A Methodology for Project Use Case Definition

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Abstract. This paper proposes a methodology to support researchers, technology developers and industrial pilots, which are part of a European project consortium, on the use cases definition for the demonstration and validation of the project results. The proposed methodology analyses all the current business processes of each industrial pilot, to establish the starting point of the use cases project solutions. Thanks to this methodology, the detailed specification for the development of all composing elements of the use cases will be laid down, establishing the boundaries for the implementation and validation of the project results.

Keywords: Project use case · Industrial pilots · Business processes · Key performance indicators

1 Introduction

Horizon Europe is the EU's key funding programme for research and innovation with a budget of €95.5 billion [1]. It aims to (i) support Sustainable Development Goals (SDG) implementation; and (ii) boost the EU's industrial competitiveness and growth. Horizon Europe programme leads its activities on creating jobs, gathering talented personnel, stimulating economic growth and increasing industrial competitiveness; through the properly use of investment to strengthen the European research area. According to [1] a new approach to partnerships is boosted within the Horizon Europe Programme with the aim of achieving more ambitious partnerships with industry in support of EU policy objectives.

A use case is a sequence of transactions that yields a measurable result of value for an actor. In this way, when an actor uses the system, the system performs a use case. The collection of use cases defines the system's complete functionality [2, 3]. On the other hand, a scenario is a specific instance of a use case, in which a set of possible actions are carried out for that use case [4].

In order to help project managers and partners, including researchers, technology developers (RTDs) and industrial pilots, this paper has its objective on providing a Methodology to define Use Cases for the validation of the European research projects Results (MUCER). In this regard, a case study complements the proposed methodology,

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by using a metal machining industry pilot, participating in the European Project "Industrial Data Services for Quality Control in Smart Manufacturing" i4Q [5] project. To do so, the paper is outlined as follows. MUCER methodology is depicted and contextualised in Sect. 2. In Sect. 3, MUCER is applied in the metal machining use case that is part of the i4Q project. Finally, Sect. 4 provides some conclusions and future lines.

2 Definition of Use Cases with MUCER

In this section a methodology to define use cases for the validation of European research projects Results (MUCER) is proposed (Fig. 1). The outputs of MUCER are related with the: (i) definition of the use cases *(UC^m)*; (ii) definition of the AS IS scenarios (*AsIs_Py_BP0x*) represented through business processes modelling notation (BPMN); (iii) definition of TO BE scenarios (*ToBe_Py_BP0x*) with BPMN: starting from the *AsIs_Py_BP0x* scenarios, the *ToBe_Py_BP0x* scenarios include the results of the project and where are going to be implemented (ERP_S^N); and (iv) mapping between the solutions that are going to be developed along the European research project (ERP_S^N) with the use cases; that is, amongst all the solutions ERP_S^N which of them are going to be implemented and validated in each of the use cases (UC^m).

The next step of MUCER would be led to define and formulate the KPIs to be measured for identifying the extent into which the solutions developed within the project (ERP_S^N) contribute to the industrial pilots' performance improvement. Nevertheless, the KPIs definition will be considered on extended works. Parallel to the project use cases definition, the requirements analysis and functional specifications must also be carried out. This is because, the complete definition of requirements and functional specifications is based on the use cases definition, from the TO-BE scenarios. Thus, the AS IS and TO BE scenarios defined within the use cases give further knowledge to analyse the requirements and functional specifications that the project solutions should have (see Fig. 1).

The purpose of MUCER is to describe and characterize European project use cases. The MUCER reflects the methodology to be carried out to help the industrial pilots become aware of the solutions developed in a project, as well as the technical capabilities and potentiality, and at the same time express the needs and future expectations from the project results. Hence, MUCER includes:

- The industrial pilots' characterization, modeling their current state (AS IS) and forecasting the future state (TO BE) when the results of a European project are implemented, as the foundation to reach a use case;
- The description of the use cases, based on the industrial pilots manufacturing processes;

The MUCER steps are:
Step 1. Characterize the industrial scenarios

1.1. Describe the current manufacturing domain
1.2. Identify and describe the technical advancement desired from the European research project.

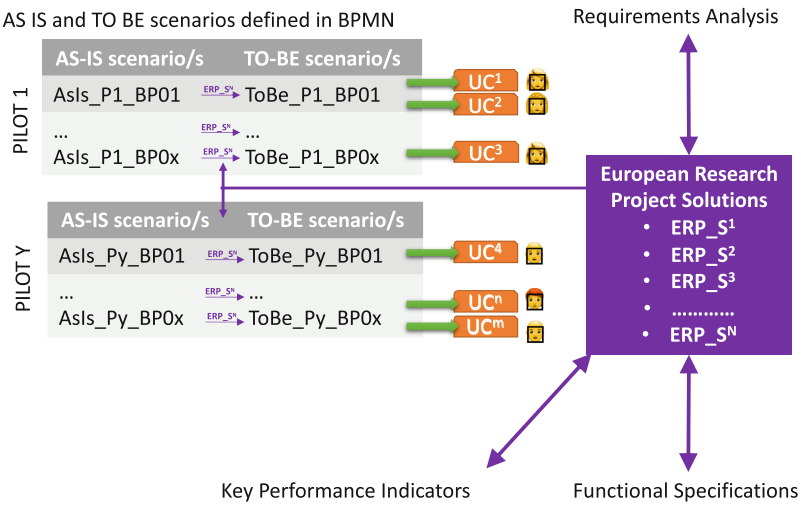

Fig. 1. MUCER contextualization

1.3. Map the technical advancements with the European research project solutions

Step 2. Describe and analyze the current situation of each use case (AS-IS scenario)

2.1. Introduce the industrial pilot involved
2.2. Define the current industrial pilot business processes
2.3. Describe the main facing problematics of the industrial pilot
2.4. Describe the desired improvements of the industrial pilot

Step 3. Describe and analyze the future situation of each use case (TO-BE scenario) by considering the implementation of the european project solutions:

3.1. Define the industrial pilot business processes expected after the implementation of European project solutions
3.2. Map the TO-BE business processes of the use case with the European project solutions

The main results from MUCER are grouped in three categories:

- The definition of business processes identified in each use case (AS-IS scenarios);
- The definition of TO-BE business processes in each use case, in which the AS-IS scenarios evolve to the TO-BE scenarios, which include the European project solutions;
- The mapping between the TO-BE business processes and the potential European project solutions applicable to achieve such TO-BE scenarios.

3 Metalworking Enterprise Use Case Definition in i4Q Project

In i4Q European project [5] participate six industrial pilots, each one takes part of different use cases that will serve to validate i4Q project solutions. This paper focuses on the industrial pilot of aeronautics and aerospace metal parts quality. FACTOR [6] is an engineering and metal machining company located in Valencia, Spain. FACTOR is labelled as pilot 4 within the i4Q European project, and includes two business processes, which has been modelled both in the AS-IS analysis of the current situation and in the TO-BE analysis of the expected use cases that will implement and apply i4Q solutions:

- *AsIs_P4_BP01: Product quality control*
- *AsIs_P4_BP02: Machine adjustments in the machining process*
- *ToBe_P4_BP01: In-line product quality control*
- *ToBe_P4_BP02: Automatic online correction of the CNC machining process*

MUCER application in the ToBe_P4_BP01: In-line product quality control is shown in Table 1. In the meanwhile, the BPMN for the ToBe_P4_BP01: In-line product quality control, is represented in Fig. 2.

Table 1. MUCER application in the ToBe_P4_BP01: In-line product quality control

Process name	"In-line product quality control"
Process description	The in-line control process begins once the machine has started production and the quality department checks the part and confirms that it is OK. The i4Q RIDS will be connected to the machine controller, tool and other sensor systems available for measuring the pieces as they leave the machine. i4Q solutions will be trained to correlate a range of processing parameters with the quality of the manufactured parts. During the process, i4Q systems will predict the final quality of the future production and will propose to the machine controller the parameters that can improve the quality of the manufactured parts or stop the machine in case there is not any alternative
Actors and roles	Innovation department, Engineering department, machine operator, machine assembler, quality manager
Information systems	CNC machine tool, Data Acquisition Systems, Inspection guideline and part drawing, i4Q solutions
Problems and needs	It is necessary to have a system for inspection/control of the manufacturing process that allows the permanent reading and storage of the data of the manufactured parts for subsequent analysis

(*continued*)

Table 1. (*continued*)

Process name	"In-line product quality control"
Internal and external barriers	The barriers are on the one hand internal as the appropriate information systems infrastructure and training of manufacturing staff is not in place, and on the other hand external as there are no qualified staff to operate/analyse these information systems
i4Q solutions involved [7]	i4Q Services for Data Analytics; i4Q Big Data Analytics Suite; i4Q Analytics Dashboard; i4Q Infrastructure Monitoring; i4Q Rapid Quality Diagnosis; i4Q Continuous Process Qualification; i4Q Line Reconfiguration Toolkit

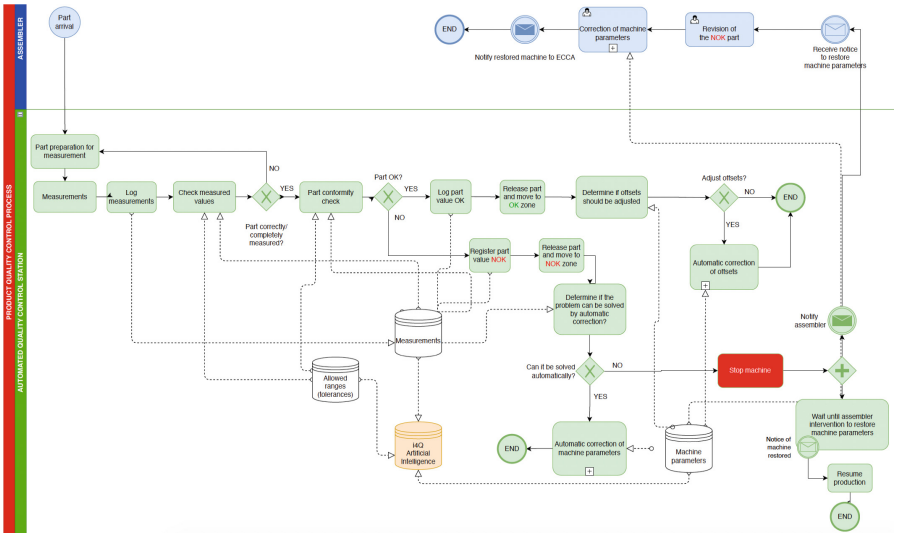

Fig. 2. BPMN example for the ToBe_P4_BP01: In-line product quality control

4 Conclusions and Future Research Lines

The purpose of MUCER is to propose a methodology to define the use cases that will validate the solutions of a European project. MUCER leads to model use cases in BPMN, both in the AS IS and the TO BE scenarios, which are prompt to be improved by the implementation of the project results. Future research lines of MUCER are led include a methodology that will enable to collect the use cases requirements and functional specifications. Additional effort in MUCER will be devoted to the definition of precise validation methods and procedures to univocally determine the real values of KPIs, that will enable to compare AS IS and TO BE scenarios in each use case. These KPIs will be used for an initial assessment of the use cases in order to allow results comparison and

improvements analysis at the end of the project, when solutions are implemented in the use cases.

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