

An i* based Approach to Support Strategic Decision in Virtual Enterprise

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Abstract: Virtual Enterprise is becoming remarkable as the business environment for enterprise is more and more dynamic. Existing approaches for describing and designing structure for those collaborations adopt Goal oriented approach but tend to focus on functional goal for the system supplemented by an examination of quality constraints. In trying to get a complete knowledge of the way to structure and organize the Virtual Enterprise it is also necessary to have an understanding of the specific expectation, intent, and concerns of the different partner involved in the Virtual Enterprise design process. This paper presents an Agent and Goal oriented approach, iStarVE, taking i* framework as a basis, to model and evaluate the different views of actors on the Virtual Enterprise and their potential impact on the design of its internal structure.

1 INTRODUCTION

Virtual Enterprise (VE) mostly results from an evolution of the business context (Jähn et al., 2005). When attempting to design the collaboration structure between the stakeholders involved in the VE, it can happen that many alternatives need to be considered, each with different implications for the parties that may have an interest in the sub-process. Identify, evaluate, and classify alternatives regarding to the impact on agent's self-goals has only been partially study yet.

The present paper intends to build a Goal-Oriented approach, iStarVE, based on existing frameworks designed for Requirement Engineering and Computing system, in order to deal with these problems.

Designing such approach faces multiple challenges. The fact that this issue is situated on the intersection of different areas of research makes the design of consistent approach complex. Indeed we need to consider research contribution about Virtual Enterprise, Breeding Environment, Agent and Goal Oriented approaches, in order to get a strategic view on the agents involved in the process.

Therefore, iStarVE first contributes to extend and apply goal-oriented approach to VE. It includes extensions for i* framework to model VE problematic. A second contribution is to support strategic decisions about VE structure using agents'

point of views.

In the first part we introduce background notions and identify specific issues for VE, and justify why a goal-oriented approach is suitable. In the second part we describe how it is possible to use i* framework to model VE to facilitate strategic decision. The third part illustrates iStarVE with a case study. Finally we conclude, describing outcomes of iStarVE, its limits and relevant further works.

2 RELATED WORKS

2.1 Virtual Enterprise (VE)

For the approach presented here, we take the definition of VE formulate by (Thompson, 2008) as a base. He pointed out that a VE is a voluntary and dynamic community of SMEs that undertake to work together for a set period of time and to collectively seek opportunities to participate in collaborative projects of mutual business interest.

Our approach focuses on issues appearing during the early creation phase of Virtual Enterprise. Indeed choosing architecture for the VE is equivalent to allocate tasks, which must be performed, to the different stakeholders (Kaisler et al., 2005). Along that process we identified two main reasons of dilemma to select the entity in charge of a task:

- Several actors have the ability to perform the task
- None of the partner already possess resources and skills to complete the task

In the first one, several actors possess necessary resources and expertise to be in charge of the task. The second one can be seen as the opposite problem, none of the stakeholder has adequate knowledge or resources to implement the feature required. In both scenarios the task allocation can not be performed only considering actor abilities.

We also identified a third issue specific to Extended Enterprise, which is a VE centralised with a dominant actor. In this special kind of VE the central actor may face difficulties to determine a suitable status for his partners, and select a benefit way of collaboration for both parties. This problem is different from the tasks allocation issues, because the tasks are clearly dispatched. This last point equals to define boundary for the dominant actor.

The main idea developed by our approach is to use and extend methods and theories coming from Requirement Engineering to model those problems at first, and then support strategic decision and negotiation.

iStarVE must be implemented by a single entity in order to improve its understanding and positioning in the VE. The main idea, for the company using iStarVE, is to assess the acceptance of its partners for each alternative, in order to refine its own strategy as one of the actors taking part in the VE.

2.2 Goal Oriented Approach and Agent Modelling

Goal Oriented Analysis occupied a central position in Requirement Engineering Area. It can address the issues we just underlined. In fact, a goal-oriented approach start from high-level goals, then refines them to obtain sub-goals and finally the tasks which must be completed by the entities in the system (Van Lamsweerde and Letier, 2004).

Such refinement technique guarantees a perfect traceability for the tasks identified. Therefore including such approach to treat our problematic, first allows identifying precisely the origin of the task which has created the allocation dilemma considered. Indeed this only requires to rollback the refinement process until we obtain a suitable level of detail for the goals description.

Moreover most Goal Oriented Approaches are combined with analysis and models for system's agent. The definition of agent depends of the

framework considered. Nevertheless it is remarkable that several frameworks already provided models for Strategic Agent. Such description required to distinguish the system's goals from the internal goals of the agents.

Moreover in order to get a rational representation of systems, another distinction has been made between main goal and soft-goal. Soft-goal are mostly used to constraint the achievement criteria of the main-goals, and bring consideration about quality, efficiency, cost and so on. Soft-goals represent a popular way to put strategic considerations in the model. Nevertheless every soft-goal does not refer to a unique level of strategy. Our research leads to distinguish four level of view which can be model by four types of soft-goals for VE's actors.

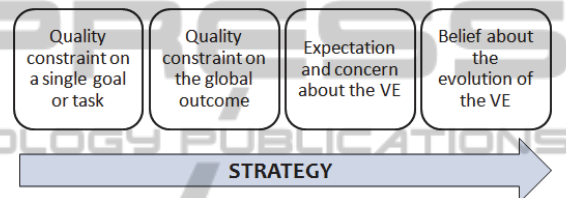


Figure 1: Categories of sot-goals.

Naturally we have selected i* framework which focuses on strategic aspect for modelling systems. The following section details possibilities to extend it to model VE problematic.

3 i* FRAMEWORK OVERVIEW

3.1 Adoption of the i* Framework

The i* framework is originally designed to be applied in computing area to support processes involving computing treatment. It was created to identify, evaluate and select process alternative (Yu, 1993).

Although it is possible to represent refinement process, using graphic elements defined by the framework, this is not the core of i*. Indeed i* framework focuses on the “why” representation for the process using strategic and intentional representation of actor.

More precisely Yu defined two models to represents the process. First, the Strategic Dependency model (SD) describes dependency relationships among organisational actors (Figure 2). Considering VE problematic, it can provides a synthetic representation for alternatives we needed

to compare.

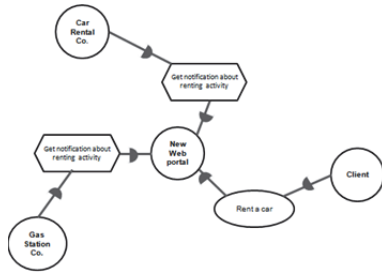


Figure 2: Strategic Dependency diagram.

The i* framework also includes diagram to represent the roles of the different actor and their positions (Figure 3). An idea to build iStarVE approach is to use i*'s role to aggregate the tasks for each agent in a few number of role, in order to simplify the representation of the problem.

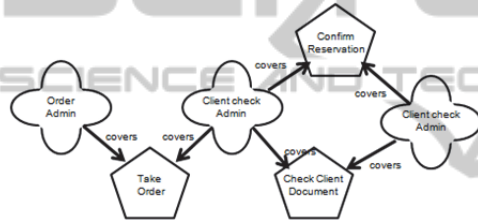


Figure 3: Role-Position Diagram.

Another key idea used by iStarVE is that one alternative can exactly correspond to one position for each agent. Then, such “exhaustive” position can be used to compare all alternatives using only one diagram, and therefore provide a synthetic and complete representation of the problem.

This idea has been combined with the second model of i*, Strategic Rational model (RS), to express rational attitudes representing internal goals, tasks and resources for the agents. Indeed using such “opened up” representation of agent, allow focusing on internal strategic soft-goal (Yu, 2011). If we combine it with “exhaustive” positions we already introduced, we are able to create diagram to evaluate the different alternative relatively to agents’ expectations (Figure 4 Case Study).

3.2 Modelling Process

Because iStarVE aims to support strategic decision during VE creation phase, it must be implemented by system architect and business expert to guarantee a consistent analysis.

The approach includes several steps progressively leading to assess the views of other

partners on the issue.

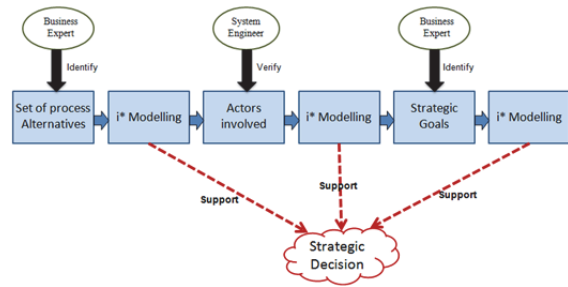


Figure 4: Approach's Steps.

3.3 Strategic Decision Supporting

As defined by (Mariotti, 1996), enterprise partnerships suggest a relationship between companies and people who share common goals, strive to achieve them together and do so in a spirit of cooperation, collaboration and fairness.

Beyond that definition there are questions about how to evaluate partnership, and do it relevantly in the context of VE. Indeed a VE is unique as its structure is dynamic, and can include asymmetric partners with different sizes and level of implication (Gajda, 2004). Therefore it is necessary to focus on these two aspects for the evaluation.

The SD diagram (Figure2) can support an evaluation about the interdependence of the partner in front of business process. Studies about VE suggest that more the business process is mature and includes interdependent stakeholders, more the durability of a VE is important.

Moreover an analysis of diagram representing actors’ positions and their coverage in terms of role, permit to assess the implication of actor in each solution evaluated, and thus, draw conclusions about the longevity of the partnership.

Finally, Actor-Position diagram is a key feature provided by iStarVE, the acceptance of each potential solution by the agents may be deduced from it. But to obtain relevant evaluation we have to combine it with assess about the importance of each role and uncertainty about it.

The following formula is just an idea of how to calculate the acceptance but we did not apply it in iStarVE because it requires quantifying the impact of the alternative on the soft-goal, as well as the importance of the soft-goal.

$$A_n = \sum x_i \cdot y_i \quad (1)$$

According to (1), the acceptance of the n alternative (A_n) is a sum of the impact of the position in this

alternative on the soft-goal (x_i) weighted by the importance of the soft-goal (y_i). We can normalise this result dividing by the some of the weights for the soft-goals of the agent.

In addition, it is interesting to notice an i* social modelling extension created by Alistair Sucliffe (see Eric et al., 2011, p.669-691), including diagrams to model dominance among the partners. This embodies another strategic view on VE actors, which may be combined with iStarVE.

4 CASE STUDY

4.1 Context and Hypothesis

The Case Study is inspired from a Requirement Analysis accomplished with KAOS to determine tasks and feature for a potential collaboration. It had been submitted to students by an enterprise which did not have contact other partners at that time, so the study initially represented a preliminary analysis to determine the feasibility about a new VE.

For this case study we use this idea of VE as a starting point. But we modified it, and formulated the following hypothesis, for the case study:

- The minimum number of partner to launch the VE have been identified and contacted
- A business process analysis to determine the high level structure of the VE have been done
- The choice of the problematic correspond to the implementation of a new feature which can hardly been carry on by one actor alone
- The soft-goals identified refer to classic concern of Actors in VE, and have been extract from articles which provide a analysis of Agent in VE, as it is detail in the following section

4.2 VE Considered and Problematic

A branch of a Car Rental firm and a local Gas Station Company located in the same area decided to create a new VE allowing to rent car near the city centre. This service targets local customers without car, who need cars for exceptional activities. In fact the Gas Station Company became aware that they disposed of vacancy area on small parking lot in their station downtown. Therefore they want to create a new car rental service. They plan to implement an online reservation system and use their staff members in the gas stations to deliver the key to the client, and get back the vehicle after use.

So the main goal of the VE is to provide vehicle

with homogenous quality for rent in strategic place inside or near the city centre, and to allow the client to order and provide the entire guarantee needed online.

The core of the new VE is an online reservation system to support most of the interaction with the client. The partners have to discuss who will be in charge of the implementation.

4.3 Agent and Solutions Modelling

4.3.1 Alternatives Modelling

First it is necessary to model each alternative. So first we use synthetic Strategy Dependency diagrams to model those solutions. In our case Study they corresponded to the following strategy of implementation for the website:

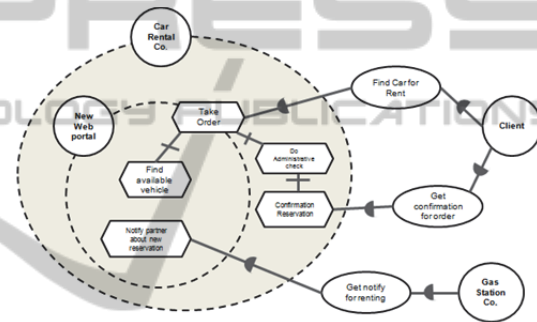


Figure 5: Alternative 1.

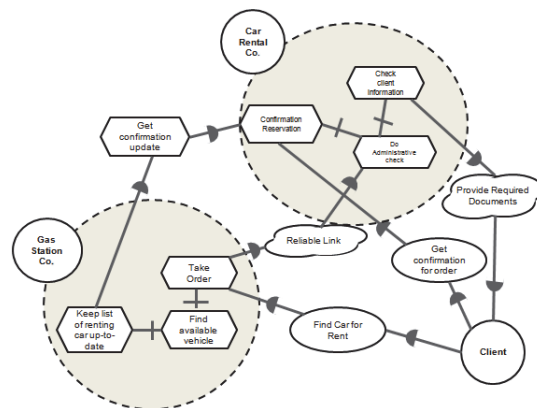


Figure 6: Alternative 2.

These diagrams allow identifying the set of roles potentially play by each agent in each alternative.

- Alternative 1: The Gas Station Company is only a resource agent for the problem considered, and the Car Rental company occupies a dominant position in the organization
- Alternative 2: Both Companies are in charge of a

part of the online system.

- Alternative 3 (Figure 2): Both play the role of resources agents, and another organization implements the web portal.

4.3.2 Agent Expectations Modelling

The second part of the modelling process focuses on the agents soft-goals. The study at the origin of the case study did not include consideration about the expectation and concerns of the agents, so the soft-goals listed for the agents involved came from other study on VE and partnership in general, such as (Zota and Fratila, 2013) and (Martinez et al., 2001). They correspond to classical agent concerns in inter-enterprise relationship, and we choose to only attribute less than three soft-goals by actor in order to facilitate the comprehension.

Moreover the quantification for the importance of the role and their uncertainty has been design in order to be realistic. This is acceptable as the present case study is presented first to illustrate a potential application of the approach, and as the deductions about the VE considered do not have any value for itself.

Respectively the soft goal identified represents the following concerns for the agents:

- Exclusivity (Car Rental Co.): occupy a dominant position in the VE to block association of the Gas Station with other partners
- Improvement of its reservation system (Car Rental Co.)
- High profitability (Car Rental Co.)
- Visibility (Gas Station Co.)
- Investment in the VE limited (Gas Station Co.)

Finally, we can model these soft-goals using an actor-position diagram (Figure 7).

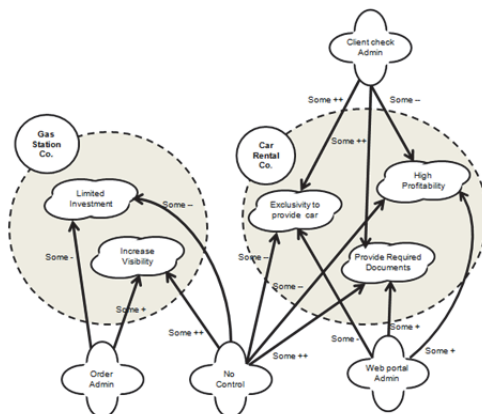


Figure 7: Diagram Position/Soft-goal final.

4.4 Case Study Outcomes

Applying our approach to the present case study highlights potential issues related to the choices made to construct the approach. Indeed the creation of the case study itself, based on hypothesis to define concerns for the stakeholders underline that a central question is the definition of a strategic view for the different stakeholders.

Furthermore, it appears that several kinds of diagrams are not relevant all the time, especially diagram describing roles and position. We can skip it because in that case it is not necessary to aggregate the tasks in role as the number of tasks considerate is already limited.

In addition it seems complex to define explicit name for the position of each actor as the position must summarize the complete set of task of an actor for one alternative.

We can also notice that the initial task decomposition is critical as it conditions the creation and the modelling of the alternatives. For example here we identify two principal features for an online reservation, which is the treatment of the customer requests and the verification of client information. But another tasks' decomposition is maybe possible and lead to considerate different possibilities. Nevertheless this decomposition is supposed already done, by business experts, when iStarVE is implemented.

5 CONCLUSIONS AND FUTURE WORK

5.1 The Outcomes of iStarVE

First iStarVE includes factual representations and do not include any assessment about personal goals of the different parties. This could be used to support discussion between the partners.

Nevertheless the diagram representing internal soft-goals for each agent and the evaluation extract from the diagram must not be shared, as they permit to identified weakness of other agents, and thus, refine negotiation strategy. The actor-position diagram is a part of it. Sharing assessments about relative importance of goals for other actors can lead to a switch in their strategies.

As it is the case in RE the analysis of the actors leading to identify soft-goals is the more critical part in the process. It is directly linked to the knowledge of the entity which conducts the study about its partners.

Moreover the quantification of the importance is based on assessment, and has only been considered to prioritize the different soft-goals. The early identification of those limits pushes us to the introduction of uncertainty factor, but all those parameters are not yet well formalized.

5.2 Further Work

A first step for further works would be to define uncertainty and importance indicators, with detailed description of each level, and then refine the formula assessing acceptance.

A second point would be to establish more precise characterizations for agents and VE's structures. Definitely, typing architecture, with precise description of their specificities, would allow reusing analysis of previous cases, and build little by little a bank of classic sub-structure includes in VE. Also, typing actors according to their position in the VE would provide a mean to check all along the design process if the way the structure is evolving match the initial idea for role distribution among the partners.

Finally we believe that it could be relevant to put forward the idea of evaluation focused on Agent, and consider each stakeholder as a user of the VE, who tries to use it to complete his own goals, and so, conduct strictly user-oriented evaluation (Mourouzis et al., 2006).

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