process performance measures deployed over the Initial Service Delivery process.

5.3.2.1. CEFOP Product Meta Model for Process Measures

The method CEFOP formalizes process performance measures within the second meta-class in the analysis package, ***process measure***. This metaclass formalizes all measures used to assess the state of the business process. A process measure is assessed upon one process component which in its turn can be assessed by none or several measures,

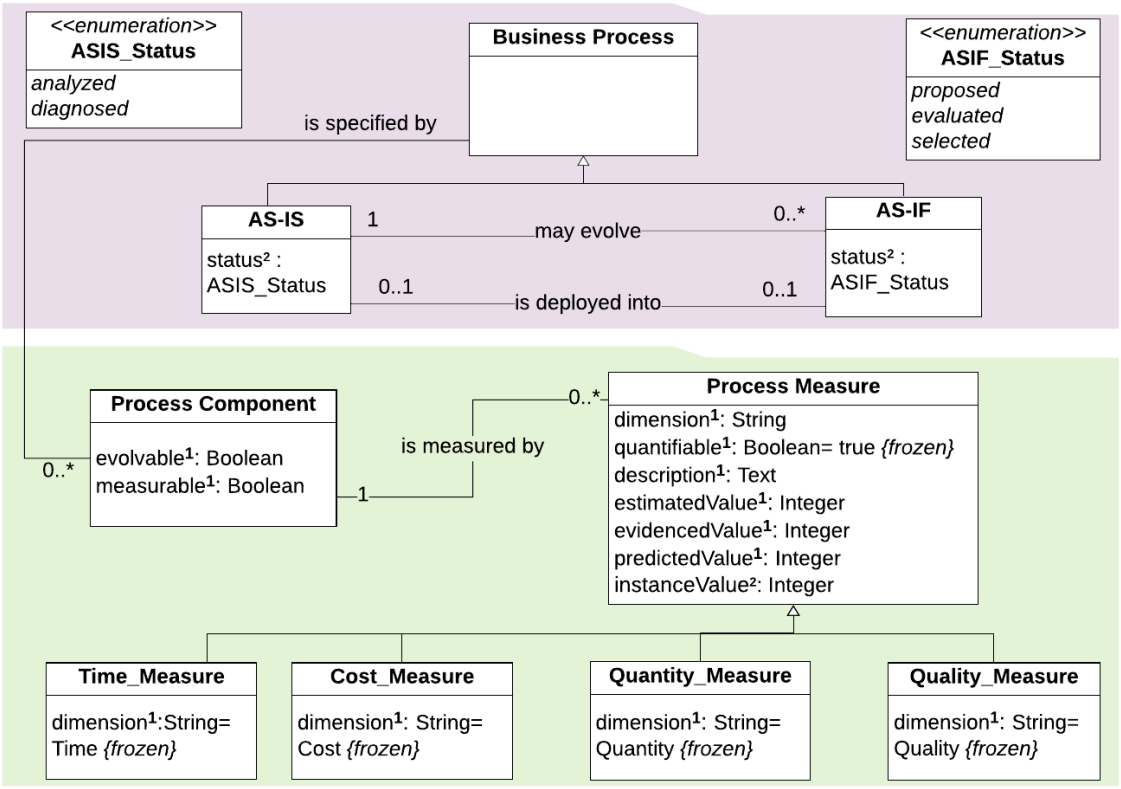


Fig. 47: CEFOP product meta model fragment corresponding to process measures and their association to process component metaclass.

is measured by association, Fig. 47. This association highlights the principal component in the center of the assessment of the measure, as previously described.

As previously stated, CEFOP is currently oriented towards quantitative process performance measuring, so this metaclass is defined by two properties; ***quantifiable*** which is true {frozen}, since all process measures should be quantifiable in CEFOP and ***dimension***- defining the performance dimension targeted in the process measure.

The method specializes process measure into 4 metaclasses refereeing respectively to time, cost, quality, and quantity performance dimension. The dimension property is frozen in each of them; Time{frozen} in ***Time_Measure,*** Cost{frozen} in ***Cost_ Measure,*** Quantity {frozen} in ***Quantity_ Measure*** and Quality {frozen} in ***Quality _ Measure***. Besides the two frozen attributes, process measures are characterized also by the following attributes:

Description: a brief definition of the measures semantic, detailing its operationalization and possible aggregations for the valorization, Table 9.

Estimated Value: the value assessed to the measure by the process participants based on their experience and perception, estimated value in Table 13.

Evidenced Value: the value computed over traces or evidence left during the process execution, computed value in Table 13.

Predicted Value: the foreseen value of the process measure, predicted for an upcoming future if the process is not changed, the predicted value in Table 13.

Instance Value: measures value computed for a given process instance.

The last attribute, ***Instance Value*** is assessed on M0, where the value corresponds to a given instance of process execution. Besides this valorization, all other attributes of process measure metaclass are instantiated on M1; they describe process performance aspects that don't relate to a unique instance of its execution. For example, the measure *"Average time to validate the vendor's subscription request"* assesses the time taken by the task, *Validate Request* in level M1.

We are instantiating the CEFOP process measure meta model fragment in the case of the ISD process, Fig. 48. The process measures, used to define the performance of the process, belong to the time dimension, and targets a process component, stated in Bold.

The ***estimatedValue***, ***evidencedValue,*** and ***predictedValue*** for these process measures were assessed in the process performance workshop in section 4.4, whereas the last attribute ***instance Value,*** is computed for the Seller 1 process instance.

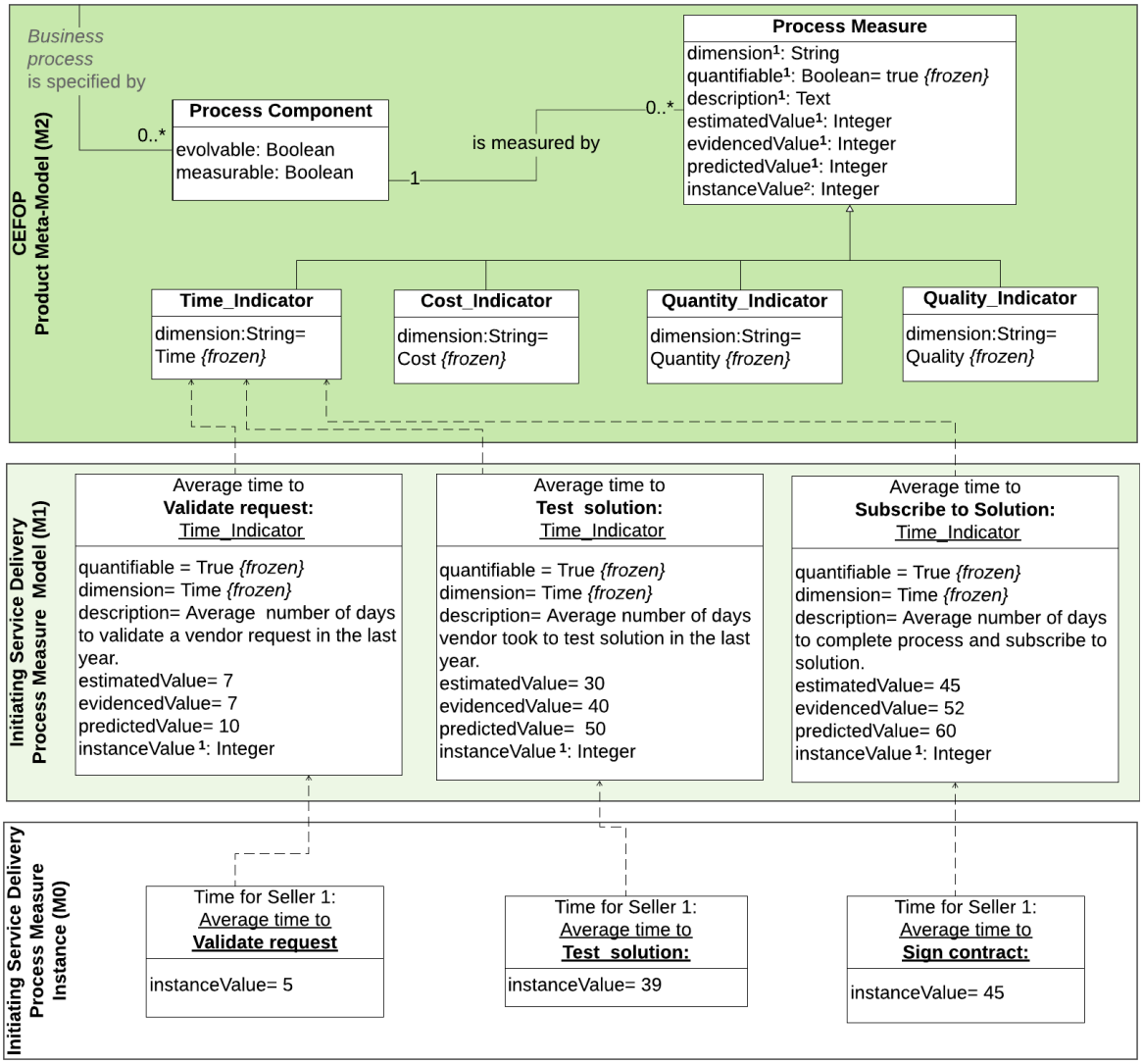


Fig. 48: The fragment of CEFOP process measure meta model instantiated on M1 and M0.

5.3.2.2. CEFOP Process Map for Process Performance Assessment

Similarly, to the approach followed for the specification of process components, CEFOP combines both participative and evidence-based approaches to measure the business process performance and collectively consolidate performance assessment.

The process model proposed for process performance assessment has two intentions: ***Define Process Measure*** and ***Measure Process Performance***, and seven strategies, Fig. 49. This process model refines the session, <Identify Process Components**,** Develop Process Measure, ***by measurement strategy***> of the analysis map and it is structured as a three-step workshop, detailed in Table 8.

CEFOP defines process measures following two strategies; ***by affiliation-*** it is the process owner that starts measures elicitation by translating the business strategy and ***by elicitation-*** process participants and owner are incited to propose measures

based on their needs and personal experience. These two strategies relate respectively to the first and second step in the process measure protocol. We are proposing both these strategies to define measures to combine the top-down and bottom-up approaches and give both process owner and process participants the possibility to measure the performance aspects concerning business strategy, as well as, working experience.

Once the list of process measures is defined, the remaining intention to be attained is to assess process performance, which implies assessing measures values. CEFOP proposes three strategies for this valorization, each resulting in a distinct value of the process measure;

- ***by estimation strategy-*** process participants and owner are asked to estimate the value of a process measure, relying on their experience in the process.
- ***by computation strategy,*** provides a more objective valuation for the measure. Similarly, to the evidence-based approach for specifying the process components, this valuation is based on the traces of previous process execution where values are computed based on the measure semantic.
- ***by prediction strategy,*** assesses the measure with a predicted value for the upcoming future. This valorization illustrates how the performance of the process evolves in time if the process is not changed.

Measures valorization is performed in two steps: each measure is estimated while it is defined during step 1 and values computation and prediction are structured as a separate activity, step 2 in Table 8. This diversity in the valuation of process measures can point out gaps between estimation, computation, and prediction.

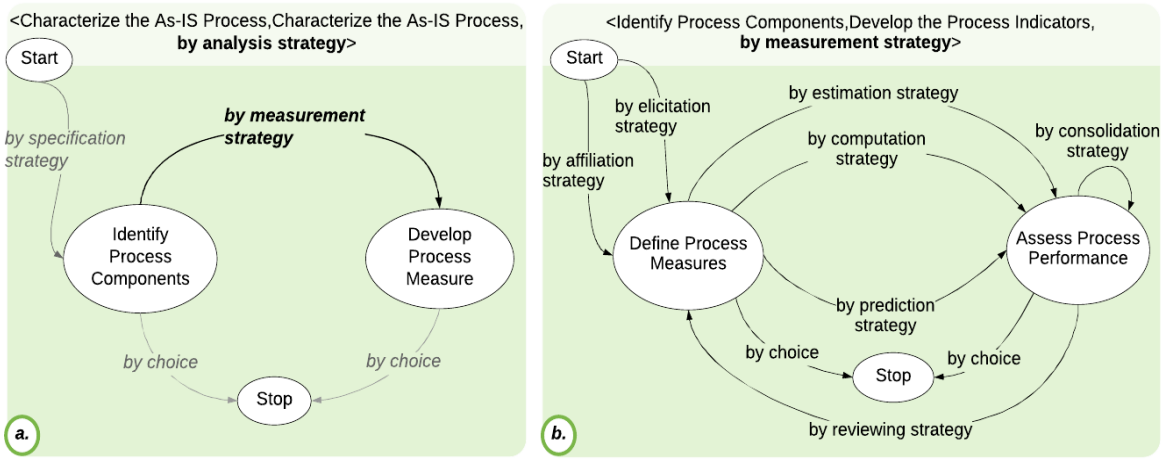


Fig. 49: The intentional map of; a) analysis highlighting the session of process performance measurement b) refinement of by measurement strategy.

To deal with these "inconsistencies", CEFOP proposes ***by consolidation strategy***, step 3 in process performance assessment protocol. This strategy guides participants in collectively reflect on the cause of the gaps and can result either in 1) triggering the need to review the measure semantic, ***by reviewing strategy,*** and redefining its description or 2) making participants apprehend the gap between their perception and the reality or the need to intervene and change the process based on the upcoming performance values.

5.4. CEFOP Diagnosis Package

Once the process analysis is completed, process characterization pursuits with its diagnosis. The goal in this phase is to identify performance blocking points exiting in the process and the goals and concerns related to this business process. Contrary to the process components or measures, performance blocking points and concerns describe characteristics or features of the business process, so all metaclasses and attributes defined in this package are instantiable up to the M1 level.

5.4.1. Performance Blocking Points, Goals, and Concerns

A ***performance blocking point*** refers to a performance issue or problem existing in the business process that forbids the achievement of a business objective. In CEFOP, we are oriented toward the identification of non-functional objectives, highlighting a non-satisfying aspect in the performance of the business process. These issues are structured as single phrases resuming the problem identified through stakeholders' feedbacks. Each performance blocking point is further detailed into smaller and explicit performance concerns, expressed as SMART objectives.

A concern might declare either an improvement goal or a constraint to be respected. ***Goals*** are objectives stating a performance value to be achieved to resolve a performance blocking point, whereas, ***constraints*** are non-to-be-modified performance objective, referring to performance values to be preserved and not altered when changing the business process. The alteration of these performance constraints can cause the emerging of new performance blocking points.

Due to time limitation, we didn't manage to organize a complete workshop to detect all performance blocking points or concerns in the ISD process, however, some issues and goals were gathered during the process owner interview for process identification, Intervention Initialization step in the process modeling workshop.

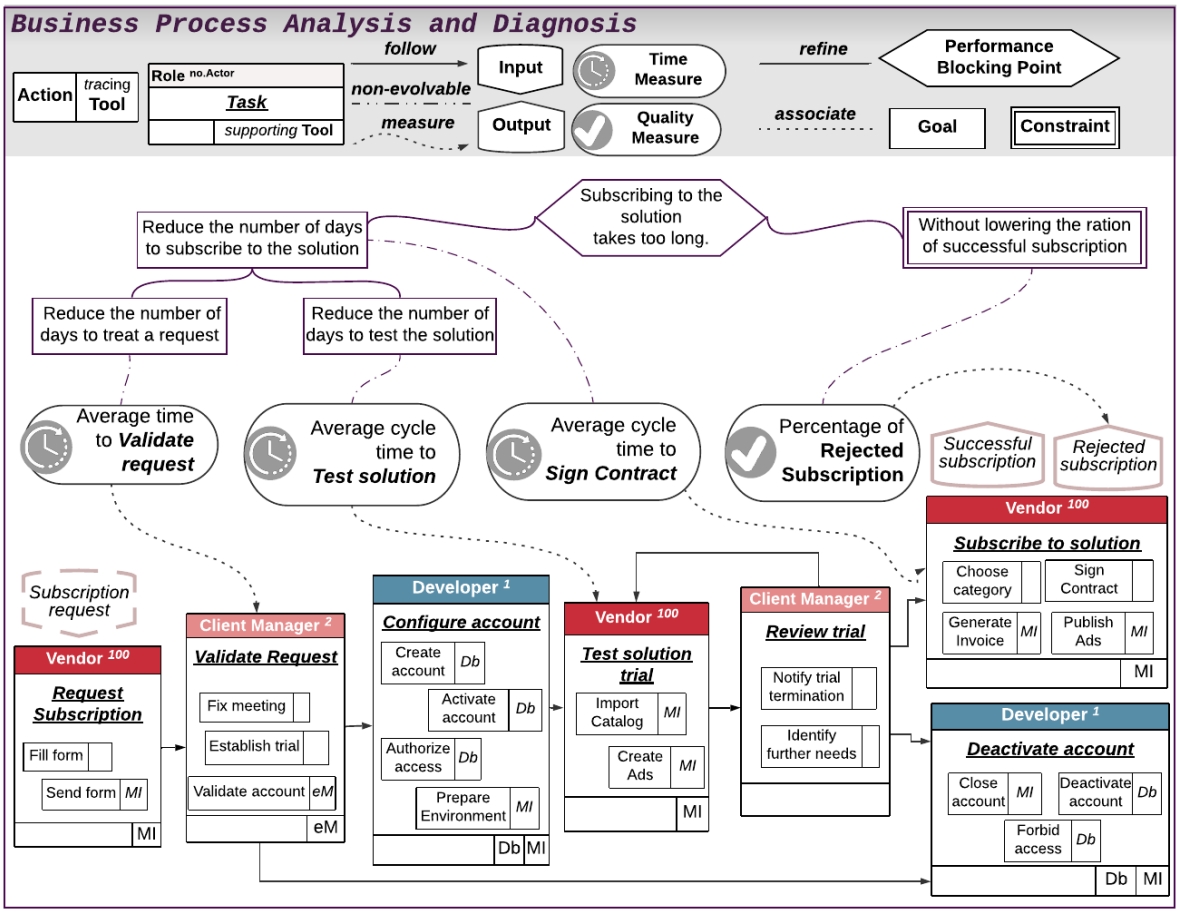


Fig. 50: The performance blocking points and concerns elicited in the Initial Service Delivery process and associated with the performance measures and components.

The performance blocking point identified was *Subscribing to the solution takes too long*, Fig. 50, which was translated into a goal *Reduce the number of days to subscribe to the solution to less than 40 days within the following six months* and a constraint, *Without increasing the ration of rejection beyond 25 %*. The achievement of these concerns is assessed upon the measures "A*verage time to Sign Contract"* and *"Percentage of Rejected Subscription"*.

We can assume that the ISD goal, derived from the performance blocking point, is decomposed into two smaller sub-goals targeting respectively the average number of days to *Validate Request* and *Test Solution* since the gaps identified on these measures' values were critical, 4.5. The detailed descriptions of both these goals and constraints are instantiated in the following section.

5.4.1.1. CEFOP Process Diagnosis Product Meta Model

CEFOP formalizes performance blocking points and concerns within the product meta model fragment illustrated in Fig. 51. The diagnosis product meta-model is composed

of four metaclasses; ***performance blocking point*** and ***performance concern*** specialized in ***goal*** and ***constraint***.

Performance blocking points are defined as short phrases, ***description*** property**,** briefly stating the issue present in the business process and the impacted performance dimension. For each blocking points, performance concerns are ***identified,*** each ***related to*** a process component and ***correlated to*** at least one process measure. The performance concerns detail how the resolution of the performance blocking point is achieved. They state:

> ***The value***: an index illustrating the threshold starting from which the performance concern is considered achieved and the performance blocking point resolved.
>
> ***The intention***: a verb indicating the direction in which the value associated with the goal or constraint points toward. This specification facilitates the evaluation of the concern achievement.

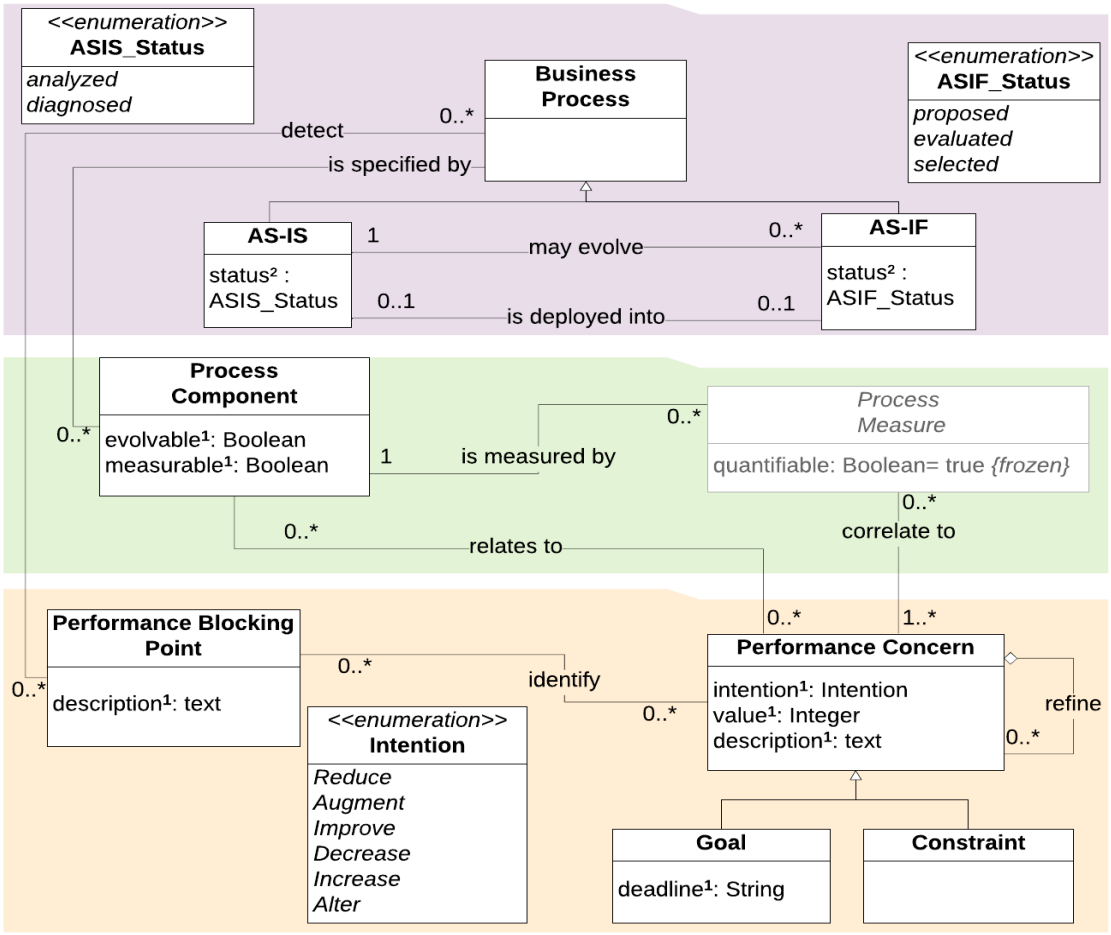


Fig. 51: CEFOP product meta model fragment formalizing Performance Blocking Points and Performance Concerns.

The description: a brief description of the performance concerns and how the process components contribute to evaluating its achievement.

In addition to the above characteristics, goals are defined also by a ***deadline***. They represent an ephemera objective, to be achieved within a specific time or else its nature change. The ***deadline*** states the time within which the goal must be achieved. Constraints, on the other side, are not time-limited since they express restrictions that must be always respected by the process.

Fig. 52 illustrates the instantiation of the diagnosis product meta model fragment in the case of the ISD process. The performance blocking point triggering the need to change this process was that *Subscribing to the solution takes too long".* To resolve this issue, three goals and a constraint were identified. Initially, the goal *Reduce the time to Successfully Subscribe* and constraint *Without increasing the rate of Rejected Subscriptions*, which are associated with the performance blocking point. The constraint ***intention*** is to *not increase*, the ***value*** of non-successful subscription beyond *25 %*. Its achievement is assessed upon the rate of subscription signed compared to the number of requests received as inputs.

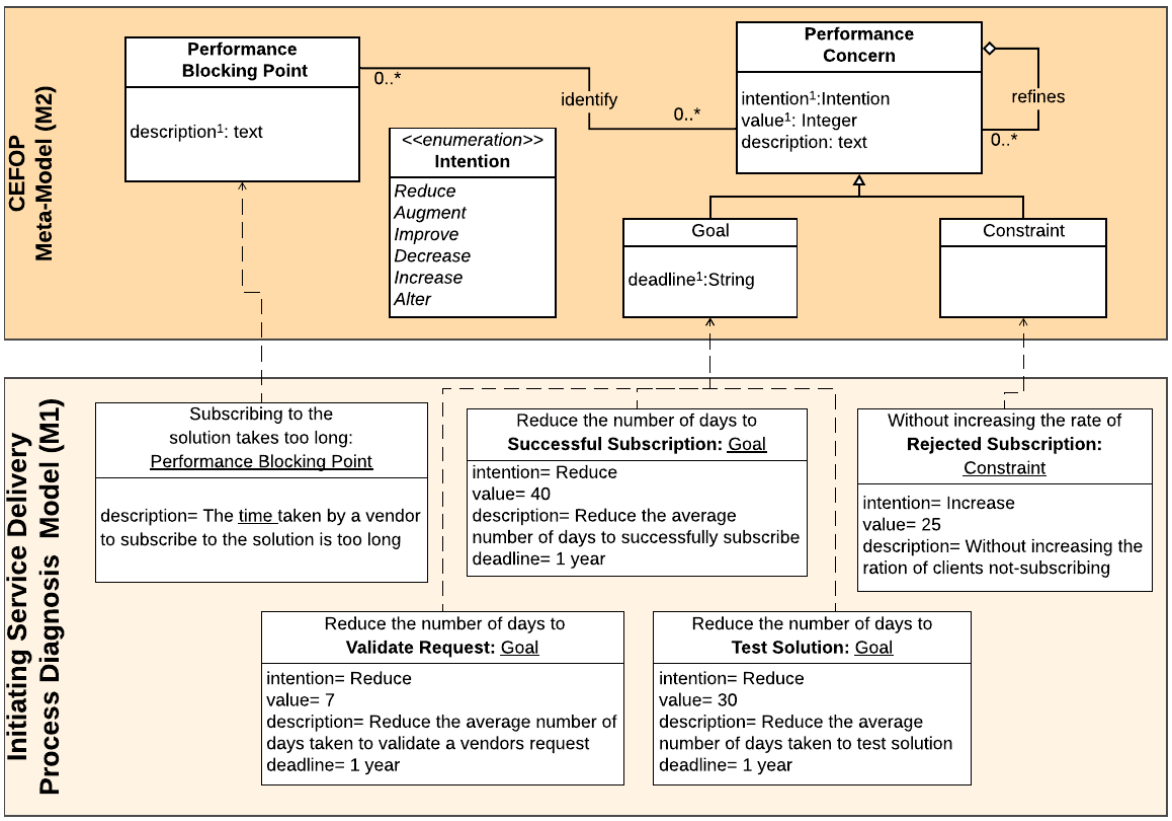


Fig. 52: The fragment of diagnosis product meta-model instantiated on M1, where the related to process components and concerns measures are in Bold.

The goal, on the other hand, is more oriented toward the ***intention*** of *reducing* the time taken from the request to subscribe up to the successful subscription to *40 days* within the ***deadline*** of *one year*. This goal is further refined into two smaller sub-goals, *Average cycle time to Validate Request* and *Average cycle time to Test Solutio*n, with the same intention and deadline, but with different targeted values. The former goal targets a maximal value of 7 days to complete the task of validating the vendor request whereas to test the solution, the value is 30 days.

5.4.1.2. CEFOP Diagnosis Process Map

CEFOP proposes a process map composed of six strategies aiming to attain two main intentions: ***Detect Performance Blocking Points*** and ***Define Performance Concerns***. The attainment of both these intentions, the method proposes to combine:

1. The top-down with the bottom-up approach, guiding involved actors to detect performance blocking points and defining concerns: 1) starting from business strategy or customer feedbacks, ***by elicitation*** and ***by translating*** strategy or 2) to identify goals and constraints based on process measures computed on process participants' demand, ***by proposal strategy,*** and grouping them into business process performance blocking points, ***by grouping strategy.***
2. Participative, analytic, and consolidation approach, where performance blocking points and concerns are detected and defined taking into consideration process measures values, besides business strategy. Each performance concern must be collectively reviewed and validated, ***by refining strategy,*** and if required reviewing the performance blocking points detected for the business process.

Business process diagnosis starts with eliciting performance blocking points, ***by elicitation strategy,*** following a hierarchical top-down approach, where it is up to the process owner to elicit the performance blocking points concerning the process, based on the organization's operational objectives. The elicited performance issues are translated, ***by translation strategy,*** into performance goals and concerns, each related to a process measure in the analysis package. Each performance concerns can be refined into sub-goals or sub-constraints, ***by refinement strategy.***

The second approach proposed in CEFOP starts with eliciting performance constraints upon process measures proposed by process participants or critical gaps

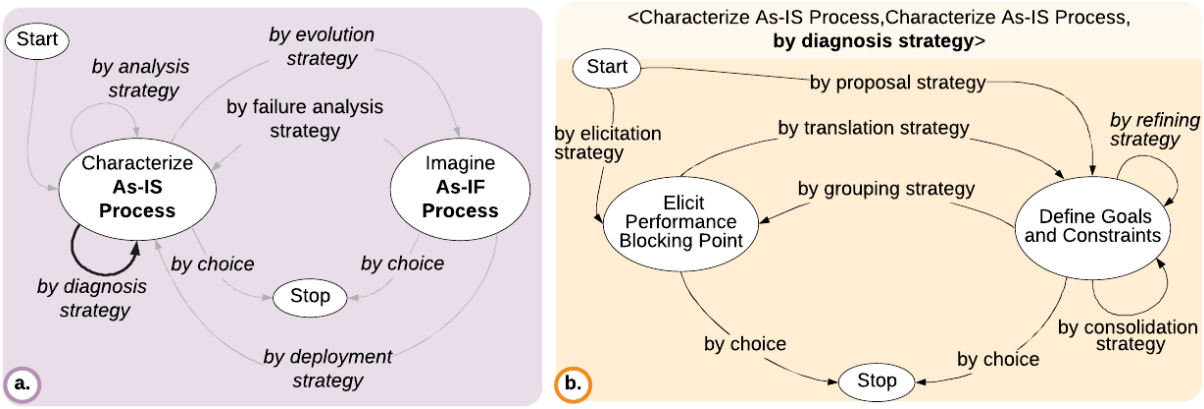


Figure 53: The a) by diagnosis strategy refined b) intentional map in CEFOP.

identified in their values, ***by proposal strategy,*** and group them with the previously elicited performance blocking points or introduce new ones.

Each performance blocking point and concern derived by both approaches proposed in CEFOP must be collectively consolidated into a unique set, where the component is approved. This scope is covered in the ***by consolidation strategy.*** This session aims to collectively validate: (1) the set of performance concerns and blocking points diagnosed for the business process and (2) the value targeted by each goal and constrain, making them realistic and approved by each participant.

5.5. CEFOP Evolution Package

5.5.1. Change Elicitation, Operationalization, and Evaluation

Up to now, we illustrated the artifacts to be defined and the criteria to be full field so that a collective comprehensive, complete, and objective view of the As-IS business process is characterized. While constructing this artifact, participants detect performance blocking points that need to be resolved, triggering so the need to improve the process. For this, different scenarios of improvement are imagined out of which one is chosen for deployment. Imagining the As-IF scenario of improvement is the second intention to be attained in CEFOP, Fig. 54.

A business process can be changed on different scales from improvement- rethinking some of the steps up to innovation- radically redesigning completely the process. At present CEFOP covers business process improvement where each improvement scenario is specified by imagining at least one change in the business process.

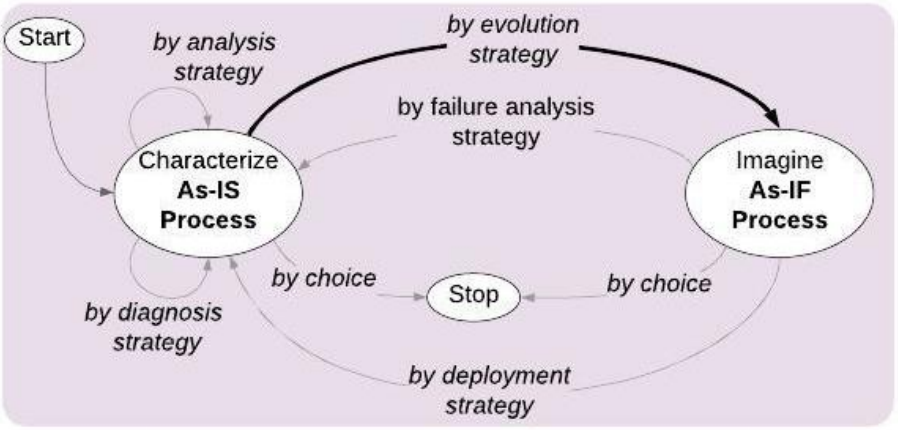


Fig. 54: CEFOP process model, illustrating the strategy proposed to Imagine AS-IF.

Change designates the modification introduced in the process; the elements to be modified and the nature of the modification. In general, it characterizes the continuity of the question "*What if …?*". For example, we can assume that a possible change in the ISD process is to imagine how the process will behave *What if a new client manager is employed*? This improvement scenario is shown in Fig. 55. Each change is associated with a timeline constraint, stating the time and the milestones required to deploy this change. As illustrated, Fig. 55, the change *"employing a new client manager"* requires a time-lapse of four months to be deployed: the first milestone of three months to recruit the employee and a second milestone of 1 month to form him/her to be fully operational.

To imagine the AS-IF business process, each change must be detailed into ***operational changes***, each detailing how an element of the As-IS process is affected to obtain its corresponding in the imagined As-IF version when the change is implemented. Going back to the example of ISD, when imagining to *employ a new client manager*, one possible operational change can affect the role *client manager* altering the number of actors grouped in this role and a second one affects the indicator *Review Trial Cycle Time* since the intervention of the client manager will be more rapid due to the increased number of employees.

Each imagined scenario for improvement is evaluated to assess its impact on the resolution of performance blocking points. The ***Evaluation*** of a change in CEFOP is defined by stating which of the As-IS performance concern does the change fulfills; the goal is achieved, and constraint is not violated.

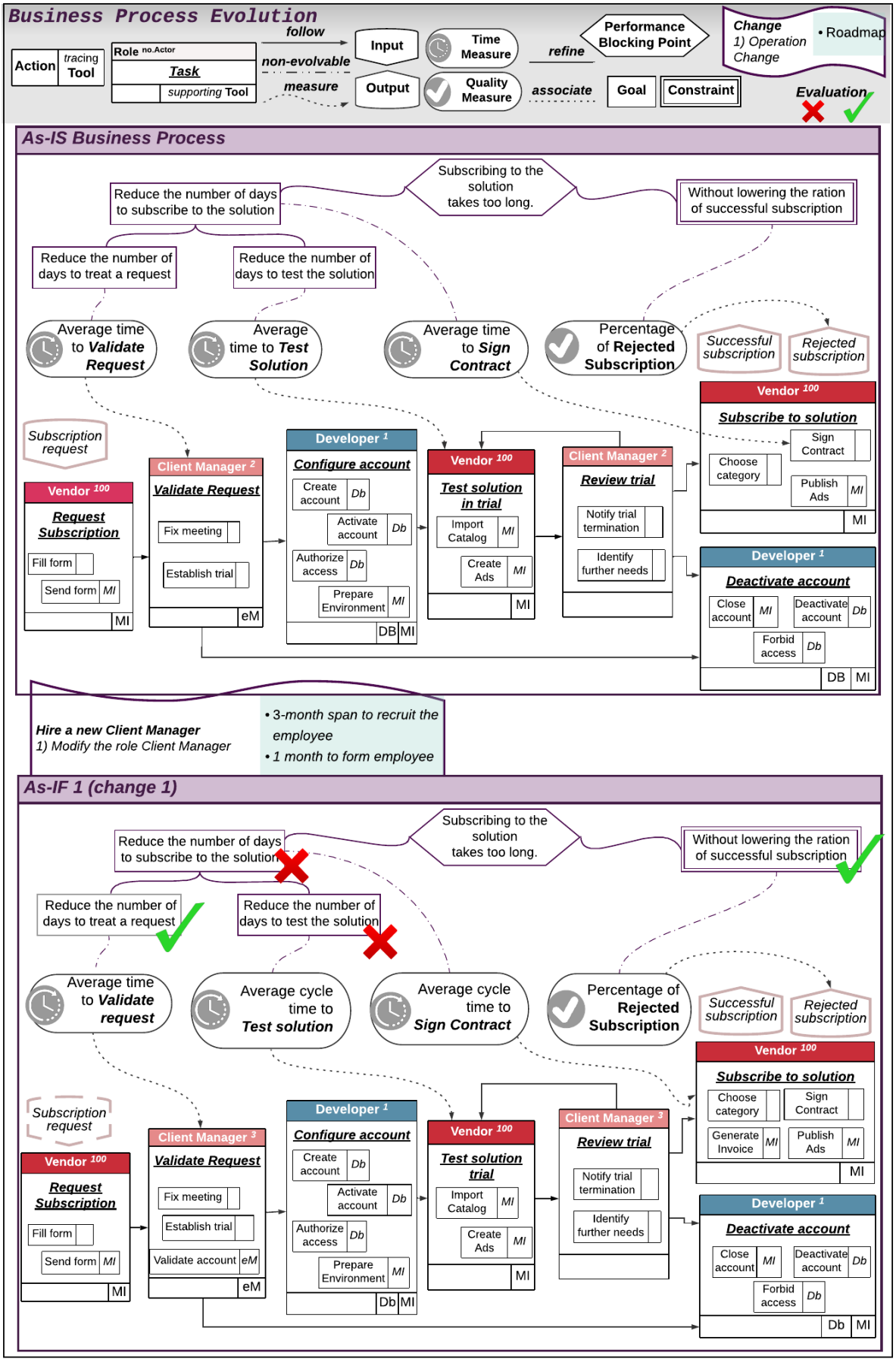


Fig. 55: The As-IF scenario imagined for ISD for "What if a new client manager is employed?"

Several changes can be proposed, and evolution scenarios imagined for improving a business process. Each of these scenarios is evaluated and the better fitting scenario is collectively chosen for deployment. We imagined three evolution scenarios for the ISD process: As-IF$_1$ when embarking change 1 "*What if a new client manager is employed",* As-IF$_2$ *What if the task Review Trial is automated in MI?* and As-IF$_3$ imagining a scenario when both of these changes are embarked. Out of these propositions, the third scenario is most satisfying, resolves most performance concerns. The three imagined scenarios of improvement are illustrated and evaluated in Appendix IV.

5.5.1.1. CEFOP Evolution Product Meta Model

The evolution product meta model fragment is composed of three metaclasses in CEFOP, Fig. 56*;* ***change, operational change,*** and ***evaluation.*** Each of the metaclasses is instantiable up to the M1 level since they refer to alteration and evaluation performed on the model level and not to a specific instance of the business process.

Change metaclass refers to a possible solution that is proposed to resolve at least one performance concern previously defined in the As-IS business process. Each change is paraphrased as a brief ***description,*** stating the modification to be deployed and what is to be changed. Additionally, CEFOP characterizes it by a ***roadmap,*** a time guideline describing the principal steps for the deployment of this change. AS we previously illustrated, the time guideline of the change *What if a new client manager is employed* is a 3-*month span to recruit the employee and one additional month to form the employee so that he/she can be fully functional*.

Each change is detailed in ***operational changes*** to describe how the As-IF process would be conceptualized. The ***As-IF process*** represents an imaginary state of the process on the assumption that at least one change is embarked. The As-IF process is conceptualized by first defining the components used to model the process and on a second time assessing its performance. The As-IF process is composed of 1) As-IS process components not affected by the operational changes and 2) the new targeted components derived by the operational changes. Once the components are specified, the values of the process measures are assessed according to the As-IF process.

Operational changes are characterized by the ***description*** and ***operation*** attributes, where the description is a text phrase detailing the operation to be performed over a specific process component and the operation describes the type of change. Three operations are supported today in CEFOP; modify an existing business process

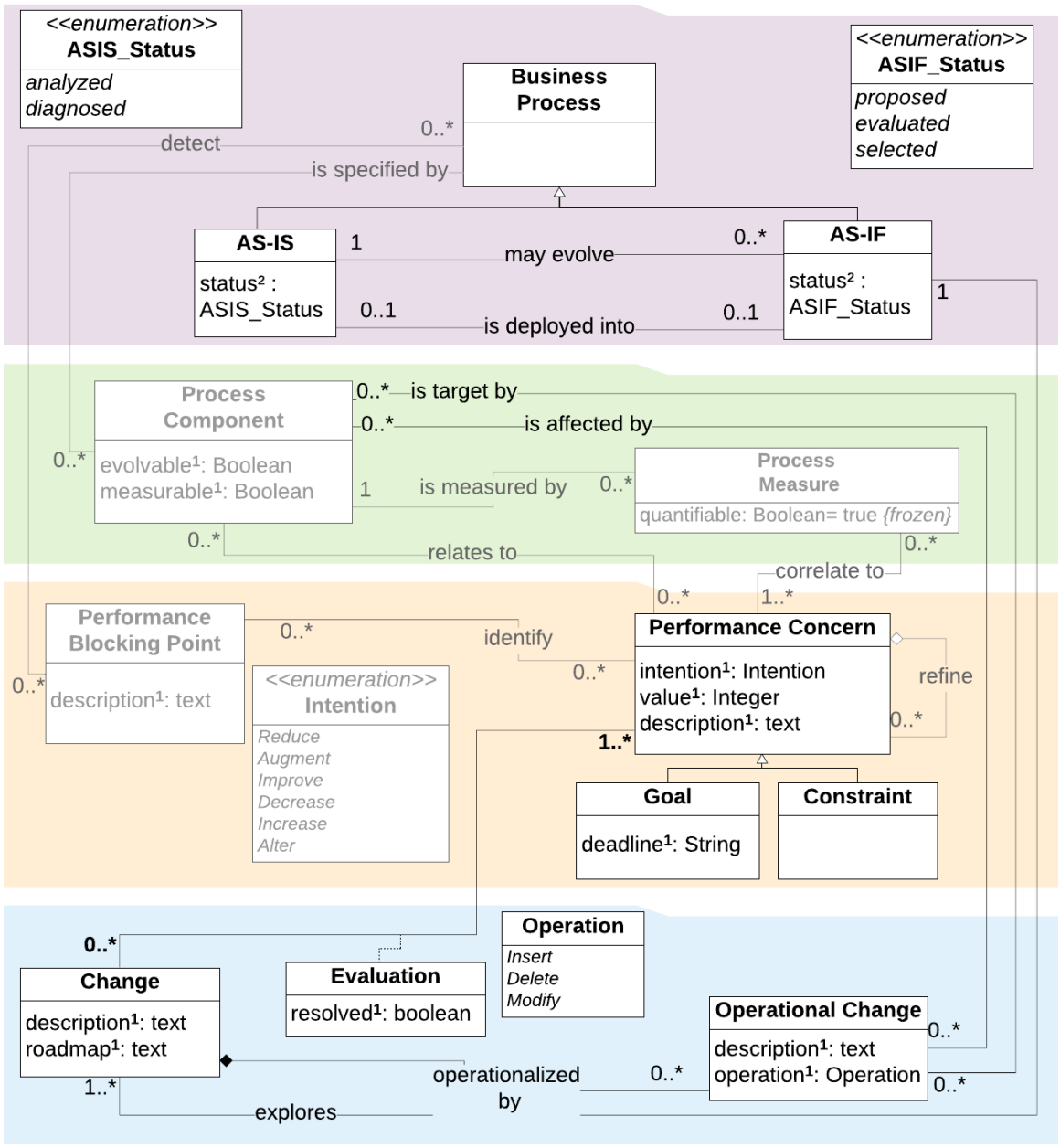


Fig. 56: CEFOP product meta model fragment formalizing Change, Operational Change, and Evaluation.

component to obtain the component of the As-IF process, *Modify the role of Client manager by increasing the number of actors by* 1; Insert- introduce a new component in the As-IF process that doesn't exist in the current state, As-IS and delete- remove form the process a component that exists in the current state but should not be present in the As-IF process. ***Evaluation*** is the last meta-class in the evolution package. It traces whether the explored change resolves the performance concerns. Each couple, change - performance concerns, is associated with a property, ***resolved: Boolean***.

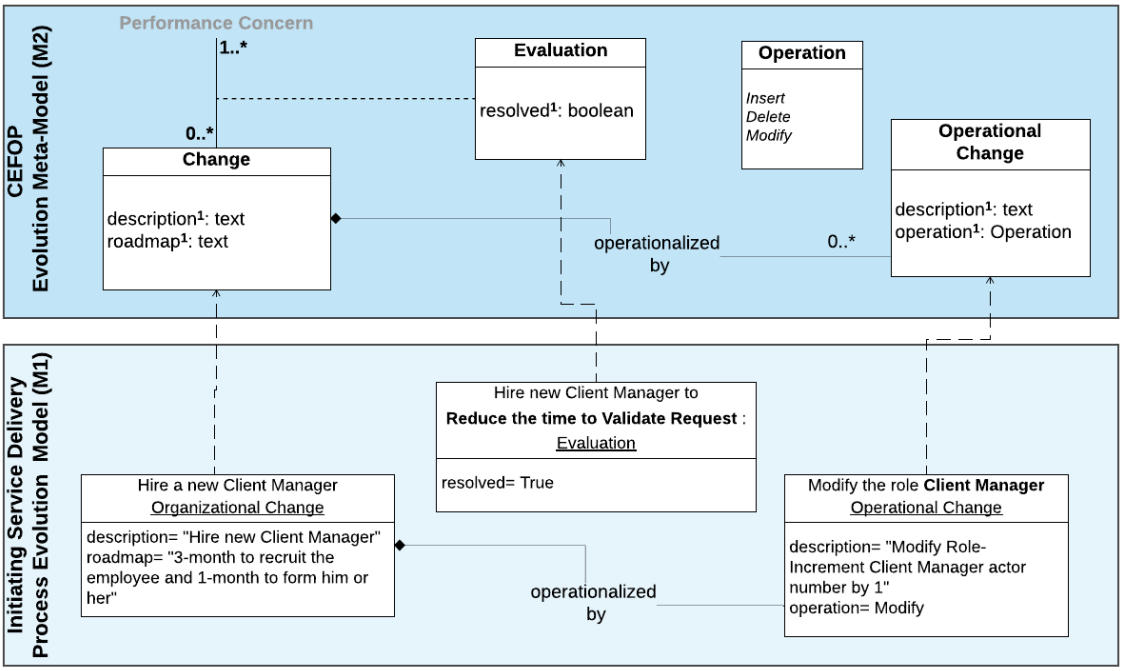


Fig. 57: The CEFOP evolution package instantiated on M1 for the ISD process.

The evolution process model fragment is instantiated for the change *What if a new client manager is employed* in the ISD process, Fig. 57. This change is deployed by imagining over the current As-IS process the operational change, *Modify Role - Increment Client Manager actor number by 1*. To perform such modifications, the change defines a roadmap of 4 months.

When imagining the As-IF process obtained if this change is implemented, only the performance goals *Reduce the number of days to Validate Request* is achieved, *resolved=true*, the remaining performance concerns are not resolved.

5.5.1.2. CEFOP Evolution Process model

The process model proposed in CEFOP for the evolution package aims to attain two intentions, ***Identify Change*** and ***Characterize Operational Changes,*** Fig. 58. We propose three main strategies to attain these intentions:

- ***by exploration strategy*** that identifies all possible changes that can be implemented over the business process to resolve the diagnosed performance concerns.
- ***by operationalization strategy*** which decomposes the identified changes into operational changes targeting the business process components impacted by improvement. This strategy results in the generation of all components characterizing the As-IF process.

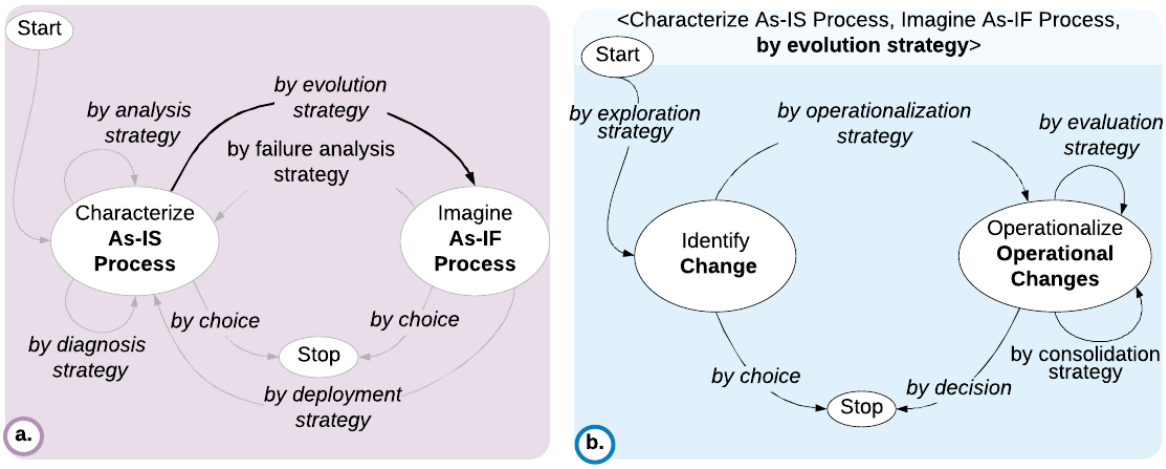


Fig. 58: The a) by evolution strategy refined b) intentional map in CEFOP.

- ***by evaluation strategy*** that aims to assess the performance of the process and the resolution of its performance concerns.

The scope of CEFOP when introducing these strategies remains the same as in the previous steps of process modeling, analysis, and diagnosis: the method proposes to combine different approaches to identify comprehensive, complete, and objective changes.

Comprehension: All involved process participants need to understand how the change will impact their intervention. The AS-IF scenario should be easily readable, and the impact of the change should be easily detected. CEFOP proposes to collectively model the As-IF process, following similar approaches as for process modeling, combining participative and simulation methodological fragments for process redesign.

Objectivity and completeness: Imagining the complete scenario of the transformation permits us to have a complete view of how the possible changes can impact the business process performance and blocking points resolution. For performance assessment we are proposing a similar approach as for As-IS process measures computation, we propose to gather estimated expectation and compute measures upon traces generated through simulation. All process measures are collectively reviewed and used in collective decision making.

At present, CEFOP is not equipped with a detailed protocol describing the steps and techniques to use for process evolution, however here below we are refining the session < *Identify Change, Operationalize Change*, ***by operationalization strategy***> and <*Operationalize the changes, Operationalize the changes*, ***by evaluation strategy***> to describe the main approaches to be followed.

5.5.1.2.1. **CEFOP Process Map for Change Operationalization**

The method CEFOP follows different approaches to well define the set of operational changes related to a change. The process model, we are proposing, has two main intentions, ***Identify Operations*** and ***Model As-IF Process,*** attained by ***proposal strategy*** and *by* ***modeling strategy,*** Fig. 59.

Change operationalization starts by identifying the first set of operational changes following a participative approach, where participants are guided to translate a change into operations based upon their perception of how this change impacts the process, by ***proposal strategy***.

Once the identification of the operation is completed, Model As-IF process intention is to be attained, by ***remodeling strategy.*** During this session, the set of operations identified previously are used to generate the components for the As-IF process. This model imports all existing process components and modifies those targeted by an operation. During this modeling session, the completeness of the set of operations is validated, whether all identified operations are enough to remodel the AS-IF process or additional operations should be introduced. If the last situation is produced, new operational changes must be identified following the ***by reviewing strategy.***

The current state of art proposes several methodological fragments that we can reuse to cover the As-IF remodeling: participative workshops can be structured following existing serious game or role-playing workshop protocols, as well as, analytical working section based on model play-out solution proposing to simulate process execution and detect functional blocking points.

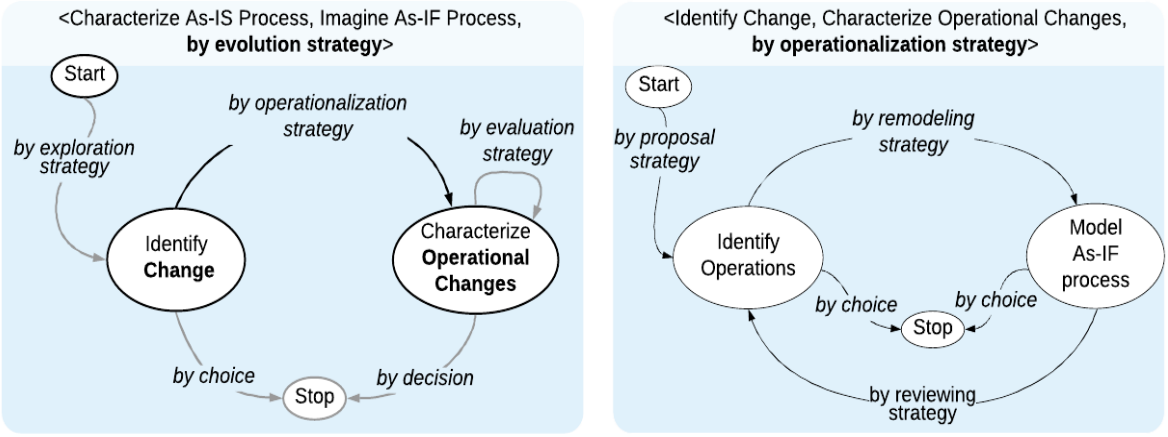


Fig. 59: CEFOP evolution process map and the process model proposed to refine the by operationalization strategy

The operationalization of a change leads to a situation where the proposed operations are not feasible, for this the walkout strategies, ***by choice***, is followed to stop the operationalization of the change and return to the evolution process.

5.5.1.2.2. CEFOP Process Map for Change Evaluation

Another aspect of change explored in the evolution process is the evaluation of its impact. CEFOP refined the evaluation session of the evolution map as shown in Fig. 60. The process has two intentions to be attained: ***Assess process indicators*** and ***Assess performance concerns resolution***, following four different strategies.

The As-IF process performance is assessed by combining the *by* ***estimation strategy-*** where measures values are estimated by process participants based on their perception of the change impact, with the ***by simulation strategy-*** computing process measures upon traces generated through process play-in approach**.** Like the consolidation approach proposed when assessing the performance of the As-IS process, the ***by consolidation strategy*** permits to confront the perception of participants with an objective outcome from the evidenced-based approach.

Once process performance is assessed, the evaluation process continues with assessing the resolution of performance concerns that emerged during As-IS diagnosis, ***by evaluation strategy***. This approach is imagined as a collective workshop where all involved actors, based on the process measures valuation, decide whether the goals are achieved, and constraints are respected. This evaluation is performed by comparing the values of the process measures associated with each goal or constraint with the value to be attained by this concern. At present, CEFOP performance concerns can be either achieved or not. The method doesn't track the partial achievement of a goal or concern.

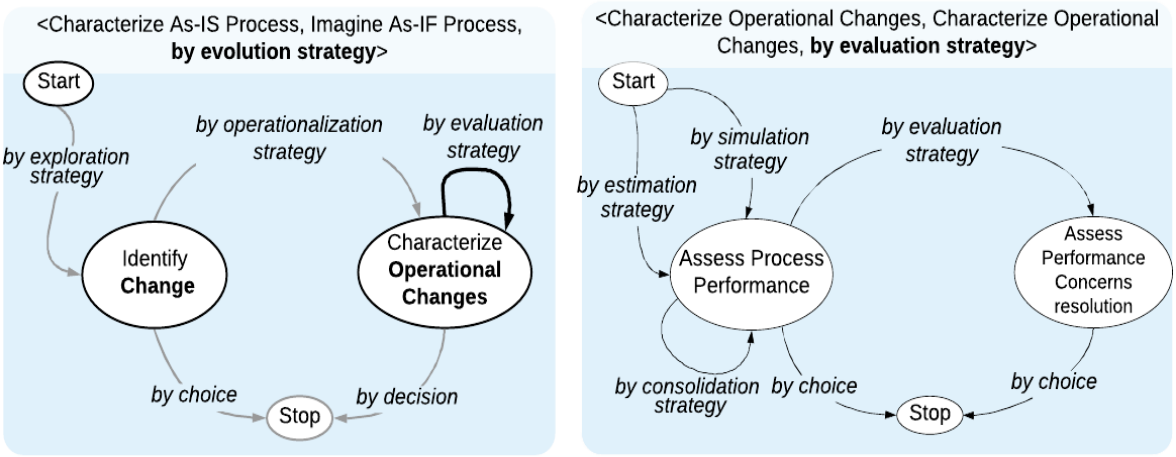


Fig. 60: CEFOP evolution process map and the process model proposed to refine the by evaluation strategy

5.6. CEFOP Global View and Happy Path

This chapter introduced CEFOP formalization, composed of the product meta model and the process model proposed to guide continual evolution of business processes, taking into consideration the organizational aspect of SME (small or medium enterprise).

The method introduces an approach that combines participative and evidence-based methodological fragments and consolidates their artefacts to obtain more complete, comprehensive and objective; analysis and diagnosis of the existing state of the business process As-IS and imagining of evolution scenario, As-IF.

Additionally, this consolidation aims to facilitate the collective decision making by allowing:

- Process participants to realize the gap between their perception and the reality. Each actor is given the possibility to have an objective view over his activities, which facilitates the comprehension over the need to change.
- The confrontation of different points of view and interest. The evolution of the business process impacts the strategical and operational level of the organization. The empowerment of actors in the improvement process allows them to express their point of view and collectively agree on the most convenient scenario for the evolution.
- The representation of a more reality conformant scenario for the evolution. The artifacts used in the construction of the scenario are objective, which induces to the detection of the best way to change the business process and having a better view of the change impact in the future. This element provides a clear view of what is to be expected once the change is deployed and motivate participant in change acceptance.

The method product meta model and process model are grouped in four packages, describing respectively:

Core: The two principal artefacts, As-IS and As-IF process, generated when planning the business process improvement and the roadmap to attain these intentions.

Analysis: The business process components used to model it and process measures used to assess the process performance and the strategies proposed to generate these artefacts**.**

Diagnosis: The performance blocking points and concerns related to the business process and the process for business process diagnosis.

Evolution: the remaining products defined when planning an improvement of business process, Change- a possible solution explored for improvement to resolve the blocking points, Operational Change- the steps taken to deploy the change into the business process and Evaluation- the impact of the change in the achievement of goals and non-violation of constraints.

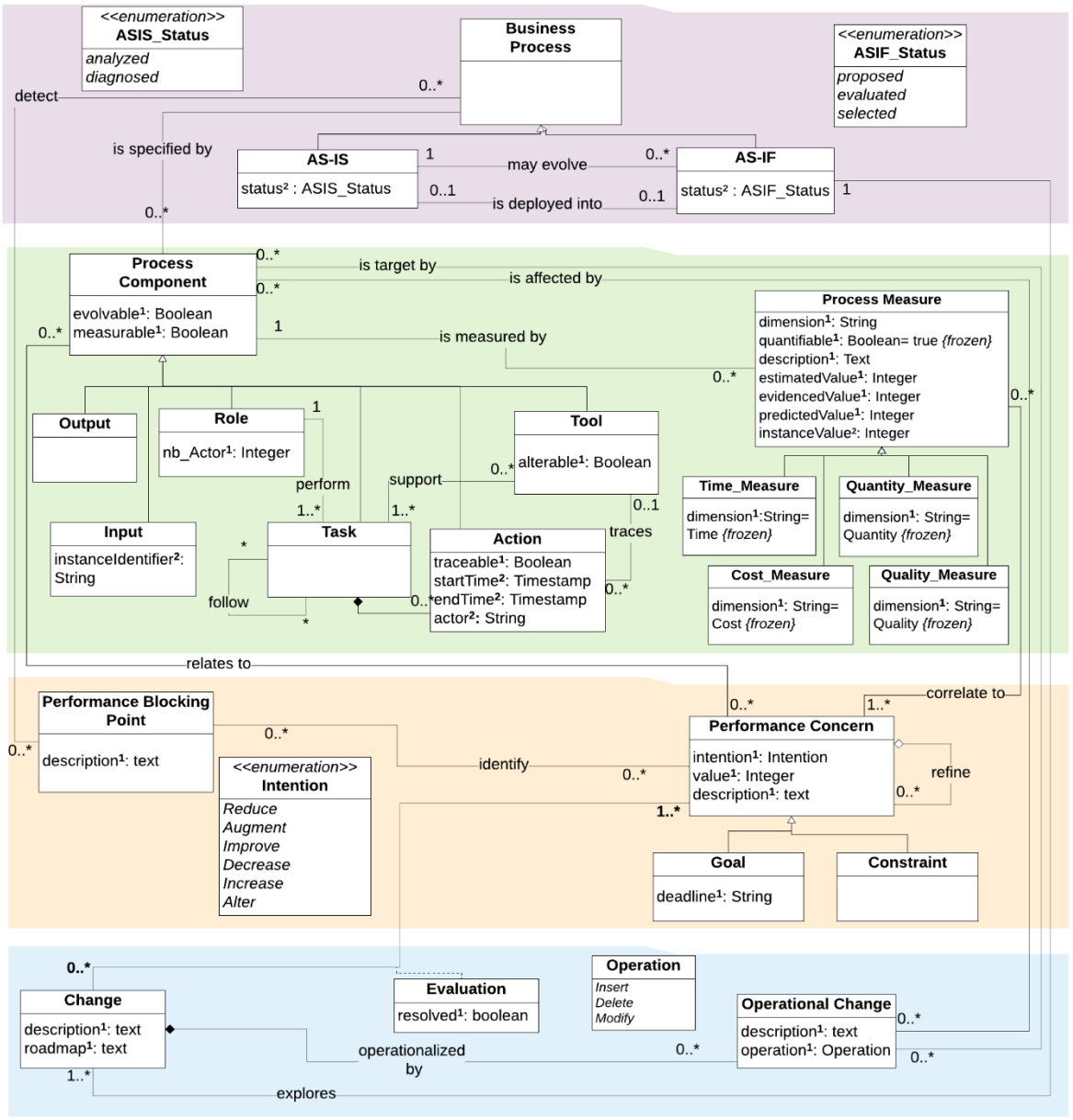


Fig. 61: The complete product meta model of CEFOP.

CEFOP complete meta-model is illustrated in Fig. 61 and the process models with all refined sessions are illustrated in Fig. 62. We modeled the intention to be attained when improving the business process using intentional map formalism to illustrate the

possibility and liberty given to the method analysis to adapt the order of steps to follow when planning business process improvement. As previously discussed, we can follow different orders of steps: a. start with process analysis, diagnosis, and then evolution or b. start with diagnosis, then analyze and lastly plan the evolution.

This liberty is also given on the level of components to be defined within one step, where the process analyst can choose for example to identify the process component in the analysis strategy and then go through diagnosis, to detect the performance blocking points and concerns and latter return and develop the process measures.

The path that we are recommended and followed to plan the improvement of the ISD process is shown in Fig. 63. We are referring to this order of steps as the happy path and we propose:

1. Start by initializing the intervention, outlining the business process, and detecting the first set of performance blocking points and concerns.
2. Processed with process modeling; first model the process participative, then analytically, and lastly consolidate this artifact.
3. In parallel define performance concerns and measure process measures. These steps as discussed in 4.4 are dependable one from the other so multiple exchanges between their tasks are necessary.
4. Elicit the change and operationalize it by modeling the As-IF process.
5. Lastly, evaluate the imagined evolution scenario.

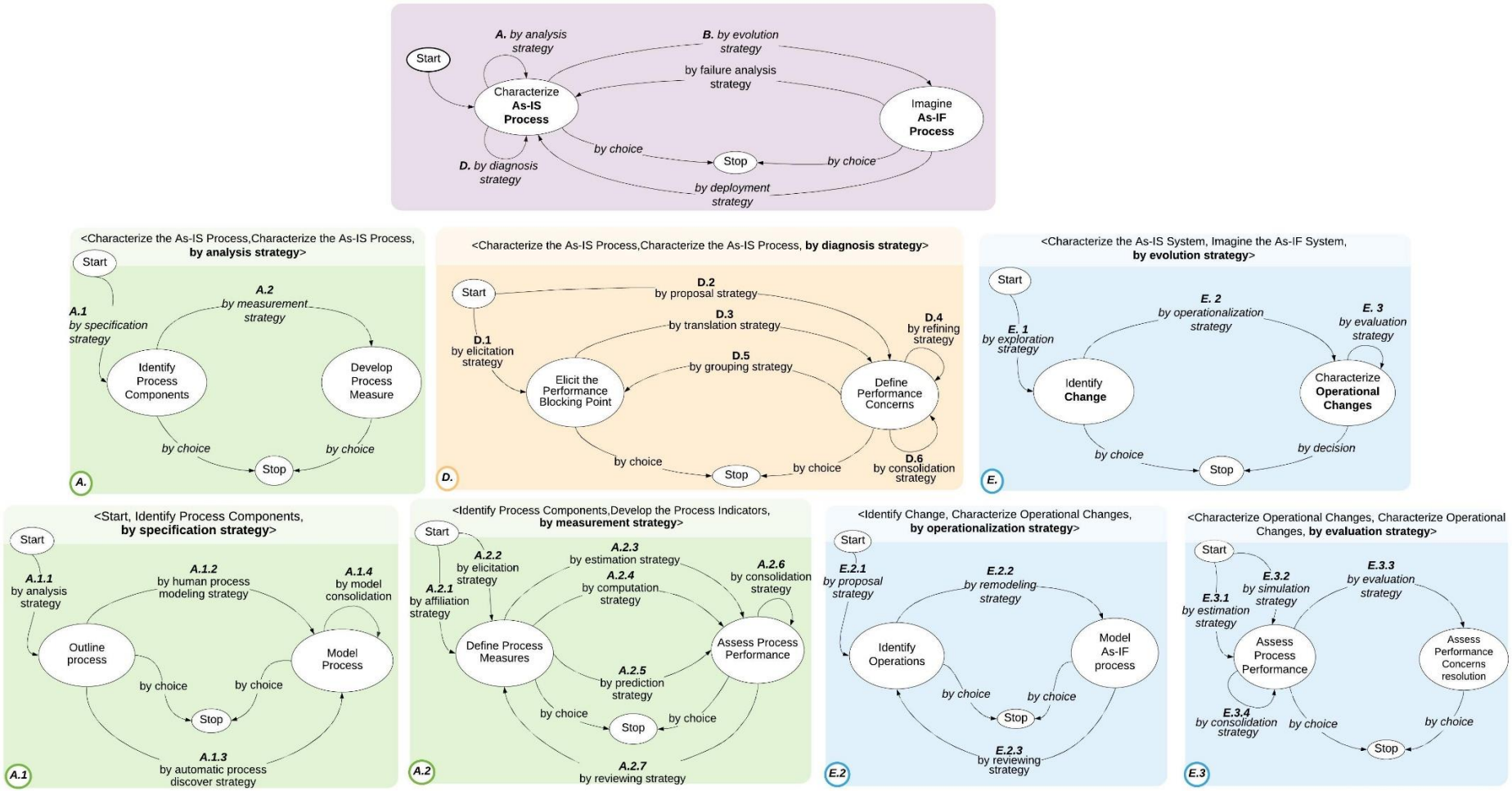


Fig. 62:The process model of CEFOP and all refined sessions.

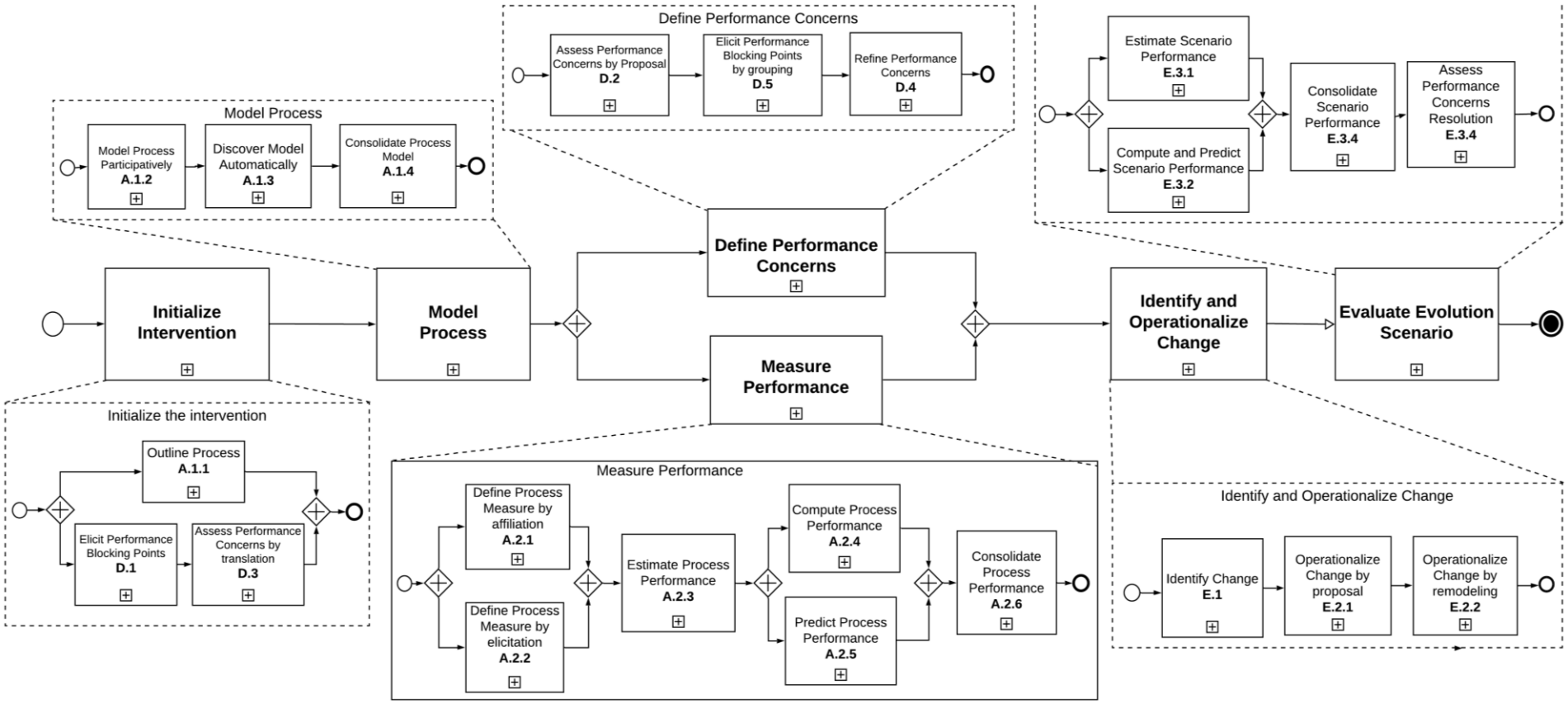


Fig. 63: CEFOP Happy Path: The recommended order of steps for business process improvement.

Chapter 6. As-IS/As-IF Framework

6.1. Introduction

Business processes are not the only type of systems within an organization that continually faces the need to evolve. Ecosystems, information systems, products or services, patterns of collaboration, etc., are required as well to continually evolve; improve and innovate. These evolutions might trigger the engagement of a method engineer to construct or adapt a method to guide each type of evolution of a given system within a given context. The choice of the method to be followed depends on:

- *the type of system to be evolved*. Depending on the system, the choice of the method can be oriented toward Lean-Six-Sigma, ISEA, PM² that cover the continuous improvement of business processes; Lean Manufacturing to improve production and manufacturing chains; ADInnov to understand and support innovations in ecosystems, etc.
- *the type of evolution (improvement or innovation)*. Methods such as Lean-Six-Sigma, ISEA, PM², Lean guide the continuous improvement of a system whereas Design Thinking and ADInnov focus on innovation
- *the type of approach.* Some methods follow a creative and participative approach, such as ISEA, ADInnov, Design Thinking, ... where actors are involved in the evolution process, whereas other methods, such as Lean-Six-Sigma or PM² generate the evolution artifacts following analytical approaches.

Each method proposes its cycle of steps and ways to characterize the artifacts guiding the evolution. Today, method engineers must deal with this vast and variable context when charged to construct a method guiding the continual evolution of a given system. They are led to explore and analyze several methods to define 1) the steps to be followed and methodological fragments to use for the system evolution and 2) the artifacts to be formalized, which can be time-consuming and result in the construction of an incomplete method.

To facilitate and structure the construction of continual evolution methods, we propose As-IS/As-IF, a framework composed of a product meta-model and a process model, that method engineers must adapt when constructing a target method. The target method is a method guiding the continual evolution of a system in a given context.

Besides the guidance of continual evolution, As-IS/As-IF contributes also to install a culture of continual evolution within the organizations. The framework

provides a global guide to plan continual evolution, by describing the main steps and artifacts, which permits organization employees to have a clearer and better-structured view of the continual evolution process, increasing so their empowerment.

6.2. The As-IS/As-IF Framework

While constructing CEFOP, we noticed that methods guiding continual evolution share similar intentions, which induces an affinity in the set of artifacts manipulated while planning the evolution. As discussed in 3.4 and illustrated in Fig. 68, continual evolution methods (CEFOP, ADInnov, Lean, Design Thinking, etc.), even though guiding different types of evolution, on different systems and following different approaches, handle the same kind of artifacts that can be categorized, in:

- **System components**, grouping all concepts used by a method to describe the system and its context. In ADInnov, the ***ecosystem*** is composed of ***roles, functions, points of views***, etc.; CEFOP specifies the ***business process*** using the concepts of ***roles, tasks, actions, inputs***, etc.; Lean describes the ***manufacturing system*** through ***flows, activities, resources, clients***, etc.
- **Features**, characterizing the system to be evolved: ***ADInnov*** characterizes the ecosystem through ***blocking point*** triggering the need to innovate, in ***CEFOP*** business process improvement is triggered from ***performance blocking point***; ***Design thinking*** through ***customer needs***, ***Lean Manufacturing*** by identifying ***wastage***, etc.
- To answer these needs, ***CEFOP*** and Lean ***Six Sigma*** propose to ***improve*** the business process, ***ADInnov*** to ***innovative the services,*** and ***Lean*** to ***improve the flow***.

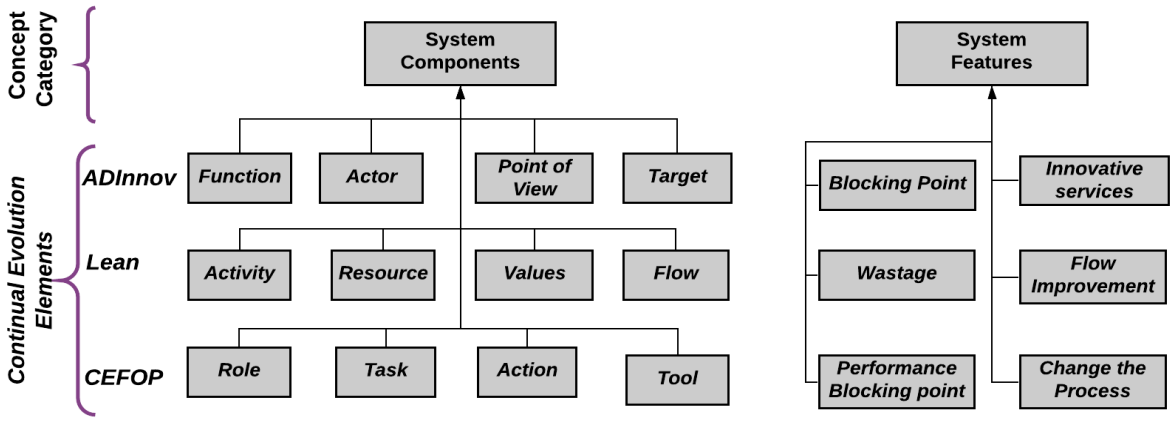


Fig. 64: The artifacts characterized by continual evolution methods, grouped on concept category.

The As-IS/As-IF framework generalizes:

- the similar artifacts, identified in these continual evolution methods into a product meta-model,
- the similar intentions to be attained in these continual evolution methods into a process model.

Like CEFOP, As-IS/As-IF concentrates on the planning of the evolution, leaving out of its scope the three remaining steps in the Deming Cycle; the change implementation (DO), its absorbance (CHECK), and its enactment (ACT). The process model and the product meta-model of the As-IS/As-IF framework are structured into 4 packages, as shown in Fig. 69. Like CEFOP, to differentiate the behavior of meta-classes in the product meta-model, we are using the in-depth instantiation[54], where each meta-class and attribute is assigned a tag, a number indicating its level of instantiation. For example, **system components** meta-class is instantiated on level 0, instance level, thus the meta-class is tagged with the index 2, whereas blocking points and changes are valued on the model level since they describe features of the whole system not associated to a single system instance.

Core package structures the **system** in the target of the evolution. The term system refers to the artifact to be evolved, for example, in CEFOP the system is the ***business process,*** and in ADInnov the ***ecosystem***. This package illustrates the association between the existing state of the system, **the As-IS,** and the imagined evolution scenarios, **the As-IF**. The process map introduces, in this top-level, five mains phases to 1) Characterize the As-IS system and 2) Imagine the most propitious As-IF scenario for the system; **analysis, diagnosis, evolution, failure analysis, and deployment**.

Analysis package formalizes all the artifacts characterizing the **analyzed** As-IS system, which are the components specifying this system and its context and the measures used to assess its state. These artifacts relate to the two intentions 1) **Identify Components** and 2) **Assess Measure**, attained through two strategies; by specification and by measurement strategies.

Diagnosis package gathers all concepts derived when diagnosing the system: **blocking point**, issues detected in the system and their **concerns**, and business objectives to be achieved. These artifacts relate to the two intentions to be attained in the process map:

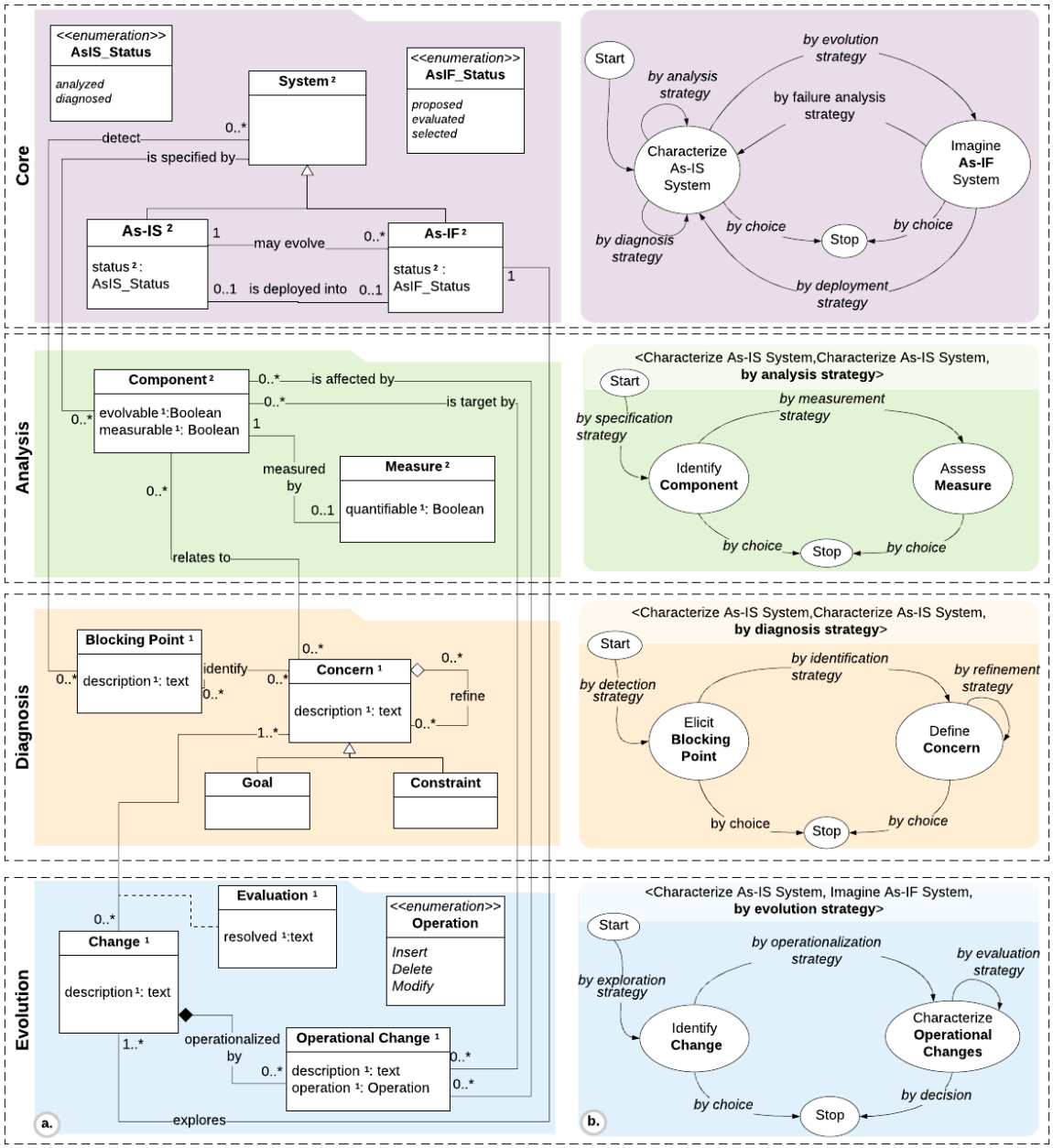


Fig. 65: The models of As-IS/As-IF Framework
a) the product meta-model and b) the process model

1) **Elicit Blocking Point** and 2) **Identify Concerns**. The diagnosis map presents two strategies to attain these intentions, that must be structured by the method engineer.

Evolution package assembles all artifacts related to evolution; the possible **changes** that can be undertaken and their **operationalization**. To attain them, three strategies are proposed in the process map: exploration strategy to identify the changes, operationalization strategy to characterize each of the changes by their corresponding set of operational changes, and evaluation strategy to assess the change impact.

Each one of these framework packages is described more in detail in the upcoming sections and their adaptation illustrated in CEFOP and ADInnov. The

adaptation of CEFOP resulted in the second version of its product meta-model and process model which were detailed in chapter 5.

6.2.1. **As-IS/As-IF Positioning towards Method Engineering**

Before proceeding with the framework explanation, we are discussing in this section the formalization of As-IS/As-IF and the heuristics proposed for the adaptation.

To formalize the similarities evidenced in continual evolution methods in the framework, we turn towards Method Engineering. This discipline is defined as "*the engineering discipline to design, construct and adapt methods, techniques, and tools for the development of information systems*" [55], but we are not limiting to the development of information systems. As previously illustrated, As-IS/As-IF can target different types of systems such as ***ecosystems*** (ADInnov), ***business processes*** (CEFOP), ***production processes*** in manufacturing chains (LEAN). Thus, it is wider in terms of target, but more restrictive in terms of development cycle since it addresses only continual evolution.

As-IS/As-IF process model and product meta-model are dedicated to a method family [20]of continual evolution methods. The approaches proposed in ME for the construction of a method, are classified according to the input knowledge[17][18], to:

- the ad-hoc approach concerning the construction of a method "from scratch"
- the assembly-based approach proposing to reuse and compose method components (fragments, "method chunks", services…) to construct a specific method or a method family
- the extension-based approach consisting of extending a method to produce a new one
- the model-based or paradigm-based approach, where the construction of a new method is realized by instantiation or adaptation of models [20] [21]

The approach which we are adopting for As-IS/As-IF framework is a model-based approach by adaptation where the framework product meta-model and process model and target product meta-model and process model (i.e. product meta-model and process model of the target method) are at the same abstraction level, Fig. 66.

The target process model is an adaptation of the As-IS/As-IF process model, conformed to the MAP formalism. Therefore, this adaptation is limited to the strategy refinement techniques proposed by this formalism. On the low-level refinement, it is

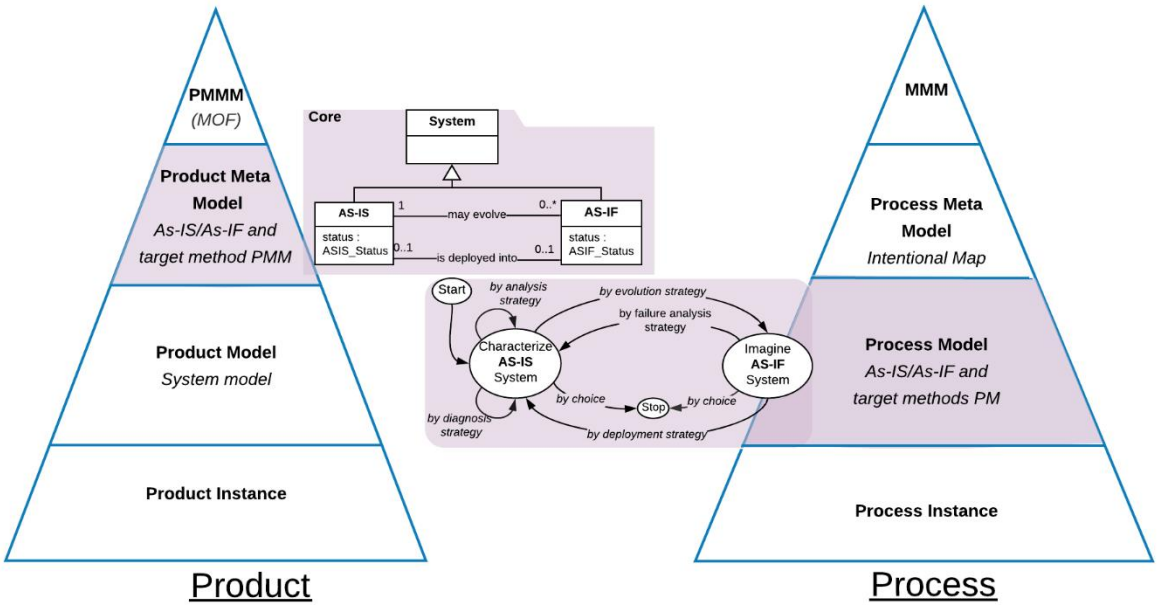


Fig. 66: The positioning of the As-IS/As-IF product meta-model and process model towards the OMG pyramids

interesting to adopt the assembly-based approach inciting method engineers to reuse method fragments for strategies deployment. Two kinds of assembly approaches are proposed in the literature [17]:

- association approach dealing with assembling methodological fragments with different objectives;
- integration approach consisting to assemble methodological components having similar objectives but different manners to achieve them.

The association approach is particularly interesting to finalize the process model of the target method. For example, CEFOP followed this approach by associating a fragment of the ISEA method in the refinement of the analysis map to identify the business process model components, following collaborative and participative guidance. ADInnov also reused methodological fragments from various disciplines: CAUTIC to validate innovation, serious game players to imagine innovations, etc.

Same as the process model, As-IS/As-IF product meta-model is constructed based on the model-based approach and left purposely incomplete; so, it cannot be used without adaptation. This justifies the non-proposing of a concrete syntax (notation) associated with the meta-model. Instead, when adapting the product meta-model, the method engineers must propose a notation associated with the various concepts of their language. In Chapter 5, we presented the notation elements introduced in CEFOP, corresponding to each concept defined when evolving a business process.

6.2.2. **Heuristics of As-IS/As-IF Prototype Adaptation**

The As-IS/As-IF product meta-model and process model prototype must be adapted and enriched to adequately represent the context of the target method. Nonetheless, this adaptation must be carefully performed and respect the dependency between the two models. The process map illustrates the fundamental strategies taken to obtain the artifacts formalized in the product meta-model. To ensure the consistency between these models, two rules are proposed:

1) Each meta-class in the product meta-model is translated to an intention to be attained in the process model. The name of the intention is composed by the name of the meta-class and a verb describing the operation to be performed; identify, elicit, characterize, etc.
2) Each association between meta-classes corresponds to strategies followed to attain an intention. The strategies are named using the structure "by *noun* strategy" as proposed in the MAP formalism, where "noun" derives from the association label.

In addition to these rules, As-IS/As-IF is equipped with a set of heuristics guiding the adaptation of the framework prototypes to generate the target method product meta-model and process model.

Heuristic 1: ***Core package cannot be extended.***

The concepts, introduced in this package, refer to states that the system goes through when planning the evolution. As-IS and As-IF are the only two artifacts characterized in the package through five strategies; analysis, diagnosis, evolution, failure analysis, and deployment.

Heuristic 2: ***Meta-classes and stipulated intentions can be renamed, but not deleted or added.***

The method engineer must rename the system meta-classes and the corresponding intentions in the core package to clearly state the object target of the method for the continual evolution. For example, when constructing CEFOP, the **system** is renamed to the ***business process***.

The meta-classes and intentions in the analysis, diagnosis, and evolution package refer to artifacts defined to characterize As-IS and As-IF when planning the

evolution. Method engineers are strongly encouraged to adapt their names to the discipline or the context of the evolution. Some examples of ***blocking point*** meta-class renaming are shown in Fig. 64: ***performance blocking point*** (CEFOP), ***customer needs*** (Design thinking), ***wastage*** (Lean manufacturing), etc.

Heuristic 3: ***Strategies and associations can be renamed, or new ones introduced but they cannot be deleted.***

Method engineers have the liberty to change the name of the strategy if they correlate with the corresponding association in the product meta-model. Additionally, they can introduce new strategies or associations in their model if needed to state additional relationships between the concepts.

Heuristic 4: ***Analysis, Diagnosis and Evolution package can be extended; a meta-class as class diagrams and a MAP session refined as sub-maps***.

Metaclasses and intentions refer to concepts manipulated when planning the evolution, they are specified during the adaptation. The method engineer can extend each concept to better delineate the artifacts representing the system and its context. The metaclasses can be extended as a class diagram where the meta-class of the framework becomes the superclass. Method engineers are strongly invited to extend the ***component*** metaclass to introduce all the concepts used to model the targeted system; for example, in CEFOP we extend the process component metaclass and specialized it in ***task***, ***role***, ***path***, *etc.*

The adaptation of the process model implies the operationalization of each strategy by the method engineer when constructing the target method. For this, the method engineer can refine a section in the map to illustrate that the complete achievement of an intention is obtained either 1) through the attainment of a series of sub-intentions or 2) through the usage of different methodological fragments. CEFOP refines <Start, Identify process components, ***by specification strategy***> to describe the three strategies; participative, evidence-based, and consolidation used by the method when modeling the business process.

Heuristic 5: ***Enumerations and attributes can be enriched and added but cannot be removed.***

The product meta-model proposed in As-IS/As-IF is incomplete and it's up to the method engineer to enrich each meta-class with the corresponding set of attributes and required enumerations.

The attributes proposed in the framework for each meta-class refer to aspects of the concept that must be obligatorily defined during the evolution. To this intent, none of them can be removed, but their type can be adapted to better conform to the context. Similarly, the three enumerations introduced by As-IS/As-IF (AsIS_Status, AsIF_Status, and Operation) cannot be removed since they represent the state of As-IS and As-IF system or the elementary type of operation to be performed.

The following sections detail the packages of the As-IS/As-IF framework and illustrate the usage of these heuristics when adopting the framework to CEFOP method which guides the continual improvement of business processes and ADInnov method that understands and supports innovations in socio-technical ecosystems.

6.3. As-IS/As-IF Core Package

The core of the framework groups the metaclasses representing the system and the strategies for attaining their corresponding intentions. As-IS/As-IF formalizes the same proceeding, as introduced in CEFOP, to plan the evolution of a system, Fig. 67: starts with the characterization of the **As-IS system** and pursuits with the imagination of the possible evolution scenarios, **As-IF** systems, out of which the most propitious is chosen to be deployed over the system. The deployment of the change generates a new version of the As-IS system. We are using the term "***The world of As-IFs"*** to group all scenarios of evolution that can be explored for an As-IS system.

The As-IS/As-IF core package is composed of a product meta-model and a process model, Fig. 68. In the product meta-model, the **System** meta-class refers to the artifact subject of continual evolution and its outlining. This meta-class is specialized into **As-IS** and **As-IF** referring to the existing state of this system and the possible evolution scenarios. These two states of the system are translated into two intentions to be attained in the process model; 1) **Characterize As-IS System** and 2) **Imagine As-IF System**.

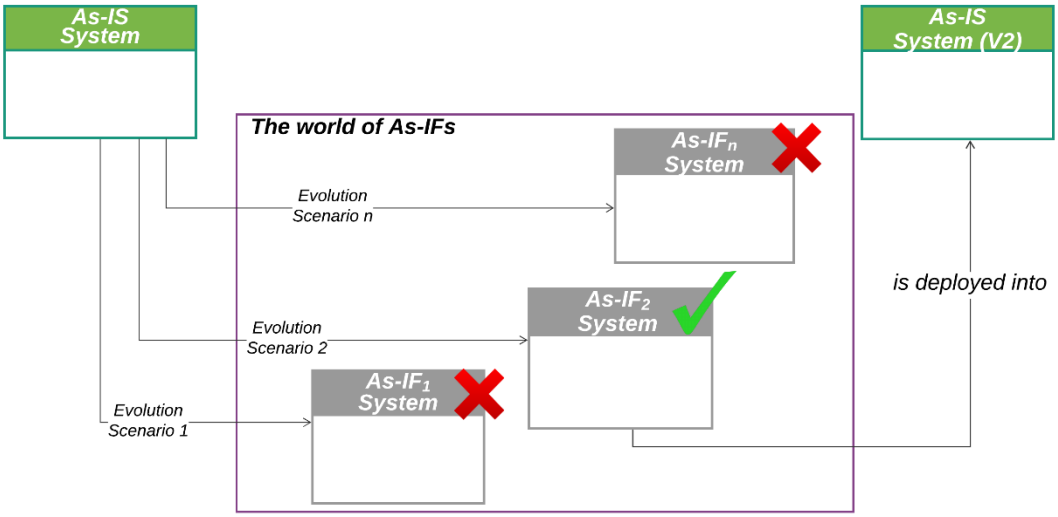


Fig. 67: The path proposed in As-IS/As-IF framework to plan the evolution of a system.

Planning an evolution starts with As-IS System **analysis** and **diagnosis**. The complete As-IS system is obtained out of several cycles of analysis and diagnosis, so both strategies are constantly interchanged to have the complete set of artifacts. The enactment of each of these strategies results in obtaining respectively the **analyzed** and **diagnosed** status of the existing AS-IS system. AS-IS ***may evolve*** into an As-IF. Each evolution scenario is ***proposed*** by imagining at least one change over the As-IS system. All imagined As-IFs are ***evaluated*** to assess the impact of the change and only one of these scenarios can be ***selected*** to be deployed and become the next **As-IS System**.

The exploration of "The worlds of As-IFs" can either complete with the deployment of a chosen change or on the contrary, with the grasping that no suitable evolution scenario is imagined. This last understanding might trigger the need to go back, ***by failure analysis strategy,*** and review the As-IS characterization so that other AS-IFs scenarios can be explored.

As previously discussed in section 5.2, the intentional map formalism is deliberately chosen to model the process in the framework, since it perfectly illustrates the possibility to leap from one strategy to another during the planning of the evolution or/and stop the project at any moment following **by choice strategy**.

The adaptation of the As-IS/As-IF Core package is governed by Heuristic 1, stating that it cannot be extended, and the method engineer must only state the system in the target of the evolution. Dressing the role of the method engineer to construct the core of CEFOP an ADInnov, Fig. 68, we have imported the core package and:

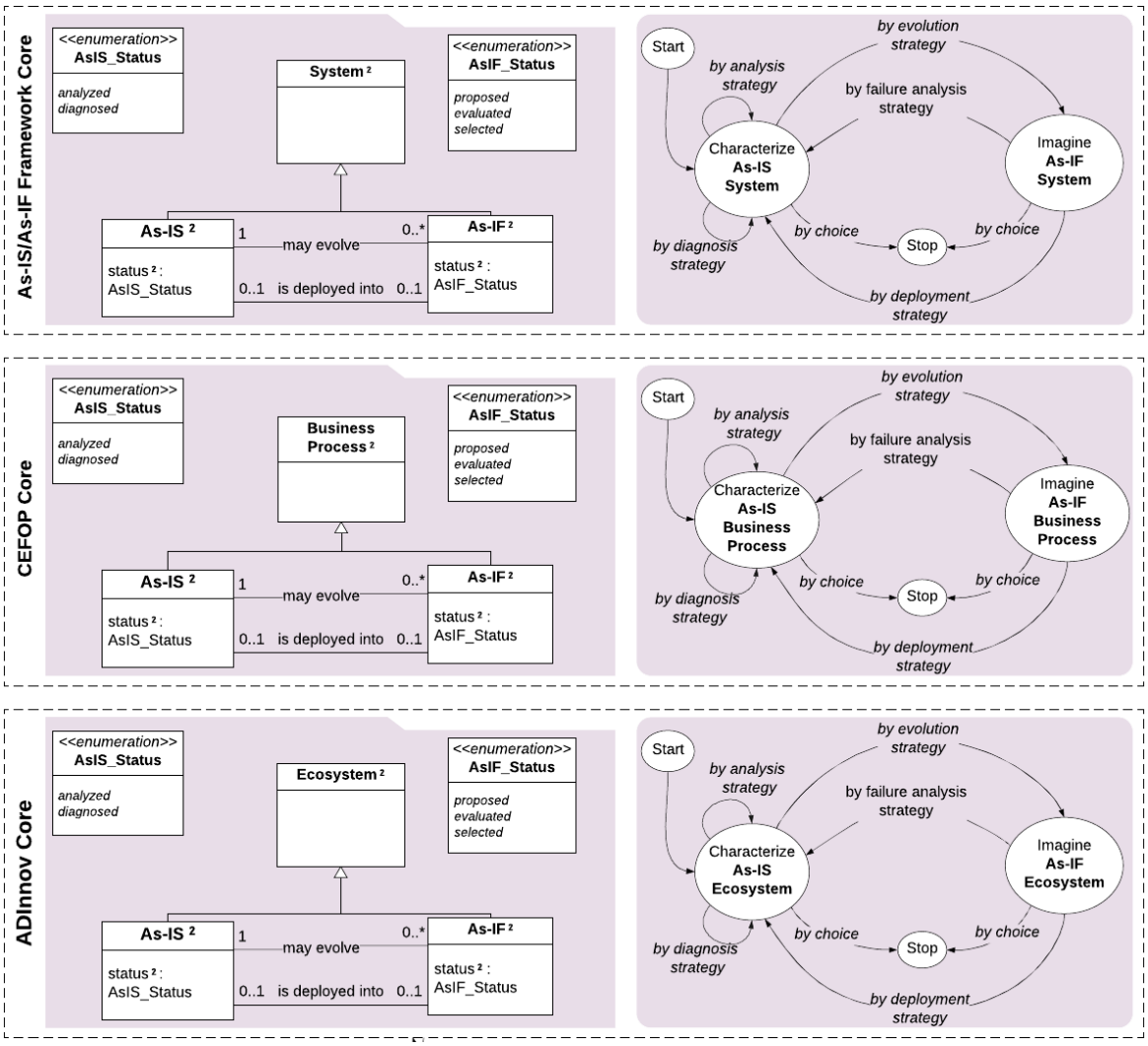


Fig. 68: As-IS/As-IF Core Package and its adaptation in CEFOP and ADInnov; on the left the product meta-models and on the right the process models.

1. renamed the **System** meta-class to ***Business Process*** and ***Ecosystem*** to refer to the system targeted for evolution in CEFOP and ADInnov.
2. renamed the intentions to Characterize As-IS ***Business Process*** and 2) Imagine As-IF ***Process*** in CEFOP and to Characterize As-IS ***Ecosystem*** and 2) Imagine As-IF ***Ecosystem*** in ADInnov.

6.4. The Analysis Package

The analysis package develops how the analysis of the AS-IS system is structured, which are the concepts to be defined and the process to be followed. The product meta-model is composed of two meta-classes, Fig. 69; **Component** and **Measure**. Both these metaclasses are instantiable up to M0 and must be refined and enriched by the method engineer to formalize the artifacts of the target method.

Component group all artifacts used to **specify** the system. This meta-class can be extended in the form of a class diagram, Heuristic 4, to detail all the components modeling the system. **Measure** metaclass represents the concept of the evaluation of a given aspect of the system or its components (**is measured** association). This assessment can be **quantifiable** if system evaluation is computed and valued such as *performance, security, etc.* or **non–quantifiable** referring to a qualitative assessment gathered through observation, such as *satisfaction, happiness, utility, etc.*

Concerning system components, As-IS/As-IF recommends that the system model should not be exhaustive. The product meta-model should be limited to describe those components that are:

- directly targeted by evolution ***(Evolvable)***. The method scope covers their possible modification when aiming to evolve the system.
- essential for system measuring ***(Measurable).*** Each component used by the method to assess a measure used for the system characterization.

A component can be ***evolvable*** and ***measurable*** if the method covers its alteration and usage for measuring purposes. On the other hand, if it is not in the target of evolution or measuring, method engineers are strongly discouraged to formalize this component.

As previously stated, the meta-classes of the product meta-model are translated into intentions to be attained in the analysis process maps; **Identify Component** and **Assess Measure**. The process map starts **by specification strategy**, identifying the system's components, and either pursuit **by measurement** or stop **by choice** strategy.

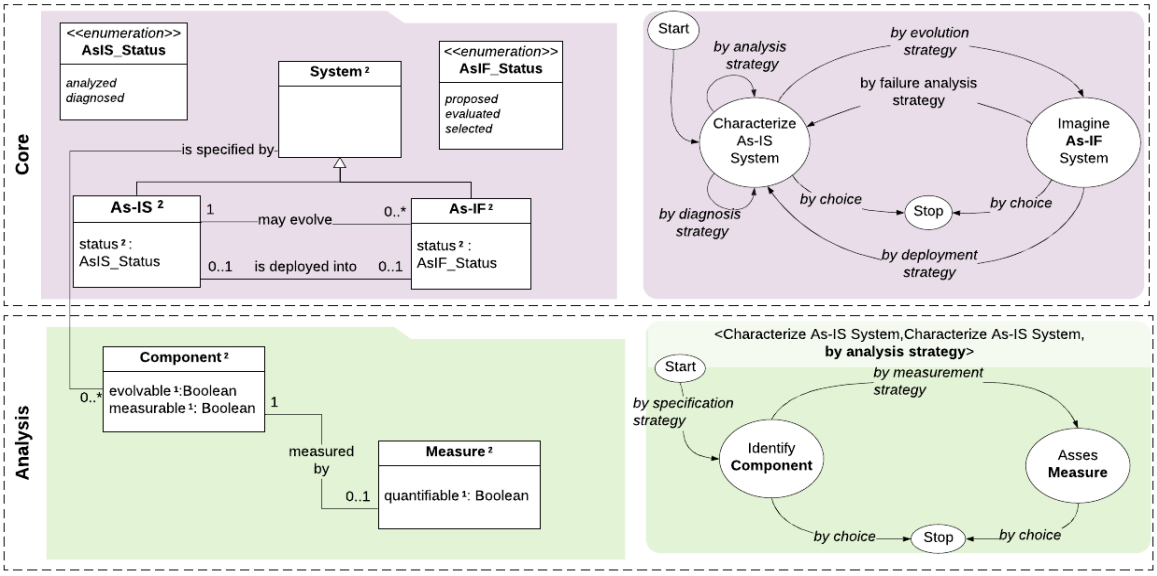


Fig. 69: As-IS/As-IF Analysis Package and its association to the Core.

6.4.1. **Analysis Product Meta Model Adaptation**

When adapting the analysis product meta-model fragment to the context of CEFOP and ADInnov, we exploit Heuristic 2 and rename the metaclasses to ***Process Components*** and ***Process Measures*** in CEFOP and ***Ecosystem Components*** and ***Measures*** in ADInnov, Fig. 70. CEFOP enriches both metaclasses with additional attributes, Heuristic 5, detailing how process components and measures are formalized in the context of the continual evolution of the business process. Also, since the current scope of CEFOP is restrained to the quantitative performance assessment, the ***quantifiable*** attribute is frozen to true in the process measure metaclass.

Both methods extend their component meta-class as a class diagram, Heuristic 4, illustrating so all the components composing the business process in CEFOP and the ecosystem in ADInnov. CEFOP models the business process using the concepts of ***input*** and ***output***, ***task***, ***role***, ***action,*** and ***tool*** whereas ADInnov uses the concepts of ***actor, target***, ***service***, ***function***, ***point of view,*** and ***responsibility network,*** detailed in section 2.2.3. Each proposed class diagram introduces new associations stating the relation between components; **perform, follow**, etc. in CEFOP and **is related to** and **composed of** in ADInnov.

CEFOP formalizes all these components since they are either altered by the method (*participants can propose to change the roles, tools, and task*s) or used for the assessment of process measures. Gateways are not formalized as the method doesn't target their evolution or usage in the assessment of the process performance.

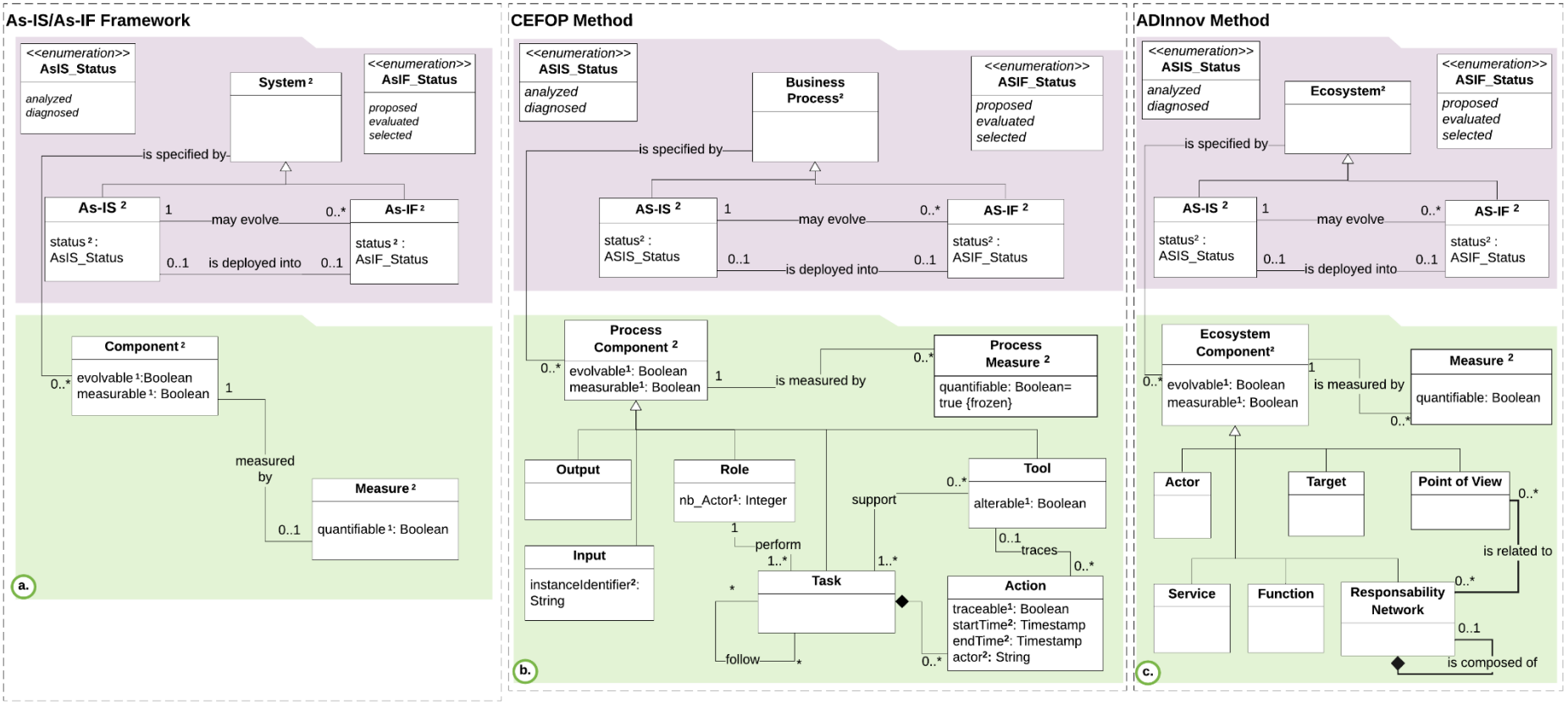


Fig. 70: The Analysis Package and the association to the Core:
a) proposed in As-IS/As-IF framework, b) adapted for CEFOP, and c) adapted for ADInnov.

6.4.2. **Analysis Process Map Adaptation**

The analysis process map adaptation is performed in parallel to that of the product meta-model. CEFOP embarks the maps proposed in the framework and renames the intentions to ***Identify Process Component*** and ***Develop Process Measure,*** Fig. 71. The method imports the two strategies proposed by As-IS/As-IF and refines them into 2 sub-sessions to illustrate the different approaches combined to model the business and measure its performance.

The identification of the process components is translated into two sub-intentions 1) ***Outline process*** and 2) ***Model Process***. CEFOP starts by identifying the inputs and outputs outlining the business process and proceeds with human (***participative workshop***) and automatic (***process mining***) process modeling and concludes with model consolidation (***collective workshop***).

Similarly, process measures development combines participative and evidence-based approaches. The assessment of the process performance is attained by firstly, ***Define Process Measure***- translating business strategy into process measure (***by affiliation*****)** then, ***Assess Process Performance-*** by ***estimating*** measures, ***computing*** and ***predicting*** measures values and consolidating them.

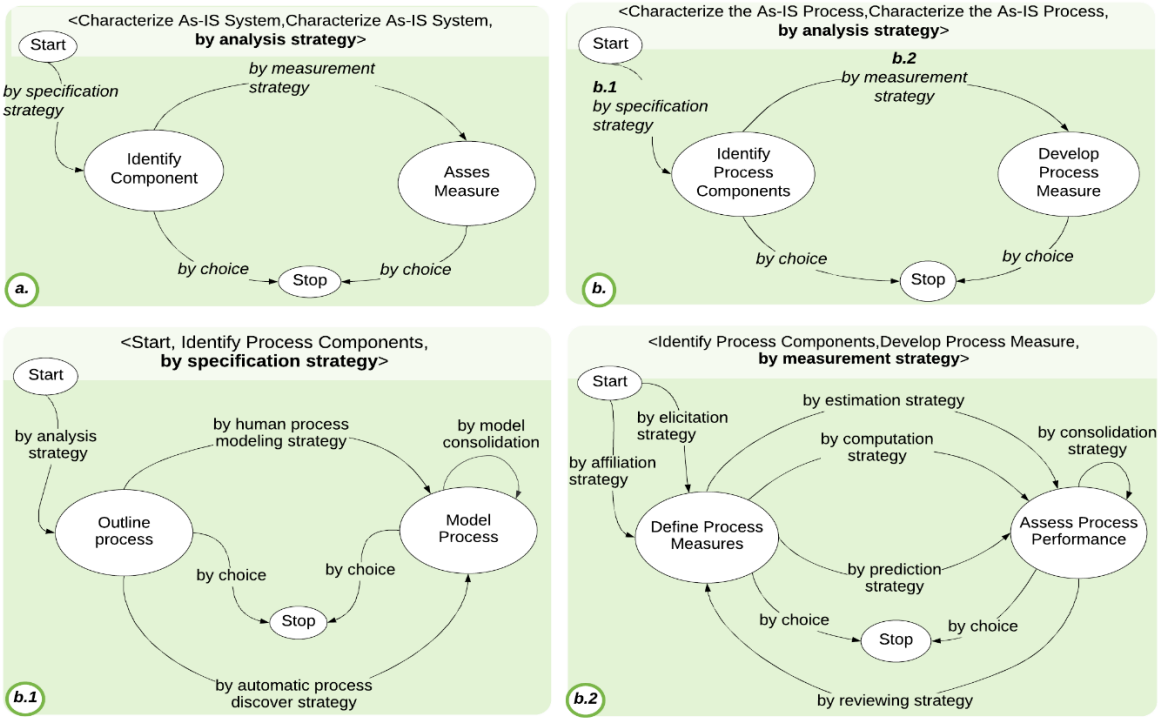


Fig. 71: The Analysis process map: a) proposed in As-IS/As-IF and b) adapted for CEFOP. b.1 and b.2 maps illustrate the refinement of the CEFOP analysis process map

We are not illustrating the adaptation of the ADInnov analysis process map. The adaptation and refinement of the maps to this method context were not performed due to limited time and we preferred to focus on the evolution strategy since ADInnov covers ecosystem innovation, a different type of evolution from CEFOP.

6.5. The Diagnosis Package

The third package proposed in As-IS/As-IF is Diagnosis, and groups the **Blocking Points**- issues or problems detected in the system (**detect** association) and the main **Concerns-** business objective correlated to these issues (**identify** association), Fig. 72. Both metaclasses describe system features and are instantiable up to M1. The method engineer is guided to formalize the diagnosed blocking points and concerns by the method and structure the steps to follow to generate these artifacts in the target method.

Blocking Point refers to an issue or problem in the system that causes the need for an intervention and evolution of the system. To better refine a blocking point, **Concern** must be identified. A concern expresses an intention toward the system, that can be either a goal or a constraint. **Goal** expresses the desired objective to be achieved through the system evolution and the desired state to be obtained. Contrary, **Constraint** expresses the intention to not alter a system aspect while evolving or changing. Both these concepts permit to evidence the process components (**relates to** the association) to be monitored during the evolution and upon which the estimation of the impact of the evolution is assessed.

As-IS/As-IF formalizes blocking points and concerns as simple text (attribute **description**) and leaves method engineers the liberty to refine these meta-classes, enriching them with attributes to better define their properties or specializing and expanding them as a class diagram.

The process map proposed by the framework for the generation of this package artifacts aims to attain two intentions:1) **Elicit Blocking Points** and 2) **Define Concerns**. System diagnosis starts by eliciting the blocking points, **by detection strategy,** and then identify the concerns; goals, and/or constraints, related to them, ***by identification strategy***. Each concern can be refined into smaller objectives to be achieved.

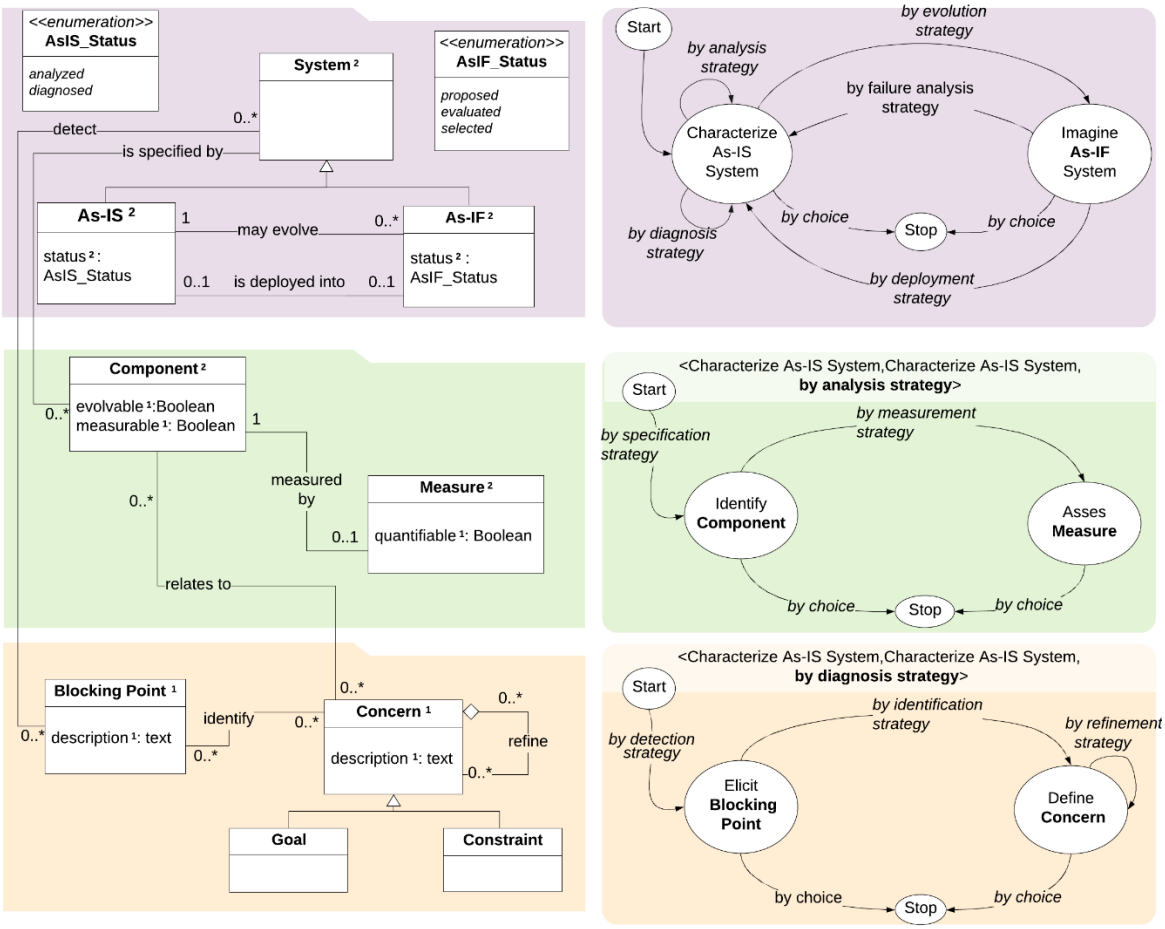


Fig. 72: As-IS/As-IF Diagnosis Package and its associations to the Core and Analysis package.

6.5.1. **Diagnosis Product Meta Model Adaptation**

The diagnosis package of CEFOP and ADInnov are constructed by importing the metaclasses proposed in the framework and renaming them to accentuate the scope of the method focusing on performance diagnosis in CEFOP.

The method enriches the metaclasses in the product meta-model with additional attributes, Fig. 73; however, in CEFOP, we are keeping the same formalism and structuring **Performance Blocking Point** as a simple description of the issue detected in the business process, whereas Performance Concern is enriched with three additional properties:

- ***Intention***- the direction of improvement targeted by the objective
- ***Value***- the desired process measure value to be achieved
- ***Deadline***- a time limit within which the goal must be achieved.

The adaptation in ADInnov is simpler: this method imports the same package as proposed in the framework and introduces the association ***identifies*** between blocking

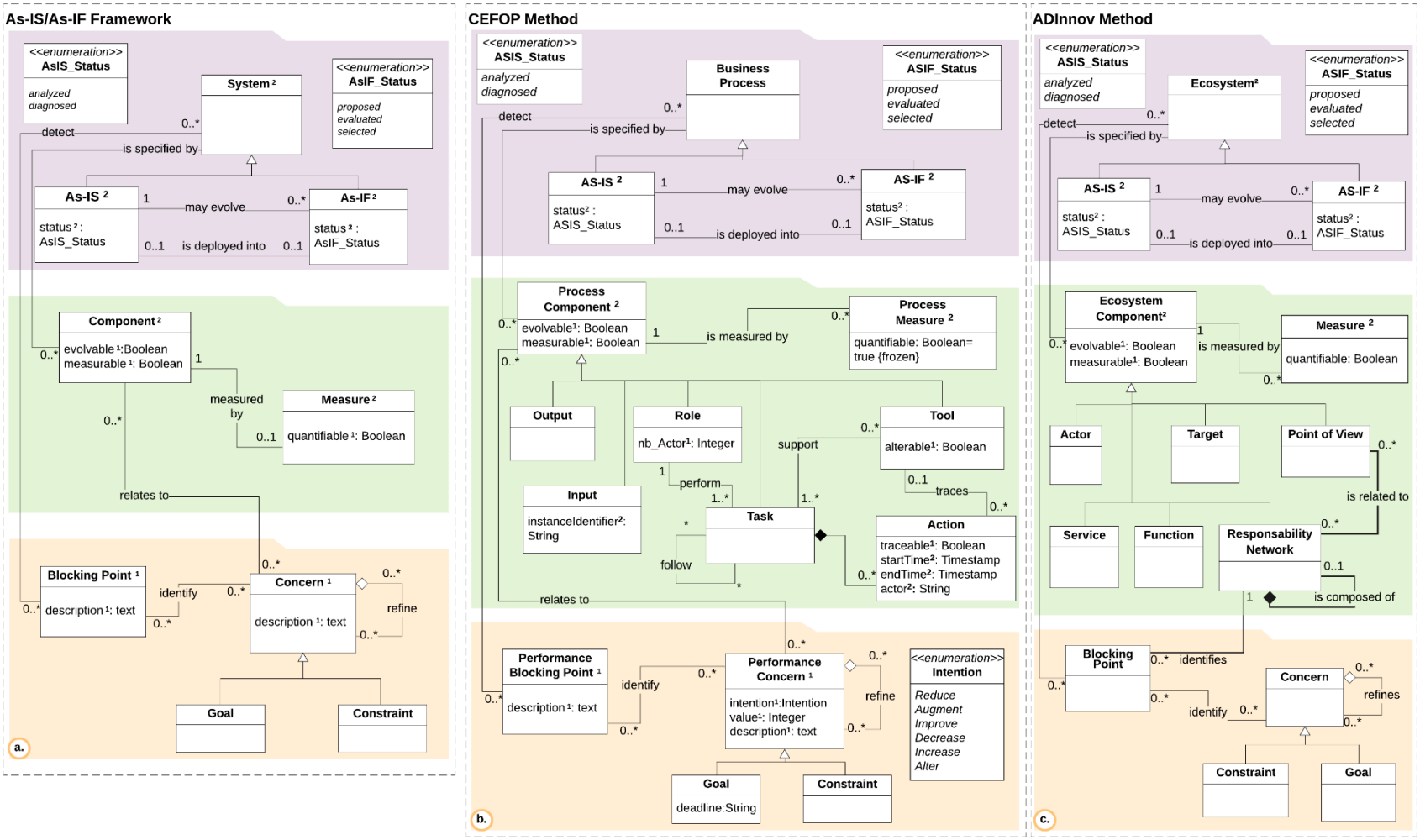


Fig. 73: The Diagnosis Package and the association to the Core and analysis package: a) proposed in As-IS/As-IF framework, b) adapted for CEFOP and C) adapted for ADInnov.

points and responsibility network since it is within this component that issues are identified by the method.

6.5.2. **Diagnosis Process Model Adaptation**

The adaptation of the diagnosis map to construct the path for diagnosing the business process performance in CEFOP is shown in Fig. 74. As-IS/As-IF process map is embarked, and intentions are renamed to ***Elicit Performance Blocking Point*** and ***Performance Concerns*** so that they correlate with the metaclasses' names.

Besides the changing of the intention names, CEFOP renames the strategies proposed by the framework and introduces new ones in the map. Each strategy proposed in this target method is named based on the approach followed for attaining the intention. For example, the starting strategy aiming at the **detection** of the blocking point is renamed to ***by elicitation***- which identifies performance blocking points based on business objectives emerged from business analytics and ***by translation***- the strategy that defines performance concerns related to these issues.

In addition to the renaming, CEFOP introduces three new strategies in the diagnosis map:

by proposal strategy where performance concerns are formalized by the process stakeholders based on their experience. This strategy encourages process participants to propose goals and constraints

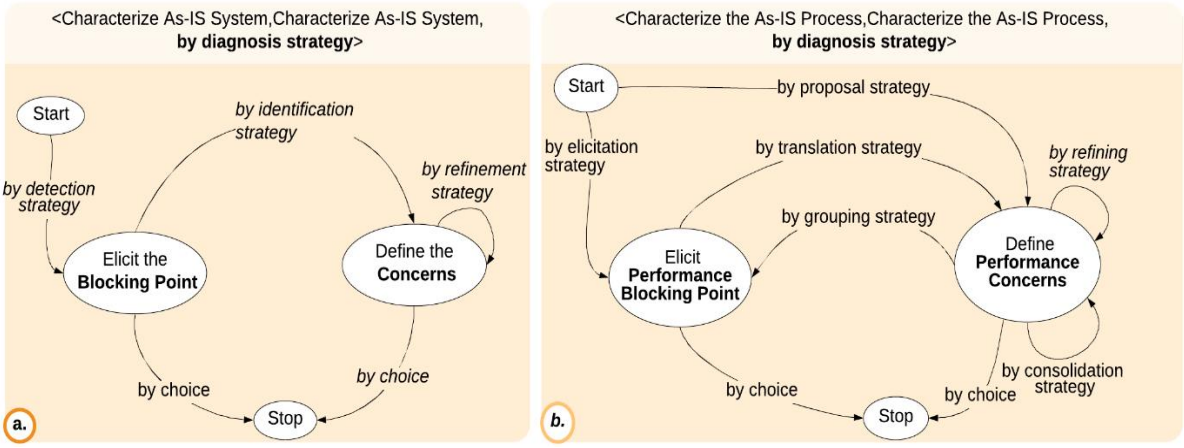


Fig. 74: The Diagnosis process map: a) proposed in the As-IS/As-IF framework and b) adapted by CEFOP method.

by consolidation strategy which collectively validates and consolidates each performance concerns defined by proposal and translation strategy. This consolidation is supported by the process measures developed during the analysis and aims to identify realistic concerns that must be achieved through business process improvement.

by grouping strategy gathers the performance concerns proposed by the stakeholders or emerging during consolidation into performance blocking points.

6.6. The Evolution Package

The fourth and last package in As-IS/ As-IF framework is Evolution. It formalizes the possible **Changes** that can be deployed over the system, the **Operational Changes** to be implemented to change the system, and the **Evaluation** of the impact of a change. The evolution of product meta-model is composed of three meta-classes, corresponding to each one of these concepts, Fig. 75.

Change meta-class formalizes the evolution introduced in the system to ***resolve*** at least one of the **Concerns** identified during the diagnosis. The framework characterizes it as a brief **description**, stating the modification to be deployed over the system. Several possible changes can be proposed to resolve the diagnosed concerns which can trigger the **exploration** of different scenarios of evolution. Each evolution scenario, **As-IF system**, represents an assumed state of the system imagined when replying to the question *"What if the change is applied?"*.

To guide the construction of the As-IF system, a change is broken down into **Operational Changes,** each of them stating the components of the As-IS that ***is* affected by** the change and the As-IF component **target by** this generation. Each operational change is characterized by a **description**, detailing the proceeding, and an **operation**, defining the nature of the transaction to be performed on the component. As in CEFOP, three basic operations are proposed in the framework:

Insert: introduce a new system component in the As-IF scenario that is not present in the As-IS system.

Delete: deciding to not embark on an As-IS system component when imagining the As-IF scenario.

Modify: alter the properties of an As-IS component to obtain the component of the system for the As-IF scenario.

Evaluation is the last meta-class of the evolution product meta-model. Each imagined As-IF system is evaluated to assess the impact of the change. This assessment aims to define if system concerns are ***resolved*** or not in the evolution scenario. A concern is resolved when either a goal is achieved or a constraint non-violated. Depending on the method, concerns resolution can be traced differently: *Boolean* value (the resolution is complete or not achieved at all) or *Text* description marking the scale of concern's resolution on the given scenario.

To obtain the artifacts of this package, As-IS/As-IF proposes the process map illustrated in Fig. 75. The map indicates the paths to follow to explore possible evolutions scenario and choose the most suitable one to be deployed. The evolution

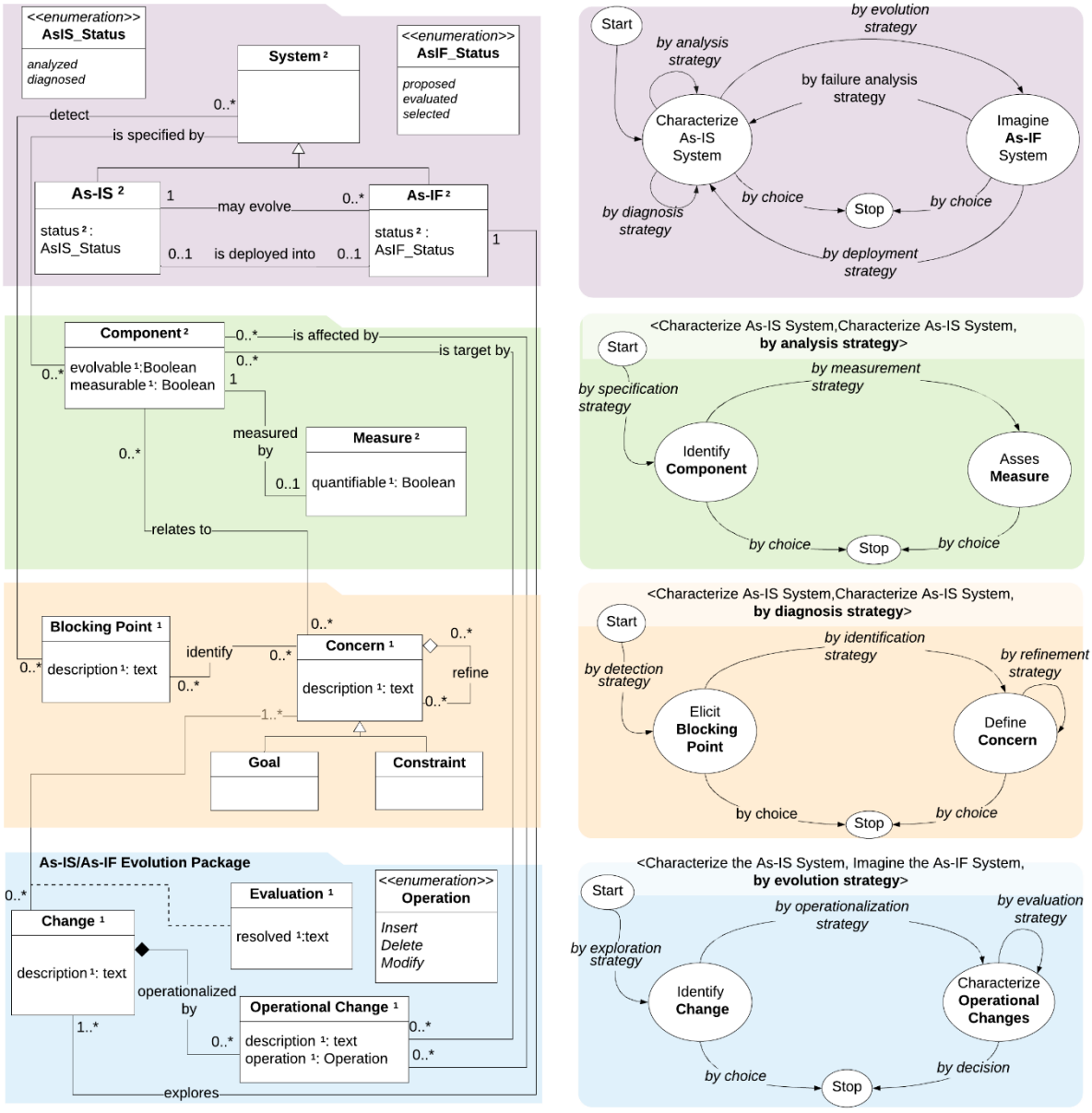


Fig. 75: The complete product meta-model and process model of As-IS/As-IF Framework

process has two intentions to attain: **Identify Change** and **Characterize Operational Changes,** corresponding respectively to change and operational change metaclasses. Evolution starts **by exploring** the possible changes proposed to resolve the diagnosed blocking points of the system and then operationalize each of them, following the **by operationalization strategy.** The operationalization of changes permits us to imagine the AS-IF scenario and evaluate the change impacts**, by evaluation strategy**. This evaluation elucidates if the change manages to succeed in resolving the systems concerns or not. Lastly, the evolution map is equipped with walkouts strategies, **by decision** indicating the path to be followed when a scenario of evolution is chosen for deployment.

6.6.1. **Evolution Product Meta Model Adaptation**

Evolution is the last package adapted by the method engineer to complete the product meta-model and process model of the target method. The adaptation of the product meta-model in the context of business process improvement, CEFOP, and innovation of the ecosystem around a fragile person, ADInnov, is shown in Fig. 76.

The method CEFOP imports the evolution meta model fragments as proposed by the framework and keeps the same names. The only adaptation introduced by us as method engineers is the enrichment of the **Change** meta-class with a ***roadmap*** attribute that details the time guideline for the deployment of the change. CEFOP evolves the business process by introducing changes in the organization, increasing or decreasing the number of ***actors*** in a ***role***, altering the ***tools*** supporting the process execution, or changing the operation performed during the process execution; ***tasks,*** and ***actions***. These changes can either achieve or not a performance concern, thus in the **Evaluation** meta-class, the ***resolve*** attribute is stated as Boolean.

The product meta-model adaptation in ADInnov is more noticeable since this method renames both Change and Operational Change meta-classes to **Innovation Service** and **Point of View Service**. The type of change elicited by this method is the innovation of service, that can be introduced as new services proposed in the ecosystem (e.g. *a digital service of piloting*), new actors in the ***pools of competencies*** to balance

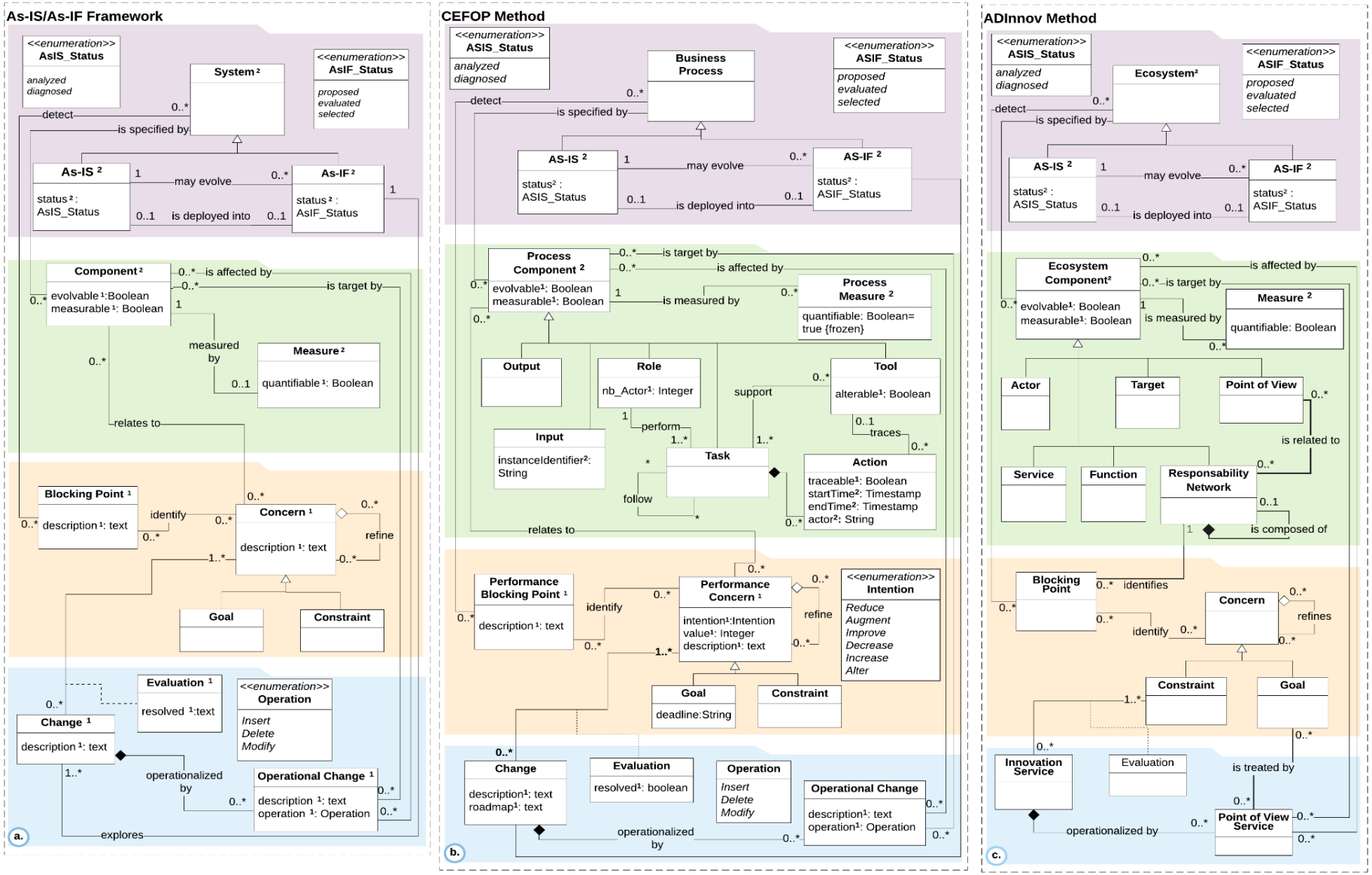


Fig. 76: The four packages a) proposed in As-IS/As-IF framework b) adapted for CEFOP and c) adapted for ADInnov

the ecosystem workload or new functions, such as ***an orchestrator*** to manages one or more ***fragile persons*** and actors in the ***pool of competencies***.

Each innovation proposition is operationalized through the point of view services, describing how a technical or intellectual capacity or a useful work for a beneficiary would be provided once a new concept or an innovation is introduced in the ecosystem. Each one of these points of view helps to resolve ecosystem goals - ***is treated by*** association. The impact of each proposed innovation is ***evaluated*** in order to assess its relevance.

6.6.2. **Evolution Process Model Adaptation**

The adaptation of the As-IS/As-IF evolution process model is more significant in CEFOP and ADInnov. Each of these target methods imports the process maps proposed by the framework and refines the session to express the approach proposed for business process improvement and ecosystem innovation.

As shown in Fig. 77 b, CEFOP imports the same process map as proposed in As-IS/As-IF framework. We don't change the name of intentions since we kept the same name for the metaclasses in the evolution product meta-model adaptation. However, to illustrate the method approach, CEFOP refines the sessions, <Identify Changes Characterize Operational Changes***, by operationalization strategy>,*** Fig. 77 b.2, and <Characterize Operational Changes, Characterize Operational Changes***, by evaluation strategy>,*** Fig. 77 b.3.

The by operationalization session, as proposed in Fig. 77, is refined to illustrate the two sub-intentions to be attained when operationalizing the change, ***Identify Operation*** and ***Model As-IF system*** and the strategies proposed for their attainment. Similarly, CEFOP refines the by evaluation session into a process map aiming to attain ***Assess Process Performance*** and ***Assess Performance Concerns Resolution,*** Fig. 77 b.3. This refinement illustrates the combination of participative, evidence-based, and consolidation approaches when imagining the ***As-IF business process***. We detailed the protocol of both these refined sections when describing CEFOP formalism in section 5.5.1.2.

The adaptation in ADInnov starts from the evolution process map. This target method imports the As-IS/As-IF framework and changes the name of the intentions to ***Identify Innovation Services*** and ***Characterize Point of View Service***, following the naming used in the product meta-model. Additionally, it introduces a new strategy, ***by***

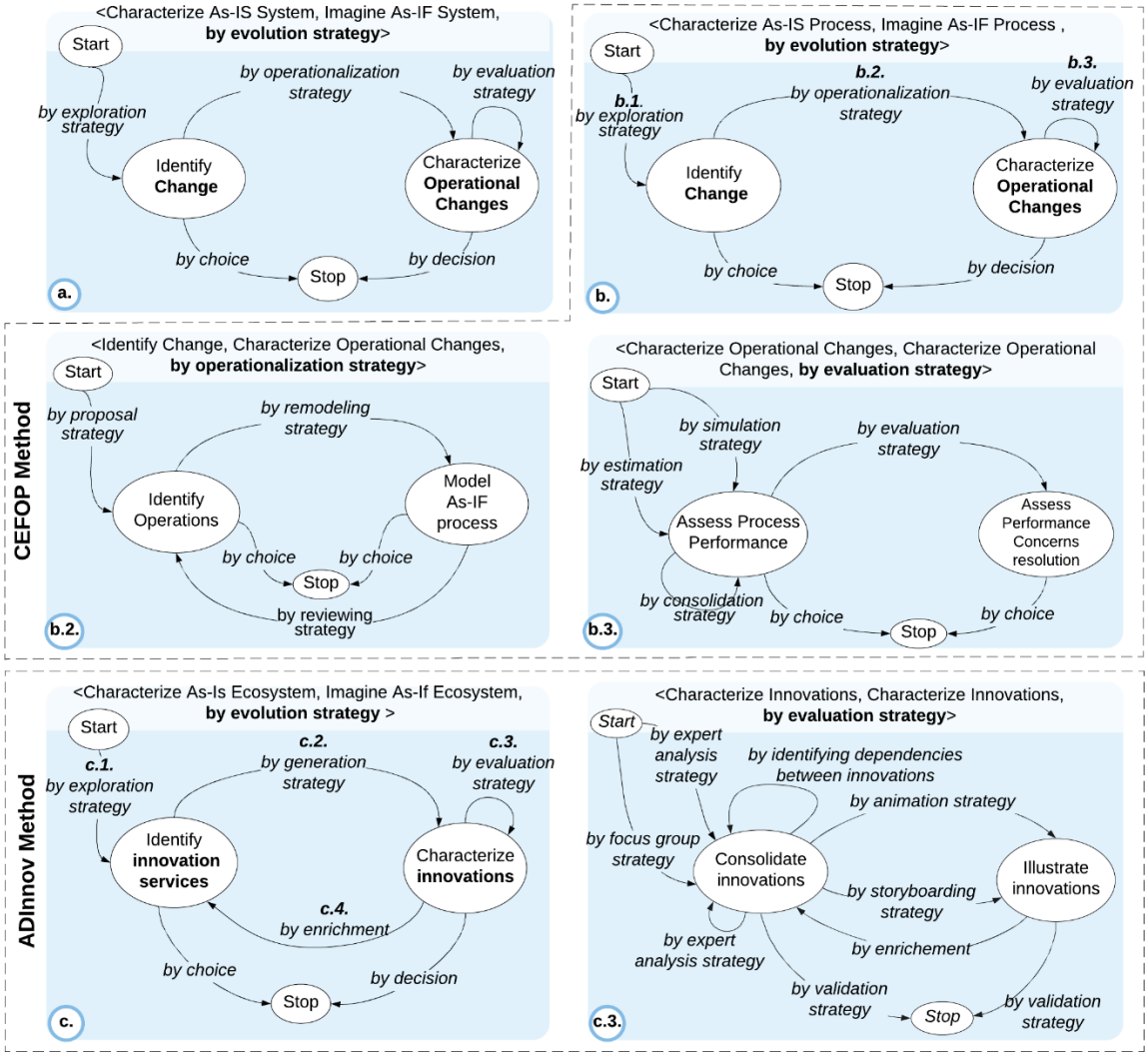


Fig. 77: The Evolution process map: a) proposed in the As-IS/As-IF framework and b) adapted and refined, b.2 and b.3, by CEFOP and c) adapted and refined, c.3, by ADInnov

enrichment, traveling from the point of view characterization to innovation identification. This strategy illustrates the possibility of going back to identifying a new point of view services if required while characterizing an innovation. Similar to CEFOP, ADInnov refines the section of the evolution process map to illustrate the sub-intentions to be attained and the usage of different approaches in the attainment of an intention. The intentional map in Fig. 77 c.3, illustrates this refined map to evaluate the point of view characterization. Two sub-intentions must be attained in ADInnov during this step, ***Consolidate Innovation*** and ***Illustrate Innovation***. This method proposes different strategies and approaches to attain them, for example:

Consolidate Innovation: ADInnov combines, 1) ***by expert strategy-*** which is a workshop aiming to consolidate the propositions by checking with experts the coherence and the good alignment between goals and innovation services and 2) ***by identifying***

dependencies between innovations- that uses post-its methodological fragment to analyze dependencies between services.

Illustrate Innovation: ADInnov proposes the strategy, 1) ***by storyboarding*** which relies on the storyboard techniques to define dependency relations between services and 2) ***by validation*** to validate the evolution scenarios by actors in the field before building the animated scenario that serves as a demonstrator of the project's innovations. This latter strategy uses CAUTIC methodological fragment to evaluate innovations in a focus group considering different aspects of innovation.

6.7. Chapter Synthesis and Conclusions

This chapter of the manuscript introduces the As-IS/As-IF Framework, a contribution guiding method engineers when constructing target methods covering the continual evolution of a system. This framework was constructed by generalizing similar concepts and steps or intentions, identified in continuous improvement or innovation methods. The framework proposes a product meta-model and a process model, constructed adopting a model-based approach by adaptation; the framework and the target method product meta-model and process model are on the same level of abstraction, Fig. 66.

- Process model adaptation adopts an assembly-based approach inciting method engineers to reuse method fragments for strategies deployment. This model is formalized using the intentional map formalism that provides the liberty to refine the proposed strategies if several methodological fragments are assembled to attain the intention or its attainment is decomposed into several sub-intentions.
- Product meta-model is constructed based on the model-based approach. It is left purposely incomplete and so cannot be used without adaptation. The method engineer must also define a concrete syntax (notation) when constructing the product meta-model of the target method.

The As-IS/As-IF framework is equipped with five heuristics to guide the adaptation of the product meta-model and the process model to the context of the target method.

Dressing the role of a method engineer, we illustrated the usage of this framework and its heuristics when restructuring CEFOP, a method covering the continual evolution of business processes, and ADInnov, a method previously introduced by

SIGMA team to instill innovation in socio-technical ecosystems. These adaptations are illustrated in the chapter in parallel to the presentation of the framework.

Besides facilitating the construction of continual evolution methods, As-IS/As-IF framework installs within the companies the philosophy that change is continual and there is no endpoint. The framework helps in promoting the change vision and the collective construction of the evolution scenarios and their evaluation. The structuring of the evolution plan facilitates also the employee's empowerment and communication in the planning of the evolution and the collective construction of the change vision.

Chapter 7. Conclusions and Future Perspectives

7.1. Introduction

This Ph.D. is the result of a collaboration project with the company NetInvaders. In this chapter, we detail some conclusions from our intervention and list future work perspectives that can enrich both contributions.

Our thesis started by aiming to construct a method guiding the continuous improvement of business processes, so that small and medium companies, including Net Invaders, can quickly and effectively reply to change. This method emphasizes the process of participants' empowerment when planning evolution. This element increases the efficacity when responding to the need to change and change acceptance. However, in the existing state of the art, this intention was not achieved since 1) management hesitates to delegate the responsibility to its actors fearful that they will lack objectivity, and 2) actors are reticent to continually engage in the improvement or innovation fearful that their points of views and efforts are not part of decision making.

Our work provides a solution for these blocking points by proposing a method that fully empowers process participants in the business process improvement and replying to the following research questions:

Research Question 1: *How to objectify process participants' intervention in business process improvement?*

Research Question 2: *How to collectively create the vision of change and imagine the most convenient improvement scenario?*

While aiming to answer the above questions, we came across the need to expand our research scope and answer a third research question:

Research Question 3: *How to guide a method engineer in constructing a method planning the continual evolution of a system?*

1. *Which are the steps to follow and the products to expect when creating the vision of change?*
2. *How to identify the most convenient evolution scenario, called the As-IF system?*

This last question emerged while overviewing methods covering continual evolution to identify approaches that increase employee empowerment in planning the evolution of a given system. As method engineers, during this research, we were presented with a vast variety of methods, each proposing their steps and methodological fragments, to guide improvement or innovation. This diversity makes the construction of a new method complicated and time-consuming since the adaptation or reuse of existing methods fragments demands to understand the approach proposed by each method and the intent and scope of the proposed fragments.

To facilitate the construction of continual evolution methods, we replied to the third research question by proposing to reduce the gaps between improvement and innovation cycles and generalize their processes, followed steps, and products, the artifacts generated when planning an evolution.

7.2. Conclusion

We presented two contributions in this Ph.D. 1) CEFOP a method empowering process participants and stakeholders in the planning of business process improvement and 2) As-IS/ As-IF a framework structuring a guideline for method engineers to facilitate the construction of continual evolution methods. The proposed answers to the three research questions are resumed in Table 14 and detailed in the following sections:

Table 14: The contribution introduced for each research question.

Research Question	Contribution
R.Q.1: How to objectify process participants' intervention in business process improvement?	***CEFOP*** The method combines participative and analytical methodological fragments where: • Participative fragments facilitate and motivate process participants intervention • Analytical fragments increase artefacts objectivity
R.Q.2: How to collectively create the vision of change and imagine the improvement scenario?	***CEFOP*** The method introduces a consolidation step, where artefacts are collectively validated and consolidated. This step allows to: • discuss and review all points of view: process owner and participants. • confront gaps between process participants perception and reality

***R.Q.3*:** How to guide a method engineer in constructing a method planning the continual evolution of a system?	***As-IS/As-IF*** The framework proposes a product meta-model and a process model, to be adapted by the method engineer when constructing a target method. This adaptation is guided by a set of heuristics.

7.2.1. **The Method CEFOP**

CEFOP (**C**ontinual **E**volution **f**or **O**rganizational **P**rocesses) guides and structures the continuous improvement of business processes within small and medium companies, such as is Net Invaders. This method details the steps and approaches to follow, and artifacts to be elicited when planning an improvement. The roadmap proposed for this evolution and to construct the vision of the change to be deployed is defined by:

1) Initially, characterizing the current state of the business process, the ***As-IS Business Process***. This artifact describes the list of components composing the current business process, its performance, and performance blocking points and concerns triggering the need for improvement.

2) Imagining all elicited ways on how to improve the business process, creating so the **World of As-IFs**. Each ***As-IF business process*** represents a scenario imagined when replying to a *"What if"* question. This question defines the change that is planned over the business process to improve As-IS performance.

3) Collectively choose the most convenient scenario for business process improvement to be deployed and obtain so the **As-IS new version**, which is an improved version of the As-IS business process.

To characterize the As-IS business process and imagine the As-IFs scenario, CEFOP proposes to combine participative and evidence-based methodological fragments and consolidate their artifacts into more complete, understandable, and objective products. The method is equipped with:

- ***Participative methodological fragments*** to increase the involvement of process participants and minimize the barrier of knowledge or skills required for participating in the improvement of business processes. CEFOP combines participative fragments such as the ISEA approach to collectively model the process or elicit process measures and estimate the process performance.

- ***Analytic methodological fragments*** to guarantee the objectivity of the artifacts generated out of each step of business process improvement planning. The method uses the automatically discovering approach and techniques proposed in the PM² methodology to model the process and data analytics to assess its performance.
- ***Consolidation methodological fragments*** that guide participants in merging the artifacts generated from the participative and evidence-based approaches. Chapter 4 presented the protocol and the supporting instruments constructed for the consolidation of the business process model and process measures.

We used the method CEFOP to plan the improvement of ISD-Initial Service Delivery process, a business process from Net Invaders. The steps taken during this case study are illustrated in the manuscript in parallel with the method description and the approach presentation.

Using the approach and the methodological fragments proposed in the CEFOP method to plan the improvement of this process resulted in:

❖ **The generation of more qualitative and objective artifacts:** The business process model and the performance process measures obtained out of CEFOP consolidation are more complete, comprehensive, and objective.

- The process model is ***complete***, includes possible deviations or tasks forgotten when describing the process that emerged from event logs mining. This last approach increases also model ***objectivity*** since all described process components, paths, tasks, actions, etc. are aligned with traces left in the supporting information system during previous process executions.
- Similarly, the elicitation and valorization of the process performance measure are more objective since a data analytic approach is combined with a participative process measure elicitation and estimation. The artifacts consolidation permits to have ***complete and comprehensive*** process measures: all necessary measures for each process stakeholders are used to develop process performance which permits them to understand the current performance of the business process. Moreover, it brings ***objective*** values: process measures are analytically assessed upon the execution traces.

- **A collective decision making and vision of change construction:** The approaches presented by CEFOP involve all process stakeholders in each step and artifact generation. The method introduces a collective consolidation strategy, which increases the quality and objectivity of the artifacts, by allowing stakeholders to:
  - Individually assess the gaps between perception and reality: Combining participative and analytical approaches permits process participants and owners to assess the gap between their perception and reality. The consolidation of the process model and process performance measures in ISD allowed the detection of process deviations or gaps in measures values that made actors reflect and understand the need to improve the process.
  - Confront and discuss different points of view: The method uses participative methodological fragments to collect the apprehension of each process stakeholder, describe the model, or elicit the process measures to be developed. These approaches collect all participants' points of view and take into consideration several business process improvement scenarios when constructing the "World of As-IFs". The choice of these scenarios is also collectively constructed and validated, which makes the change to be deployed understandable and apprehended for all process participants.

To resume, the approach presented in CEFOP increases process participants' empowerment since they are continually involved and dressed in the responsibility to generate artifacts. This involvement is objective because supported by analytical methodological fragments and collective since each decision making is structured as a collective consolidation workshop where each point of view is inspected.

7.2.2. **The Framework As-IS/As-IF**

The second contribution presented in this Ph.D. is the As-IS/As-IF framework. This proposition is a guidance for method engineers to design and help them in the construction of continual evolution methods. It introduces two adaptable models:

1. **A product meta-model** constructed following the model-based approach that describes the set of elements required to characterize the As-IS system and imagine the As-IF systems. The model is to be completed by the method engineer to define a concrete syntax, notation, when constructing the product meta-model of the target method.

2. **An intentional process model** structuring the intentions to achieve to derive all necessary artefacts to plan the improvement of the business process. This model is constructed by adapting the assembly-based approach inciting method engineers to reuse method fragments for strategies deployment. It is formalized using the intentional map formalism that provides the liberty to refine the proposed strategies if several methodological fragments are assembled to attain the intention or to decompose them into several sub-intentions.

The framework is equipped with five heuristics to guide the adaptation of the product meta-model and the process model by the method engineer when constructing a continual evolution method for a given context.

This contribution derives from a more extended research context, where we reviewed continual improvement or innovation methods, as well as the methods ADInnov and ISEAcap, results of InnoServ and ACIC projects of SIGMA team.

Both propositions, CEFOP and As-IS/As-IF, target the structuring of the plan step in PDCA cycle. The framework introduces two main intentions to be attained: **Characterize As-IS system** and **Imagine As-IF system**. The roadmap for the continual evolution of a system, similar to CEFOP, starts by eliciting all artefacts requested to characterize the current state of the system and then proceed with imagining all possible scenarios of evolution, the population of the "World of As-IFs".

Dressing the role of a method engineer, we adapted the As-IS/As-IF models, following the proposed heuristics, to restructure CEFOP first proposition presented in [22] and restructure ADInnov. These adaptations, illustrated and detailed in chapter 6, resulted in a second version for CEFOP formalism and a more complete product meta model for ADInnov.

The adaptation of these methods aims to illustrate the usage of the framework in the construction of methods covering different types of evolution; improvement and innovation, and different contexts; business processes within small and medium enterprises in CEFOP and complex socio-technical ecosystems in ADInnov.

7.2.3. **Personal Project Conclusion**

Our thesis was a collaboration with Net Invaders, a dynamic startup which gave us the possibility to gather real working environment feedbacks for each proposition. This

element allowed to adapt and improve CEFOP during its construction and resulted in a more solid and real working-environment compliant method for the improvement of business processes. However, as most collaboration of this type, a lot of effort is demanded to manage the need of both parties and the time constraints of the company.

Today, I have changed my professional path, leaving the research and going back to the industrial environment, as a business analyst. In one of my intervention, luckily, I got the chance to come across a business modeling and improvement project which allowed me to assess the impact of the approach proposed in CEFOP, as a contracted process participant. Combining the participative approach planned by the company with the evidence-based techniques in process modelling, gave me, as a new employee, the possibility:

- **To have a voice in the process modeling workshop**

Even though my introduction in the business process was quite recent at the moment when the modelling started, the presence of traces, left by previous process instances execution, gave the possibility to 1) express and illustrate the paint points personally encountered during the first interventions and 2) identify deviations and short paths that more experienced actors had developed in their routine and which were neglected during the modelling.

- **Rapidly gain process knowledge and understand the need to change**

Going through process modeling workshops can be quite enriching for a new employee since it permits to overview the general flow of the process and the main interactions for his intervention. However, the consolidation can further enrich the experience, since the modeling is refined on the action level, detailing so each participant activity. This refinement gives to the employee a better vision and comprehension of each role intervention and helps him understand the impact of each action to be performed.

7.3. Perspectives

Like every thesis, our intervention was time-limited, leaving us with several future enrichments and validations for both propositions. The following sections detail some of the perspectives that we propose to complete and enrich both CEFOP and the As-IS/As-IF framework.

7.3.1. **Future works on the CEFOP Method**

This manuscript introduced CEFOP method, a proposition combining existing approaches linked by a consolidation approach to improve the business process. We illustrated the reuse of existing methodological fragments and introduced two new fragments covering respectively the consolidation of business process and process performance assessment.

One of the short-term perspectives concerning CEFOP is to **assess the usage of the method CEFOP in a different business context** that Net Invaders. This validation would help assess the impact of the proposed approach within an organization that was not involved in the method construction and gather first feedbacks from their employees. Even though, I was able to personally assess CEFOP approach in my new working environment, this experiment was not complete since 1) the modelling session was not fully structured using the proposed approach because the project was previously planned and structured by another method analyst and 2) my personal engagement in the modelling can subjectify the assessment.

This last topic brings us to a second future work for CEFOP validation; **experiment method usage and apprehension when the method guidance is delegated to another actor outside of the project**. During this project, we dressed different roles: method engineer- to construct the method, method analyst- to identify the better fitting methodological fragments to the context and animator- to guide and facilitate the work session proceeding. This diversity can be source of non-objectivity and unrealistic evaluation of the charge delegated to the method animator. The validation of CEFOP with a different animator would permit to identify if the methodological fragments proposed for the consolidation of the process model or performance measure can be easily handled from a person, who is new to process mining discipline.

On a more middle term perspective, we propose to enrich the CEFOP method on different axes:

Complete process diagnosis strategy. At present, CEFOP instrumentation supports the detection of the performance measures that are critical and must trigger the elicitation of performance concerns. In the future, the method should be enriched with a performance concerns consolidation protocol. This workshop is imagined as a

collective proceeding where process stakeholders are guided to define the performance concerns to be achieved through process improvement.

Refine and instrumentalize the evolution strategy. CEFOP evolution process model and its refinement were illustrated in Fig. 78. One of our future works is to instrument and structure each of these strategies which implies: 1) identifying the better fitting existing methodological fragments for the by simulation, by estimation and by evaluation strategy and 2) structuring and instrumenting the consolidation workshops for the As-IF process remodeling and process performance assessment consolidation.

Both these workshops will be structured following similar approaches to the ones proposed to model and assess the process performance of the As-IS business process, but they should be enriched with instruments inciting process stakeholders to reflect over the change feasibility.

In addition to the above enrichment, we propose some future improvements to the already introduced methodological fragments and supporting tools:

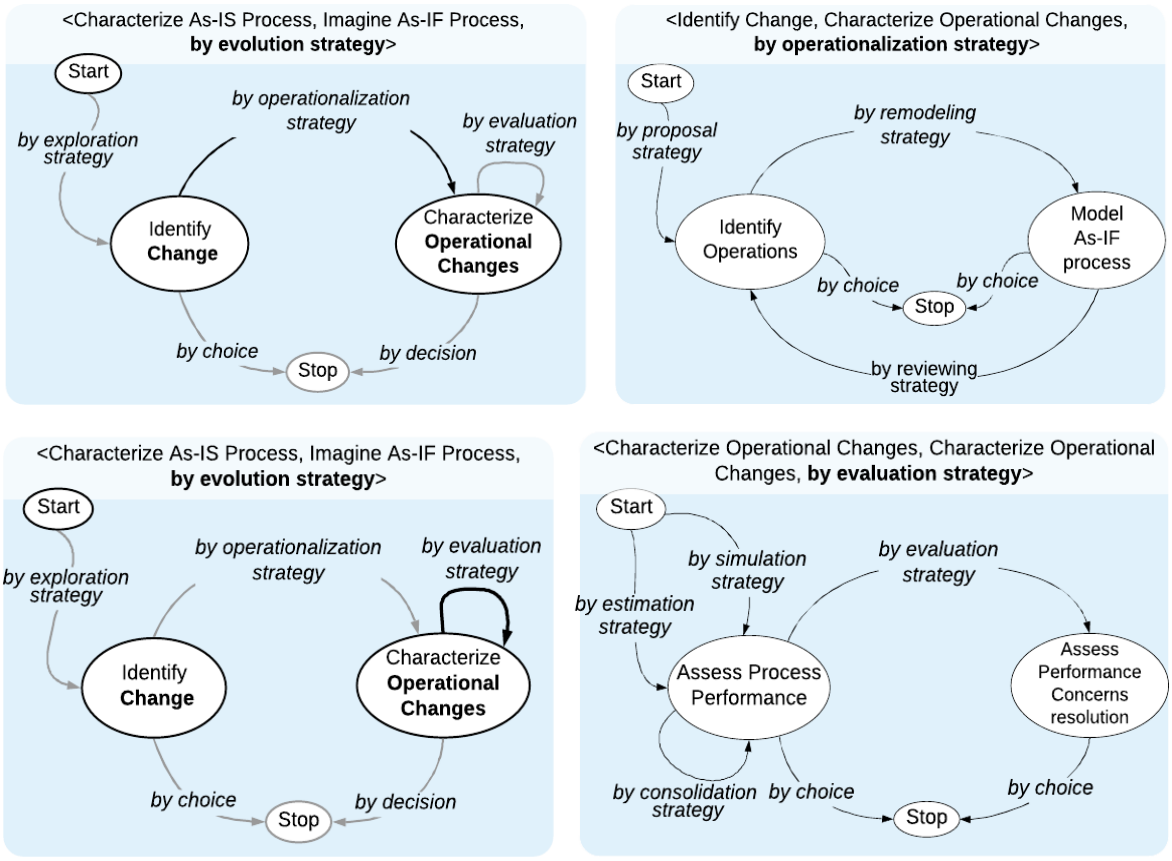


Fig. 78: CEFOP evolution map and the refined process models for each strategy of evolution.

Facilitate the event logs file construction. This step in the automatically process discovery can be time consuming and demands process mining knowledge. For this, a future short-term work will be to formalize a guide that will permit the complete delegation of the traces extraction to the database administrator and process owner.

Improve the action-task association steps. The traces extracted in both business processes case study was refined on the level of action performed by a user in the system, but in other environment, this refinement can be even more granular. For this, the need to integrate within CEFOP an unsupervised data analyzing technique emerges. This processing can be integrated into the event log file construction steps as a suggestion for an initial grouping that process participants would further validate during the model consolidation.

Lastly, **enrich ISEAsy and unify CEFOP supporting tools**. Today, the different strategies of the method are supported by different tools, ISEAsy, Disco, or a business intelligence suite. This is confusing for the method animator. In the future, we propose to unify all these functionalities under a unique tool to support CEFOP deployment.

7.3.2. **Future works on the AS-IS/AS-IF Framework**

Same as for the method CEFOP, we are proposing the following enrichments and future perspectives for the framework AS-IS/AS-IF.

First, **further experimentations should be planned in order to validate** the As-IS/As-IF contribution. Our lead for this perspective is to validate the framework usage when constructing a continual evolution method from scratch. The current validation of this proposition was performed using CEFOP and ADInnov: both these methods were previously constructed and As-IS/As-IF focused on their restructuring and completeness assessment. The usage of the framework in constructing a new method would permit to evaluate the main scope of this contribution: the help brought to a method engineer when constructing a new target method covering the continual evolution of a given system. To this intent, the framework was introduced as a starting point in two new starting projects where the SIGMA team is collaborating:

1) IDEX CIRCULAR project[19] aiming to develop a method to facilitate the transition towards circular economy in industrial supply chains will be proposed.
2) AURA MOBIPA research project (2018-2021) proposing a method to improve the access of elderly people to mobility services.

The construction "from scratch" of these two new methods using the AS-IS/AS-IF framework will allow to assess and enrich it when supporting and facilitating continual evolution method construction.

Moreover, the framework needs to be improved and enforced on several points:

Defining a dictionary. The current proposition is composed of two models and a set of heuristics to facilitate its adaptation; however, a more detailed guide and explanations of all presented concepts will facilitate the apprehension and the usage of the framework from the method engineer. For this, a framework dictionary will be constructed, stating the concepts' definition and illustrating its examples in different contexts.

Constructing a methodological guide for method engineers. This is a more long-term perspective compared to previous. Considering the strategies in the process model, a guidance on the reuse of the methodological fragments supported by participative, elicitation or creativity techniques, needs to be enhanced. The goal will be to work on solutions to guide the method engineer in choosing the best methodological fragments adapted to her/his specific context. One promising solution could be the development of software tools supporting the library of methodological fragments deployed on MethodForChange[20], a platform aiming to collect and provide methods and tools related to innovation.

[19] https://circular.univ-grenoble-alpes.fr/en/main-menu/circular/
[20] https://methodforchange.com/

Appendix

Appendix I ISD Process Performance Measuring

Fig. 79 shows several performance measuring dashboards configured in Knowage[21] business intelligence suite, to assess in real time several process performances measures for the ISD Process.

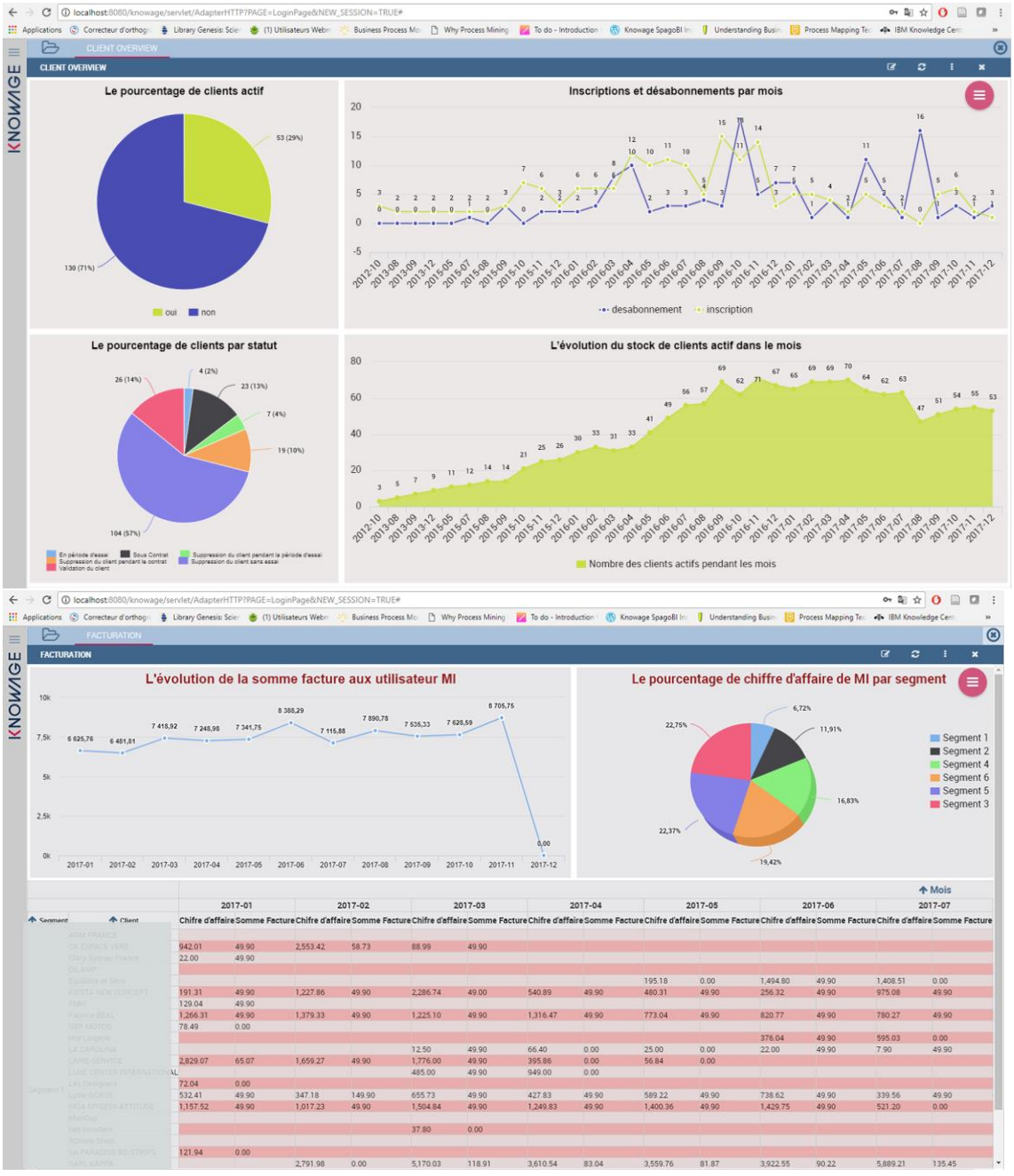


Fig. 79: The business intelligence interface set up to monitor ISD performance.

[21] https://www.knowage-suite.com/site/

Appendix II Ticket Resolution Business Process Improvement

Th ticket resolution business process was the first process modeled in our project. We are using the acronym MBT to refer to this process based on Mantis Bug Tracker system used to completely support the process execution. The model consolidation in this case study was the initial paper-based version that was proposed in order to validate our proposition.

2.1 Business Process Identification

The identification of the business process is scheduled as a 15 minutes interview between the facilitator and the process owner. To support this guide the following structure is proposed to the method facilitator.

Interview to the Process Owner
Part 1-Performance Issue

1. Title the process that is in focus of this intervention.

The client's subscription to the solution process

2. What is to be improved in this process? Structure you proposition using the format below.
** If needed to propose several ideas, copy/ paste the structure.*

Reduce	*Time*
Reduce the time for subscribing to our solution	

3. In the table below, list the starting points and the ending points of your proces.

Input(s)	***Output(s)***

4. Which are the role participating into the process

Role(s)

5. Are there tools that used during this process

Software(s) or Tool(s)

Interview to the Process Owner
Part 2 - Set the Goals

Set the goal by filling the below listed elements

Choose a Verb	Cost
	Choose a Measure
Choose a Time Constraint	*Output*
	Input 1
An example of goal generated once the upper part is filled	

2.2 MBT Described Process Model

MBT process is supported by mantis bug tracker an information system that model the workflow proposed by the software as detailed in Fig. 80.

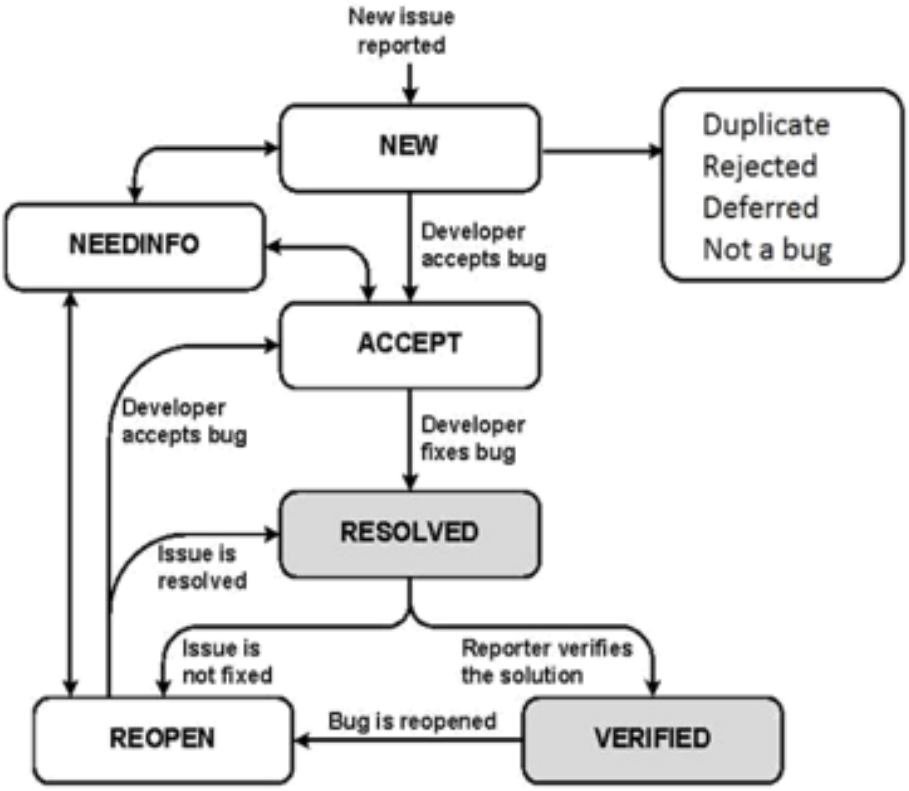


Fig. 80: The model of Mantis Bug Tracker

2.3 MBT AUTOMATIC PROCESS DISCOVERY

The mode of the process discovered using DISCO process mining tool.

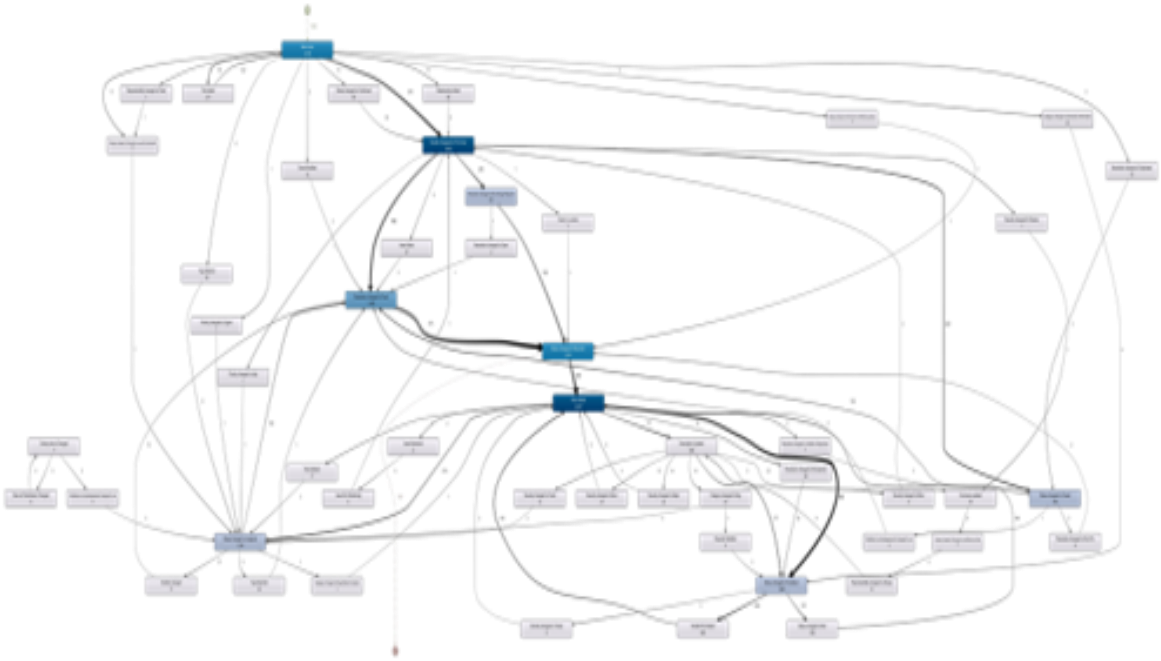


Fig. 81: The model of MBT discovered using process mining.

2.4 MBT MODEL Consolidation: Paper-Based Version

Even though the MBT process was already modeled by the solution provider, before pursuing with the model consolidation step, we asked the roles involved in this process to describe their intervention using ISEA methodological fragment.

Fig. 82 illustrate the tasks the MBT process participants have described as intervention in this process and the set of actions they propose to link to each of them.

A color code was used to mark each task and action performed by a given participant.

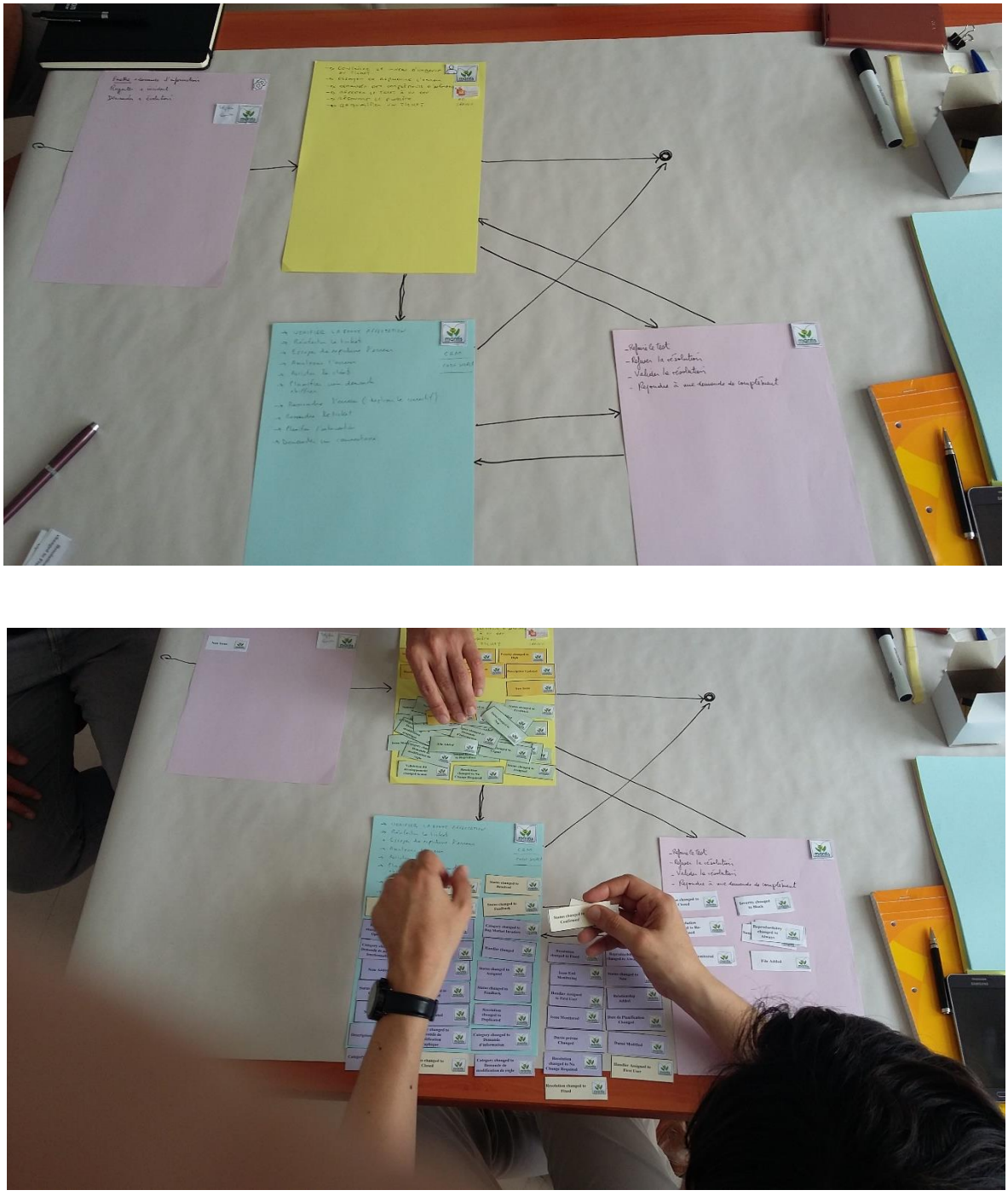
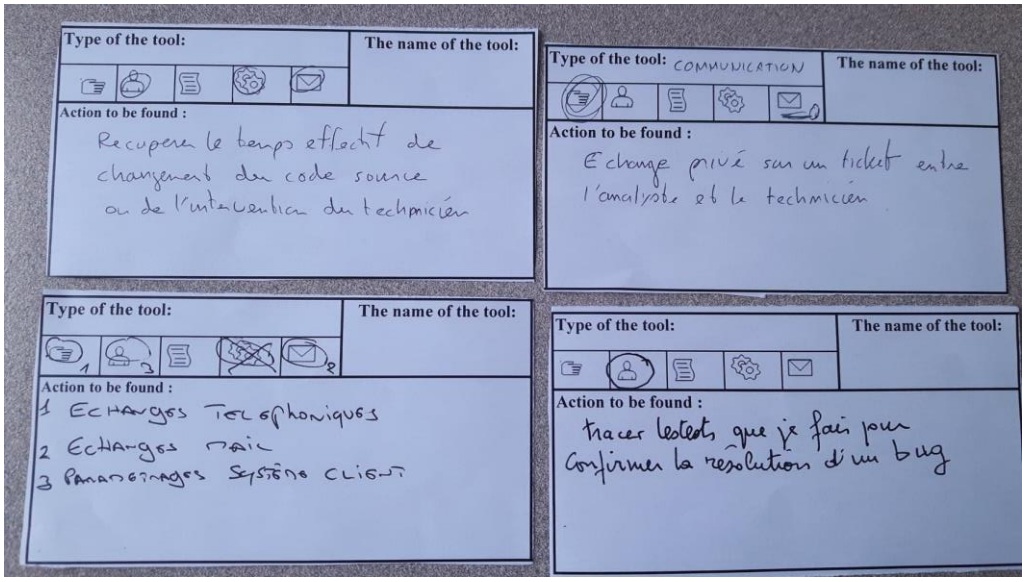


Fig. 82: The above image illustrates the model described by the process participants and the below the actions linked to the described tasks.

2.4.1 New Tasks and Sources of traces Detection

Once the linking of the actions performed by each participant was completed, the need to insert new task in the model and explore new data sources emerged. The roles described that beside this solution they performed several other task outside the system which implies exploring other information systems to complete the data set.



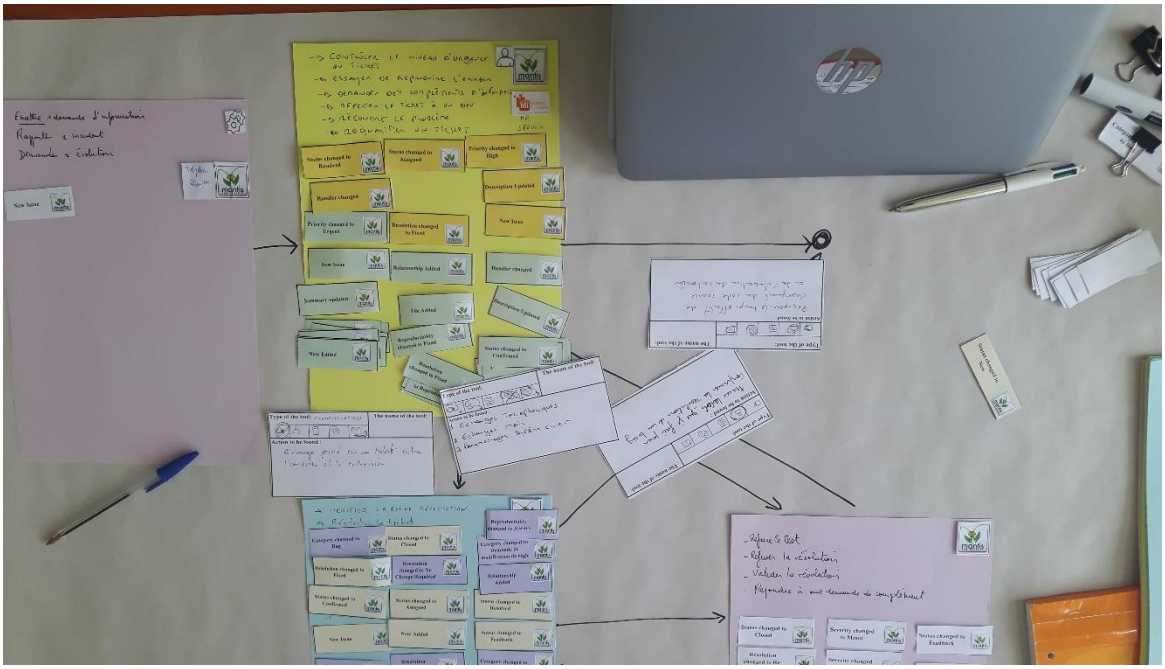
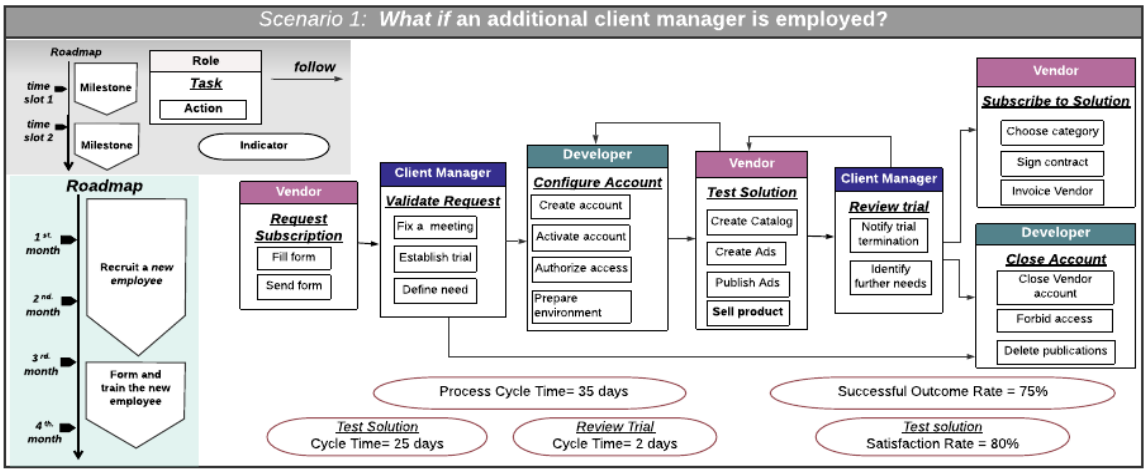


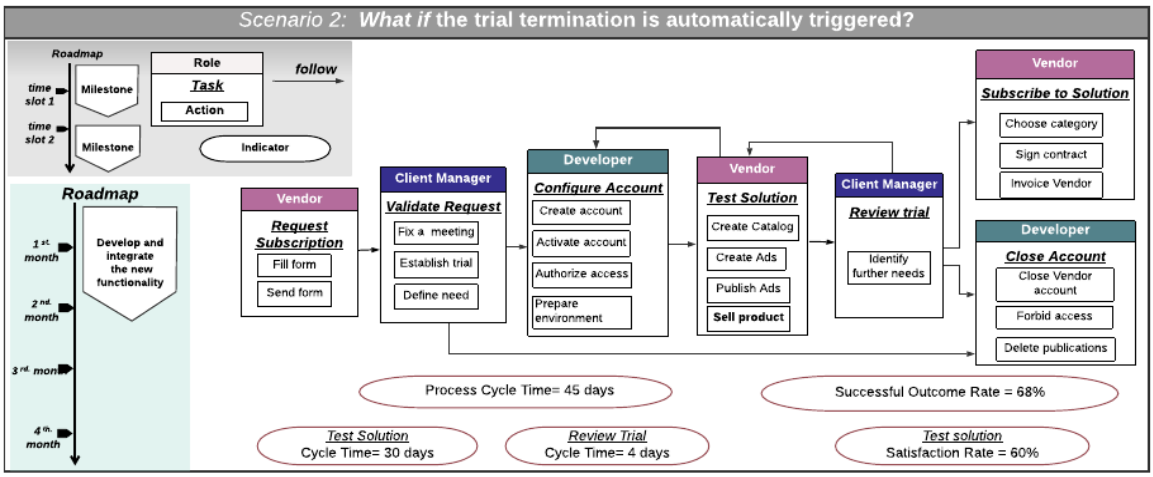
Fig. 83: New sources of traces and tasks emerged during this workshop.

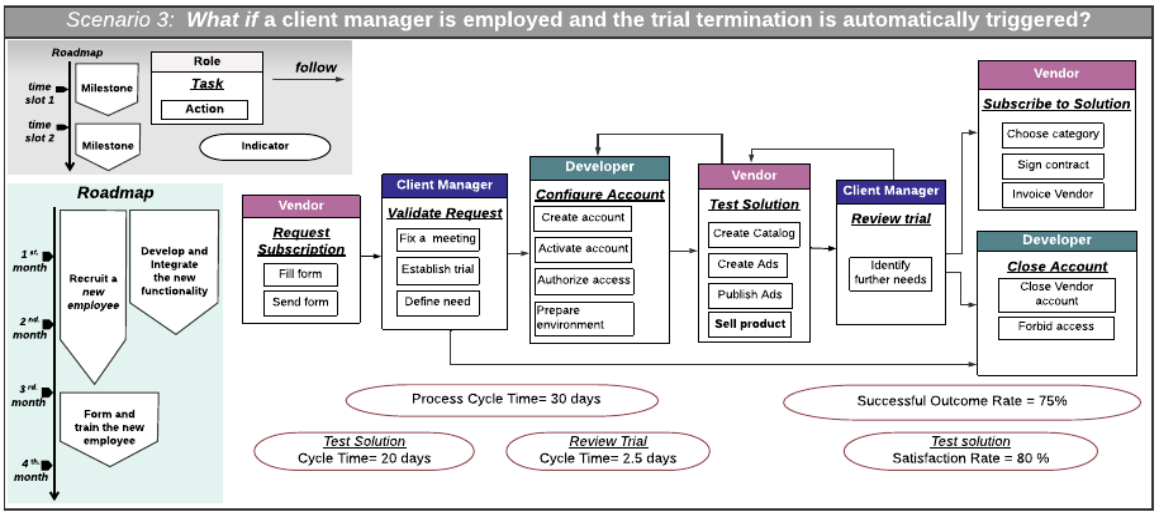
Appendix III Process Measures Template

	Description (function)	Operationalization
Quantity	**Complexity** (Avg., Max, Min, ….) Number of elementary operations to complete an instance of the process or activity.	*The actions related to the work unit and specify how to deal with tasks*
	Occurrence (Avg., Max, Min, ….) Number of process instances, tasks or actions executed per time unit, process instance or in total	*The action(s) marking the instance execution*
	Execution (count, percentage) Number of executed instances over the total number of submitted	*The actions marking submission and delivery*
Time	**Throughput** (Avg., Max, Min, ...) Number of processed submissions per time unit	*The actions marking the submission and delivery*
	Input (Avg., Max, Min, ….) Number of inputs submitted per time unit	*The action marking submission*
	Cycle time (Avg., Max, Min, ….) Time to handle a process instance, activity, group of activities end-to-end. [Submission time] − [Response time]	*The actions marking the submission and delivery for the segment.*
	Lag time (Avg., Max, Min, ….) Time lag between consecutive inputs, outputs or activities.	*The action marking process or activity submitting or delivery*
Cost	**Cost** The time and role implication cost to carry out the process or an activity.	*The action marking the end of process execution*
	Unit cost (Avg., Max, min….) Number of employees (headcount) per instance.	*The action marking the start and end of the process or activity(ies)*
Quality	**Output Error** (count, percentage) Number of instances having a negative output	*The action marking the end of process execution*
	Error (count, percentage) Number of errors: repeated work, problem-execution of specific work units, etc.	
	Rework time (Avg., Max, Min, ….) Time to redo work for an incident that was solved partially or totally incorrect the first time	
	Schedule compliance (count, percentage) Number of times the cycle time is realized according to the planning or schedule	

Appendix IV The Evolution Scenario of the ISD process







Vocabulary and Abbreviation

Ads	an online advertisement for a product or a service commercialized by a vendor on a given marketplace.
article	a product or a good commercialized by a vendor.
As- IF	an evolution scenario imagined as if a change is deployed over the current system
As-IS	the current state of the system
BPI	Business Process Improvement
BPM	Business Process Management
competitive advantage	a factor allowing the company to produce a better goods or services more cheaply or rapidly
continual evolution	the continual need organizations face to evolve a system and combine improvement to innovation cycle
continuous improvement	the ongoing effort to improve products, services, or processes.
innovation	the use of new ideas and methods to resolve an existing blocking point in the system.
ISD	Initial Service Delivery business process
marketplace	a platform permitting vendors to sell their products or services online
method analyst	the role charged to identify the better fitting methodological fragments to the context
method approach	the philosophy followed by the method
method engineer	the role charged to construct or adapt a method to guide the evolution of a given system within a given context
method facilitator	the role charged to guide and facilitate the work session proceeding
methodological fragment	the followed approach and the supporting tool (instrument) used by a method to obtain an artifact
MI	Market Invaders, a SaaS solution proposed by Net Invaders
process instance	an instance of a process, e.g., the production of a specific purchase order is one instance of the purchasing process.
process owner	the person immediately accountable for creating, sustaining and improving a process, as well as, being responsible for the outcomes of the process

process participants	all involved persons who are directly involved in the process
process stakeholder	all involved persons who are directly or indirectly involved in the process
SaaS	a Software as a Service solution
To-Be	the chosen scenario of evolution to be deployed over the existing system
transactional	small improvements put in place up to enhance a system
transformational	radical change of a system to completely innovated and transform.
vendor	a seller proposing to sell a product or a good through a marketplace

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