An Organizational Ontology for multiagent-based Enterprise process modeling and automation

Application to Scrum

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Main goal

- model and automate enterprise processes
- provide a rich model to describe enterprise processes and their related products and participants
- use this model for designing software tools to support human activities (management, control, etc.)

Focus on Software Companies and the famous development process Scrum: provide an assistance tool
Plan of Presentation

- Introduction
- Scrum
- An organizational Ontology: K-CRIO
- Scrum Tool
- Conclusions and Perspectives
Part I: Introduction

- Introduction
- Problem Description
- Context
- Objective
- State of the Art

- Scrum
- An organizational Ontology: K-CRIO
- Scrum Tool
- Conclusions and Perspectives
Context

Enterprise

- an entrepreneurial economic organization or a business organization
- aiming at delivering products/services to identified markets.

Enterprise Process (Business Processes (BP) in Enterprise)

- a collection of related, structured activities or tasks, which are executed in a specific order, that produce a specific service/product for a particular customer.

- Accompanying with rising market competition, BP are becoming more and more complex.

- Aspects that should be modeled in BP:
  - Individual, Actor, Organization Structure, Behavior, Data Flow, Workflow Pattern.
Objective

- Proposing an approach for modeling and conceptualizing various business processes in enterprises

  K-CRIO: An Organizational Ontology

- Designing and implementing an intelligent assistance system to support human activities within business process.

  Application to Scrum

  An intelligent assistant system for Scrum project teams to support human activities within Scrum process, based on the conceptualization of Scrum.

  Scrum Tool: A Web Application using Multi-Agent System
State of the Art

- Ontology
- Models/Methods (Ms/Ms) used for Business Process
- Multi-Agent System (MAS)
What is Ontology?

 Ontologies are defined as a formal specification of a shared conceptualization.

 An Ontology is as "an explicit specification of a conceptualization".

 An ontology defines the basic terms and relations comprising the vocabulary of a topic area as well as the rules for combining terms and relations to define extensions to the vocabulary.

 Binding ontology with a knowledge base, "an ontology is a hierarchically structured set of terms for describing a domain that can be used as skeletal foundation for a knowledge base".

 Why Ontology?

 share common understanding of the structure of information among people or software agent

 include machine-interpretable definitions of basic concepts in the domain and the relations among them

 Organizational Ontology

 the first, fundamental, and in-eliminable pillar to build a precise and rigorous Enterprise Model [Bottazzi and Ferrario, 2009]
Ontology

Ontology Description Language

Some of existing standards:

- RDF: Resource Description Framework
- RDFS: RDF Schema
- OIL: Ontology Inference Layer
- OWL: Ontology Web Language

Logical Constructs of OWL

- owl: class → concepts
- owl: objectProperty → relationship
- owl: individual → instance of class

we used it

Extensions of XML for describing resources
- a greater machine interpret-ability
- a larger vocabulary
- a rich syntax
### Some Models/Methods used for BP

<table>
<thead>
<tr>
<th>Model</th>
<th>Scope of modeling</th>
<th>Related Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Individual</td>
<td>Actor</td>
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<tr>
<td><strong>Descriptive Model/Method</strong></td>
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<td></td>
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<tr>
<td>UML Activity Diagram</td>
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<tr>
<td>BPMN</td>
<td>Yes</td>
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<td><strong>Procedural Model/Method</strong></td>
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<tr>
<td>XPDL</td>
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<td></td>
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<tr>
<td>BPEL</td>
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<tr>
<td><strong>Formal Model/Method</strong></td>
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<tr>
<td>AIC Model</td>
<td>Yes</td>
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<td>MOISE+ Model</td>
<td>Yes</td>
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<tr>
<td><strong>Ontology-based Model/Method</strong></td>
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<tr>
<td>TOVE</td>
<td>Yes</td>
<td></td>
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<tr>
<td>Ontologies based on SPEM</td>
<td>Yes</td>
<td></td>
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<tr>
<td>BPAL</td>
<td>Yes</td>
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<tr>
<td>PSL Ontology</td>
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</table>
An organizational Ontology based for multiagent based Enterprise process modeling and automate

**TOVE & DOLCE**

**Tove** [Fox et al., 1996]

- An Organization Ontology for Enterprise Modeling, which puts forward a number of conceptualizations as agents, roles, positions, goals, communication, authority, commitment.

- **Drawbacks:** No concepts for Workflow description

**DOLCE** [Masolo et al., 2002]

- A top-level ontology, which may describe very general concepts (like space, time, matter, object, event, action...) that may be across all domains.

- **Drawbacks:** too general to provide actual support for BP (human activities in BP)
An organizational Ontology specially for modeling/conceptualizing business processes.

could model/conceptualize all the aspects of business processes, including individual, actor, organization structure, behaviors, data flow and workflow pattern.
Agent [Ferber, 1999]

- an autonomous entity that is pro-active, reactive, social, able to take part in an organized activity, in order to achieve its goals.

Multi-Agent System [Ferber, 1999], [Zambonelli et al., 2000]

- a loosely coupled network of agents who work together as a society, in order to solve problems.

Advantages

- Distributed problems and systems
- Open systems
Part II: Scrum

Introduction

Scrum

An organizational Ontology: K-CRIO

Scrum Tool

Conclusions and Perspectives
An **iterative, incremental framework** for projects/products or application developments

A famous **agile software development process**

**Two groups of people**

- **Pig (Scrum Team)**
  - Product Owner
  - Scrum Master
  - Developing Team
- **Chicken (Ancillary People)**
  - Stakeholders
  - Manager
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Part III: K-CRIO Ontology

- Introduction
- Scrum
- An organizational Ontology: K-CRIO
  - Description of K-CRIO
  - Model/ Conceptualize Scrum with K-CRIO
- Scrum Tool
- Conclusions and Perspectives
An organizational ontology

to understand, analyze and reason about organizations.

organizations: composed of individuals, who are involved in design of a product and to do so, following a business process in enterprises.

Used to support process in the described organizations, specially to model/conceptualize processes.

General BP: product order, shopping online, etc.

BP in software companies: Waterfall Model, Scrum, OpenUP, etc

Based upon CRIO meta-model.

OWL is used as description language.
An existing organizational meta-model

Used for description of MAS Organizations

4 Fundamental Concepts:

Capacity
Role
Interaction
Organization
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The targeted organizations are dedicated to product design.

**Design Object** is the inheritance root class of all possible products that an organization can produce.

**Ontology**
- **OntologyElement**
  - **casualInteraction**
  - **FormalizedInteraction**
- **DesignObject**
  - **input**
  - **output**
- **Capability**
  - **requires**
  - **ensures**
- **Organization**
  - **isSubOrganizationOf**
  - **isThePlaceOf**
  - **includes**
  - **provided**
- **Interaction**
  - **hasParticipants**
- **Role**
  - **hasParticipants**
- **Predicate**
  - **has subclass**
- A set of interacting entities: sub-organizations or roles, which are regulated by social rules and norms. (these entities are contributing to a common goal.)

- It may have an unspecified number of sub-organizations

  - ObjectProperty: isSubOrganizationOf is a transitive ObjectProperty.

    \[
    \text{isSubOrganizationOf} \quad (\text{Organization}, \text{Organization})
    \]
    
    \[
    \text{isSubOrganizationOf}(O_1, O_2), \text{isSubOrganizationOf}(O_2, O_3) \Rightarrow \text{isSubOrganizationOf}(O_1, O_3)
    \]

- It must include one Role at least

- It may provide capacity for its including role.

- One (or more) interactions must occur in an organization.
A role may identify a person, status or generic behavior.

It is a necessary part to achieve social objectives (goals of its organization).

In order to fulfill this common target, each role of an organization may require specific individual capacities.

An Organization includes Roles, which may require Capacity.\[\text{includes}(\text{Organization}, \text{Role})\]
\[\text{required}(\text{Role}, \text{Capacity})\]

An Interaction (occurring in an Organization) has Participants that are Roles. \[\text{hasParticipants}(\text{Interaction}, \text{Role})\]
A capacity is a know-how and ability, which may be considered as an interface between the role, as generic behaviors, and its role-players.

Capacities may be required by a role or provided by an organization to define their respective behaviors.
Two types of Interaction

Interaction(\(X\)) \equiv \text{Casual Interaction}(\(X\)) \cup \text{Formalized Interaction}(\(X\))

- Casual Interaction
  - No
  - being specified by a sequence of events
  - producing at least one Design Object

- Formalized Interaction
  - Yes
  - Two main aspects:
    - Workflow
    - Schedule
  - produces (Formalized Interaction, Design Object)

- Casual Interaction
  - No

- Formalized Interaction
  - Yes
  - produces (Formalized Interaction, Design Object)

- The whole Scrum Process
  - produces
  - A software Product

- Pre-Game Phase
- Game Phase
- Post-Game Phase

Yishuai LIN

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Reuse and Improve

- OWL-S [Martin et al., 2004]: Semantic Markup for Web Services
- OWL-WS [Beco et al., 2005]: An existing workflow ontology
### Process as being a class equivalent to FormalizedInteraction

- two sub-classes of Process
  - Atomic Process
  - Composite Process

\[
\text{Process}(X) \equiv \text{FormalizedInteraction}(X)
\]

### Each process has its participants

- Participant as an owl:class is equivalent to the Role class

\[
\text{Participant}(X) \equiv \text{Role}(X)
\]

### Each process has its parameters.

- two sub-classes of parameters
  - Input
  - Output

### Each Composite Process is composed of a Control Construct (or called Process Component).
Control Construct

- Sequence
- Split
- Split-Join
- Any-Order
- Choice
- If-then-Else
- Iterate
- Repeat-While
- Repeat-Until

The whole Scrum Process produces A software Product

Pre-Game Phase
  ↓
Game Phase
  ↓
Post-Game Phase

Start/In

Condition: The Sprint is Not finished?
  ▸ True
    ↓
    Daily Scrum Meeting
  ▾ False
    ↓
    Finish/Out

Sprint produces Some Release

Some Release produces True

Formalized Interaction: Workflow’s aspect
pay more attention to the state and time-table of each Formalized Interaction

FormalizedInteraction "is in" some State

- State has three sub-classes
  - NotStarted
  - Doing
  - Done

In certain situations, a formalized interaction has its pre-Interaction

\[ \text{hasPre} \rightarrow \text{Interaction}(\text{FormalizedInteraction}, \text{FormalizedInteraction}) \]

FormalizedInteraction may respect time constraints

- Time has four sub-classes
  - BeginningTime
  - EndTime
  - RealBeginningTime
  - RealEndTime.
Introduction

Scrum

An organizational Ontology: K-CRIO

Scrum Tool

Overview

Design and Implementation

Conclusions and Perspectives
The goal of our Scrum Tool is to provide an assistance platform for distributed Scrum users.

- modeling and automating human activities and concepts during development projects following the Scrum
- monitoring projects by estimating both the cost and time of each task;
- managing data/knowledge about elements and events appearing in the Scrum process.

Uses MAS

- ASPECS Methodology [Cossentino et al., 2010a] for design
- Janus Platform [Gaud et al., 2009] for implementation
The majority of existing tools for Scrum Method

- based on a typical web-based architecture
- their main functionalities are to build the project and monitor project lifecycle

Our Scrum Tool

- makes projects not only follow the Scrum Method, but also helps Scrum Master to monitor human activities in scrum process implementation
- provides an accurate estimation of time/cost and workers’ efficiency, when any change is happening during the development.
- uses MAS for adding intelligent behaviors.
- relies on the modeling of Scrum Method by K-CRIO.
Integration of MAS into web-based System

Struts 2: the popular framework for web application
Java: Janus Platform for MAS

MAS is triggered by User actions
Various agents will be launched accompanying with the successful log-in of any user.
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IS Organization

Monitor Organization

g0: get Users' action in client part

g1: Monitor project proceeding
How to provide an assistance platform for Scrum users?

All the basic performances necessary for building projects as Scrum method are implemented in our Scrum Tool, such as:

- for each project, user owner its specific role and specific allowed operations
- build and edit user stories
- update the hierarchy of tasks with estimated effort (hours) in the Sandbox and Backlog
- build and edit iterated sprints and releases to implement user stories or tasks selected from Backlog for one project.
- each project owns specifics burn-down charts of sprints and releases, etc.

Help Scrum Masters understanding, monitoring and controlling each project:

- estimate how much money needs to be spent for finishing one project, timely
- monitor each workers’ efficiency
- provide suggestions to Scrum Master
  - recommend workers from the current project team, for one selected task
  - estimate time of one task (assigned to a specific person)
How to monitor workers’ efficiency?

- A worker finishes her/his tasks
  - in advance? on time? or delay?

Rate of finishing tasks on time = \( \frac{\sum \text{Initial Estimated Time of Task}}{\sum \text{Real-time Estimated Time of Task}} \times 100\% \)

Initial Estimated Time of Task:
Before Sprint beginning, estimated time of one task in Sprint Backlog

Real-time Estimated Time of Task:
During the Sprint, in the Daily Scrum Meeting (Assigned worker), spent hours for the task + re-estimation of required time for finishing the task
<table>
<thead>
<tr>
<th>Name</th>
<th>Rate of on Time</th>
<th>Roles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yishuai LIN</td>
<td>100.0%</td>
<td>Scrum Master</td>
</tr>
<tr>
<td>Harry Potter</td>
<td>93.75%</td>
<td>Developer</td>
</tr>
<tr>
<td>weidong lei</td>
<td>100.0%</td>
<td>UI Designer</td>
</tr>
<tr>
<td>Vincent Hilaire</td>
<td>100.0%</td>
<td>Designer</td>
</tr>
<tr>
<td>Haoxuan LIU</td>
<td>100.0%</td>
<td>Java Developer</td>
</tr>
<tr>
<td>Nicolas Gaud</td>
<td>100.0%</td>
<td>Product Owner</td>
</tr>
</tbody>
</table>
Suggestions

for estimating the time of one task (assigned to a specific person)

Estimated spent hours for one Task = \( \frac{Initial \ Estimated \ Time \ of \ the \ Task}{Assigned \ workers’ \ efficiency} \)
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Part V: Conclusions and Perspectives

- Introduction
- Scrum
- An organizational Ontology: K-CRIO
- Scrum Tool
- Conclusions and Perspectives
Contributions

- **K-CRIO**: an organizational ontology for modeling and conceptualizing various business processes in enterprises

- Several business processes are modeled with K-CRIO
  - Waterfall, OpenUP, Scrum

- Design and implementation of an intelligent assistance software tool
  - aiming to support human activities within Scrum process.
  - a web-based system using a Multi-Agent System to implement its functionalities.
  - The current Scrum Tool is available to use freely. [http://www.multiagent.fr/ScrumProjectManagement](http://www.multiagent.fr/ScrumProjectManagement)
Perspectives

- Improve the formal foundations of K-CRIO to implement high-level reasoning mechanisms
  - semantic queries
  - expert’s rules integration

- Integration within a knowledge management approach
  - knowledge capitalization
  - knowledge reuse thanks to development of organizational enterprise memory

- Methodology for guiding design and implementation of intelligent assistance systems to support business processes, based upon conceptualizations with K-CRIO
  - Scrum Tool as a practice
Improving Scrum Tool

- the current Scrum Tool is just the primary version.
- a lot of functions could be improved, such as
  - reusing of released user stories/tasks in new projects;
  - helping Scrum Master to find problems leading to project delays/project deficit;
  - providing solutions to Scrum project teams, after understanding problems.
An organizational Ontology based for multiagent based Enterprise process modeling and automate
In the Part of Introduction


In the Part of Scrum

In the Part of K-CRIO Ontology


In the Part of Scrum Tool
