iStar Support to Open Innovation Management

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Abstract
The Open Innovation business paradigm promises relevant competitive advantages and at the same time, it presents important challenges at strategic level. Particularly, issues like coworking, incorporation of external innovation, creation and value capturing, and evolution of the entire business model, must be incorporated into early modeling stages, in terms of actors, goals, resources, and tasks. In this context, iStar constitutes a suitable and well-known goal-oriented modeling tool, that can be applicable to any problem domain; nevertheless, in the case of Open Innovation, there is lack of support to manage the issues previously mentioned. In response, the present work proposes an iStar extension that allows the modeling process in a consistent, clear and intuitive way.

Keywords 1
iStar extension, Open Innovation, Goal-Oriented Modeling.

1. Introduction

Nowadays, independently of its nature or size, organizations are operating in a highly dynamic and competitive environment characterized by flexibilization of geographical barriers, permeability of boundaries among enterprises, global changes guided by knowledge and technological development, among others. In this context, the innovation constitutes an essential component that all business models must have not only as a factor of differentiation and survival. This innovation can originate from internal and/or external sources, and demands both strategic internal changes and the opening to generate synergies with its environment. In this context, Open Innovation (OI) arises as a business paradigm, based on inbound and outbound flows of value and knowledge that allows organizations to align with its partners, customers, collaborators, competitors, and other stakeholders [1].

No matter the business paradigm applied, its subjacent goal model has the mission of facilitate the communication of the business model, establishing a common vocabulary among its different areas, and creating a common understanding of the organizations. Hence, the adequate selection and application of a goal modeling tool is critical.

iStar constitutes a well-known goal modeling tool that brings a set of elements capable to represent the intentionality of business, and in order to identify which elements support the modeling of intrinsic characteristics of OI, we perform a bibliographic review. The work of [2] analyses a broad research works about iStar extensions. For our objective, we review the work related to the following areas: Enterprise, General Development, and Other NFR extensions. In the case of Enterprise, the authors of [3] develop the concept of Added Value as a "principle result", that is the result of following a specific guideline about achieving goals efficiently; and Future State as a situation that would be attainable (if a principle is applicable) and so contributed positively to high-level goals. The work of [4] introduces the elements of Completition, Duration, Fulfillment Condition, and Precedence; all of them to develop an extended notation for tasks that gives timeline information. In the case of General Development, [5] deal with Collaborative Systems elements as Awareness Resource, Awareness Soft-Goal; Collaboration, Communication, Coordinator, Individual, and Priority Tasks; and Participation and

Responsibility Links. Finally, in other NFR extensions, the work of [6] proposes a method to combine a qualitative assessment of goal models to quantitative assessment based on time cost; hence, this work manages entities as Time Indicator to tasks, and Satisfaction Value with which a task is completed.

All works reviewed support the modeling of different enterprise areas, but not the specific ones of OI business models presented in [7]. We group these issues into three areas: a) Intentionality; b) Creation and Capture of Value; and c) Knowledge generated from Coworking. Each of these areas present diverse restrictions when we use only standard characteristics of iStar to model them. These restrictions are resumed as follows:

a. To model intentionality: OI requires to model occasional cooperation between the organization and external actors. Due that iStar does not manage occasional relationships, the solution might be to elaborate one model without the cooperation, and another model with the cooperation and its implications. However, the elaboration and maintaining of two (or more) models for each issue previously described, reduces the modeling agility and can be source of confusion, misunderstanding and errors.

b. To model value management: OI requires differentiate goals involved in value creation (like "To increase product availability in retailers") from goals involved in value capture (like "to obtain additional revenue due optimization of retailers agreements"). iStar does not allow to differentiate this nature in goals and qualities.

c. To model the knowledge originated in coworking activities: When iStar models the goals of knowledge management, it does not differentiate whether this knowledge comes from external actors, or is generated within the organization. This differentiation is important because allows to quantify the level of dependence on external actors.

In response to the difficulties previously explained, we identify the need to propose a specific iStar extension that brings: independence of business nature, feasibility and clarity to model IO issues; and ease of integration with other iStar extensions involved in enterprise modeling.

The rest of the paper is structured as follows: Section 2 presents the fundamental concepts and definitions that support proposal; Section 3 describes the proposal itself; finally, Section 4 shows the conclusions.

2. Fundamental concepts and definitions

The present research arises from the convergence of several concepts that we briefly introduce below. The first one is the *transdisciplinarity*, referred in [8] as the universalization of concepts and categories, and applied to develop research beyond boundaries of diverse knowledge areas. The second one is the relationship between enterprise management and biological concepts that is not recent: in [9], the author refers to the enterprise as a "Living Organization", which has particular characteristics like identity, identifiable boundaries, autopoiesis (ability of a living organism to reproduce and maintain itself); and capabilities to perceive the environment, to design its own strategy, among others. The third one, as appears in [10] also treats enterprises in light of biological concepts: synergism, DNA and genes, and considers the companies as a "cells of market economy".

Following this trend and based on our experience on OI modeling and adoption, we propose a set of extensions to iStar. We start with the biological definition of *Adaptation* given by [11]: "Evolutionary adaptation, or simply adaptation, is the adjustment of organisms to their environment in order to improve their chances of survival in that environment. In this reference we also found two types of adjustment: biological (related to alterations in body functions with permanent character) and behavioral (related to changes in actions that organisms exhibit in response to temporary environmental factors).

Creating a parallelism for our work, the adjustments denotes a set of changes to improve the business efficiency and/or effectiveness, while trying to reach the organizational mission. If the business benefit resultant of these adjustments is considered constant over time, we say that there is a (permanent) **adaptation**, usually involving a loss of skills, capacities, resources, structures or processes that have ceased to be used. On the other hand, if the business benefit has a limited lifetime beyond which it only represents costs to the organization, we say that there is a (temporal) **transformation**; in this does not

exist loss, and there is a mechanism to return to previous state (of course, this mechanism has a specific cost).

A business is a system in permanent change because both internal factors like process improvement, technologies adoption, human talent rotation, customer offer renewal; and external factors like market competition, threat of substitution, threat of new entry, buyer power, supplier power, government regulation [12]. Nevertheless, not all of these changes should be considered an adaptation. In fact, most of the changes are *transformations*: a short or medium-term actions that reflect the daily operation.

The Table 1 shows the differences and similarities between *adaptations* and *transformations*.

Table 1 Characteristics of Business Adjustments

Characteristic	Description
Start	All adjustment has a start event, which arises by identifying some external product / service / information that contributes to satisfy a need or to create an opportunity.
Duration	Period in which the adjustment represents a business benefit in terms of incomings, process improvement, knowledge increment, customer benefits, or similar. Only *transformation* has a specific duration, which is measured in periods (time units, months, fiscal years, trimesters, semesters, calendar years)
End	If the adjustment has an end point, it is a *transformation*, and can and return to the previous state when: a) the business benefit disappears; b) the external threat disappears; or c) the cost or risk of maintain the transformation is greater than its benefits.
	If the adjustment has not an end point. It is a business *adaptation,* and it is considered permanent.
Wide scope	The *adaptation* involves some business areas considered critical for the business survival, and constitutes a *critical success factor*.
	On the other hand, the *transformation* generally belongs to a specific business area, and has a low impact.

The reasoning technique applied to construct the proposal is the analogy of organizational behavior with the behavior of living organisms. This business analysis approach is called Living Organizations. The decision making of go back an adaptation or transform an adaptation in a transformation, was conducted applying Conditional Probability, environmental analysis (extended PESTLE and Porter's Five Forces).

The organization requires a mechanism to decide if an adjustment has an endpoint (in other words, a mechanism to decide if the organizational changes are sustainable over time). We suggest that a quantitative metric that works around the point of no return might be considered as this mechanism. The metric works with conditional probability:

$$BenefitPrevalenceProbability = \frac{P(A \cap B)}{P(B)} \tag{1}$$

Where A is the event of TotalBenefitAdaptation-TotalCostAdaptation is positive
B is the event of Trigger is maintained
Trigger is the external thread or opportunity that origins the adaptation
The acceptation range to continue the adaptation depends on the environment variability.
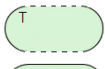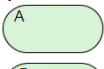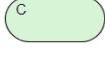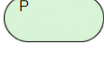
3. Proposal description

In this section, we describe our proposal using the PRISE process [13]. We selected PRISE because it focuses on critical quality aspects like completeness, consistency and conflicts reduction. Additionally, it provides a large set of previously modeled iStar extensions which have been validated by experts.

3.1. Application of Process to support iStar Extensions (PRISE)

The main process of PRISE is composed by an initial sub-process, three intermediate sub-process which are developed in parallel with a monitoring task, and finally a closing task. An excerpt of this application is shown in Table 2. Due to the fact that our proposal is a new initiative to bring support to OI, we adopt an iterative approach to conduct the PRISE process. In the first iteration, we work with identification, definition, supporting and conceptualizing issues, in order to build a version of iStar OI extension that can be reviewed by external visions: OI experts and iStar experts.

Table 2 PRISE application (Excerpt)

Sub-Process	Application
1 Analyses the need for extension.	Extension Specification: There are three areas of OI to which iStar does not provide support to: a) Intentionality; b) Creation and Capture of Value; and c) Knowledge generated from Coworking. All of them are referred to OI application area.
Task 1.1 Review the domain/application area	Set of references identified: Open Business Models [7], Open Innovation Maturity Model oriented to Open Source Software Adoption [13].
Task 1.2 Identify the concepts to be introduced by the extension	List of concepts in Intentionality: *Adaptation goals* and *Transformation goals.* List of concepts in Creation and capture of business value: *Creation goals* and *Capture goals*. List of concepts in Knowledge generated from Coworking: Link types to build relationships among goals and qualities: *Absorption Links* and *Generation Links*.
Purpose of the extension	Brings: application independent of business nature, feasibility and clarity to model IO issues; and ease of integration with other iStar extensions involved in enterprise modeling.
Test 2 to Test 5	Open Innovation issues to be modeled are described in [7]; the goal model for each OI model is referred in [13]. The proposal not uses the default iStar. Proposal does not use the default iStar notation, reasons are provided in Introduction Section. Our proposal should be reviewed by other experts in domain/application area of OI in order to obtain additional feedback.
	Sub-Process 2 Describe concepts of iStar Extension
Task 2.1 Search and selection of constructs to be reused	List of constructs with its own graphical representation: Transformation : (T) Adaptation : (A) Creation: (C) Capture: (P) Absorption : Generation :
Task 2.2 Describe extension's concepts	List of concepts to be introduced [with concepts description]: List of concepts in Intentionality: ***Adaptation goals***: they represent a permanent modification of process, politics, adaptation made permanent). ***Transformation goals***: they allow the organization to establish a non-permanent adjustment in order to obtain a specific business benefit. List of concepts in Creation and capture of business value: The ***creation goals***, which can support the achieving both *creation goals* of higher level, or *capture goals*. The ***capture goals***, which can support the achieving of *creation goals* only to model a new business innovation. List of concepts in Knowledge generated from Coworking:

	Link types to build relationships among goals and qualities:
	Absorption: represents the incorporation of external knowledge that is new for the organization
	Generation: represents the internal creation of knowledge, with or without an external knowledge component.

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Sub-Process 3

Develop iStar Extension

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Task 3.1 Define metamodel for extension	*Adaptation*, *Transformation*, *Creation*, and *Capture* goals are constructs introduced on iStar as specialization of *goal*. *Absorption* and *Generation* are constructs introduced on iStar as specialization of *neededby link* and *contribution link*, respectively. See Fig. 1
Task 3.2 Define validation rules for extension	There are not additional validation rules required by the extension.
Task 3.3 Define concrete syntax for extension	The consideration that OI extension requires in Strategic Dependence (SD) diagram is indicated in 2.2 task, in relation to how associate the *creation* and *capture* goals. During goal evaluation, the Absorption and Generation links has the same behavior that contribution links. The OI extension has no impact on SR diagram.

Table 3 shows the fulfillment of the guidelines provided by [12]

Table 3 Application for the iStar Community

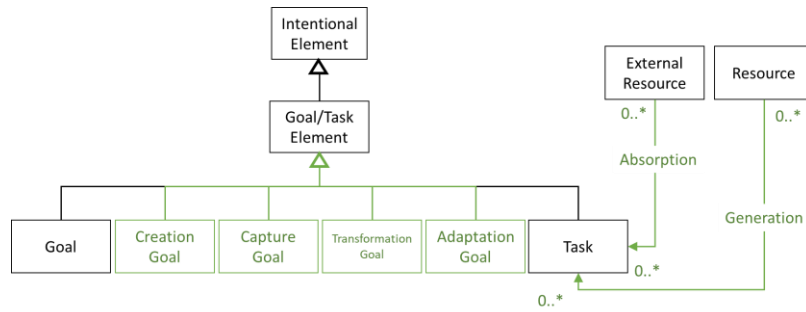| Guideline	Fulfillment
G1 — Preserve the language (iStar) original syntax	Our extension is conservative, which means that conserves all nodes and links of iStar syntax.
G2 — Carry out consistent, complete and without conflicts extensions and follow a process/method to do them	Our extension is proposed following a specific process; it is not an ad-hoc creation.
G3 — Perform a literature review, consider the participation of domain experts and iStar experts, and model systems of application area before extending	We perform a literature review. The participation of OI domain experts and iStar experts is planned as part of studies that are developed in parallel way with the present research.
G4 — Describe a clear definition of the extension concepts	All concepts are described in the present research.
G5 — Propose concrete and abstract syntax of the extension	Abstract and concrete syntaxes are provided with our proposal
G6 — Check consistency between abstract and concrete syntaxes	The correspondence between abstract syntax (metamodel) and concrete syntax (in our case, the graphical representation proposed) was verified.
G7 — Relate concepts introduced by the extensions with the iStar concepts	The concepts introduced by our proposal were related to the iStar concepts through specialization.
G8 — Define extensions with a smallest possible number of modifications and new representations in order not to complicate the use of the modelling language (iStar)	Our proposal has a minimized number of modifications in order to maintain the iStar scalability.
G9 — Propose careful and simple graphical representations, able to be drawn on paper without a tool	The graphical representation proposed is simple and easy to draw, as well as iStar.

Fig. 1 Integration of iStar extension components

In the Fig. 2 we present an example of iStar extension applied to an organization that adopts one form of OI: The Open Source Software (OSS). This example shows the environment constituted by three actors: the adopter organization (OSS Adopter), the OSS Developers Community (OSS-DC), and the consulting firm which offers training courses in OSS.
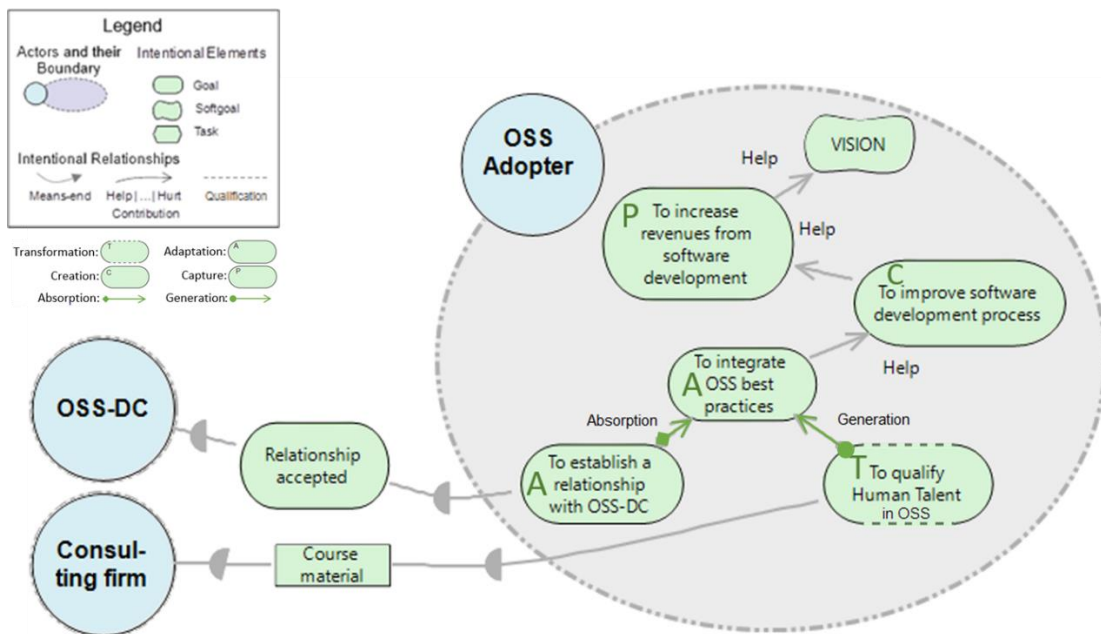

Fig. 2 Example of OI iStar extension application

4. Glossary

Term	Description
Adaptation	From Latin adaptō, denotes the change(s) that an entity must develop at level of structure, behavior and/or functionality, to guarantee its survival and health relationships with this environment.
Coworking	Defines a collaborative work in which, the activities are shared by people from different roles and disciplines, with the aim of generating synergies and creating and strengthening knowledge networks
Critical Success Factor	Business element considered vital to achieve the organizational mission. its non-compliance prevents success; however, its compliance does not guarantee success.
Environment variability	The business environment is dynamic, and is the resultant of interrelation forces at micro level [14] (Porter's five forces: competition, threat of substitution, threat of new entry, buyer power, supplier power) or macro level [15] (political, economic, socio-cultural, technological, legal, ecological, geographic factor analysis)
Point of no return	Originated in air navigation, denotes the point in which, to continuate the process or course of action is the only way possible, because the high consumption of resources/efforts makes its current amount insufficient to return the point of origin.

Term	Description
Transformation	Permanent business change originated in an adaptation (progressively) or in a change of evolutive stage (disruptively).
Value capture	Involves a set of related activities that allow retain for the organization, a part of the value that was created for the customer.
Value creation	Involves a set of related activities that brings value to the product / service / information that the organization offers to the customer.

5. Conclusions

This work focuses on the main aspects of Open Innovation business paradigm, and search an optimal way to be modeled through iStar language. In conclusion, we proposed a set of entities and relationships that support the fundaments of Open Innovation: Intentionality; Creation and Capture of Business Value; and Knowledge generated from Coworking. All of them are structured around the *Adaptation* concept, which in analogy with the biologic adaptation, brings the perspective to model the business open up.

6. References

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