

# Design of Web Information System Process-Oriented

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## ABSTRACT

*Modern Web Information System must answer “on the fly” to the company’s change requirements. To do this, companies left the vertical vision that locates business logic in functional areas orienting them toward a transversal vision that, according to the process logic, tries to improve the management exploiting as much as possible the existing resources. Process vision seems a good way to guarantee to the manager a full business activity control and to increase the flexibility degree in the IS management in order to apply immediately changes. To reach a good flexibility level a company “process vision” is not enough: it is very important that processes are explicitly taken in consideration in the Information System and not hidden in the code. In this paper, our goal is to provide a methodological approach to the design of Web Information System in order to obtain a good flexibility level. We consider the two main aspects of the Web Information System that is the management of the user experience (a typical web application problem) and the design of the business process already made by business experts and we try to integrate them through methodological guidelines.*

**Keywords:** Business Process Management, BPMN notation, Web Information System

## 1. INTRODUCTION AND BACKGROUND

Companies have abandoned a functional logic that provide a vertical vision and they are moving towards a horizontal vision that allows, thank to a correct use of business process, to provide the appropriate flexibility level to the Information System. This involve a change to the companies’ Information Systems but, because the Information Systems are now oriented to the web (WIS-Web Information Systems) it is important to consider not only the process aspects (the business processes must be considered in a explicit way in order to reach a good flexibility level) but also the web application paradigm that is the information, navigation and the transactional aspects typical of Web Applications. According to these requirements, the WIS became more complex and they need a careful design phase made up by ad-hoc methodologies to manage the complexity.

In the traditional design and development of an Information System, it is important to consider two kinds of actors: internal actors and external actors. Today, because Information System is delivered on the web, this distinction is still important:

- *Internal actors* interact with the WIS through intranet considering the Information System as a job tool needful and irreplaceable.
- *External actors* (as an example customers or suppliers) take advantages of Information Systems only through Internet.

The two kinds of user and the two platforms (Intranet and Internet) share the same characteristics: the application implements one or more process in order to drive the user to execute them. The main difference is that the internal users actions are essentially process driven while, when external users interact with the application, they need information not strictly related to the processes (such as marketing information) that make easy the process execution by the final user.

Therefore, there are several approaches (methodological and technological) to follow in the design and implementation of a WIS process-oriented and the main difference concerns the necessity to manage or not the user experience (UX). The

UX design is the design of the information and navigation aspects in a user centred style focusing on the dialogue between user and application so the information are presented to the user in order to facilitate this dialogue avoiding the user to lose in the web application.

We focus in this paper on the WIS design for the external actors, so we consider both the UX design and the business process design linking together the know-how coming from these two research area. We deal in the intranet design problems in a separate paper where we describe a methodological approach focused on the portlets.

Several methodologies attempt to solve the WIS design problem for external actors.

WebMI [1] is a web application design methodology: to support processes authors made an extension to meta-data and add the concept of interface in order to provide to the final user the interface to execute process. The authors of WebMI state that the methodology is not efficient when process hide sophisticated business logic.

UWE[2] start from an UML class diagram and from a process design made up by an UML activity diagram. The design methodology is made up of several steps starting from a refinement of the conceptual model adding new attributes in order to take in consideration the process logic. In the navigational model, the extension for business process adds new access structure (in order to support business process) and the rules of their use.

WSDM [3] extend itself in order to support processes with a first integration with the information aspect of the methodology: this integration is made up by a design of the information needed in each process task. In the Task Navigation Model, in order to complete the design, WSDM add the *process logic link* that express the link between tasks and semantic link.

Each methodology has its strengths and weaknesses; for example, all these methodologies are user-centred but just UWE provides support in order to stop the process execution and continue its execution later. Only few methodologies support a standard notation to design process and it is not always possible to make a clear distinction between process link and semantic links.

Our research work, starting from a Web Application design methodology that, focusing on the dialogue between user and application and using well-known techniques for process analysis, design and representation, defines methodological guidelines that drive the designer towards the design of complete WIS.

We selected IDM [4][5] as web application design methodology. IDM seems a good methodology to manage the UX aspects of WIS and we implemented, for IDM, a code generator [6] considering IDM as the domain specific language to design the web application. The code generator allows us to obtain in a few minutes the final application. Today, IDM does not provide guidelines about the integration with business processes.

Regarding business process design, we select BPMN [7] an OMG standard notation simple and effective.

In IDM, the main concepts are: *Topics* and *Relevant Relation*. Topics are made up by *Dialogue Acts* that are information unit of the main topic. The access structures express how the final user can reach and use the information. Each topic may be related to one or more *Introductory Act* that is the entry point to the topic’s information. Furthermore, IDM provides the possibility to indicate that the topic

is related to an operation using the *Operation Act* but IDM does not provide any detailed description about the operation. IDM provides a specific design for each user and each device. Information contents are organized in page (*P-IDM*). Screens with input and/or output information contents make up each page; each screen has its own layout and belongs to a screen template. Pages are grouped in view; each view focuses on a specific aspect: the *structural view*, for example, represents the navigation within the same topic; the *association views* represent the navigation between topics.

In this paper, we present in the section 2 the open issues in the WIS process-oriented design and in the section 3, we present the integration guidelines between IDM design and the business process. In section 4 we apply guidelines to a real world case study, finally, we present in section 5 conclusions and future works.

## 2. WEB INFORMATION SYSTEMS PROCESS-ORIENTED: OPEN ISSUES

Before to define the methodological guidelines we present here some open issues. We know that other works deal with the same open issue [8] but here we refer to a specific design methodology focused on the UX and not on a general UML-based methodology.

### Several Types of Information in the Same Web Application

A traditional web application has the main goal to provide the user with information using a well-defined plan close to the user's expectation. The introduction of process logic, adds process information to typical web application information. In a WIS process-oriented, we can see three different kinds of information:

- Information used by process task: for example input and output data of each task.
- Information related to the process already finished;
- Hypermedia information that are data not related to the process: for example marketing information are related to a specific process but are not input and/or output information of the process task.

Information related to the UX design and information related to the process are not disjoint: it is possible that a UX information hide information related to one or more process tasks; in the same way, a process task may hide information related to different UX information unit.

### Navigation Design

The navigation design plays a very important role in the web application design. In the WIS process-oriented, it is hard to make the navigation design because the final user must follow several steps coming from process logic in a well-defined order. We observe that process links (links coming from process design) must be related to the semantic links: an inconsistency between process link and semantic link warns the designer about the possibility of an error in the process and/or in the UX design.

### Process State

The user during the task execution may want to exit from the process in order to read marketing information or information related to process instances yet finished. The user wants to continue the process later exactly where he/she leaves from. This is not only an implementation problem but this is a design problem: at design level, it is important to provide information about the process state in order to provide dynamically generating access structures that allow the user to continue the process execution.

### Web Page for Task Execution

In the web page design, it is important to define if the process uses just one page or multiple pages. We observe that there is not a rule to assign a well define number of pages to a task: it depends on the graininess level of the process design. Sometimes a task execution ends in one page; sometimes the task execution require several pages, other times a task is an automatic task so web pages are not required.

## 3. WEB INFORMATION SYSTEM PROCESS-ORIENTED: GUIDELINES

To approach the open issues presented in section 2 we provide not a design methodology but integration guidelines: in this way the know-how coming both from web application design and from business process design are related in order to not lie the designer to many restrictions. In the guidelines definition our attention was oriented to the *traceability requirement*: in the web application process-oriented design, it is important to follow the process flow. In this way, it is simple to obtain quickly changes in the web application process oriented when a change in the business process happens: very often companies change their business process in order to answer to the companies' requirements changes.

### Type of Users

There is a natural mapping between web application type of users and business process actors: each pool and each lane of pool can be mapped to a web application user. This is not a general rule; in fact, in BPMN notation it is possible to represent with pool and/or lanes non-human actors that are not related to a specific web page; pools can be black box (when they represent external institution related to the company but not directly involved in the process).

### Mapping Between Process Information and UX Information

Starting from IDM design it is possible to identify topics, dialogue acts and slots belonging to the process. It is possible that information related to only one topic are enough to execute the process but it is also possible that information needed to execute the process are in several IDM topics. So, it is impossible to define a general rule in order to identify the information helpful to execute process starting from the UX design; in the same way it is impossible to define a general rule in order to identify where process information are located in the process depending on the specific case study.

### Operations

Operations are very often not taken into consideration from design methodologies: operations are, instead, a key aspect to integrate process design and UX design but it is important to define the operation properties. For each process task, it is important to see if it requires one or more operations, a simple navigation or both. The operation act (the IDM element that defines the operation) may be related to a topic or to a dialogue act but may be related neither to a topic nor to a dialogue act. For example, if we think to an operation related to a message exchange the operation is not lies to any elements of the UX design. The operation act properties that we define are:

- *Name*: the same to the task related to the operation act (when exist);
- *Process name*: the name of the process;
- *Task*: the task related to the operation act (when exist);
- *Implementation*: the reference to the code that implements the operation;
- *Pre-condition*: the condition need to execute the task (when exist);
- *Output*: the output of the task related to the operation act (when exist);
- *Gateway*: is defined only if the operation is related to a gateway. It expresses the condition related to the gateway ;
- *Kind of topic*: identify the kind of topic where information are located;
- *Dialogue act*: identify the dialogue act where information are located;
- *Slot*: identify the slot where information are located;

### Traceability Between UX Design and Business Process Design

As we state before, it is very important to provide traceability between UX design and business process design. We add to the IDM design the operation strategy  $\hat{\uparrow}$  (to show the dialogue act or topic where the process starts) and the intermediate strategy  $\hat{\uparrow}$  (to show a pause in the process execution) that is related to an intermediate event. Another important aspect is the introduction of the *process link*: it links together two operation acts in order to trace the process flow. The name of the process link is the name of the target operation act.

### Access Structures

Access structure allows the user to access the web application. In the web application without business process, access structure allows to access to the information

Table 1. IDM extension

IDM extension for Business process integration	Comments
Structure of operation act	To provide the right structure to operations (very important in the process)
Intermediate strategy	Answer to the traceability requirement
Operation Strategy	Answer to the traceability requirement
Process link	To separate the free navigation from the navigation coming from the process logic
Specific access structure for process	User must be able to execute a task of the process
Management of the state of the process	Allow to stop and re-start process
Input form	Allow to insert input data in order to execute a process task
Screen with input form (<<P>>)	Answer to the correspondence requirement
Process view	Answer to the traceability requirement

according to the UX design; when the web application hides a business process, it is important to add access structures in order to allows the user to start the process and to continue its execution when he/she stop the process. We advise to define an access structure for each operation act.

**Page Structure**

The page structure design changes when we integrate the business process design in the UX design. In P-IDM each topic produce a structural view made up by screens aggregate to contents (in order to show information) or screens aggregate to an input form (in order to insert information). When the process design is taken into consideration, the same information may be, depending on the process state, input information or output information. We state that in the page design level must coexist both input form and content: the input form or the content will be dynamically presented to the final user depending on the *process state*: the screen has also information about the state. The input screen related to a process will be show with a <<P>> symbol.

If the information of the same topic is useful in order to execute two or more operation, the related screen will be linked together with a process link. In the structural view, we define the *intermediate link* in order to represent the intermediate strategy.

Regarding to the *template view*, it is important to define links that allow the user to continue the process: the state of the process allows to dynamically activate the correct link.

We recommend to add a process view in order to design in a single view all the process screens. The process view is useful when the information needed to execute a process are in several topics in order to understand how the process flow moves towards information. If the information to execute process is all in the same topic the process, view is the same of the structural view.

We summarize in table 1 the IDM extension proposed.

**4. GUIDELINES IN PRACTICE: A CASE STUDY**

We apply the guidelines proposed in section 3 to two different research project founded by Italian government: one project is related to the management of environment domain and another is related to the commerce of the wheat.

We present here the first project born with the goal to design and implement a family of web application compliant with European standard related to the environment. From this family it will be possible to obtain specific web application for several public administrations with different competencies and responsibilities. Obviously, the web application family will consider both the UX and the process aspects.

Figure 1. IDM design of the management flora and fauna census

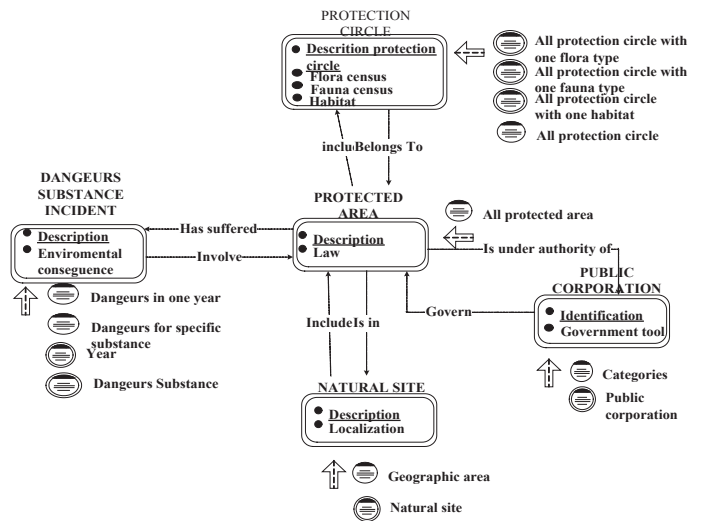
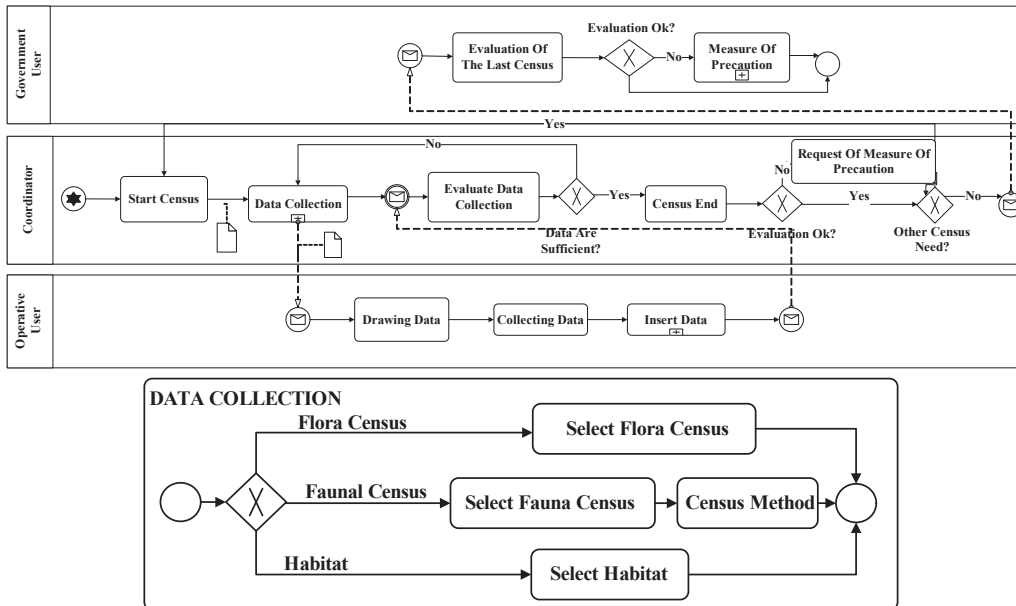


Figure 2. BPMN design of the management flora and fauna census process



In this project business experts and IT experts' teams design, in a separate way, both the UX and the business process of the overall information system (Fig. 1 and Fig. 2).

We present here, due to space limitations, a fragment of the overall Information System: the management of flora and fauna census. The sub-process "data collection" considers three kinds of census but we are interested only to "faunal census".

In fig. 2 we can immediately observe three kinds of user one for each BPMN pool: we focus only on the coordinator user.

A careful analysis of the process design and of the UX design helps to select the process information defined also in the UX design. We observe that all process tasks refer to one dialogue act: "faunal census". Each task is related to a different

slot of the dialogue act. As an example the task "Start Census" is related to the slot "Description" and "Start date" while the task "End Census" is related only to the slot "End Date".

The task "Request Of Measure Of Precaution" is not related to any slot: this task is the request of a precaution made up by the coordinator user to the government authority, so it does not require neither to write nor to read any slot.

In fig. 3 we show the process start on the integrated design with an operation strategy near to the dialogue act related to the first process activity (the first operation act).

We define now the operation act (in this case study all the operation act are on the topic Protection circle). In fig. 3 we show only the properties of the operation act related to the "Start Census" but all operation acts have its own structure. We

Figure 3. IDM Process of the management flora and fauna census process

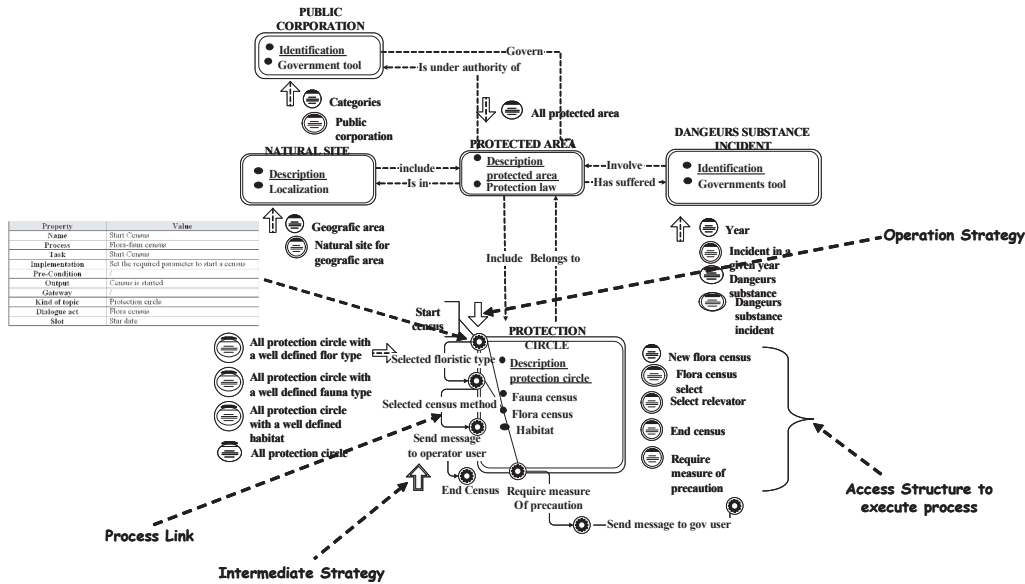
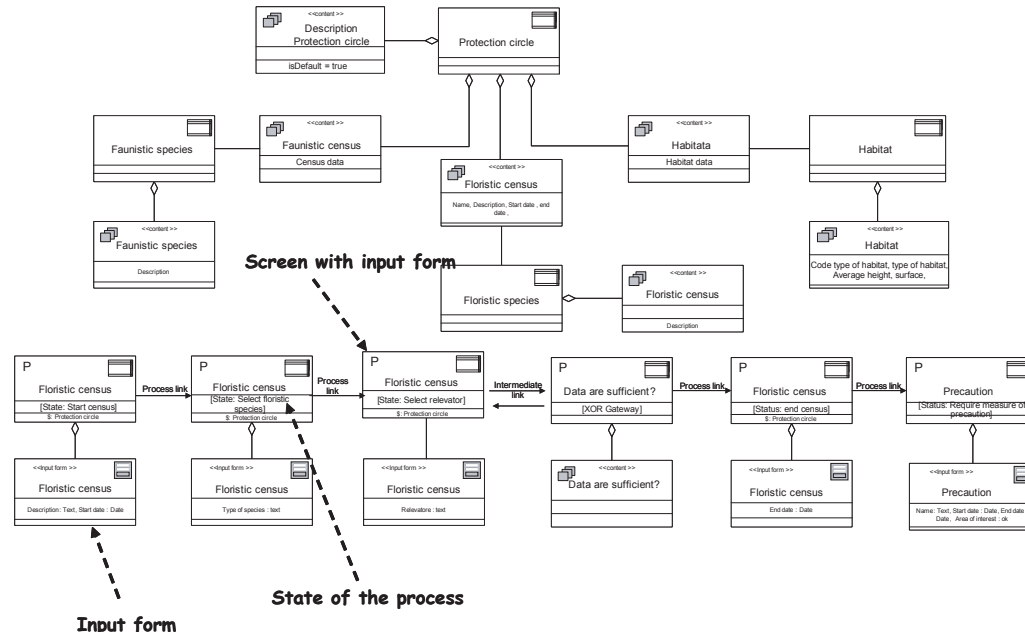


Figure 4. Structural view



can see that there is an operation act related to each process task also for the task related to operation not directly related to the information.

At this point, we design the process link that links together, in a well-defined order and according to the process flow, the operation acts. The name of the process link is the name of the target operation act.

We define now the access structures (in IDM methodology named introductory act) in order to start a new process or to continue the process. There is an introductory act for New Flora Census that allows to make a new process instance; in the same way, we define an introductory act for each operation act. If the operation act represents only a message exchange there is not an access structure related.

Regarding the page design, we consider the structural view related to the *Protection Circle* Topic (Fig. 4). We can see that the screen related to each dialogue act has both content and input form. Process screens are marked with a <<P>> on the top and contain information about process state. *Process link* links together the process screens according to the process flow. We highlight that the process screen related to the gateway is related with content and not with an input form: a gateway does not require input data (defined through slot) but only an answer to a well-defined question. The slots needed to execute task are shown in the input form.

In the *page template view* (not shown here for space reasons) there are links that brings to the process screens. These links do not appear in all the pages but they will be dynamically generated depending on the process state and allow the user to start or to continue the process exactly where he/she left.

Finally, the process view contains the entire process screens and their relationships: in this case study the process view is the same of the structural view because all the information need to execute process are in the same topic.

## 5. CONCLUSIONS AND FUTURE WORK

To achieve the goal of the flexibility in the modern WIS process-oriented, it is important to think to a design methodology that links together the know-how coming from the UX design and the know-how coming from the process design. In this paper, we defined an integrated methodology focusing on the differences between kinds of information and between free navigation and navigation process-

driven. We apply the guidelines to a real case study with good results. The buyer was very happy because it is possible to trace, in the final design, both the UX and the process design. Processes, was, also, defined by their business expert so, the final WIS matches exactly their needs with an added value. Public administration, that is the final user of the WIS, was very happy to work with a WIS where all the information are really where they need and are reachable exactly as they need. In addition, developers have a clear documentation.

Naturally, the implementation actually is made by hand but we are planning to extend our code generator in order to support also the introduction of these guidelines.

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