Evolution of Business Processes towards eBusiness using a critiquing approach

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ABSTRACT
Innovating the business processes of an enterprise requires their preliminary analysis and assessment. In particular, information on the performance and costs of activities and processes must be gathered in order to identify candidates for innovation. A critical point is finding suitable presentation means of the gathered data in order to support effectively the decision makers. This paper presents a strategy and supporting tools for business process innovation. The strategy integrates measurement, decision making, and critiquing techniques, for analyzing business processes, identifying activities and software systems that are candidate to innovation, and mapping critiques onto specific innovation actions. The strategy is supported by a toolkit, named WebEv+, that integrates the WebEv environment [2], for managing the assessment and evaluation tasks, and ArgoUML [1], for modeling and critiquing business processes.

Keywords
eBusiness, business process reengineering, measurement framework, modeling languages.

1. INTRODUCTION
Fast changes of business requirements are forcing enterprises to innovate their business processes [8, 9]. Currently, several strategies and methods exist to drive process reengineering [6]. All these methods comprise an initial stage for creating a baseline of the enterprise by analyzing and assessing its business processes. The baseline is used to identify critical processes and activities and devise suitable changes.

The research presented in this paper is aimed at the definition of a strategy for assessing existing business processes and derive innovation actions. A measurement framework is used to assess existing process and is used to identify opportunities for change. The use of critiquing as tool for design is not new, as several authors have applied it to the design of software systems [18]; in this paper the approach is applied to business process innovation.

The strategy comprises a measurement framework, a set of critiquing tables, and a software environment.

The measurement framework creates the baseline by collecting qualitative and quantitative data on the existing processes and their activities. Both business and technological issues are included in the framework. The measurement framework adopted in the strategy is based on the Goal-Question-Metrics, GQM, paradigm [4], and considers both process and supporting software systems. The aim of the critiquing tables is to assist business analysts to formulate critiques on existing business process and derive actions. These tables capture heuristic rules that link deficiencies in the baseline processes, as expressed by critiques, to changes to overcome them.

A software environment, named WebEv+, supports the creation of the baseline, and the formulation of critiques, and suggests changes. The environment integrates a custom tool, WebEv – Web for the Evaluation, that implements the measurement framework, with the open source modeling tool ArgoUML; the latter is used to model the business processes and critiquing them.

The paper is organized as follows: Section 2 gives some background information on the use of critiquing as a design tool and briefly presents some environments that use it; Section 3 introduces the strategy used and presents both its methodological approach and supporting toolkit; the software tool is described in Section 4; finally, concluding remarks are discussed in Section 5.

2. BACKGROUND
The concept of critique, as it is used in social science, is referred to the discovery of the basic limitations of the existing reality, or, in more optimal dimension, the detection of the possibility of its future change [13]. However the “critiquing” was firstly used in the research by Perry Miller [14] to describe systems evaluating medical treatment plans. Then it was applied to a wide range of knowledge-based applications, ranging from medical therapy planning to computer aided design.

The critiquing techniques that have been developed differ in the way the concept of critique is used. In some cases critiques are used to comment the observed problems and indicate a treatment; in other cases critiques are used to comment the solution proposed by the human analysts. Both the approaches have been applied to a wide range of domains and problems (see [18] for an overview). The common feature is that they take a problem description as input and return some comments aiming at defining or improving the solution. Most of them preliminarily involve the development of a plan or the production of a design specification.

An area in which the critiquing approaches have been applied with some success is that of the critiquing design [7, 11], where critiques have been implemented to assist the design of buildings.

The critiquing design systems, applied to software systems, are widely diffused in literature [12, 19]. The motivation for this diffusion regards mainly the need to support the decision making process of the human designers who necessitates of useful feedbacks to improve the design. ONCOCIN [12] is a critiquing system developed by Langlotz and Shortliffe. It uses critiques as explanations of differences. In this system, the emphasis is on the system’s solution; the suggested solution was used only to choose which parts of the system’s solution needed to be explained. The studies conducted by Silverman [19] are mainly focused on the nature of human error and categories of errors. Their definition of critiquing implies that critiques not only help to correct the errors at hand, but they also identify a possible treatment.
The ideas underlying the approaches above have been exploited in this research for defining an automatic support for critiquing business processes. The motivation is due to the fact that typical applications for process reengineering scarcely support decision makers in the identification of solutions, even if they provide facilities for simulating solutions once they have been defined. In addition, the following advantages can be achieved:

- the critiques represent an useful means to present the results of the analysis of the baseline;
- the critiques, if they are well-posed, directly address the actions required to overcome the problems they evidence;
- the critiquing table and the measurement framework are not fixed and predefined tools but they can be customized at the beginning of a process reengineering project in order to be as adequate as possible to the context.

Furthermore a software system based on critiquing techniques can help the business analysts to identify the critiques to the process and the best actions to be performed.

3. THE STRATEGY FOR PROCESS EVOLUTION

The strategy proposed in this paper consists of the following two parts:

- a methodological approach, which defines the basic activities of a business innovation project and provides guidelines;
- a toolkit, which supports the activities of the methodological approach. More specifically, the toolkit is made of: a measurement framework, for supporting the collection of the qualitative and quantitative data required during the application of the methodological approach; a set of critiquing tables, for supporting the identification of the actions to be applied to the process to be evolved; and a software environment, WebEv+, supporting the application of the methodological approach and toolkit components.

3.1 The methodological approach

The overall methodological approach is shown in Figure 1. The activities are grouped in four main phases.

- **Improvement definition.** This phase aims at identifying processes and technologies that can achieve more competitive advantages. The critical factor of success of the phase is the choice of the processes to be reengineered. The first activity to perform is the Definition of the Improvement Goal that aims at clearly identifying the goals to face in of the reengineering and improvement project. Once these goals have been defined, it is possible to conduct in parallel the tailoring of the toolkit component. The activities involved are the Tailoring of the Measurement Framework and the Tailoring of the Critiquing Table. They exploit the two components of the toolkit, i.e. measurement framework and critiquing tables, defined during the previous application of the strategy and tailor them to the specific context before their re-application.

- **Process analysis and assessment.** The process to be reengineered is analysed. Then the first activity performed is the Process Model Definition. The analysis is conducted for developing a model of the chosen process and collect data in order to further understand its performance and execution mode. An abstract view of the process is achieved by producing a high-level diagram of how the process works. Then, it is important to identify the process customers and their needs, as the reengineering must begin by understanding the customers of the process. Finally, the entire process needs to be documented, putting activities into each functional area as they currently exist. It is also important to identify the software systems supporting the activities and that need to be evolved. A valid support for achieving a full knowledge of the process is offered by the measurement framework of the toolkit that guides during the collection of the needed measures. The following activities are the Identification of the Object to assess and the Process Assessment and both exploits the measurement framework. All the collected data represent the primary output of this phase.

- **New process model definition.** The aim of this phase is to redesign the process. The critiquing tables tailored in the first phase are used by activity Analysis of the Critiques to the Activities aiming at extracting critiques on the business process and its activities in order to drive its redesign and subsequent implementation. Indeed, this analysis will permit the identification of the requirements for the process evolution. The following activity is the Redesign of the Process Model, aiming at restructuring the process taking into account the critiques identified by the previous activity. For the new model, a clear description of the technologies, standards, procedures, systems, and controls employed by the reengineered process is developed.
Moreover, a description of the organization, staffing, jobs, career paths, and incentives employed by the reengineered process is produced.

**New process model implementation.** This phase includes only the implementation activity, during which the process innovation is executed by connecting all the results together and institutionalising the reengineered process throughout the affected areas of the enterprise. Therefore, the organization is prepared for the implementation of the new process model. Prior to implementing the new model, it is critical to ensure that the environment is ready to encompass the change.

### 3.2 Supporting toolkit

As previously stated, the proposed strategy is supported by a toolkit including a measurement framework, a set of critiquing tables and the software environment WebEv+. This sub section describes the first two components.

The **measurement framework** is the part of the toolkit that has been defined to support the assessment of the business processes. The aim is to collect all the data required to perform the critique analysis proposed in the methodological approach, in order to obtain evolution suggestions. It has been defined on the basis of the Goal-Question-Metric (GQM) paradigm [4, 5]. The references to the specific framework described in the following can be considered as an example of a possible definition and tailoring of the assessment tool. It is evident that each application of the strategy can require changes of the framework for making it pertinent to the specific context.

The GQM paradigm guides the definition of a measurement framework on the basis of three abstraction levels: Conceptual level, referred to the definition of the GOALs to be achieved by the measurement activity; Operational level, consisting of a set of QUESTIONS facing the way the assessment/achievement of a specific goal is addressed; and Quantitative level, identifying a set of METRiCs to be associated to each QUESTION in order to answer it in a quantitative way.

In the interests of clarity, Table 1 shows just a small example of the measurement framework. In particular it addresses the goal "Analyze a business process with the aim to evaluate its efficiency from the manager’s point of view". The process efficiency is evaluated as the ratio between the results the process activities produce and the resources they require. The resources are measured in terms of costs, and productivity. Then, for addressing the goal, it is needed to identify the resources involved in the process and quantify them. In particular, for each process activity, the cost, its critical level, the amount and quality of the output produced, and the factors impacting the output of the process can be measured. Table 1 reports some of the questions and the metrics addressing the specified goal. As it can be observed, the measurements are made for each process activity and used resource.

The measures to be assigned to the metrics are mainly numeric, while other evaluations produce lists of items, singularly considered in the measurement of the other metrics.

To abstract useful information from the data collected, a set of formulas have been defined to combine the single gathered measures. Table 2 contains the formulas defined to identify the values related to the process efficiency and productivity. The formulas have been defined in terms of metric identifiers, some of which are introduced in Table 1. It can be noticed that the process cost is evaluated in terms of costs for the human resources, software systems, hardware components and other resources, and that the process productivity is defined on the basis of productivity of each activity. The productivity of an activity is evaluated in terms of outputs it produces, and the time needed to produce them. The amount and quality of the produced outputs can be impacted by a set of variation factors regarding the activities.

The second component of the toolkit is the set of the critiquing tables. Once the data have been collected, the critiquing tables represent a support for interpreting them and identifying useful critiques on the existing business process. The structure of a generic critiquing table is shown in Table 3.

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**Table 1 - Questions and metrics of GOAL-1**

<table>
<thead>
<tr>
<th>ID</th>
<th>Metric Identifier</th>
<th>QUESTIONS AND METRICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td></td>
<td><strong>Q1</strong>: How many activities compose the process?</td>
</tr>
<tr>
<td>M1.1</td>
<td>n</td>
<td>No. of activities composing the process</td>
</tr>
<tr>
<td>Q2</td>
<td></td>
<td><strong>Q2</strong>: What are the resources involved in the process? (for each activity of the process)</td>
</tr>
<tr>
<td>M2.1</td>
<td>n</td>
<td>List of type of human resources</td>
</tr>
<tr>
<td>M2.2</td>
<td>n</td>
<td>No. of human resources in activity j</td>
</tr>
<tr>
<td>M2.3</td>
<td>n</td>
<td>List of supporting software system</td>
</tr>
<tr>
<td>M2.4</td>
<td>n</td>
<td>No. of different software system supporting activity j</td>
</tr>
<tr>
<td>Q3</td>
<td></td>
<td><strong>Q3</strong>: What are the costs of the resources used in the process? (for each activity of the process)</td>
</tr>
<tr>
<td>M3.1</td>
<td>c</td>
<td>Cost of human resources of type i working in activity j</td>
</tr>
<tr>
<td>M3.2</td>
<td>c</td>
<td>Cost of the software resources of type i supporting activity j</td>
</tr>
<tr>
<td>Q4</td>
<td></td>
<td><strong>Q4</strong>: Which is the allocation time for each resource? (for each activity of the process)</td>
</tr>
<tr>
<td>M4.1</td>
<td>t</td>
<td>Allocation time of the human resources j in activity j</td>
</tr>
<tr>
<td>M4.2</td>
<td>t</td>
<td>Allocation time of the software resources j in activity j</td>
</tr>
</tbody>
</table>

**Table 2. Formulas for the GOAL-1.**

<table>
<thead>
<tr>
<th>NAME</th>
<th>FORMULA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COST</strong></td>
<td></td>
</tr>
<tr>
<td>Total cost of the process</td>
<td>( C = \sum \left( C' + C'' + C''' + C'''' \right) )</td>
</tr>
<tr>
<td>Total cost of the human resources for the activity j</td>
<td>( C' = \sum_{j} \sum_{i} c_{ij} t_{ij} )</td>
</tr>
<tr>
<td>Total cost of SW resources for the j-activity</td>
<td>( C'' = \sum_{j} c_{j} t_{j} )</td>
</tr>
<tr>
<td>Total cost of the HW resources for the activity j</td>
<td>( C''' = \sum_{j} c_{j_{HW}} t_{j_{HW}} )</td>
</tr>
<tr>
<td>Total cost of the other types of resources for the j-activity</td>
<td>( C'''' = \sum_{j} c_{j_{other}} t_{j_{other}} )</td>
</tr>
<tr>
<td><strong>PRODUCTIVITY</strong></td>
<td></td>
</tr>
<tr>
<td>Productivity of the process for the output of type</td>
<td>( P = \frac{N_{j}}{T_{j}} )</td>
</tr>
<tr>
<td>Productivity for the j-activity</td>
<td>( P' = \frac{\sum_{j} P_{j}}{n_{output}} )</td>
</tr>
<tr>
<td>Productivity of the output of category i for the j-activity</td>
<td>( P_{i} = \sum_{j_{output}}^{} )</td>
</tr>
</tbody>
</table>

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**Table 3. Generic critiquing table.**

<table>
<thead>
<tr>
<th>Parameter 1</th>
<th>Critique 1</th>
<th>Critique 2</th>
<th>Critique i</th>
<th>Critique n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameter 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameter ...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameter m</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The parameters listed as row headings of the table are those assessed by using the measurement framework. The critiques used as column headings represent comments on the assessed business process/activity. A critique is made active if a value assumed by a parameter is not valid with reference to a given threshold, indicating the goodness level of the parameter value and specified in the measurement framework. For example, the cell in correspondence of the goodness level of the parameter value and specified in the process/activity. A critique is made active if a value assumed by a specific parameter is below/above the given threshold indicates eventual anomalies to be investigated either in the process or in its activities and resources. In this case, Critique i is considered active. It can represent a simple comment or, even, a suggestion of the actions to be acted on the assessed business process/activity. During the tailoring activities of the first phase of the methodological approach, each enterprise can indicate a threshold value for each parameter and support the definition and tailoring of the critiques and related tables.

For sake of clarity, Table 4 represents an example of critiquing table definition. It has been defined to indicate which critiques should be considered at activity level. All the considered critiques are listed below the table. For example, if the value of the parameter Automation Level is low, some of the actions to be undertaken should be: the decomposition of the complex activity in more simple activities to execute in parallel (AA2); the evolution of the software system to introducing web based technologies (AA11); the evolution of the software system to introducing web based technologies (AA10); the evolution of the software system to introducing web based technologies (AA10).

Another example can be referred to the parameter Number of output that requires the following kind of actions: the decomposition of the complex activity in more simple activities to execute in parallel (AA2); the reduction of the production of paper documents in the activity (AA7); the evolution of the software system to introducing web based technologies (AA10); and so on.

The values of the parameters and the execution of the critiques suggested by Table 4 permit to identify the process evolution requirements and the activities that can be impacted by the evolution process. This brings also to the identification of the software systems to be evolved and the definition of their evolution requirements that can regard the addition, modification or deletion of functionalities. The effective implementation of the identified requirements requires the software system analysis and assessment and the identification of an evolution strategy.

### 4. THE SUPPORTING SOFTWARE TOOLKIT WebEv +

To effectively support the presented strategy a software environment should implement a set of requirements that define the management of all the needed tools and support phases and activities of the proposed methodological approach. In particular, the main requirements of the toolkit should be the following:

**Req-1.** A generic measurement framework based on the GQM paradigm has to be defined, with all the metrics to be assessed and the necessary mechanisms, in order to extract from them useful information;

**Req-2.** The set of the managed parameters have to be refined on the basis of the exigencies of the business process re-engineering intervention;

**Req-3.** The measurement framework has to be tailored before proceeding to the assessment activities;

**Req-4.** The critiques to be considered jointly with unsatisfactory parameters values, have to be generically defined and tailored on the basis of the particular business process re-engineering intervention;

**Req-5.** The tool should provide all the support for designing the process model by using a standard description language;
Req-6. the metric measurements regarding process, activities and resources should be inputted and stored in a database;

Req-7. the measurement data has to be synthesized in order to identify the parameter values;

Req-8. unsatisfactory parameter values have to be associated to consistent critiques, both in a textual and graphical environment;

Req-9. all the stored data have to be kept for future analysis and comparison.

Based on the requirements above, the software toolkit WebEv+ has been implemented by using some software environments already available. In particular, WebEv+ enhances the WebEv environment and integrates it with the open source tool ArgoUML. Figure 2 shows the software toolkit architecture. The different grey tones indicate the components of the two already available environments and the integration modules. In the following subsection, a brief description of the three types of components of the software toolkit will be given and the requirements that each of them supports will be presented. The last subsection will describe the usage of the WebEv+ environment.

![Software Tool Architecture](image)

**Figure 2. Software Tool Architecture.**

### 4.1 WebEv+ components

WebEv [2], *Web for the Evaluation*, is an environment implemented by the authors for supporting the management of measurement frameworks and assessment activities. It represents a practical mean to collect all the available quantitative information about an organization’s process and/or software system and allows their diffusion through the enterprise. The recovered data can be used to identify the quality of the assessed object and provide useful information to consider during its evolution. WebEv can be used both in the planning and enacting stages of the assessment. In the first stage, WebEv permits the definition of the measurement framework and its customization to the specific context. Then, it supports the configuration and management of the items under assessment and the actual collection of metrics. Using a Web-based interface and, then, collaborating with other experts, the software engineers can define and store in the database, the framework to be used in the assessment activities (Req-1, Req-2 Req-3), and inserting the Goals of the analysis, and, then, all the Questions and Metrics required for collecting all the information of interest. The assessors can access via Internet the framework questionnaire and use the environment facilities for inputting the measures of the metrics, regarding process, activities and resources, through a web-based user interface (Req-6). WebEv implements also the calculations of formulas that value the chosen parameters in terms of the measures of the metrics (Req-7).

All the information to be managed by the measurement framework through WebEv is stored into a relational database. It stores information about the definition of the measurement framework, in terms of Goals, Questions, and Metrics and its characterization in terms of values the metrics assume. It takes in consideration that the metrics can be referred to various kinds of components interacting each other and having different granularity. For example, it is possible to measure aspects related to both processes and supporting systems. Moreover, if the evaluation is referred to the processes, it can be needed to assess all its activities and, for each of them, the used resources and the supporting software systems. One of the main requirement of WebEv is the possibility to store a large amount of information that can be accessed from different users acting in different sites and time (Req-9). With this in mind, Web technologies have been used for its implementation. In particular: the Java programming language, was chosen for its portability and independence from the hardware platform and operating system environment; the Java JDBC (Java Driver Database Connection) API, for the connection to the relational database; the Java Servlet API, for implementing the interface between the Web server and the application. Moreover, WebEv is based on the Model-View-Controller (MVC) design pattern that was chosen to achieve maximum reciprocal independence and proper localization of the functionalities.

ArgoUML is a pure Java open source CASE tool that provides cognitive support for object-oriented design [1, 17]. It is a tool for object-oriented design using the Unified Modeling Language [15, 16]. It supports UML class diagrams, state diagrams, use case diagrams, activity diagrams and collaboration diagrams. ArgoUML provides the same types of editing and code generation features of commercial CASE tools, but it focuses on features that enhance usability and support the cognitive needs of designers. It uses the XML file formats, i.e. XMI and PGML, for storing the UML diagrams in the model and graphic mode. For the ArgoUML’s characteristics of supporting the design of UML diagrams, it can be used in the *Process Analysis and Assessment* of the proposed methodological approach with particular reference to the *Process Model Definition* activity. In fact, the diagram useful for designing the process model can be elaborated by using: the use case diagrams highlighting the internal and external actors involved in the process; activity diagrams listing the process activities and the sequence of their execution; and class diagrams showing the involved entities in terms of artifacts, resources, etc.. The capability of ArgoUML of designing a process permits to satisfy Req-5, and this functionality can be used in the approach phases *Process Analysis and Assessment* and *New Process Model Definition* for designing both the old process model and the redefined one. ArgoUML exploits also critiques and criticism control mechanisms by integrating the concept of UML design critics through its Critics Framework. It is designed around a thread of control that is separate from the main application thread. Critiquing is done continuously so that designers do not need to request the feedback produced by the critics when needed. The critiquing capabilities of ArgoUML permit to partially address Req-8. In fact, identified the critiques, they can be graphically presented by using ArgoUML. The two newly implemented modules *Decision Support for Critics* and *WebEv Module for Critics integration* are defined for integrating the critiquing capability of ArgoUML with the assessment one of the measurement framework managed by WebEv. The former module is an extension of the WebEv environment and of its database for supporting the decision tables presented in the previous section. It permits the definition and next tailoring of the set of critiques to be considered when the values of the parameters do not reach the imposed thresholds (Req-4). This extension module addresses also Req-8. In fact, during an evaluation session, the critiques can be showed in output in a textual format through an HTML page.

The second module allows the automatic definition of the critiques on the UML Activity Diagram. This is achieved on the basis of the
measurements and the evaluation of the calculated formulas for Processes and Activities. The module annotates the Activity Diagram and its Activities with the UML comments and the specific ArgoUML “ToDoItem” list on the UML artefacts. The module queries, through the http protocol with authentication, the WebEv application in order to obtain the annotations to apply on each UML artifact. The matching between an activity of the UML diagram and one inside the WebEv database is achieved by calling the activity with the same name in the two environments.

4.2 Using WebEv+

The interface of WebEv+ is divided in three frames (see Figure 4). The left frame contains the list of the tables that can be edited and/or searched. They are grouped on the basis of their usage and user role. Three kinds of users can be defined: the Administrator can access all the tables and functionalities and is the only user that can define new users by interacting with the links in the Role Menu; the Software Engineer can access the definition operations; and the Assessor can access all the analysis and evaluation operations and can view the goals, questions and metrics defined.

During the definition activity, it is possible to interact with the tables listed in the Software Engineer section and store information related to the framework definition, the project, the kind of assessment to be performed and the measurement framework defined in terms of Goals, Questions, Metrics and Values each metric can assume. During the Analysis activities, the Assessor section permits to interact with the tables storing the data about the objects to be evaluated and the reciprocal interactions. They can be referred to the Organization, an Organization’s process, its activities, all the used resources (both human and not), and/or an adopted software system. Finally, the Assessor can access to the Measurement link and view the entire framework. The top right frame of the interface is used for searching in the selected table, while the bottom right permits the editing of the selected table and displaying of the selected information and its connected tables.

WebEv provides a set of functionalities useful for the definition of: the goals, questions and metrics composing the measurement framework; the collection of the information from the users involved in the assessment; and the analysis of the data through the application of the formulas. The definition of the measurement framework is performed using the appropriate menu elements, see Figure 3. Selecting the Project item from the Software Engineer Menu, a new frame is loaded and data about the measure project can be edited, see region number 1. Then, personal information of the software engineer that will manage the assessment can be edited through the frame in region number 2, if the user is already in the database it is enough to select s/he from the list. Similarly, goals and related questions can be defined through the fulfillment of the form in region 3. In the same way, it is possible to define metrics related to the defined questions and the values they can assume, also in this case, when the software engineer identifies the metrics for each question, s/he can select it from the already defined ones or insert a new one. From both the Software Engineer and Assessor Menus, it is possible to achieve a synthesis of the data characterizing the measurement framework. Figure 4 shows a complete view of the measurement framework once its definition has been completed. By using the WebEv facilities for the analysis, the software environment permits to insert the formulas and evaluate them automatically on the basis of the values assumed by the metrics. In particular, a manager can achieve a view of the assessment with detailed data with the related synthesis for each activity of the process. In Figure 5 there is a synthesis of the data collected for the Protocol activity of the chosen process and the indications extracted by the analysis of the cost characteristic. Then, by using the Decision Tool For Critics component of WebEv+, the critiques for each activity of the process are achieved. Figure 6 shows the UML activity diagram modeling the process, some of the critiques achieved by the analysis of the chosen process. Finally, as it is more useful for the manager to analyze the process from its graphical representation, the same critiques are also shown integrated with the process model. In particular, the critiques are directly annotated to the impacted activities. Figure 6 shows user interface of ArgoUML integrated in WebEv+. 

5. CONCLUSION

Business process reengineering projects require the analysis of the processes and the support of useful software systems. The methodologies, strategies, and tools supporting the process evolution still present some limitations. Therefore, the aim of the research described in this paper is the definition of a complete strategy that, by introducing a toolkit, extends already existing approaches and overcomes the cited limitations. In particular, a methodological approach, defined to specifically address the evolution towards the eBusiness, and additional tools, such as the measurement framework and the set of critiquing tables, are proposed. These tools can be generally applicable after an adequate customization to the goals and exigencies of the evaluation. Indeed, both the measurement framework and critiquing tables cannot be specifically predefined and always applicable, but they have to evolve together with the arising evolution needs. Therefore, the support of the software environment is
Authors’ previous experiences [3] highlighted the importance of using a supporting tool in the assessment activities. In fact, the assessment of a business process involves a continuous interaction with users,
developers and maintainers. Moreover, it is important to help the interviewed people to answer in an objective manner without considering their ideas and sensations. This can be avoided by formulating the questions in such a way to suggest the possible metric values and favoring the objective interviewed employees’ answers.

The strategy presented has been preliminarily validated within an case study that involves a local public administration of the Sannio area, the City Administration of Apollosa. The interest in this case study is motivated by the fact that, driven by the directives and the initiatives regarding the process reengineering and technology innovation of the Italian central public administration, the local administration represents potential customer for this kind of strategy.

The final goal of the case study is the validation of the effectiveness of both the methodological part and the supporting toolkit of the strategy. To fulfil this objective, the “payment of the land taxation” process has been considered for reengineering. Currently, the parts of the project that have been completed regard the analysis of the process and the extraction of the critiques on it with WebEv+, while the complete redesign of the process and its implementation in the real context are still in progress.

The following lessons learned have been currently drawn:

- the use of a methodological approach to understand the processes and model them made the interaction of the project team with the process owners easier as the conducted interviews were well addressed respect to the objectives;
- the collection of the required data by using WebEv+ effectively reduced the number of meetings respect to those planned without considering the use of the software environment; in addition, this also contributed to achieve a positive feeling with the process owners, as the application of the methodology was not to invasive and the actors could answer to the questionnaire by accessing the web and without time constrains;
- the initial activities of the methodological approach regarding the tailoring the measurement framework and of the critiquing tables, and this significantly reduced the typical negotiation to be conducted between the process re-engineering team and the manager of the public administration; the application of the toolkit components significantly reduced the time and cost required for the data gathering and their interpretation;
- most of the process re-engineering tools are very expensive and their cost significantly impacts on the cost of the entire project; therefore, the development of the WebEv+ environment, based on Open Source systems, and the use of a standard high-level process modelling language, independent from any application, has been particularly appreciated by the managers of the local administration, as it has been possible to conduct the project without doing external commitment;
- the use of the critiquing tables represented an effective support for taking decisions; in fact, the critiques to the process were considered appropriate by the engineers and the manager responsible of the identification of the best actions to be performed for redesigning the process; this overcame a limit of a large part of process re-engineering tool;
- finally, the critiques incorporated to the activity diagram represented a useful means to present the data gathered.

The future work of the authors aims at performing the full validation of the proposed strategy. This goal can be achieved only when the implementation of the restructured process in the real context will be completed. The refinement of the strategy will be performed on the basis of the suggestions coming from its application. With this aim, the authors are interested to share information and experiences with whoever is interested. WebEv+ will be available for the researchers who want to apply it in other contexts. WebEv information is accessible through the link http://www.rcost.unisannio.it/L2eCi/WebEv.html.

6. REFERENCES