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Luz María Priego

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et codirigée par **Agnès FRONT**

préparée au sein du **Laboratoire d'Informatique de Grenoble**
et de **l'Ecole Doctoral de "Mathématiques, Sciences et Technologies de l'Information, Informatique"**

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Thesis

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CHAPTER 1

Introduction

Contents

1.1 Research Context 1
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1.1 Research Context

The research described in this thesis is concerned with Model driven Requirement Engineering (RE) devoted to Information System (IS) elicitation for Virtual Organizations (VOs). To address the subject, we illustrate our findings with a real world case study exploring two research axis: Virtual Organizations (VO) and Requirement Engineering (RE).

Nowadays, organizations encounter a more competitive environment that demands flexible business structures, one way to build these structures is to form VO. A VO is an alliance among independent organizations for integrating competences and resources throughout the layout of an information systems infrastructure, this term was used for the first time by Mowshowitz in 1986 [Mowshowitz, 1986]. The possibility of switching between organizations that can satisfy a need by producing goods or services makes consumers unaware of the complexity of the processes behind. Therefore, with advance information technology a high level of coordination can be assured for executing the required processes from different locations to satisfy customers demands.

The UGRT case study used to construct and validate the 360° vision for Virtual Organizations (360° VisiOn) presented in this thesis was possible thanks to the grant support of the Stockbreeders Associations of Tabasco, Mexico and the author's working experience in these organizations.

1.2 Research Questions and Objectives

RE for VO adds complexity to traditional RE: many organizations and actors involved, governance of the new VO structure, and heterogeneity of organizations and actors. Therefore, the research questions are:

- **What are the characteristics of a VO?**
  It is difficult to reach a general consensus on the term, the definition and the characteristics of a VO. The business domain offers a rich source of innovative organizations forms that take advantage of market opportunities or technological advances, these organizations are obviously described from the managerial point of view. In our work, we delve into the VO concept having in mind that Information and Communication Technology (ICT) is a broad platform that enables collaboration among organizations and not only information exchange.

- **How can we define the IS requirements for a VO?**
  IS requirements is difficult for a "traditional" organization due to the individuals involved, the changing environment and the context were the system will operate. Therefore, it is more difficult for a VO since there are involved a set of independent organizations with different backgrounds, and they need to work coordinately while preserving their independence. Our challenge is to structure all the organizations concerned and their relationships in a clear and comprehensive way.

- **What models and methods can we offer to help define the requirements of a VO?**
  Our interest is centered on model driven RE, and the challenge is to define the VO requirements taking into account not only one organization but an assemblage of organizations. The proposal consists in exploring, gathering and visualizing the information that defines the requirements of divers stakeholders, users, analysts, etc.

- **How can we guide the requirements elicitation process for a VO?**
  Structuring the elicitation process facilitates VO understanding. The proposed method should include a non-linear guide for discovering and improving the information viewed in the models, and for achieving models completeness.

1.3 Research Approach

The research approach followed consist of four steps described in detail in section 5.6 and showed in Figure 1.1:

- To characterize a VO by identifying, classifying and formalizing the VO concepts. This characterization results in particular from work in the management field and is formalized in UML models.

- To model the IS requirements for VO with graphical and textual models to help actors understand and communicate their knowledge. These models were inspired from service oriented and RE modeling proposals.

- To instrument the VO IS requirements with a methodology, a model tool and a platform for facilitating the RE process.

- To validate the concepts, the methodology and the models with a set of IS experts.

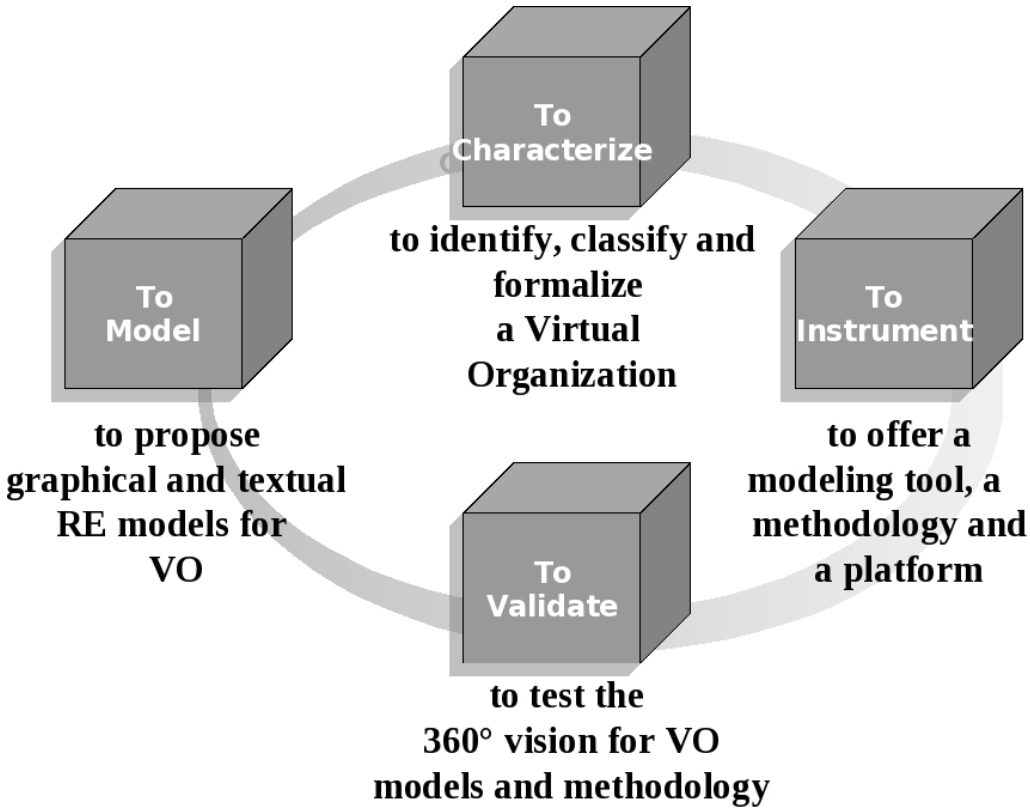

Figure 1.1: Research approach followed

1.4 Research Contributions

The main achievement of this thesis is to propose an approach that helps to elicitate systems requirements for a VO. Briefly, our approach contributes the RE field with:

1. an alliance-based characterization for VOs which precisely defines the concepts to be taken into account;
2. simple to use graphical and textual models to represent the VO;
3. a modeling tool support;
4. a validated methodology to guide the RE process which includes a partial transformation from the intentional level to the organizational level

1.5 Structure of the Thesis

The thesis is composed of a case study (Chapter 2), the state-of-the-art (Chapters 3 and 4), our proposal (Chapters 5,6 and 7),validation (Chapter 8) and the conclusions and future work (Chapter 9). The chapters are summarized as follow:

- Chapter 2 describes the case study. We introduce the set of organizations forming the VO and interacting with it. These organizations are used to exemplify and illustrate our proposed methodology and models. This exploration case study was reported in three publications [Priego-Roche et al., 2009b, Priego-Roche et al., 2009a, Priego-Roche et al., 2010].

- Chapter 3 presents a state-of-the-art of VOs from the business perspective describing some ICT projects and platforms devoted to VOs.

- Chapter 4 presents a state-of-the-art of model requirements engineering over viewed in [Priego-Roche et al., 2010].

- Chapter 5 explains the multi-view requirements engineering framework for the virtual organizations proposal introduced in two articles [Priego-Roche et al., 2009c, Priego-Roche et al., 2009a].

- Chapter 6 discusses the intentional level aspects of the 360° VisiOn and it presents the graphical and textual models proposed. Two of these aspects (Alliance Identification and Collaboration Willingness) were introduced, characterized and instantiated in [Priego-Roche et al., 2009a, Priego-Roche et al., 2010].

- Chapter 7 proposes a set of rules and functions to transform the intentional models of the 360° VisiOn to the business process of the organizational level.

- Chapter 8 describes the qualitative validation of the concepts, relations and models proposed in the 360° VisiOn.

- Chapter 9 concludes the research work of the thesis and summarizes the research perspectives.

- Chapter 10 presents the French translation of Chapters 1 and 9 as required by the doctoral school for the thesis written in English. The former includes a sumary of each chapter.

The Webliography of the thesis presents a list of the hypertext links to sources of information on the Net. In [1], it can be seen the date of the last Uniform Resource Locator (URL) verification.

CHAPTER 2

Cattle Union: a case study

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2.1 The Case Study

Our research method is based on a case study of the Tabasco's Regional Stockbreeders Union (Unión Ganadera Regional de Tabasco (UGRT) [36]). Based on the author's working experience in this organization, we employ it to illustrate the state of the art examples (Chapters 3 and 4) and the proposed models resulted from our research (Chapter 6). The UGRT gathers several companies working in the cattle industry. The headquarters are at Villahermosa, the capital of the southeast state of Tabasco in Mexico. It offers multiple services and products to its members in a strong cooperation atmosphere in order to increase the economic revenue of cattle production. It is formed by several enterprises (a slaughterhouse, a packing facility, a retail store, etc.) illustrated in Figure 2.1 and described in the following paragraphs.

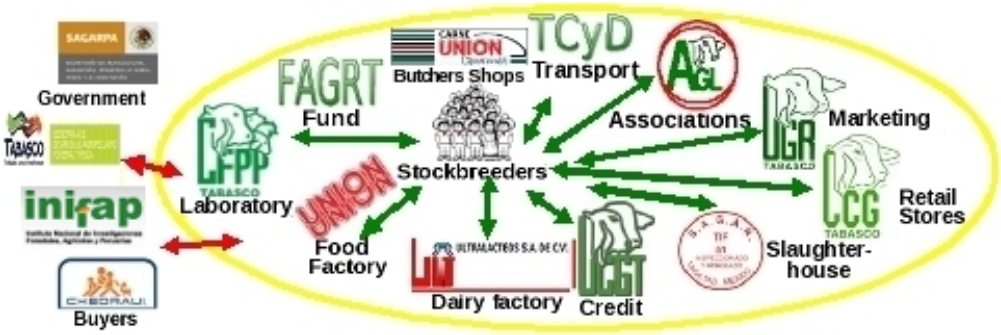

Figure 2.1: Case study: the UGRT Virtual Organization

Each organization has a board of directors formed by a president, a treasurer, a secretary and two delegates that represent the organization before the UGRT. These boards are elected in a stockholders general assembly. With regard to their business administration, each enterprise has an independent staff usually formed by a general manager, senior executives and employees.

2.2 Stockbreeders

Stockbreeders are located in the tropical area of Mexico with particular characteristics that demand adequate approaches to satisfy their needs [Améndola et al., 2005]. These particularities are: hot and humid climate with a long rainy season, a 90% of floodplain land, small farms with 20 hectares on average and mainly hybrid cattle breed.

Table 2.1 shows the total population of Stockbreeders and cattle heads in the State of Tabasco. Most of Stockbreeders ranches are very small, they have up to 20 heads per herd, with a main production of dual purpose cattle (meat and milk) which gives a lower yield compared with single purpose cattle (8 to 12 liters per day vs 19 liters for specialized cows for example). Zebu breeds and their crosses with European breeds are the most common for their ability to resist high temperatures and humidity levels. Besides cattle race, other factors limiting milk production are low forage availability in the dry season and floods in the rainy season.

The feeding system is based on grazing sown (60%) and native (40%) pastures usually organized by rotational pasture. Only 7% of farmers provide supplementary feeding (molasses and/or food) to animals although this percentage varies depending on the price of food supplements.

Adoption of technology and innovation increases with farm size. Very few cattlemen have computers or access to information systems for controlling their production.

From the state Stockbreeder population, only 11,012 are UGRT members which results in 78.63% of potential new members. Members of a local association can use all services in a non exclusive manner. Stockbreeders are free to choose to whom they will sell their calves or milk depending on the market alternatives they encounter: to sell calves to feedlots in northern Mexico (to be exported to the USA either as meat or live cattle to be fattened), to

Total in Tabasco state		
Stockbreeders:		51,549
Heads:		1,873,792
Stockbreeders size		
Group	**Herd**	**Percentage**
very small	1 to 20 heads	81.8%
small	20 to 50 heads	11.8%
medium	50 to 100 heads	3.8%
medium large	100 to 500 heads	2.3%
large	500 and more	0.2%
UGRT members		
Stockbreeders :		11,012
% of potential new members:		78.63%

Table 2.1: Stockbreeders population and groups in Tabasco

sell to local butchers, to sell through the UGRT the finished cattle (which implies accepting the new rules like meat marbling, weight, equal carcasses shape, etc.).

2.3 Stockbreeders Associations

The baseline of the group of organizations is the Asociacón Ganadera Local (AGL). In 1920, ten cattle breeders founded three associations [SSP, 1999] with two main objectives: to improve cattle quality and to protect cattle breeders' economic interests. At present, there are seventeen AGLs, one per Tabasco's municipality, grouped by a Regional Stockbreeders Association.

The stockbreeders are regarded as members of the organization and have voting rights at the annual assembly where strategic decisions are taken. One of the main activities is facilitating cattle marketing where stockbreeders' average size cattle herd is very small (up to 20 heads).

2.4 Meat Marketing

The second organization of the UGRT was originally founded as "Stockbreeder Producers Union League", grouping several local associations in Tabasco. On April 3th 1936 the UGRT was founded with seventeen local associations as it stands today. At present, the UGRT has members not only from Tabasco but from other south-east states (Chiapas, Veracruz and Campeche).

The primarily founders' objective was to join stockbreeders efforts for selling live cattle. Initially, part of the production was sent to Mexico City (located at 750 Km away from Villa-

hermosa). Today, the UGRT concentrates its efforts in cattle marketing: seeking for buyers and new markets, extending the group with complementary industries that can increase stockbreeders' revenue and guaranteeing payment to cattle producers.

2.5 Cattle Slaughtering and Processing

Frigorífico y Empacadora de Tabasco S.A. de C.V. (FyETSA) has a harvest capacity of 1,000 heads per day, with only 400 heads per day the past 5 years due to a fierce competition. It is a clean, modern and federally inspected Tipo Inspección Federal (TIF) facility with higher quality standards for guaranteeing food safety. On average, 100 cattle men use the facility per day.

Producers may bring their own cattle (steers, heifers, young bulls, veals, cows or bulls) to the plant, or they can demand for a transport service to pick up and haul their cattle from the shipment pen to the packing facility. At the reception area cattle are classified, weighed and identified before being slaughtered. At least half carcasses are transformed into boxed beef, refrigerated or frozen for shipment to the retail centers.

It is important to note that the processing plant is not the owner of the animals. Each animal is identified on its hides with a code linked to the owner, day of arrival and type of animal. This code is transferred to the carcasses and then to the boxed beef before being sent to retail centers. This procedure the meat to be traced back to the owner in case of a problem or disease.

In addition to beef, other products are of use: blood and bones for fertilizers, hides for tanning, viscera for certain retail centers. Stockbreeders are paid on a 43 days basis starting from the reception date. The facility works at a break-even standard. Producers are charged a fee per animal based on the plant annual costs. When new investments are needed, producers are required to pay extra fees per animal during a fixed period of time.

2.6 Credit Union

The Unión de Crédito Ganaderos de Tabasco (UCGT) was founded with the minimal capital authorized by Mexican law. For several years a special contribution was made by the stockbreeders from the slaughtered animals in FyETSA to increase the contributed capital. These contributions are exchanged for shares which in turn convert stockbreeders in stockholders.

The UCGT authorizes different types of short and long term loans for buying or breeding cattle or for farm improvements. Most of their activities are linked to its members (sell and transfer of shares, members control, deposit accounts), to their solvency (credit analysis and control), to their capital (savings management and investment). Their interest rates are lower than those offered by the commercial banks. The advance withdrawal credit is the most common. It consists in demanding 90% of the beef value slaughtered at FyETSA while the UGRT is the reimburse guarantee.

2.7 Retail Stores

Cooperativa de Consumo "Ganadero" S.C.L. (CCG) [5] is a retail outlet idea originated from a veterinary drug shortage in 1960, the objective was to provide to the stockbreeders a first-aid veterinary kid supplied directly from pharmaceutical laboratories.

Formed by 40 retail centers all over southern Mexico, the CCG is committed to find the best price and ensure demand. It imports products from all over the world (North and South America, Asia and Europe) and has a large supplier portfolio. They sell a wide range of products used in the farms (drugs, fences, spare parts, horse accessories, working shoes, sperm storage tanks, milking machines, etc.).

Its main activities are linked to farm product sales (searching new providers, buying products, product inventory and distribution, invoicing and selling). A yearly membership fee is required to become a member, what eases access to the general public.

Product selling prices are between a 10% and 15% of the buying price. Assuring the best price in the market has created a solid relationship with its members.

2.8 Dairy Product Manufacturing

The dairy factory, Ultralacteos S.A. (ULSSA) was founded with a loan from the Tabasco state government. The government objective was to launch the internal industrial production within a market monopolized by external producers (while local producers were struggling to sell their milk mainly to international companies, producers were not assured milk harvest and payment). ULSSA started to collect the daily cow milk production, to process it and to sell dairy products.

ULSSA produces pasteurized and ultra pasteurized milk (whole, semi-skimmed and skim), cheeses (Chihuahua, Manchego, Port Salut, Oaxaca, Panela, Tabasco), yogurts (creamy and drinking) and butter. There are several collecting sites where milk is weighed and analyzed. If milk passes the quality controls, it is refrigerated and stocked before sending it to the plant. Producers may bring their own milk to the collecting site or they may make arrangements for a transportation service. This is a useful service for low volume producers. Prices payed by ULSSA are determined by the liters collected and are fixed taking into account the production costs and the milk market.

2.9 Veterinary Laboratory

Comité para el Fomento y la Protección del Ganado (CFPP) is formed by five veterinary laboratories which initially belonged to the federal Mexican government. Their main objectives are: program development and application for cattle improvement, health care (annual campaigns to prevent brucellosis, tuberculosis, etc.), nourishment control and genetic improvement (training, sperm care, etc.). They are focoused on technical assistance, training and technology diffusion for achieving these objectives. Most of the services offered are directly paid by the stockbreeder on a demand basis.

2.10 Animal Food Manufacturing

Due to competition, other meat supply sources appeared and FyETSA production fell in 1996 from 1000 to 400 heads per day. The Mexico City market, with nearly 20 million inhabitants is the biggest meat consumer of Mexico and was the main UGRT buyer. Many new abattoirs were opened near the city and meat imports from the United States and Canada where facilitated by the North American Free Trade Agreement (NAFTA). Stockbreeders were forced to change their production to bigger and more tender cuts of meat to satisfy new consumer demands.

In response to the above, the food factory Alimentos Balanceados Unión (ABU) was founded. The objective was to produce the cattle food needed for increasing weight and obtaining a marble meat (a meat containing various amounts of intramuscular fat). Traditionally, cattle are nourished in open pasture and not with grains in feedlots. Such feeding sources change meat characteristics.

This factory was created with UGRT capital savings. Its main activities are centered in row products supply, their transformation, packing and selling.

2.11 Freight Trucking

Although Transportes Cárnicos y Derivados Unión (TCyDU) had started operations when FyETSA was founded, it was not a legally independent enterprise. It had the objective of transporting live cattle from farms to the abattoir and fresh or frozen carcasses to the retail shops.

TCyDU operations were separated from FyETSA, ULSSA and CCG in 1999. This enterprise has a fleet of specialized trucks for transporting live cattle, boxed beef and beef carcasses, fresh milk, retail products, etc. A transport fee is charged per cargo.

2.12 Butcher Stores

Like in most productive chains the earnings distribution is disadvantageous for producers and fatteners as their activities take from 4 to 18 months versus one day for stockpilers, wholesalers and butchers. With FyETSA packing facility five stores were opened for selling directly to consumers. The first shop for selling high quality cuts of meat with other food products from local producers was recently opened: Tienda de Carne Unión Gourmet (TCUG). The objective is to avoid intermediaries and in the future to franchise the business.

2.13 Livestock product buyers and suppliers

The main meat buyers are supermarket chains (like Walmart [40]) that mainly buy meat boxes for the national market. There are two importers from Korea that usually buy viscera products. At present, negotiations with Chinese importers are being carried out. Tanneries from the central region of the country are the main hide buyers. On the other hand, the principal raw material suppliers are the Stockbreeders providing the cattle, while several

additional suppliers are involved in the production chain providing support materials like tools and infrastructure.

2.14 Other buyers and suppliers

A wide variety of suppliers provide different products to the assembled organization as well as many buyers that acquire the offered products and services. The main buyers for the dairy product manufacturing (ULSSA) are local supermarket chains and the retail stores (CCG) have more than 600 suppliers from 13 countries for example.

2.15 External organizations

There is a set of organizations that interact with the UGRT either as complementors, competitors, or regulators. The following subsections set these groups of organizations for our case study in the livestock industry.

2.15.1 Complementors and competitors

ClO (Complementor Organization) are those enterprises that increment the value of a product: for example transforming cattle hide into leather for shoes and garment use, half carcasses into meat boxes.

CtO (Competitor Organization) can be grouped in national retailers that buy young cattle for resale to feedlots in northern Mexico or the USA and meat importers that bring meat cuts to the Mexican market mainly from the USA. In both cases, cattle re-enters the state of Tabasco in meat cuts to be sold in supermarkets.

2.15.2 Support and regulatory institutions

Several government institutions regulate and support cattle production in Mexico at international, national and local levels. For example: Secretaría de Economía (SE) [27] and Secretaría de Hacienda y Crédito Público (SHCP) [29] for international trade, Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación de México (SAGARPA) [26] and Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) [18]for domestic affairs and Secretaría de Desarrollo Agropecuario, Forestal y Pesquero del Estado de Tabasco (SEDAFOP) [28] for local issues such as tuberculosis bovine eradication campaigns. Among the non government institutions is the Confederación Nacional de Asociaciones Ganaderas (CNOG) [7] that groups states associations.

2.16 The assembled organizations

The organizations described above belong to the Mexican cattle industry. Table 2.2 presents them with some relevant figures. From this group of organizations it can be stated that:

- they have independent administrative and production structures,
- each has an expertise domain,
- they work together in a coordinated and complementary way,
- they are located in several geographical areas of the country and abroad,
- they are in continuous evolution looking for a broader business scope, in a competitive environment even world wide,
- a long-term relationship exists between them.

ICTs have played an important role in the organizations group evolution: initially, due to the huge amount of data processed (members payment, stock control, etc.) and today, because it is seen as a way to shorten the link between producers and consumers and to increment product value.

The UGRT case study offers a rich source of information that has allowed us to illustrate the state of the art research and the findings of our proposal in the following chapters.

Table 2.2: Organizations summary of UGRT case study

Internal Organizations		
Organization	**Domain (Creation Date)**	**2010 Relevant Figures**
AGL	Stockbreeders Associations (1920)	11,012 members
UGRT	Meat Marketing (Aug.19th 1932)	13,000 members 100M USD sales
FyETSA	Cattle Slaughtering and Processing (July 19th 1962)	109,000 heads slaughtered a year
UCGT	Credit Union (June 24th 1979)	10,472 members; 75M USD in loans; 99% recovery rate
CCG	Retail Stores (July 24th 1979)	18M USD sales; 41 stores; 12,441 associates
ULSSA	Dairy Product Manufacturing (July 1st 1989)	26M liters collected a year
CFPP	Veterinary Laboratory (Sept. 28th 1989)	15,000 users
ABU	Animal Food Manufacturing (Oct. 21st 1994)	3,600 tons produced a year
TCyDU	Freight Trucking (Dec. 28th 1999)	8,600 freights a year
TCUG	Butchers Stores (Mar.12th 2010	5 stores
Livestock Buyers & Suppliers		more than 500 buyers from 3 countries and 10,000 suppliers from 4 states;
Other Buyers & Suppliers		more than 10,000 customers and 700 suppliers from 12 countries;
External Organizations		
Competitors & Complementors		UGRT has 3.7% national market share, the rest belongs to competitors
Regulators	Government Institutions	facility inspections, price revision, international agreements

CHAPTER 3

Virtual Organization: State of the Art

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3.1 Introduction

At present, most organizations are subject to many events which affect their working methods: new competitors, new customer requirements, new technologies, etc. Globalization has accelerated these changes; consequently, companies seek new strategies to survive. Moreover, organizations do not work alone; they are conscious that they are no longer isolated entities and that they must collaborate with other organizations in various ways in this changing environment. A business network eases the identification of economic, relational and material resources while considering that cooperating or sharing among business members has more advantages than competing [Miller et al., 2005]. The organizational unit concept has changed through time starting from individual and group based structures [Davis, 1917, Shani et al., 1992], passing by organizational based functional departments [Tatikonda et al., 2001], evolving to virtual organizations [Mowshowitz, 1986, Davidow et al., 1992, Tripathy et al., 2007] and eventually,

to virtual organization networks (Figure 3.1). Indeed, one way to deal with ever changing business opportunities is to form a VO.

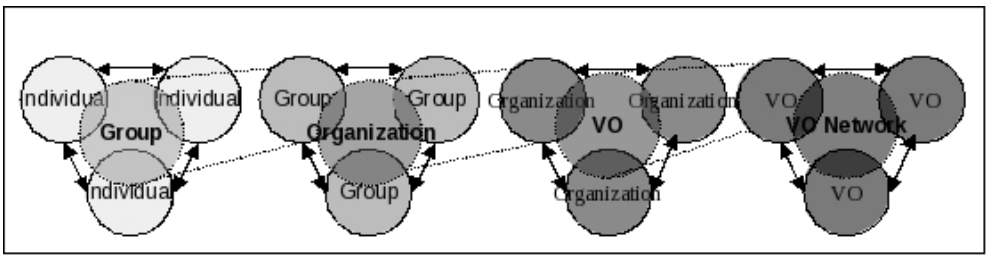

Figure 3.1: An evolution from Individuals to Virtual Organization Network

As a new business model, Miles and Snow define the concept of dynamic network organization [Miles et al., 1984] as a partnership electronically linked. Mowshowitz, uses the term of VO for the fist time in 1986 [Mowshowitz, 1986] inspired by an analogy between the concept of virtual memory in computer systems and the way global companies operate. Since then, many definitions and terms have been proposed for a VO [Meissonier, 2000, Fernandez-Monroy, 2003]. The following definitions were selected to help us obtain the characteristics of a VO supported by ICT, the original terms given by their authors are maintained:

> *VO* "an organizational innovation that identifies the needs of production independently of the ways in which they can be met. Virtual organization would not be feasible without advanced information technology. Computers are needed to mediate between needs and ways —tracking, sorting, and presenting alternatives—thus allowing management the flexibility to switch between different ways of meeting a need" [Mowshowitz, 1986, Mowshowitz, 2002].
>
> *Virtual Corporation* is "a sophisticated information network that gathers data on markets and customer needs, combining it with the newest design methods and computer-integrated production processes, and then operating this system with an integrated network that includes not only highly skilled employees of the system but also suppliers, distributors, retailers, and even customers" [Davidow et al., 1992].
>
> *VO* "refers to a temporary or permanent collection of geographically dispersed individuals, groups, organizational units —which do or belong to the same organization—or entire organizations that depend on electronic linking in order to complete the production process" [Travica, 1997].
>
> A *virtual enterprise* "is a temporary alliance of enterprises that come together to share skills or core competencies and resources in order to better respond to business opportunities, and whose cooperation is supported by computer networks" [Camarinha-Matos et al., 1999].

Agile Virtual Enterprise, also called Dynamic Alliance, "is an agile dynamic and temporary enterprise which integrates the resources in one or many real enterprises through information infrastructure to respond rapidly to the business opportunity" [Xu et al., 2000].

VO is "a strategic alliance amongst non competing companies who share forces -using mostly the Internet- for the accomplishment of a specific goal, without losing their autonomy -except for the undertakings set forth in the VO agreement- and without forming a new legal entity" [Mazzeschi, 2001] .

Collaborative Virtual Enterprise "is a temporary alliance of enterprises to share skills or core competencies and resources in order to better respond to business opportunities in a more collaborative rather than competitive manner. The whole collaboration is supported by computer networks and IT technologies" [Yang et al., 2006].

Based on the above definitions, we define a VO as *"an alliance for integrating competences and resources from several independent real companies, that are geographically dispersed. This integration is possible throughout the layout of an IS infrastructure to satisfy customer's requirements, or to seize a business opportunity without having to form a new legal entity"* [Priego-Roche et al., 2009a].

This chapter explores concepts like alliances, strategy and strategic frameworks to characterize the organization and the organizational environment before exploring VOs origin in the business domain and latest efforts for facilitating VO with ICTs. We consider that organizations and their environment are important factors for eliciting requirements [Yu, 1997, van Lamsweerde et al., 1998], objectives and the alternatives for achieving them.

3.2 Virtual Organization Characterization

An alliance can be seen as a business strategy that sets up cooperative relationships among separate firms. Strategic alliances are defined "as voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies or services ... and thus results in some form of enduring commitment between the partners" [Gulati, 1998, Gulati et al., 1999]. There has been an explosion of strategic alliances among organizations that has led to important business research interests in the last two decades [Gulati et al., 1999, Elmuti et al., 2001, Markides et al., 2010]. Furthermore, alliances are not static, they undergo a continual evolutionary change and we believe that strategy and strategic frameworks are basic concepts that can help us understand the dynamics of alliances and their evolution because they act as a compass for organizations' executives to determine the direction.

3.2.1 Strategy

First, adopting the perspective of strategy in management can guide and help us understand the motives and main elements needed to establish a collaboration relationship. Many defi-

nitions of the concept strategy can be found in the business domain, we can note that even despite their origin, decades ago they continue to be relevant today. To understand the divers strategy concerns, three models are proposed by [Chaffee, 1985] (see Figure 3.2):

- **Linear Strategy** seeks to achieve objectives. It focuses on planning for making decisions and carrying out actions to achieve organizational goals. For [Chandler, 1962] an enterprise is "a profit-oriented business firm involved in the handling of goods in some or all of the successive industrial processes from the procurement of the raw material to the sale to the ultimate customer". His definition of strategy supports this enterprise view:

  > "the determination of the basic long-term goals and objectives of an enterprise and the adoption of courses of action and the allocation of resources necessary for carrying out these goals" [Chandler, 1962].

- **Adaptive Strategy** seeks a co-alignment with the environment through means not objectives. It focuses on continual assessment of external and internal conditions to make the necessary adjustments in the organization. In [Pfeffer et al., 2003] a summary of theories of organizations and their relationship with environments is presented. He had stated that "organizations are inescapably bound up with the conditions of their environment ... they must transact with elements of the environment in order to obtain the resources necessary for survival" [Pfeffer et al., 1978]. It is evident that another approach to strategy is necessary:

  > "concerned with the development of a viable match between the opportunities and risks present in the external environment and the organization's capabilities and resources for exploiting these opportunities" [Hofer, 1973].

- **Interpretive Strategy** aims to explore the meanings of reality as socially based. It focus on social contract (as a set of cooperative agreements accepted by individuals with free will) and deals with the environment (the assessment of events guided by perceptions, culture, norms and symbols). Organizations are conceptualized as 'assemblages of interacting human beings" [Keeley, 1980] and "as a series of nested systems, and each subsystem may deal with a different external sector. Upper managers bring together and interpret information for the system as a whole" [Daft et al., 1984]. This view complements the proposed classification, adding the social context to organizations, which can be presented as:

  > "Orienting metaphors constructed for the purpose of conceptualizing and guiding individual attitudes of organizational participants" [Chaffee, 1985].

Other authors like [Tregoe et al., 1980, Robert, 1993] emphasize on *what should guide* strategy, referring to it as the *driving forces*. The driving forces proposed by the former are: products offered, production capability, natural resources, market needs, method of sale, size/growth, technology, method of distribution and return/profit. Those proposed by the latter are: product-service, sales-marketing method, user-customer, distribution method,

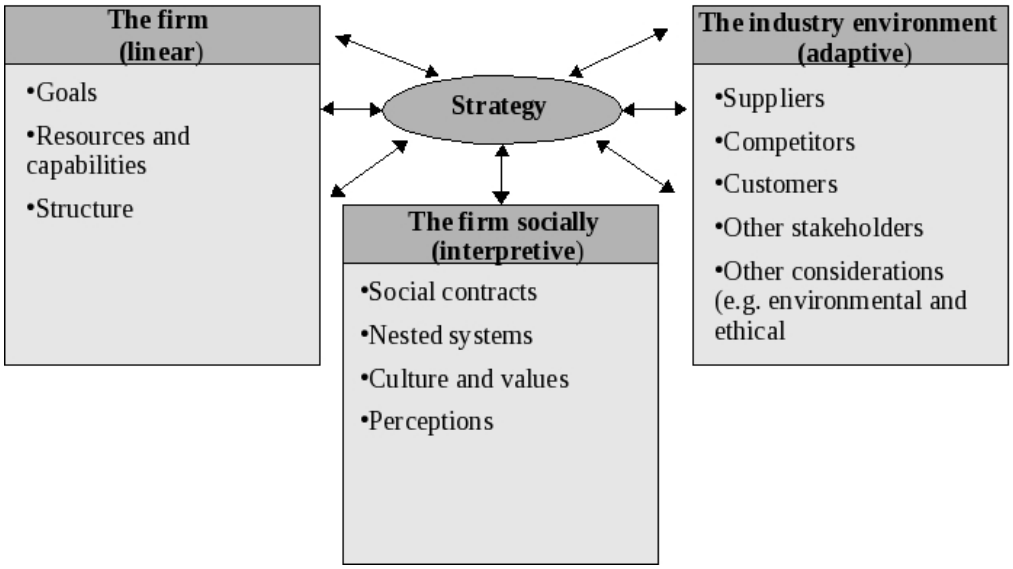

Figure 3.2: Strategy links the enterprise and its industry environment as socially based (adapted from [Woolfe et al., 2002] and [Fleisher et al., 2007])

market type, natural resources, production capacity-capability, size/growth, technology and return/profit. Both authors advise executives to concentrate not only on one driving force.

Late definitions of strategy focus on *what should be attained*. Recently, one target that has taken more relevance is *value* creation:

> "... must enable a company to deliver a value proposition reflected in a distinctive value chain" [Porter, 2001].

> "... on a general level, strategy comprises three objectives: creating value, handling imitation and shaping a perimeter" [Fréry, 2006].

Strategy is concerned with many parts of an organization in order to "state where you want to be and how to get there" [Woolfe et al., 2002]. Figure 3.2 is adapted from [Woolfe et al., 2002] and [Fleisher et al., 2007] to present the main elements that influence the enterprise from different positions: the Firm, the Industry Environment and the Firm Socially which are grouped in Linear, Adaptive and Interpretive Strategies.

3.2.2 Strategic Frameworks

Strategic frameworks have emerged to help executives and strategists choose the right strategy. Although they can be useful they have limitations, mainly because they focus on certain parts of the organization and the organization scope is larger. There is a plethora of strategic frameworks in business literature. In [Fleisher et al., 2007] for example, twenty four of them are analyzed and classified by strategic rationales such as: **Competitive analysis** (e.g., *Nine Forces* [Tregoe et al., 1980], *Competitive Positioning* from M. E. Porter),

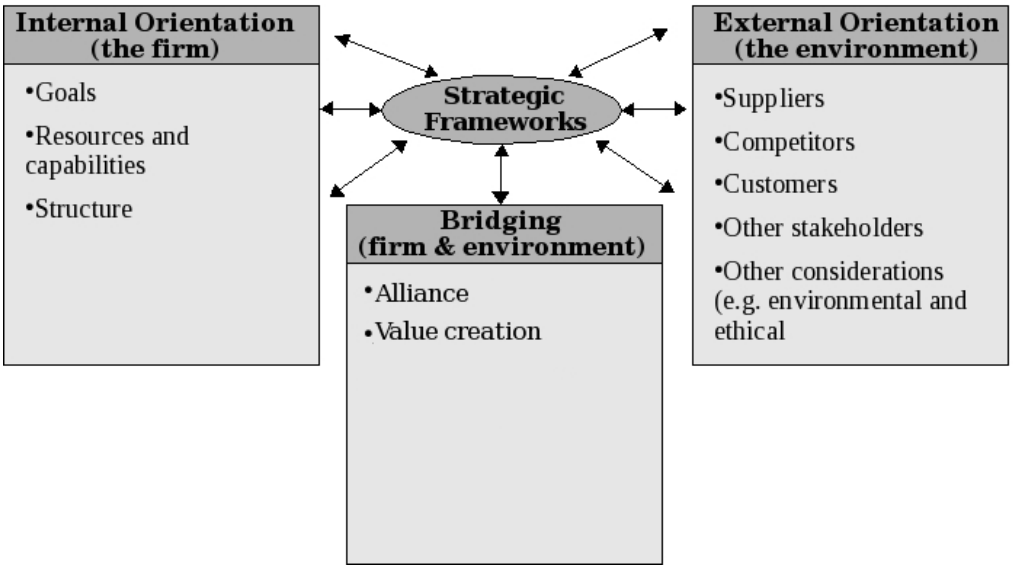

Figure 3.3: Three strategic framework groups (adapted from [Woolfe et al., 2002])

Enterprise analysis (e.g., *Bench marking* from C. E. Bogan, M. J. English in 1994 and D. A. Aaker in 1998, *7 S of McKinley* from Pascale, Athos, Peters and Waterman in 1978), **Environmental analysis** (e.g., *Strategic Relationships* from T. Levitt in 1980), **Corporate Reputation** (C. J. Fombrun, 1996), **Evolutionary analysis** (e.g., *Technology Forecasting* from W. Ascher in 1979, *War Gaming* from Chussil in 2002), **Financial, Probabilistic and Statistical** (e.g., *Basic Statistics* from R. Levin, D. Rubin, J. Stinson, E. Gardner in 1989, *Competitors Cash Flow* from C.J. Casey, N. J. Bartczac in 1985).

In another effort, [Woolfe et al., 2002] clearly and easily categorize the frameworks under three headings summarized in Figure 3.3:

- **Internal** focused on the enterprise (e.g., *Value Chain Analysis* (M. Porter and V. Millar, 1985), *Core Competencies Matrix* (G. Hamel and C.K. Prahalad, 1994)).
- **Bridging** focused between the enterprise and its environment (e.g., *Alliance Value Creation* (Y. Doz and G. Hamel, 1998), *Assumption Led Strategy* (J. Sampler and M. Blosch, 2002)).
- **External** focused on suppliers, customers and competitors (e.g., *Forces of Competition* (M. Porter, 1980), *SWOT Analysis* (K. Andrews, 1980)).

This classification integrates three complementary views. Due to the difficulty and risk of concentrating on only one part of the business landscape the proposal offers a broader panorama for selecting from different alternatives of analysis.

3.2.3 Alliances

Small and large firms are engaging in cooperative relationships for sharing costs, resources and risks or gaining new competencies or new markets. [Wheelen et al., 2000] define

Strategic Alliances as “an agreement between firms to do business together in ways that go beyond normal company-to-company dealings”.

To explain why alliances are created, Gulati [Gulati et al., 1999] proposes an endogenous embeddedness and exogenous interdependence classification as drivers of alliance formation and their evolution to inter organizational networks (see Figure 3.4).

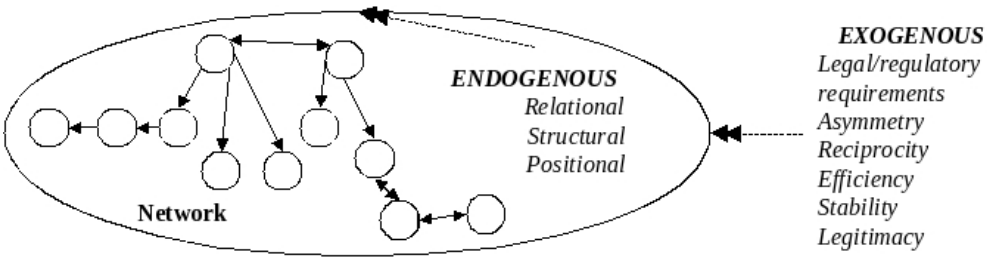

Figure 3.4: Alliance formation drivers adapted from [Oliver, 1990, Gulati et al., 1999]

- *Endogenous embeddedness* help organizations to select their partners and form new alliances. The drivers are:
  - *Relational*. The ties created among organizations that facilitate cooperation, develop trust and increase certainty in the relationship.
  - *Structural*. Structures created from the cooperative relationship are mechanisms that ease information and reputation propagation to potential participants.
  - *Positional*. The role each organization plays in the network affects its access to information like potential partners and its own exposure in the network. The more central an organization in the network is the more advantages of information collection and possibilities of reaction it has.
- *Exogenous interdependence* or *environmental contingencies* drive organizations to seek cooperation because they are partially “under the control of other organizations in their environment” [Gulati et al., 1999]. “Any organization’s activities can’t live without relationships with the surrounding environment. Its survival and performance depend on the relationships with other organizations” [Oliver, 1990]. Some examples of this research are given as follows:
  - [Oliver, 1990] classifies them in legal or regulatory requirements, asymmetry, reciprocity, efficiency, stability and legitimacy.
  - [Cannon et al., 1999] in a buyer-seller relationship classifies them in availability of alternatives, supply market dynamism, importance and complexity of supply, customer satisfaction and evaluation of supplier performance.
  - [Mentzer et al., 2000] in a supply chain relationship classifies them in environmental uncertainty, global competition, time and quality based competition.

In the following sub-sections, three typologies from different fields are described: business alliance, ICTs alliance and the Systems of Systems (SoS) approach. These typologies are the basis for alliance characterization and therefore for the VOs characterization proposed in Chapter 5.

3.2.4 Alliance typology

Alliance can be analyzed from several points of view to structure the information given by each different perspective. Following sections describe alliances from three complementary positions: foremost, business which has been the first field to explore alliances, followed by ICTs which have provided tools that facilitate alliances activities and more recently the SoS approach which gives insights to manage alliance complexity. The classifications emerged from this analysis help to characterize the VO and its components.

3.2.4.1 Business typology

There are many ways of collaborating among firms: from unstructured collaboration projects to full mergers or acquisitions [Kanter, 1994, White et al., 2003, Gomes-Casseres, 2006]. They are not limited to two companies, recently, multi partner alliances are more common [Elmuti et al., 2001, Lavie et al., 2008]. A description of the main collaboration forms or contractual arrangements is given as follows:

- *Unstructured collaboration:* although it might not deserve the term of strategic alliance, it is an informal way of collaboration where parties do not exchange assets [Elmuti et al., 2001].
- *Consortium:* companies from a similar industry environment aim to lower transaction costs by combining their purchasing power (consortium sourcing) of a product or service from one or many suppliers. In the case of one or many clients, retailers can also share their revenue from customers' buys (affiliate marketing) usually on a commissions basis [Essig, 2000, Atkinson et al., 1994, Hoffman et al., 2000]. Consortium are not limited to buy-sell collaborations, other services so-called "back office services" like payroll, administration, human resources, ICT, etc., can also be shared.
- *Distribution:* when a company (distributor) which wants to enlarge its customer base searches for other companies to market its products in a limited geographical area.
- *Licensing:* an organization (licensor) provides an intellectual property to another company (licensee) while being paid a royalty by unit produced or sold. Usually it is a viable option when the licensor does not have the money to invest in the plants for producing a product (product, patent licensing) or accelerated demand for new technologies exists (technology, software licensing) or for expanding or building a marketing image (copyright, trademark licensing) [Hastbacka et al., 1998, Frank, 2004].
- *Franchise:* an organization or a parent company (franchisor) authorizes another organization (franchisee) to commercialize in a particular location a proven product or

service under a business model (e.g., name, operational and management skills, specific site design). Franchisors pay in return for commercialization rights (usually a percentage of sales) [Rubin, 1978, Bodey, 2008].

- *Outsourcing:* an organization internal department's capabilities and resources are all or partially offered to another organization for providing the original internal service. These organizations combine their expertise and might offer these services to other organizations even in the same industry domain [Suarez-Villa, 1998, Barthelemy, 2003]. One example is IBM Service Providers and American Airlines outsourcing for human resources in 2009 [Levine, 2009].

- *Joint Venture:* two or more organizations create one or more new organizations for combining resources and capabilities among them [Kogut, 1988, Inkpen et al., 2004]. One example is cross-production between Renault-Nissan alliance: production plants of one and vehicle models of the other. This alliance has extended to Daimler AG (German) and AvtoVAZ (Russia vehicle manufacturer) [Daimler, 2010].

- *Value chain:* organizations from different industries combine complementary skills to create value to end users like suppliers-customer [Kanter, 1994].

- *Mergers:* two or more separate organizations are combined into one new company but without majority ownership of one of them. For example, both Daimler-Benz and Chrysler ceased to exist when the two firms merged, and a new company, Daimler-Chrysler was created in 1998 (in 2007, they separated again becoming Daimler AG [8] and Chrysler Group LLC).

- *Acquisition:* two or more separate organizations are combined into one single company. One of the companies purchases and takes over the others having ownership majority, the purchased companies cease to exist [Hagedoorn et al., 2002]. A recent example is Electronic Data Systems (EDS) business unit that was bought by Hewlett Packard (HP) in the latter half of 2008 and in 2009 became HP Enterprise Services [15].

An alliance can take many implementation paths and shapes, taking advantage of the complementary strengths of other organizations, strategic alliances are established as a flexible way to have access to others' skills, knowledge and resources. An increment of alliances has taken place over the last decades [Dyer et al., 2001] like acquisitions and mergers [Raymond, 2008], joint ventures and licensing agreements [Anand et al., 2000].

According to the above classification, we can situate the UGRT collaboration as a Value Chain. It is formed by different industries like marketing, abattoir, transport, banking, among others, that combine complementary skills to create value to Stockbreeders in the cattle industry.

Several elements of analysis emerge from the alliances described above. Although the elements' values might be particular for each individual alliance case, we can distinguish a behavioral tendency that helps describe the relationship: from distant to close collaboration, from less to more autonomy preservation, from low to high operability in their inter

connections, from short to long-term relationship, from weak to strong power sharing among participants. In a *Consortium* for example, there is a medium collaboration centered in lowering transaction costs, more autonomy among organizations, a low and limited operability devoted to facilitate the collaboration without much engagement, not necessarily in a long duration alliance and with an equal power tendency. Contrary to an *Acquisition* where collaboration is very close, at least one of the organizations loses its autonomy and therefore its power, a high operability is demanded in a long-term relationship.

Figure 3.5 illustrates these elements for the UGRT case, classified as a Value Chain collaboration. It can be noted that there is a tendency for a close collaboration and more autonomy among the organizations, operability among them slightly exists (towards low), and they form a long term alliance with an equilibrated power among participants (above weak).

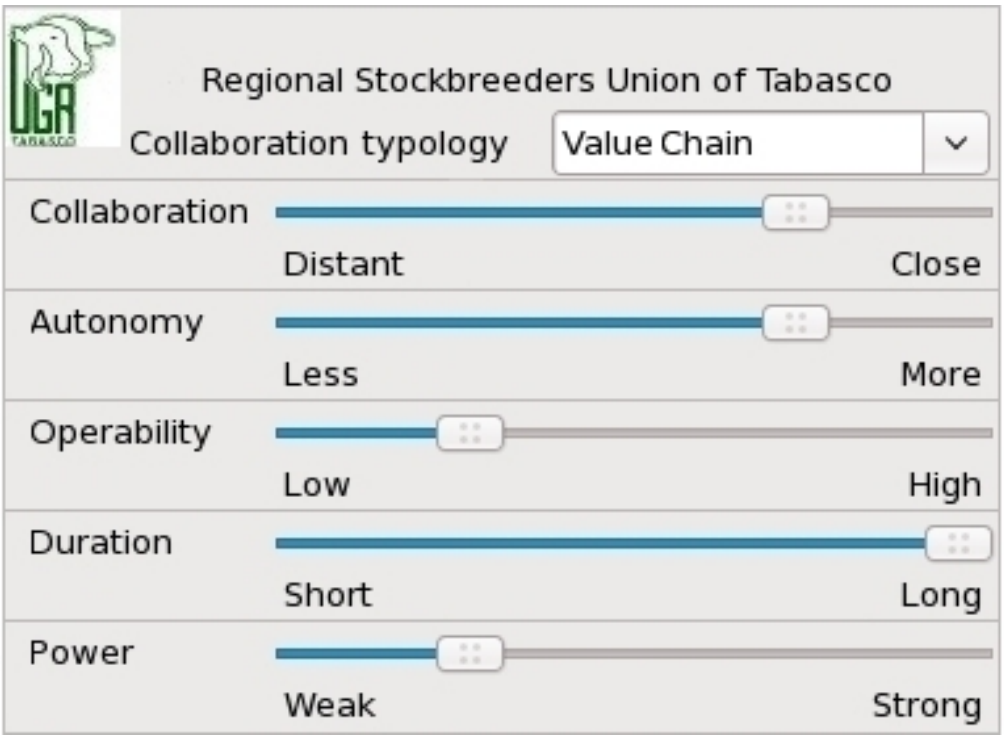

Figure 3.5: Elements of analysis in the relationship: the UGRT case

3.2.4.2 ICT typology

From the ICTs perspective, [Burn et al., 1999] identify six models of "electronically networked organizations" (see Figure 3.6). This perspective adds the electronic business context that in the past decade has favored virtual alliances:

- *Virtual face* is the internet view of a real organization that substitutes traditional fronts like telephone, mail or personal contact: it is any organization that has a website with

services that enable users to conduct traditional transactions through the Internet commonly known as e-business. In the case of media like on-line radio, TV and newspapers, the virtual face is constantly updated to enable user access to breaking news and archival searches.

- *Co-alliance* is the model representation of a consortium where organizations have equal commitment in the relationship. Co-alliances are usually based on contractual projects for sharing members core competencies like collaborative design, virtual consulting and support. Participant organizations generally have a low degree of substitutability and need support in their collaboration process (e-collaboration).

  E-collaboration understood as "collaboration among individuals engaged in a common task using electronic technologies" [Kock, 2005] can be assisted by varied products with collaboration functionality. Among them, we can cite devices (PC, phone or videoconferencing system), collaboration functions (Coordination to manage dependencies among activities, Production related to creation and sharing of information and knowledge, Decision-making to analyze, evaluate and choose alternatives and Process integration to transfer process results among the collaboration functions) and access to these collaboration functions and shared information (portals, content management service) [Weiseth et al., 2006].

- *Star-alliance* is a model where a lead organization is surrounded by satellite organizations with a strong-weak relationship and usually of the same industry domain. Renault or Ford are examples in the automobile industry where only the main vehicle producer is identified in the virtual space but not its suppliers. In this alliance, satellite organizations have a high degree of substitutability contrary to the core organization which is very difficult to replace.

  In order to ease its interactions, the leader organization imposes onto the satellite organizations the collaboration technologies that has integrated into its internal systems. Consequently, it implies that the latter have to invest in technologies, develop new competencies, re-engineer existing business processes and adopt others [Boeck et al., 2006].

- *Value-alliance.* They are based on the supply chain model bringing a variety of products or services. For example, Motorola [22] and IBM have an alliance "to plan for, enable and manage information for the increasingly mobile enterprise". In addition to these businesses, it includes participants like service application creators (Oracle, SAP), browsers developers (Microsoft), infrastructure equipment (Datamax-O'Neil, Zebra).

  Usually, many actors are involved with a low degree of substitutability over a long term. Each organization has a strong dependency on other organizations for accessing the capabilities and resources that at least partially does not have. One of the major concerns are related to the identification of inter-organizational ISs to interoperate or integrate the multiple steps of the value chain. These attempt to define procedures, applications, infrastructure (hardware, communications, security and system

services) and data [Chen et al., 2008] at different levels of each participant enterprise, what includes not only horizontal but vertical analysis.

- *Market-alliance* is an organization that only exists in cyberspace and is the front end of other organizations that provide services, products or facilities like Amazon. In this alliance, provider organizations have a high degree of substitutability. In the virtual space the cyber organization is viewed and the provider organizations can also be disclosed.

  The interactions needed between the cyber organization and the suppliers are linked to stock management and secure buying-selling activities like e-catalogs (accurate databases of digitalized products and services), e-procurement (order transfer to supplier, shipment) and payment and fees control [Schlueter-Langdon et al., 2002].

- *Virtual broker* is an organization that designs dynamic networks for providing, selling or distributing specific information services. It provides a virtual structure for information search (google), customer profiling (American Express), business opportunities brokerage (Entrepreneur) or investment advice (BusinessWeek) [Timmers, 1998].

  The broker organization is shown in the virtual space whereas the information sources are not relevant. They relay in technology to function like search engines and in the collection of information.

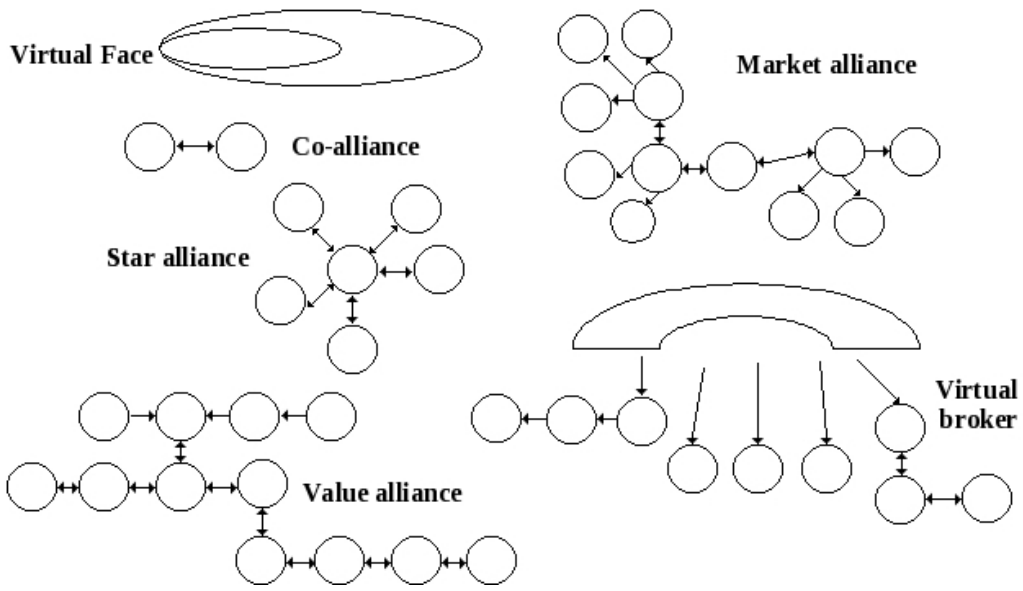

Figure 3.6: Alliance models from electronic business [Burn et al., 1999]

We can state that ICTs are enables of a wide range of business models [Timmers, 1998, Burn et al., 1999, Porter, 2001], some of them are described above. Besides the commercial viability to implement them, the feasibility of the available technology to support new and more efficient and effective coordination processes is an important criteria.

There is not doubt that the Internet and the World Wide Web offer easy and low cost forms for reaching more potential customers and organizations and new innovative business models. Regarding the UGRT case study, several business models can be identified, some of them are described below:

A Virtual face for the CCG and the UCGT. In the case of the former, mainly suppliers' transactions are taken place as an alternative to traditional orders by telephone or fax. For the latter, banking transactions are conducted for members. A Star-alliance model is presented between Meat Marketing (UGRT) and Walmart [40]. At present 90% of meat sales are to this supermarket chain, leaving Meat Marketing in a weak position, forcing it to respect all of Walmart's technological demands to integrate its ISs. The same model is presented between the UCGT and the national banking regulators. In order to comply with strict regulations the UCGT has deployed an ISs accorded to all national credit unions. Value alliance model are presented among several organizations. They share member systems even with some Regulator Organizations (Regulator Organizations). AGL, UGRT, FyETSA and TCyDU coordinate their activities with the cattle shipment system. CCG coordinate with UGRT for charging members for purchase orders from cattle payments. UCGT coordinates with AGL and UGRT shops for guaranteeing money advances.

3.2.4.3 Systems of Systems as an approach to alliances

In Section 3.1 we have stated that the concept of VO has evolved from Individuals to Virtual Organization Network, these varied participants have to be taken into account when analyzing VO alliances and the ISs needed. The [AT&L, 2008] proposes the following definition of SoS: "a set or arrangement of systems that results when independent and useful systems are integrated into a larger system that delivers unique capabilities." [Maier, 1998] argues that the traditional definitions of SoS regarding the assemblage of components as "complex and geographically distributed" is not sufficient. He states that two additional properties must be added:

- *Operational Independence of the Components:* "If the system-of-systems is disassembled into its component systems the component systems must be able to usefully operate independently. That is, the components fulfill customer-operator purposes on their own."

- *Managerial Independence of the Components:* "The component systems not only can operate independently, they do operate independently. The component systems are separately acquired and integrated but maintain a continuing operational existence independent of the system-of-systems."

[Lewis et al., 2009] discusses the challenges of SoS in early RE activities. He classifies the complexity of SoS versus individual systems in:

- *Scale.* The multiple contexts, interactions among systems, users and stakeholders involved. There is for example, only one board of directors involved in the FyETSA individual system that will participate in decisions. On the contrary, there are many

boards involved when other organizations participate (FyETSA, UGRT, TCyDU), which might complicate the decision making process.

- *Multi-Domain.* Different domains of the constituent systems provoke different points of view of the same concept (a "client" is different for a slaughterhouse than for a supermarket) as well as some individual capabilities at the moment of being used in different domains (for example suppliers payment).

- *Varied Operational Context.* Although different operational situations are not exclusive for multi-domain, they cause that a capability must have different business process depending on the context (meat information varies whether it is for meat producers, sellers or buyers).

- *Decentralized Control.* A general agreement has to be established among multiple parties because there are several decision to be made, moreover, there are more employees and authorities controlling the SoS that conflicts have to be solved. A general control agreement among UGRT, FyETSA, TCyDU, etc. has to be established respecting each organization control structure.

- *Rapidly Evolving Environments.* Technology, laws and regulations are outside the control of the constituent systems. Moreover, a change in one system can cascade through multiple systems. Originally, FyETSA produced carcasses and was forced to produced meat boxes which forced adaptation of FyETSA system as well as UGRT and TCyDU systems.

- *Multiple Life-Cycle Phases.* Systems development synchronization among individual systems is difficult because usually each system is in a different phase. This obstructs the specification of capabilities: which are currently available, which will be available in the future and which will disappear in the future. In our case study, each organization has its own IS which makes difficult synchronization with other IS departments.

- *Opportunistic Needs to Collaborate and Integrate.* As a socio-technical systems, SoS involves interactions between systems and people. Automation opportunities create new demands that might require existing systems to adapt or to create new systems. The opportunity to sell to a big supermarket chain forced the UGRT to adapt its supply system to comply Wallmart's specifications.

Table 3.1 summarizes the above complexities for the UGRT case study. Each criteria of the table is compared to an individual system and to many systems.

3.2.5 Alliance life cycle

[Kanter, 1994] considers a "collaborative advantage" when a company has the ability to "create and sustain fruitful collaborations". Three aspects of business alliances are underlined: they offer future opportunities in which not only partners benefit, they focus on collaboration (creating value together) not only in exchange (giving one thing for another) and they relay on interpersonal relationships and internal infrastructures. Building a collaboration is

SoS approach		
A comparison of the complexity		
Criteria	**Individual System**	**Many Systems**
Scale	FyETSA board of directors	FyETSA, UGRT, TCyDU boards of directors
Multi-Domain	Concept: *Client*; Capability: *Supplier payment*	Different meanings for Marketing, Retail Shop, Milk Diary
Varied Operational context	Process: *Provide meat information*	Varies whether it is for meat producers, sellers or buyers
Decentralized Control	The UGRT, FyETSA, etc. have their own control structure	A general control agreement among all organizations is needed
Rapidly Evolving Environments	FyETSA had a cutting, packing and shipping system for carcasses	UGRT, FyETSA, TCyDU systems had to be adapted to handle meat boxes, a new client demand.
Multiply Life-Cycle Phases	Each organization has its own IS department	Difficulty for synchronizing all IS departments
Opportunistic needs to Collaborate and Integrate	UGRT has its own supply system	UGRT had to adapt its supply system to comply Walmart's

Table 3.1: SoS approach: the UGRT case study example

an undergoing process. Scholars have proposed collaborative alliance life cycles in order to understand and guide the process. Proposals extend from intuitive stages to business tools for guiding collaboration formation, evolution and termination.

3.2.5.1 A life cycle as a human relation

Kanter [Kanter, 1994], makes an analogy between alliances and people interpersonal relationships: they begin, grow and develop or fail. This process description emphasizes the human relation over cold-blooded assessments that might mislead the alliance if both views are not well balanced. Although multi partner complexity is not analyzed (it focus on two partner organizations only), the main phases of the relationship are covered (see Figure 3.7):

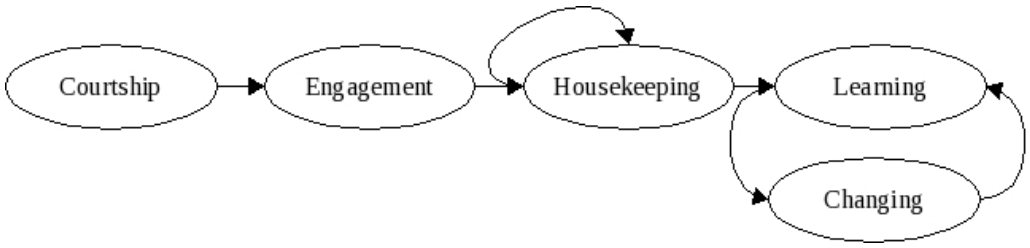

Figure 3.7: Alliance life cycle [Kanter, 1994]

- **Courtship:** organizations "meet, are attracted and discover their compatibility". Three actions are advised: *self-analysis* that consists of knowing and evaluating potential partners; good *chemistry* between chief executives helps overcome relationship tensions; and assessing *compatibility* of tangible and intangible aspects like financial viability, values, principles.

- **Engagement:** organizations make "plans and close the deal". They define a *joint project* and *commit* themselves to the alliance while preserving their *independence*.

- **Housekeeping:** organizations realize that "they have different ideas about how the business should operate" so, problems emerge from day-to-day activities (even with previous compatibility assessment) and they have to be solved. Organizations ought to *descend commitment* to all employees levels, *work out dissimilarities* through good communication channels and mutual respect.

- **Learning to collaborate:** organizations define how to solve the differences developing structures, processes and skills to reduce the gaps. Ideally, five levels of integration are recommended: *strategic* (involving top executives to align goals, define new governance, discuss changes), *tactical* (involving middle professionals to develop plans, transfer knowledge, identify changes), *operational* (sharing day-to-day information, resources and people), *interpersonal* (extended to other business areas for creating future value, making recommendations, expanding synergies) and *cultural* (creating people cultural awareness).

- **Changing:** organizations discover their internal changes for adapting to collaboration. Gaining knowledge and borrowing ideas from partners for rethinking organization performance are some of the results of this learning process.

3.2.5.2 A life cycle as a network

Another "sequence of events" is proposed by Gulati [Gulati, 1998] who adds the network perspective to the traditional analysis of alliances (Figure 3.8):

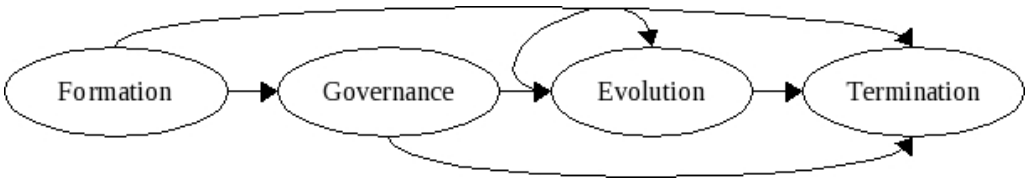

Figure 3.8: Alliance life cycle [Gulati, 1998]

- **Formation.** Includes the decision to enter into an alliance and the choice of an appropriate partner. Organizations have motivations such as cost, competition, knowledge transfer but also prior alliance experiences influence further alliances. Complementarity and good reputation makes an organization an attractive partner.
- **Governance.** The choice of structure for the alliance and their alteration is influenced by the dynamics of the relationship. When the alliance is formed a hierarchical control is usually established to align incentives, to enable monitoring. Trust enables organizations to use less hierarchical controls.
- **Evolution.** The alliance evolves as the relationship develops over time. The originally conceived alliance can change as initial conditions change (partners objectives, context, new ties, etc.)
- **Termination.** Organizations try to respond if there is a benefit from entering an alliance. Objective and subjective measurements should be taken into account to evaluate performance because all partners have multiple perspectives have to be taken into account. In the 80's, scholars had considered the survival of the alliance as a success factor; in the 90's an extensive host of measures were proposed (extendedness of relationship, performance ambiguity, customization of products for example [Heide et al., 1992]). More recently, Parung [Parung et al., 2006] proposed a complete classification spectrum that includes financial, material, human, relational and organizational measurements.

3.2.5.3 A life cycle supported by tools

In [Dyer et al., 2001, Kale et al., 2002] it is concluded that organizations that have dedicated alliance functions achieve more long term success than those without such function. This organizations have documented, codified and shared alliance-management knowledge and

they even have developed tools for guiding some aspects of the alliance life cycle (Figure 3.9):

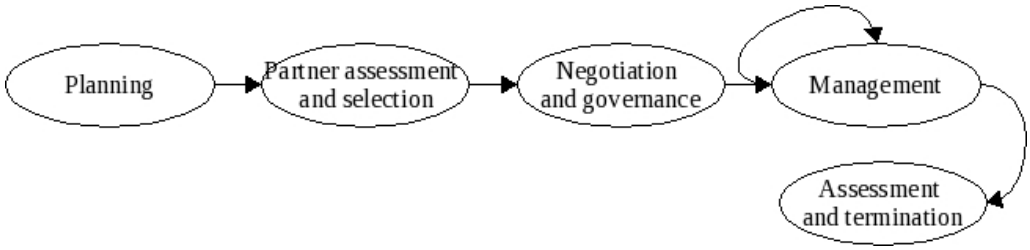

Figure 3.9: Alliance life cycle [Dyer et al., 2001]

- **Planning.** A rigorous cost and benefit analysis involving the whole organization has to be undertaken. Business case, value chain and manufacturing vs partnering analysis and needs, analysis checklist are among the tools and templates developed.
- **Partner assessment and selection.** Organizations have to identify the potential alliance partners and then assess if they will be able to work together. So, processes for partner identification like overlapping key assets with possible partners, partner-evaluation form, cultural assessment are used.
- **Negotiation and governance.** At this stage the alliance agreement is negotiated, the contract is defined, governance arrangements are made and metrics are determined. For helping this process the following tools are suggested: negotiation and contract templates outlining the roles and responsibilities of different departments, structure definition guidelines and metrics frameworks for evaluating alliance performance among others.
- **Management.** This includes ways to solve disagreements with regular evaluations (problem-tracking template), trust commitment (trust building worksheet), communication channels (infrastructure and contacts list).
- **Assessment and termination.** Among the tools are a relationship evaluation form, a yearly status report, a termination checklist, a termination planning worksheet.

3.2.5.4 A life cycle for VO

According to [Camarinha-Matos et al., 2003, Camarinha-Matos et al., 2007b] a VO life cycle is composed by four stages described below and shown in Figure 3.10:

- **Creation** is stated as a complex and considerable effort demanding stage. The VO *initiation* is triggered by a *collaboration opportunity*, then a *rough VO planning* determines the preliminary structure of the potential VO, the competencies, capacities, roles and partnerships needed. Afterwards the *foundation* activities are carried out. These includes *detailed VO planning*, partners *contracting* for finally *setting up the VO* [Camarinha-Matos et al., 2007c].

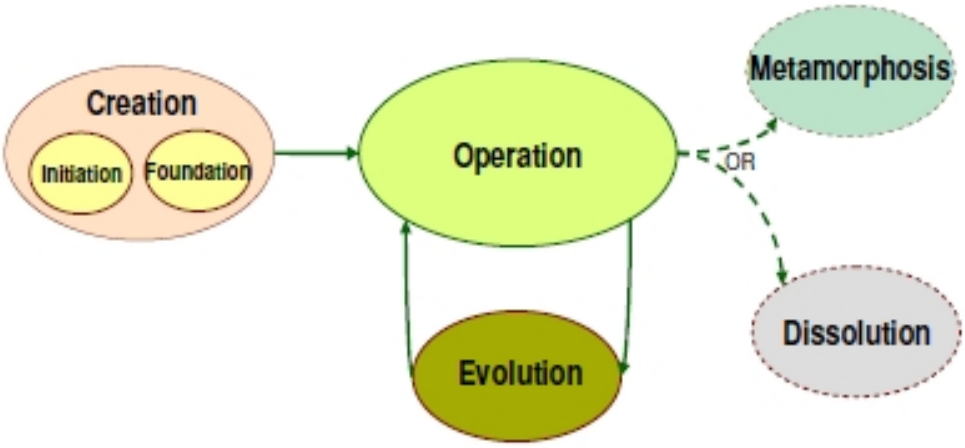

Figure 3.10: The VO life cycle [Camarinha-Matos et al., 2007b]

- **Operation** towards achieving its goals is the main phase of the life cycle. Partners execute the agreed and defined business processes and monitor their performance.

- **Evolution** or adjustment processes are carried out while the VO is operating. The aim of these processes is to refine, change or adapt the VO structure, roles, etc., as necessary.

- **Dissolution** after accomplishing its goal is usually the case for a short term VO. On the contrary, **Metamorphosis** by moving to another stage while taking advantage of the past operating experience is the usual case for long term VO.

Some alliance life cycle have been described, as well as some of the reasons why organizations choose to ally (share costs, technology, penetrate new markets, etc.) with others. Although not all whys (drivers) and stages (life cycle) of traditional alliance formations from business literature are covered, this overview can sustain the construction of a general model for VOs, its characteristics and components (Chapter 5).

3.3 Virtual Organization projects

There are several important projects aiming to support collaboration for VO from the research and operational perspectives. The European Union strongly supports collaborative networks research that has favored the organization of congresses, the publication of scientific works and the development of tools for this new discipline. In this section two of these projects are described with the objective of reviewing current efforts that address VOs considering ICTs as a significant enabler for VO development.

3.3.1 SMEcoll

Small and Medium Enterprise Collaborate (SMEcoll) [31] aims to facilitate methods and tools for managing collaborative activities with small and medium enterprises. It offers training, consulting and guidance from conceptualization to implementation of collaborative projects through two main axes:

- **SME methodology** to increase success of first time collaborating organizations consists of five phases whose flowcharts are shown in Figure 3.11:
  - *Attraction* proposes a set of questions the organizations should answer before adopting collaboration. These questions are evaluated by the Self Assessment tool.
  - *Identification* of skills and opportunities through individual and group analysis. The former is done to potential collaborating organizations, the latter to the potential group of collaborating companies. A match is done between what an individual company can offer and what the opportunity demands.
  - *Formation* is concerned with setting up the collaboration agreement: defining roles, responsibilities, accountability and resources commitment.
  - *Implementation* covers the tasks and activities of the project to be carried out.
  - *Evaluation* accomplishes the performance evaluation for determining effectiveness in delivering benefits to each partner.

- **Tools** are proposed for the specific project collaboration needs. The first tool is publicly accessible on the SMEcoll website, while the others are available for register users only. An example of the latter is given in the SME template [30] site.
  - *Self Assessment* tool for understanding if collaboration is suitable and worthwhile for the organization. It includes an `Attitude Test` for determining if the organization is suited for collaboration, an `Opportunity Analysis` for comparing from a cost-benefit-risk perspective, three different potential business opportunities, measuring them with and without partnership.
  - *Web space collaboration environment* is a work site for sharing information with restricted access to people involved in the project. A portal for registered users with their own secure collaboration space serves as the entrance to the collaboration environment.
  - *Other tools* like document sharing, work flow, contacts, calendars, communication (videoconferencing and conferencing) and task managing are offered with special configuration to the organizations involved in the project.

- **Training** programs are proposed for first time collaborating organizations. General courses are Introduction to collaboration, Collaboration methodology, Facilitator training, Portal end user training and Portal administrator. Additionally, customized training is offered.

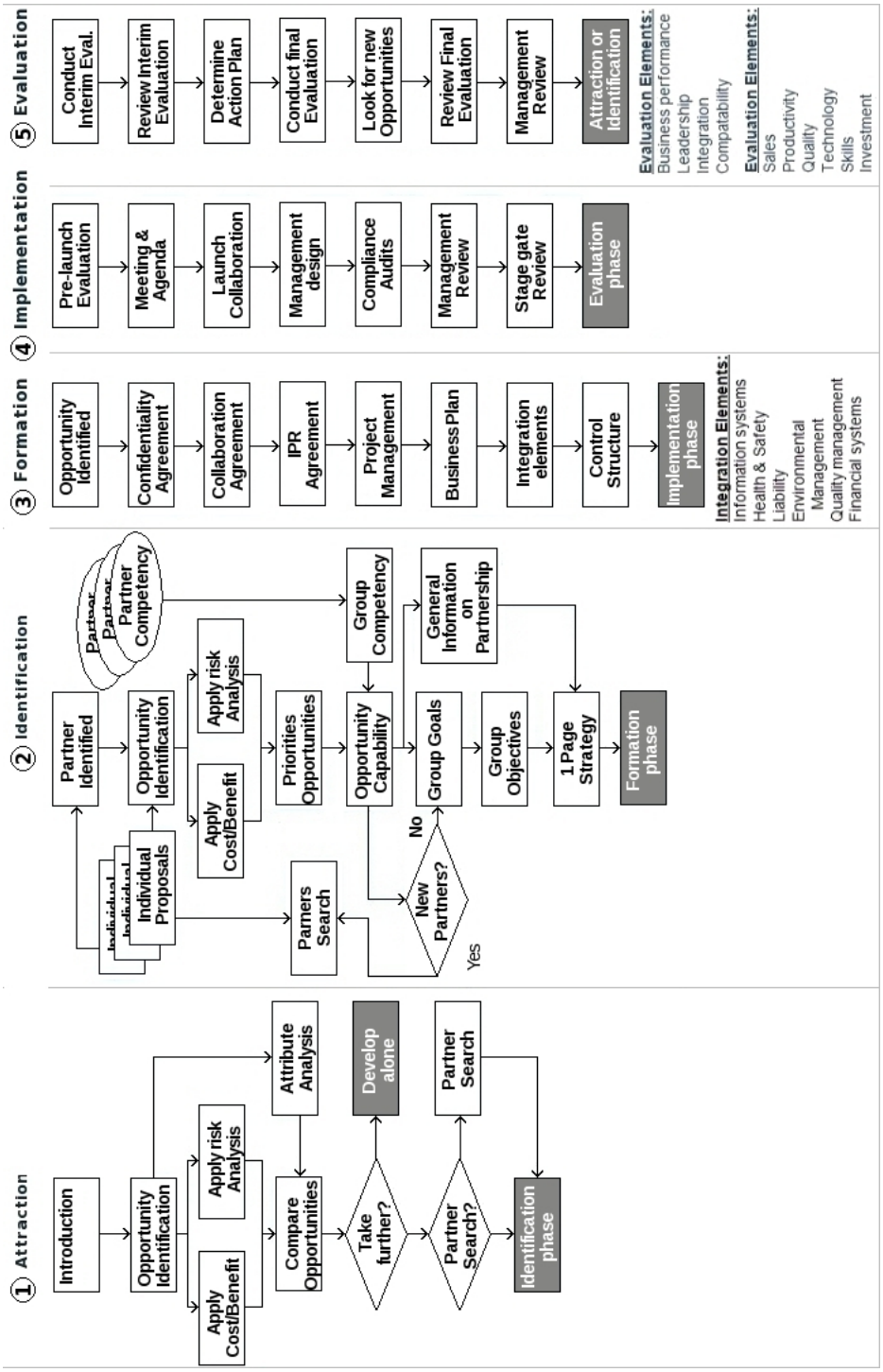

Figure 3.11: SME Collaborate methodology: stages flowcharts [SMEcoll website]

This initiative is a concrete and practical attempt to guide and help small and medium enterprises to collaborate using the available technologies. As a continuation of this project

the Future Small and Medium Enterprise (FutureSME) [13] led by the University of Strathclyde (UofS) [39] is a four years project that started in January 2009. It includes Small and Medium Enterprises (SMEs), research and development partners and industry support organizations. FutureSME objective is to "develop a business model of the future for FutureSME and to support this with a range of tools and methodologies to enable companies to survive and thrive in the emerging competitive landscape". A summary of the first year of research is presented in Figure 3.12 [14] structured in Gateway, Business Diagnostics, Support Environment and Capability Development. The topology of this structure consists of a web portal that allows user access (SME Managers, Consultants, Visitors, etc.) to the system from different web devises (computers, telephone, iPad, etc.); followed by a business logic layer that supports an application store, a semantic intelligence management system, an expert shell, a learning management system (LMS), a content management systems (CMS) and an assessment management system. They are supported by several DB running in the background (Client SME Private Resources, Expert System Knowledge Base, Moodle, Joomia, My SQL and XML).

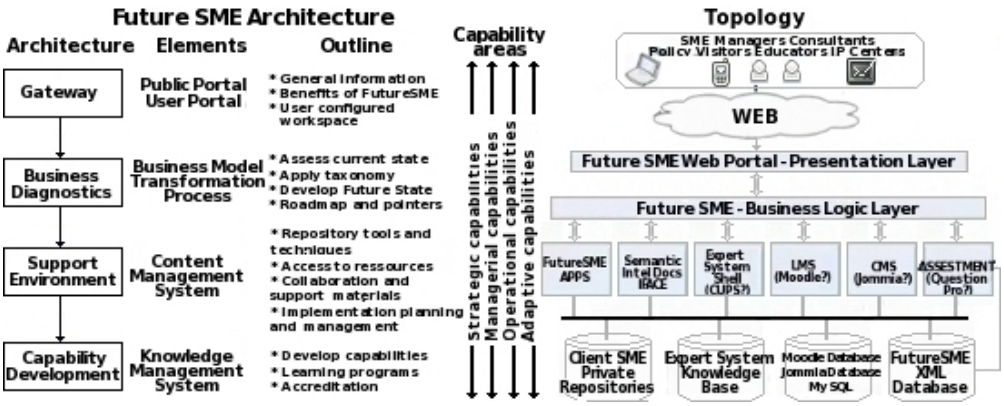

Figure 3.12: FutureSME: architecture and topology

3.3.2 ECOLEAD project

Starting from the Collaborative networked organization (CNO) perspective, the European Collaborative networked Organizations LEADership initiative (ECOLEAD) [10] compares pros and cons of divers theories that can help analyze collaboration among organizations (see [ECOLEAD, 2005]). This project proposes a modeling framework called A Reference model for COllaborative Networks (ARCON) [Camarinha-Matos et al., 2007a] aiming to represent a holistic view of CNOs through many dimensions and tools described in following paragraphs.

The **modeling framework** considers internal and external representation perspectives [Camarinha-Matos et al., 2006]:

- **In-CNO sub-space.** Aiming to provide an inside abstract representation of the CNO

as in a traditional system modeling. This in-sub-space is formed by the ***Endogenous Elements*** that consider all the elements forming a CNO. These elements are classified into two perspectives:

First, the identification of objects from a comportment point of view:

- *Structural*: Addressing the elements that form a CNO: actors (primary and support entities), their roles and some characteristics (like location and time).
- *Componential*: Focusing on individual tangible/intangible elements in the CNO (human elements, software and hardware resources, information and knowledge).
- *Functional*: Addressing the execution of processes and procedures of the CNO.
- *Behavioral*: Addressing the principles, policies, and governance rules that drive or constrain the behavior of the CNO and its members.

Secondly, the identification of CNOs objects from an operational point of view:

- *Active Entity*: tangible objects that perform an action in the CNO,
- *Passive Entity*: tangible objects to whom an action is performed,
- *Action*: the procedure or operation executed in the CNO,
- *Concept*: intangible object associated to Entities and Actions.

- **About-CNO sub-space.** Presenting an abstract representation of the CNO seen from the outside, this about-sub-space is formed by ***Exogenous Interactions*** that consider the interactions between the CNO and its environment. These interactions are classified into:
  - *Interactions objects*:
    - *Network Identity*: The CNO positioning in the environment,
    - *Interaction Parties*: Entities that interact with the CNO,
    - *Interactions*: Transactions between the CNO and entities.
  - *Targeted groups to interact with*:
    - *Market*: Covering interactions with customers and competitors.
    - *Support*: Supporting services provided by third parties.
    - *Societal*: Covering interactions with society in general.
    - *Constituency*: Covering interactions with potential new members.

In order to cover all CNOs models needed, three layers are added to the ARCON framework from a top-bottom approach for deriving different level representations [Camarinha-Matos et al., 2008]:

- **General concepts.** Represent general concepts and relationships common to all CNOs
- **Specific modeling.** Represent more detail of the different CNOs' classes.

- **Implementation modeling.** Represent concrete CNOs models.

All concepts presented above are mapped to the VO life cycle [Camarinha-Matos et al., 2003] described in Sub-Section 3.2.5.4. Figure 3.13 summarizes the multiple views proposed in the ARCON framework.

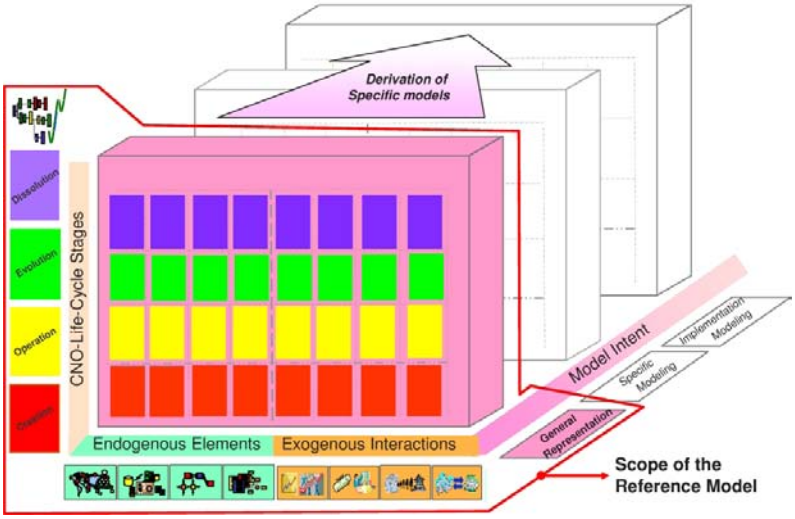

Figure 3.13: The ARCON framework multiple dimensions [Camarinha-Matos et al., 2008]

This framework presents a generic abstract representation for understanding CNOs through all elements involved and the significant interactions among them. The ECOLEAD initiative is an approach that provides the theoretical collaboration foundation based on ICT infrastructure.

Moreover, ECOLEAD offers the following **tools** as a result of the project research:

- **Dynamic VO creation assistance tool** aims to rapidly create a new VO using trust, competency, business process and past performance information of candidates.
- **VO collaboration and performance measurement tool** collects past collaboration performance of each organization for guaranteeing the right partner selection in a new VO.
- **Contract negotiation wizard tool** allows to rapidly define organizations rights and duties in the VO.
- **VO management e-service tool** aims to manage VO operations by e-services having a low impact in the organization ICT structure.
- **Collaborative problem solving support e-services tool** aims to improve Virtual Breeding Environment (VBE)'s members by starting problem solving processes to alleviate daily difficulties.
- **Advanced collaboration platform for PVCs tool** supports cooperation of a professional person to bring his/her personal and specific competencies.

3.3.3 VO projects summary

Different projects address the VO field from different angles. Nevertheless, we can compare them from three sets of criteria shown in Table 3.2. The first set relates to the project's intended use, the second to the methodology proposed and the third to the tools that support the proposal.

The two projects presented have two different reasonings that guide them: to facilitate collaboration with methods and tools for SMEcoll providing partner identification, collaborative relationships exploration and development in a secure environment and, to provide a holistic view of the field based on collaborative networks organizations for ECOLEAD by creating a VBE, taking into account the VO dynamics and integrating professional virtual communities. On one hand, SMEcoll addresses a specific set of organizations: the SMEs. On the other hand, ECOLEAD covers a wider range of members: SMEs, large-scale enterprises and professional virtual communities. Each has a different impact on the project and the ICTs approaches proposed: practical and based on well known and proven technologies for the former and theoretical and more innovative technologies for the latter.

From the methodology set of criteria, the SMEcoll provides a method named as the project and tested in industrial projects; ECOLEAD offers theoretical frameworks like ARCON tested at the research level only. Both projects cover all VO life cycle stages although they name them differently. It can be stated that the Attraction, Identification and Formation phases of SMEcoll are sub phases of the Creation phase proposed in ECOLEAD. In SMEcoll the Evaluation phase leads to the Attraction or Identification phases (see Figure 3.11) where the "Develop alone" activity of the former phase means that no work will be done in partnership, whereas in ECOLEAD a Dissolution phases is defined.

Each project offers a set of tools that supports the method proposed: more general but tested in industrial projects in the case of SMEcoll and more state-of-the-art in ECOLEAD.

3.4 Technology Platforms

Many researchers agree that ICTs play a fundamental role in a VO [Burn et al., 1999, Porter, 2001, Bouarfa et al., 2005, Robinson et al., 2005]. Thus, ISs facilitate cooperation, communication and collaboration among the VO's members. They support sharing resources and new working modes while preserving their individual administrative structures.

The following subsections describe three projects that offer ICT solutions for VO.

3.4.1 BEinGRID project

The Business Experiments in GRID) (BEinGRID) [2] project offers a VOs management technical solution based on Camarinha-Matos's VO life cycle (see Subsection 3.2.5.4).

BEinGRID is a European Union project funded by the Information Society Technologies (IST) conducting real-world experiments with business using Grid technology. The project claims to have identified clear business needs to be met by Grid technologies. It has 25 business pilots from different sectors like finance, architecture, advance manufacturing, agriculture and health.

Table 3.2: SME Collaborate and ECOLEAD projects comparison table

Questions addressed	Description	SME Collaborate	ECOLEAD
Project *intended use*			
What is the reasoning?	The main concepts that foster the methodology	To facilitate collaboration	To provide a holistic view of collaborative networks organizations (CN)
To whom is addressed?	The organizations or people that are analyzed as VO members	SME (small and medium enterprises)	SME and large-scale enterprises, professional virtual communities
What does it offer?	The general functionality offered by the project	-Partner identification -Collaborative relationships exploration and development -Secure environment provision	-VO breeding environment -VO dynamics -Integrate professional virtual communities
What is the approach scope?	The practical and/or theoretical results attained	Practical: training, consulting and guidance to SME	Theoretical: formal and semi formal reference models, ontology and CN as a new discipline
What is the ICT approach?	The set of ICT platform tools used in the project for supporting the methodology	Adaptive: known and tested commercial software tools	Innovative: design and implementation of flexible and generic infrastructure
Who form the group?	The institutions, organizations that participate in the project	Research and Development institutions, SME organizations	Research and Development institutions, Large to Small Industry Organizations
Methodology			
Does it offer a method?	The method proposed by the project	SMEcoll	ARCON framework
What are the stages supported?	The VO life cycle stages supported by the method	Attraction, Identification, Formation, Implementation, Evaluation	Creation, Operation, Evolution, Dissolution
How is tested?	The project perimeter used to evaluate	Tested in industrial projects	Tested in research projects
Tools			
What are the tools offered?	The specific tools offered by the project	-Self assessment -Webspace portal -Traditional collaboration tools like document sharing, workflows, communications tools	-Dynamic VO creation assistance -VO collaboration and performance measurement -Contract negotiation wizard -VO management e-service -Collaborative problem solving support e-services -Advanced collaboration platform for PVCs
On what platform?	The base platform used for development	Microsoft windows share point	Numerous proposals (SATINE, VEGA, ..)
What maturity?	The tools level of maturity	Strong	Partial

In the particular case of VO is stated that the VO management "deals with the secure federation of autonomous administrative domains and the adoption of semantic models and languages to improve the processing of resources and services in a VO". Four tools are offered using different Grid technology solutions for collaboration and enabling new services:

- *VO Setup* is the first step for VO creation through formalizing the collaboration among partners. Collaboration set up maintains information about users, roles, policies, usage of each VO and the sharing of resources according to the established rules [BeinGRID, 2008, Gaeta et al., 2009].

- *Application Virtualization* is a Web Service component that addresses a common issue in Service-oriented architecture (SOA) and Grid environments for putting together heterogeneous and distributed resources coming from different providers. It identifies and creates "the Grid infrastructure services for running and managing applications on a shared distributed set of resources or endpoints, and integrates and exposes application capabilities through a single point of access (a WS gateway)" [Gaeta et al., 2009].

- *Automatic Resource Discovery* is a data repository that provides Resource Description (RDF-based) for Grid middle-ware and a Web Service Resource Framework (WS-RF) based interface. It is integrated into the Globus toolkit (an open source Grid software that addresses challenging problems in distributed resource sharing). The component uses an ontology and reasoning over the ontology to describe the characteristics of the resources present in a Grid. The repository stores information about Grid resources like description of processing nodes, including operating system, processing speed, data storage capacity, network connections and ports as well as licensing information, for accountancy and administration. It can hold information about users, groups and domains for security purposes [BEinGRID, 2010].

- *Service Locator* is a subsystem that allows the searching for services inside the VO. It is composed of a *Locator* that allows to discover the services, a *Gateway Instance Registry* that stores information about all available services inside the hosting environment (the ensemble of machines within the same administrative domain) and a *Host Instance Registry* that stores in a single host, the information of available services [BEinGRID, 2010].

3.4.2 TrustCoM project

The Trust and Contract Management (TrustCoM) [35] project develops "a framework for trust, security, and contract management, for secure, collaborative business processing and resource sharing in dynamically-evolving VOs" [Wilson et al., 2005].

TrustCoM assumes that description of potential members of the VO and the services these members can provide are available as Web or Grid services, open to automated search, negotiation and Service Level Agreement (SLA). Members agree to the use policy of the platform for integrating the Enterprise Network. It also follows the Camarinha-Matos's VO life cycle presented in Subsection 3.2.5.4.

TrustCoM has several key components: VO Management Toolkit, Notification subsystem, Reputation Service, Secure Audit Web Service, Security Token Service, Policy Decision Point, SLA Management Subsystem, Monitoring Infrastructure, Policy service, Gateway, Service Instance Registry (see Figure 3.14). They are developed by the consortium and are heavily based on the proposals of Dimitrakos [Dimitrakos, 2003]. In this section we describe two of these components: the VO Management which interacts with all other components and the Reputation Service that appertain to Trust and Security. Detailed information of all components is given in [Trustcom Consortium, 2007].

- **VO Management Toolkit**. The responsible organization of this component is Systems, Applications, and Products (SAP), it is composed of three editions:
  - *Host*: provides member registration and VO monitoring. It shows the active VOs and the services required including the assigned, waiting for invitation answer and not assigned.
  - *Initiator*: is responsible for creating to managing a VO. It starts by giving a VO a name and an objective, defining collaboration (selection of available business process choreography from the Web Services Choreography Description Language (WSCDL) listed documents), access policies to each specified role, etc. It covers all changes defined in the VO life cycle.
  - *Member*: provides members administration. A member selects from a Service list those services agreeing to register. It also has a mailbox for sending/receiving messages like invitations.
- **Reputation Service**. As mentioned in 3.2.5.2, Gulati establishes that a good reputation makes an organization an attractive partner, this service allows to manage performance recognition in the VO. The responsible organization of this component is the University of Kent (UKent) [37]: it is a Web Service for maintaining the reputation of an entity. It was designed to support the following methods for service providers:
  - *initialization and drop*: a management service with two methods: initialize and drop. The former creates all needed tables and initializes them for the reputation service according to a given database schema. The latter removes all tables so that the initialize method can be called again.
  - *addActor*. To add an actor into the service. Each entity is identified by a unique string (an url for example)
  - *addActorExisting rate*: to give a reputation score. The score is between 0 and 1, where 0 represents the worst reputation (completely untrustworthy) and 1 denotes the best reputation (completely trustworthy). If an initial score is not given to a new entity, the initial reputation score is given (0.5 denoting a neutral reputation). A reputation-scoring equation is used to calculate the score.
  - *getReputation*: to get the reputation score.

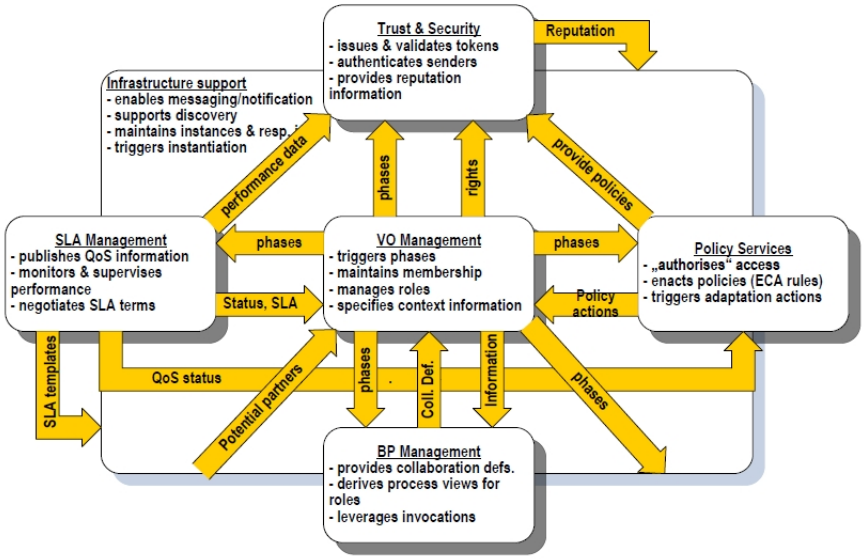

Figure 3.14: The TrustCoM framework [Trustcom Consortium, 2007]

3.4.3 SYNERGY project

Synergy research project (SYNERGY) [32] is a 3-year European-funded project which commenced in February 2008. It "researches the knowledge sharing and collaboration support needs of stakeholders working collaboratively within partnerships based on VO business models" [SYNERGY, 2008, SYNERGY, 2009].

SYNERGY offers an integrated platform composed of three major deliverables shown in Figure 3.15:

- **SYNERGY Portal** is the user interface that allows access to the collaboration platform (SYNERGY Services).
- **SYNERGY Services** delivers the following services for discovering, creating, managing and securing knowledge at individual organizations, collaboration and VOs levels:
  - *Collaborative moderator service (CMS)*: In charge of alerting about potential business opportunities, other partners with complementary or equivalent competencies, changes occurred in active projects and learning from past projects.
  - *Collaboration pattern service (CPats)*: Includes a collaboration pattern editor and assistant for finding and defining collaboration patterns. A list of available services and events is retrieved from a repository.
  - *Collaboration pattern editor (CPat Editor)*: Facilitates communication, secure information sharing and collaboration on the web. It helps to identify, search and evaluate collaboration patterns.
  - *Partner knowledge management service (PKMS)*: Manages (creates, maintains and stores) and supports the use of the Knowledge Data Bases where collabo-

rative experiences are stored under a controlled access. The knowledge repositories are defined based on three domain ontologies to represent SYNERGY's service vocabulary: Enterprise Knowledge (EK) Ontology, Collaboration Pool (CP) knowledge Ontology and Virtual Organization (VO) Knowledge Ontology.

- **Event Service Bus** is an integrated platform that allows communication with SYNERGY services.
  - *Complex event processing engine (CEP)*: Used for providing answers to complex queries for events where "events represent incidents or state changes of interest". It is composed of the operations like ordering, selection, consumption, detection of overlapping and derivation of events.
  - *Ad-Hoc Workflow engine (Ad-Hoc Wf)*: Orchestrates the execution of the collaboration pattern defined in CPats. The difference from traditional work flows (designed to carry out well-defined complex process) is that Ad-Hoc Wf allows changes on the fly (they are reorganized at run-time) which facilitates the implementation of CPats reuse.

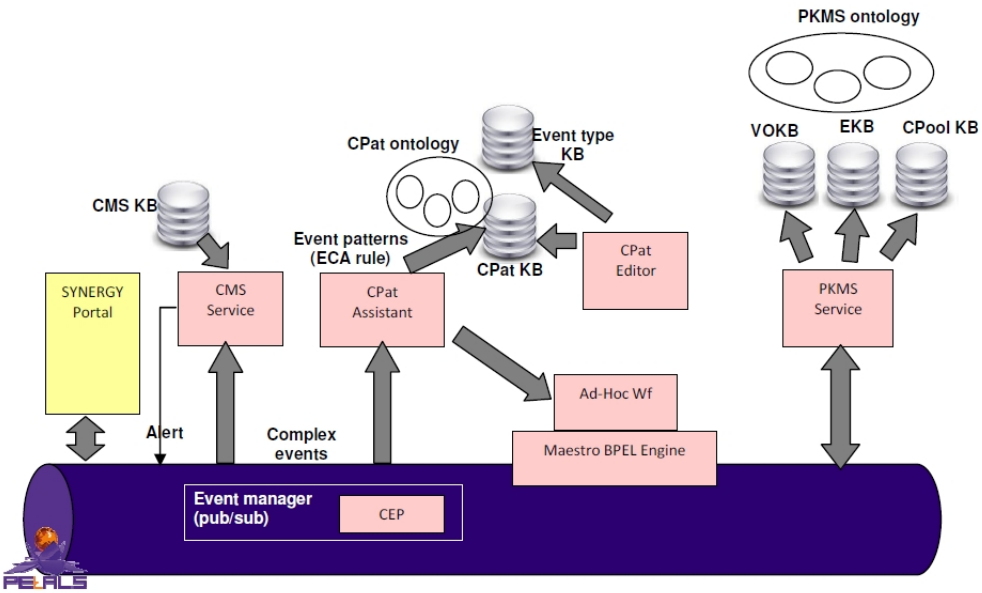

Figure 3.15: The SYNERGY conceptual architecture [SYNERGY, 2009]

3.4.4 VO technology platforms summary

Different technology platforms are developed or under development to support the VO life cycle or opportunity areas of the VO field. The three platforms described in the previous sections are compared in Table 3.3 based on three sets of criteria. The first group involves the platform's intended use stating the main concepts that foster the project and the organizations or people that are analyzed as VO members. The second set relates to the

creation phase of the VO life cycle (see Section 3.2.5.4) that includes the initiation and the foundation phases considered as two different phases in some platforms. For facilitating the comparison, four functionalities are proposed: Members administration (regarding the execution and supervision of all VO activities like creating a new member, defining the role to play in the VO, its resources ...), VO initiator (regarding the activities for creating a new VO), VO administration (regarding the activities for creating the collaboration among members) and VO service (regarding the activities for formalizing the VO: defining the work flows, the service level agreements ...). The third set involves software issues like development tools and maturity level of the platform.

The concepts that guide the platforms are varied: formalizing collaboration among partners using the Grid (BEinGRID); setting up contracts and service level agreements taking into account trust and security (TrustCoM); taking advantage of knowledge learning from VO and members past experiences (SYNERGY).

Most of the basic functionalities of the creation phase are covered by the three platforms. However, the platforms are innovative and complementary because they improve some of these functionalities and add a new concept to the VO analysis:

- **BEinGRID** takes advantage of the Grid to develop VO platforms.,
- **TrustCoM** adds the Application Service Providers as a new member of the VO who is in charge of providing the ICT infrastructure that is considered an important enabler as stated at the beginning of this section.,
- **SYNERGY**'s *PKMS* offers the possibility of increasing VO success by documenting, codifying and sharing knowledge and experience from the VO life cycle as stated by [Dyer et al., 2001, Kale et al., 2002] in Sub-Section 3.2.5.3. The *CMS* also improves functionalities by sending alerts to other members when a competency, capacity, resource or a business opportunity emerges.

A state-of-the-art VO concept has been presented in this chapter: first, investigating strategy and alliances concepts as sources of VO characterization; second, presenting some of the existing VO projects and their research work on this field and third, other ICT projects proposals regarding VOs. A comparison table is given to underline the similarities and differences of both types of projects (research work and tools). These approaches are mostly introduced in the business management domain. Other forms of organizations like the extended enterprise that "may consist of a central office, factories and branches as well as subsidiaries around the world" [Tonchia et al., 2004] relies on ICT to support the inter-organizational processes as well as the VO. Nevertheless, in the established network, a concrete extended enterprise enlarges its boundaries for establishing the needed relationships against a creation of a VO to function as a broker of its member organizations. Our goal is to propose a model based approach to assist VO's IS development. Consequently, we study which models and approaches are proposed in RE aiming VO IS elicitation. The next chapter presents a state-of-the-art of model based RE and its relation to VO.

Table 3.3: VO platforms comparison table

Criteria	Description	BEinGRID	TrustCoM	Synergy
Platform intended use				
What is the reasoning?	The main concepts that foster the project	Formalizing collaboration among partners using the GRID	Set up contracts and service level agreements with trust and security	Take advantage of knowledge learning from past experiences
To whom is addressed?	Organizations or people that are analyzed as VO members	General organizations	General organizations, Application Service Providers	Large corporations, SME, Social Networks, Freelancers
Functionality	**Tasks**			
Creation Phase				
Members administration	Handle members profile information Assign roles and policies Define Competencies, Capacities, Resources	Y Y Partially (-competencies)	Y Y Y	Y Y Y (+alerts)
VO initiator	Define VO objectives Establish VO duration	Y Y	Y Y	Y(+ a knowledge base) Y
VO administration	Define structure Define and assign roles Find, define, establish partnerships Provides security Exploit VO knowledge	N Y Y Y N	Y Y Y (+reputation service) Y N	N Y Y Y Y
VO service	Handle service information and search Support Workflows Handle business opportunities (BO) Supports service level agreements	Y N Y N	Y Y Y Y	Y Y(+on the fly) Y(+alerts potential BO) N
Criteria	**Description**			
Software				
User access	What are users access to the platform	Web service	GUI	Portal
Software platform	Software development tools	Windows Server 2003 and Windows XP Professional	Windows XP, Internet Explorer, Java	6Napsem, PEtALS ESB
Maturity level	Platform evaluation status	Tested in 25 business experiments. Moving to adoption by enterprises	Tested with Industrial scenarios on eLearning and collaborative engineering	Not tested. A pilot use case is under development

CHAPTER 4

Model based Requirement Engineering

Contents

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4.1 Introduction to Requirement Engineering

RE is considered a "young, multi-disciplinary field" [Hickey et al., 2006] that was recognized as a discipline at the beginning of the 1990's [Nuseibeh et al., 2000]. It implies concepts like: organization's objectives, real world problems, organization's people (stakeholders, domain experts, users, clients), information systems' people (requirement engineers, software designers, developers), information system creation (that has a behavior, that evolves), a process for defining the system requirements...

Several definitions have been proposed for Requirements Engineering:

- "RE is the branch of software engineering concerned with the real-world goals for functions of and constraints on software systems. It is also concerned with the relationship of these factors to precise specifications of software behavior, and to their evolution over time and across software families" [Zave, 1997].

- "RE is a distinct process in Software Engineering... because of the focus on real-world problems rather than on the implementation of its software-based solution and the variety of involved stakeholders ranging from domain experts and end-users to software engineers" [Dubois et al., 1998].

- "RE is a creative process in which stakeholders and designers work together to create ideas for new systems that are eventually expressed as requirements" [Maiden et al., 2006].

- "RE is about defining precisely the problem that the software is to solve (i.e., defining what the software is to do), whereas other Software Engineering activities are about defining and refining a proposed software solution" [Cheng et al., 2007].

The requirements engineer needs a guidance to the RE process, not only because there are many propositions available and they look for the easiest method but also because the process chosen has a direct influence in the quality of the software specifications [Humphrey, 1989, Rolland et al., 1994]. Also [Jalote, 1997] establishes that the RE process is not linear, it is iterative and parallel. At any moment, analysts might be forced to skip from one activity to another in no sequential order for enriching software specifications. In the following paragraphs three propositions for structuring the RE process are presented.

- The approach of [Nuseibeh et al., 2000] describes the RE process with the following activities:
  - **Eliciting**: to discover the problem that needs to be solved and to determine the boundaries of the system.
  - **Modeling and Analyzing**: to build an abstract description of what has to be taken into account and to be analyzed.
  - **Communicating**: to document requirements for assuring its comprehension, tracking, analysis, rewriting and validation.
  - **Agreeing**: to validate requirements though a precise description of what is demanded by the stakeholders.
  - **Evolving**: to manage requirements modifications linked to changes in the environments and new stakeholders demands.
- The approach of [van Lamsweerde, 2000] proposes the following activities:
  - **Domain analysis** of the existing system where the software is going to be built; to identify the main stakeholders, the general objectives, the problems, the opportunities and to assembly all the preliminary information.
  - **Elicitation** based on exploration of alternative models for the different options to attain the objectives. Identification of requirements, assumptions of model components and system boundary.
  - **Negotiation and agreement** of requirements and assumptions through evaluation; risk analysis and compromise acceptance among the different stakeholders.
  - **Specification** with a precise formulation of requirements and assumptions.
  - **Specification analysis** that verifies requirements completeness, inconsistencies, feasibility, adequateness.
  - **Documentation** of the decisions made during the process with an explanation of their rationale and assumptions.

  - **Evolution** or requirements modifications aiming adjustments to changes in the environment or new objectives to attain.

- In the approach of [Cheng et al., 2007], RE is decomposed in five tasks:
  - **Elicitation** involves the activities that let understand the objectives for developing the software system and that identify the requirements the system must satisfy.
  - **Modeling** consists in the specification of requirements with one or more models. The models provide a notation that helps abstract actors, relationships, behavior with a specific set of rules and vocabulary.
  - **Requirements Analysis** generally focuses on evaluating the quality of the requirements specified. It involves impact, risk, prioritization analysis among others.
  - **Validation and Verification** assure that the specified requirements fulfill stakeholders' needs.
  - **Requirements Management** includes activities dealing with evolution of requirements over time.

We can state that RE is a phase where requirement engineers iteratively define the prospect requirements until they identify customer's needs and translate them into requirements specifications that permit to set an agreement with stakeholders and to communicate with downstream developers.

4.2 Requirement Engineering Elicitation Techniques

In accordance with [BrooksJr, 1986, Mich et al., 2002, Cheng et al., 2007] requirement engineering is not only crucial for IS development but also difficult. Brooks says that "the hardest single part of building a software system is deciding precisely what to build"[BrooksJr, 1986]. Requirements generally are in a broader but less constraint problem space than the software given as solution [Cheng et al., 2007]. Analysts face ill defined situations and they have to consider many possibilities in order to limit the solution space taking into account the constraints imposed by the environment.

Requirement Elicitation is considered a decisive stage of RE [Mich et al., 2002, Cheng et al., 2007]. A classification of the techniques for requirement engineering elicitation is proposed by [Nuseibeh et al., 2000]:

- **Traditional**. They include well known and used data gathering techniques: from people and from existing information. Interviews (non structured, semi structured or structured, open or close) with different stakeholders, questionnaires or surveys to other actors for the former and organizational reports, process, standards for the latter. The problems faced are to define who should be interviewed or how to administer the questionnaire on one hand and to extract relevant organizational information. Most of the time, results are expressed in natural language, diagrams or notes. Sometimes these documents can list requirements for contractual purposes.

- **Group**. Because the divers points of view of different stakeholders arise, a structured, guided and controlled group session can be needed. They include brainstorming, Rapid Application Development (RAD)/Joint Application Development (JAD) workshops [Maiden, 1998], Group Support Systems (GSS) workshops [Liou et al., 1994] applied to RE [Herlea, 1999], creativity workshops for innovative solutions [Maiden et al., 2006]. The main objectives of these techniques include:
  - involving people of the organization from beginning to end of the development;
  - favoring collaboration between organization and IS teams, fixing resources and time;
  - defining and delivering software reduce versions.
- **Prototyping**. It is being used in RE since half of 1980's. It consists in developing a limited scale model used for testing and validating the system to be developed. This prototype aims that users can visualize the future system, have a better idea of what it would be obtained at the end and get feedback from it. The tools used go from low base technology diagrams or paper screens where users can place objects for preliminary studies to high level technology systems based on Computer Aided Software Engineering (CASE) or Fourth Generation Languages (4GL) (see University of Missouri-St.Louis (UMSL) [38]).
- **Cognitive**. These techniques are commonly used in knowledge base systems addressing knowledge acquisition problems. They aim to capture and validate domain expert knowledge. Generally, a knowledge engineer is the qualified IS expert to interpret the information given by knowledge experts. Among the techniques used, we can cite:
  - *Protocol Analysis* has its origins in Cognitive Psychology for studying thinking. It consists in demanding implicated people —in our case users or experts— to explain their thoughts while they execute the tasks known as "think aloud" (see Florida State University (FSU) website [12] for more information). This method was used in IS for software user testing [Henderson et al., 1995] consisting in identifying the important concepts of the project from the registered material.
  - *Text Analysis* helps early requirements elicitation by revealing properties in the text that facilitates key concepts identification for understanding problem domain [Sawyer et al., 2005].
  - *Modeling* is a representation of knowledge and its relationships using a set of symbols with specific rules. Knowledge models include (see website Epistemics Knowledge Models in PCPACK tool (Epistemics) [11] for more information):
    - *Laddering* supports knowledge hierarchy construction (tree diagrams are the most used). Concepts are categorized in classes, properties of these concepts correspond to classes attributes. Concepts like composition (that gives form to knowledge), decision (alternative paths of action), process

(task or activities with their respective sub tasks and sub-activities) can be represented. The hierarchy can be validated by other experts.

    * *Network diagrams* represent domain knowledge objects with nodes and arrows. Examples are concept maps (concepts are nodes and relationships are the links among them), process map (shows inputs, outputs, resources, roles and decisions associated to each process), state transition networks (states are represented by nodes and all the events and processes/tasks that can cause transitions from one state to another are represented by arrows).
    * *Frames* use a matrix representation for concepts (first line), attributes (left hand columns) and its values (right hand columns).
    * *Time line* uses a Cartesian plan where Y is the process and X is the time. They are useful for representing task or process through time.
    * *Matrix* is a Bidimentional matrix confronting Problems and Solutions or Task and Resources for example.
    * *Form* facilitates the creation of templates using hypertext and web pages for different knowledge types: for example a task template including name, description, input, output, goal, etc.

- **Contextual** aims to find activity patterns giving strong importance to the conditions where these techniques are applied. They can be classified in:

  – *Observation* is concerned with viewing what the expert or user does and taking notes while observing. It is useful when the process to study involves several participants or the behavioral sequence of operations are important to study [Paetsch et al., 2003].

  – *Teach back* where the knowledge engineer tells its findings to the expert with the objective of verifying the information gathered.

  – *Ethnomethodogy* was introduced by Harold Garfinkel [Garfinkel, 1967], a sociologist from the 1960's for studying the methods used by people who where doing something. The description of this method is linked to context and to its meaning. "It focuses on the participants and their interactions in a system rather than the data, its structure and its processing" [Sommerville et al., 1992].

  – *Conversational analysis* developed by Harvey Stacks in the 1960's, studies conversations with a "detailed inspection of recordings and its transcriptions" [ten Have, 2007]. It allows a deeper understanding of selected problematic aspects through details in ordinary conversation [Goguen et al., 1993, Goguen, 1994].

- **Model-driven**. They aim to "provide a specific model of the type of information to be gathered, and use this model to drive the elicitation process" [Nuseibeh et al., 2000]. Models in this phase can help emerge discussions among participants, examine stakeholders requirements and analyze the environment [Cheng et al., 2007]. The

model-driven techniques that have influenced our work are described in sections 4.3.2 and 4.3.3.

4.3 Model Driven Techniques

During the Elicitation process, analysts have to choose what technique to use according to the particular conditions of the project. In [Hickey et al., 2003] recommendations on when to use a particular technique are reported from the interviews of nine RE experts. Models were the most reliable: "more and more analysts are now seeing modeling as a means to (a) facilitate communication, (b) uncover missing information, (c) organize information gathered from other elicitation techniques, and (d) uncover inconsistencies".

We are focused on model driven techniques (models and approaches) that guide the elicitation process for exploring, eliciting and visualizing the information that define the requirements of different stakeholders, users, analysts, etc. for VOs.

4.3.1 A framework definition

The approaches analyzed in this section have requirements identification and modeling as a common objective. However, they offer various solutions for tackling this problem. In order to compare them, we have adapted the frameworks proposed by [Rolland et al., 1998b, Nuseibeh et al., 2000, Matulevičius et al., 2007] for analyzing the proposals in four dimensions: Characterization, Modeling, Methodology and Tools. This framework lets us answer the following questions (see Figure 4.1):

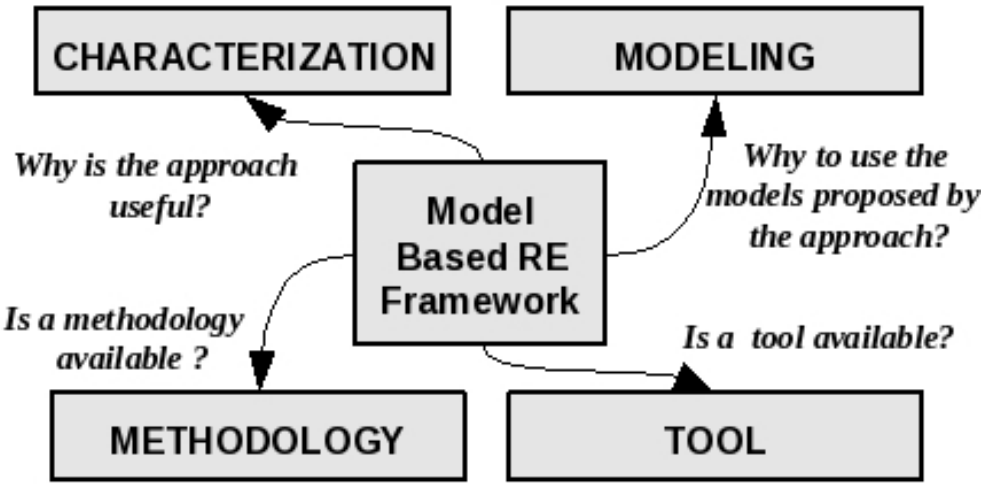

Figure 4.1: Reference Framework questions

- *Why is the approach useful? What are the elements of analysis offered?*
- *Why to use the models proposed by the approach? What are the fundamental concepts of the models?*

- *Is a methodology or tool available to guide and simplify the use of the models?*

The Ishikawa diagram of Figure 4.2 illustrates the proposed reference framework as well as its dimensions and sub-dimensions. The definitions of its elements are given below.

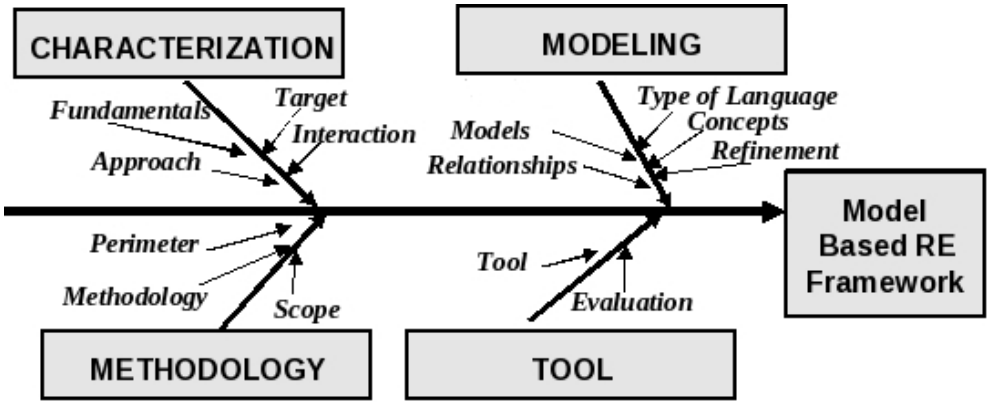

Figure 4.2: Reference Framework for model driven approaches of RE

- ***Characterization*** analyzes the fundamental concepts of the proposal. It is composed of four sub-dimensions:
  1. *Target* aims to answer what is described: the organization behavior, the organization itself, the problem domain, for example.
  2. *Fundamentals* or the base concepts that guide the reasoning: objective, service, value ...
  3. *Interactions* among concepts analyzed by the approach: intra, inter and extra organizational for example.
  4. *Approach* of analysis followed: decomposition, precision or top bottom.
- ***Methodology*** includes the guidance techniques like:
  1. The *Methodology* used for structuring and controlling the RE process.
  2. The *Scope* or the RE phases covered by the approach: Elicitation, Modeling, Requirements Analysis, Validation and Verification, Requirements Management [Cheng et al., 2007].
  3. *Perimeter* or context where the method has been tested. We take into account three possible values: proposed (not validated), evaluated (for example in industrial projects) or commercialized (used in enterprises) [Wieringa et al., 2006].
- ***Modeling*** analyzes concrete aspects linked to the proposed models, it consists of:
  1. The *Type of language* used to express the models. It can be natural language (informal), structured (semi-formal, like diagrams, forms) or formal (precisely describing the identified characteristics).

2. The proposed *Models*.
3. Models basic *Concepts*.
4. The *Relationships* that link models concepts.
5. *Refinement* describes the possibility of improving the concepts and/or relationships by deepening into them.

- ***Tool*** is formed by the set of software tools facilitating the design, creation, saving, manipulation of the different products used by the approach. It includes:

  1. The *Tool* developed for supporting the proposed models.
  2. *Evaluation* of the tools focusing on accomplishing the approach's objectives. We use the scale of values proposed by [Al-Subaie et al., 2006]: Fully, Strongly, Partially and Slightly.

In the following sections, six RE approaches are presented for comparing them with the reference framework defined in section 4.3.1. They are well known methods and have been the source of many publications [Nuseibeh et al., 2000, Cheng et al., 2007]. They have been tooled and most of them have evolved through time, what assures an improvement in their maturity and quality.

One of the major differences among these approaches is that instead of concentrating on what features the IS will support, they organize requirements based on other concepts: goals, scenario, value and service. Although these concepts are not new in other domains, their use introduces innovations in RE. The selected approaches are presented in two groups described in the following sections: the first group gathers goal based and the second, scenario, service and value based approaches.

4.3.2 Goal based approaches

Goal Oriented Requirements Engineering (GORE) is based "on the identification of system goals and the transformation of these goals into requirements" [Al-Subaie et al., 2006]. These methods are concerned with WHY a goal is relevant to the system ("is answered in terms of organizational objectives and their impact on information systems supporting the organization" [Rolland, 2007]), HOW the goal can be attained, WHO is the "owner" or "responsible" of the goal [van Lamsweerde, 2000].

The contribution of these methods is that they generate system requirements from goals what allows to manage intentionality. Among these methods we can cite Goal Based Requirements Analysis Method (GBRAM) [Antón et al., 1994], Non-Functional Requirements (NFR) [Mylopoulos et al., 1992], i* methodology (i*) [Yu, 1997] [16], Knowledge Acquisition in Automated Specification (KAOS) [van Lamsweerde et al., 1998] and Map [Rolland et al., 2000]. Following sub-sections present three of these methods in chronological order. It arouses attention that i* and KAOS are the most cited in RE literature.

4.3.2.1 i* [Yu, 1997]

i* was developed aiming "modeling and reasoning about organizational environments and their IS". Actors and their interactions are represented in two models:

- **Strategic Dependency** model describes the intentional components through goals to satisfy, resources to be available, tasks to execute, under the basis of a dependency network among actors (a depending actor or depender and an actor who is depended upon or dependee).
- **Strategic Rationale** model enriches the intentional components of the Strategic Dependency model specifying for example the inter-components relations, each actor's task decomposition, etc.

Figure 4.3 shows the meta model for i* using standard Unified Modeling Language (UML) notations. Firstly, in the Strategic Dependency model an actor seeks to attain an End Element that is a Goal (it could be a Hard or a Soft Goal), is also capable of doing a Task and has a dependee-depender relationship with other actors. Means Element can be Goal, Resource and Task. A Goal can contribute (positively or negatively) to the achievement of another Goal. Secondly, in the Strategic Rationale model an Actor, a Goal and a Task can be decomposed for refinement purposes.

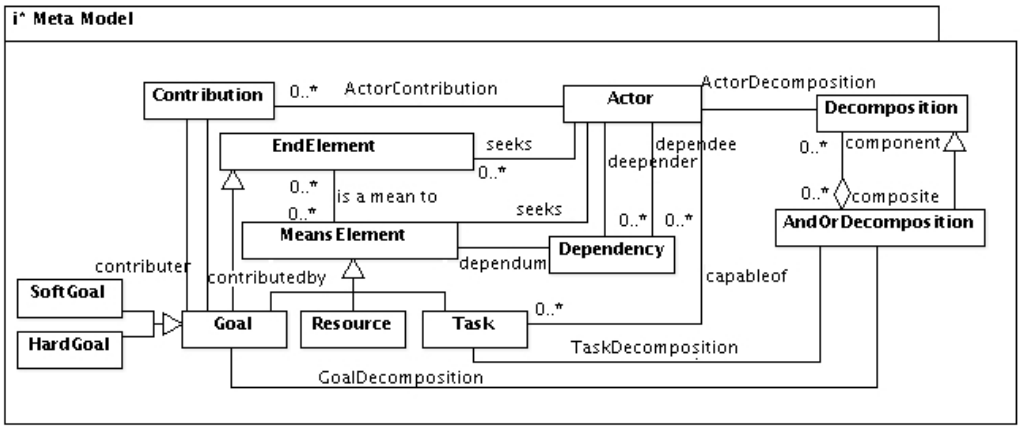

Figure 4.3: i* Meta Model adapted from [Maiden et al., 2007a, Susi et al., 2005]

i* uses a semi formal graphical notation that facilitates communication among the method users and the formal notations based on agent oriented languages like *Z state-based specification language* and *Formal Tropos Language* [Jureta et al., 2006, Fuxman et al., 2003].

Tropos project (Tropos) [34] has been applied to middle case studies and adds to i* a methodology composed of four phases [Giorgini et al., 2003]:

- **Early requirements** focus on stakeholders goals based on the Strategic Dependency model described above. It delivers the first model of an organizational environment

where main stakeholders (represented as actors), their goals, soft goals and the elements that create a dependency among them are presented.

- **Late requirements** focus on the means-ends to achieve goals and soft goals through the Strategic Rationale model which in turn is based on the Strategic Dependency model.

- **Architectural design** provides a model of the system structure describing how system components work. It is based in a Multi-Agent System (MAS).

- **Detailed Design** adds more detail to the components defined in the architectural design, agent communication and agent behavior specification based on agent communication languages.

In [17] there is a summary and comparison of twelve available tools for i*. The Tool for Agent Oriented Modeling (TAOM-Tool) [33] for example, offers to designers a visual representation of the models proposed by i* and an automatic generation of code BDI (Belief-Desire-Intention) [Penserini et al., 2007] through extensions like Tropos4AS [Morandini et al., 2008].

Figure 4.4 presents an example of i* Strategic Dependency Model based on UGRT case study where Stockbreeder, Associations, Slaughter-house, Marketing and Meat Buyers are represented by actors. The Stockbreeder wants "Profitable Sales" from Marketing. Because Marketing negotiates price, the Stockbreeder depends on Marketing to obtain this goal, therefore, "Profitable Sales" is modeled as a soft goal. The Stockbreeder attains the goal "Sell all Available Cattle" from Associations. Marketing has to "Report Post Sales" (a task) to the Stockbreeder and has to give a "Payment" (a resource) to the Stockbreeder for the cattle sold.

An instance of the Strategic Rational Model for Stockbreeder and Marketing actors is presented in Figure 4.5. In this model the soft goal ("Profitable Sale") and the task ("Report Post Sales") that are shown in the Dependency Model 4.4 are decomposed for the Stockbreeder actor. The resource "Payment" is linked to the "Finance Support" task for supporting "Cattle Vaccination, Cattle Feed and Control of Pasture" for example.

4.3.2.2 KAOS [van Lamsweerde et al., 1998]

KAOS aims to support the requirements elaboration process by "the acquisition of knowledge about the composite system that involves concepts that usually are not found in the final formal specification, such as goals to be achieved, agents to be involved and their responsibilities, etc. (composite system refers to the application to be automated and its environment)" [Dardenne et al., 1991].

KAOS meta-model is shown in Figure 4.6 based on standard UML notation for representing its main concepts and relationships. A Goal is a non operational objective to be achieved by the composite system. The Reduces relationship aims positive contribution goal refinement while the Conflicts relationship aims negative contribution goal refinement. A Goal can be a SystemGoal (an application-specific goal that must be achieved by the

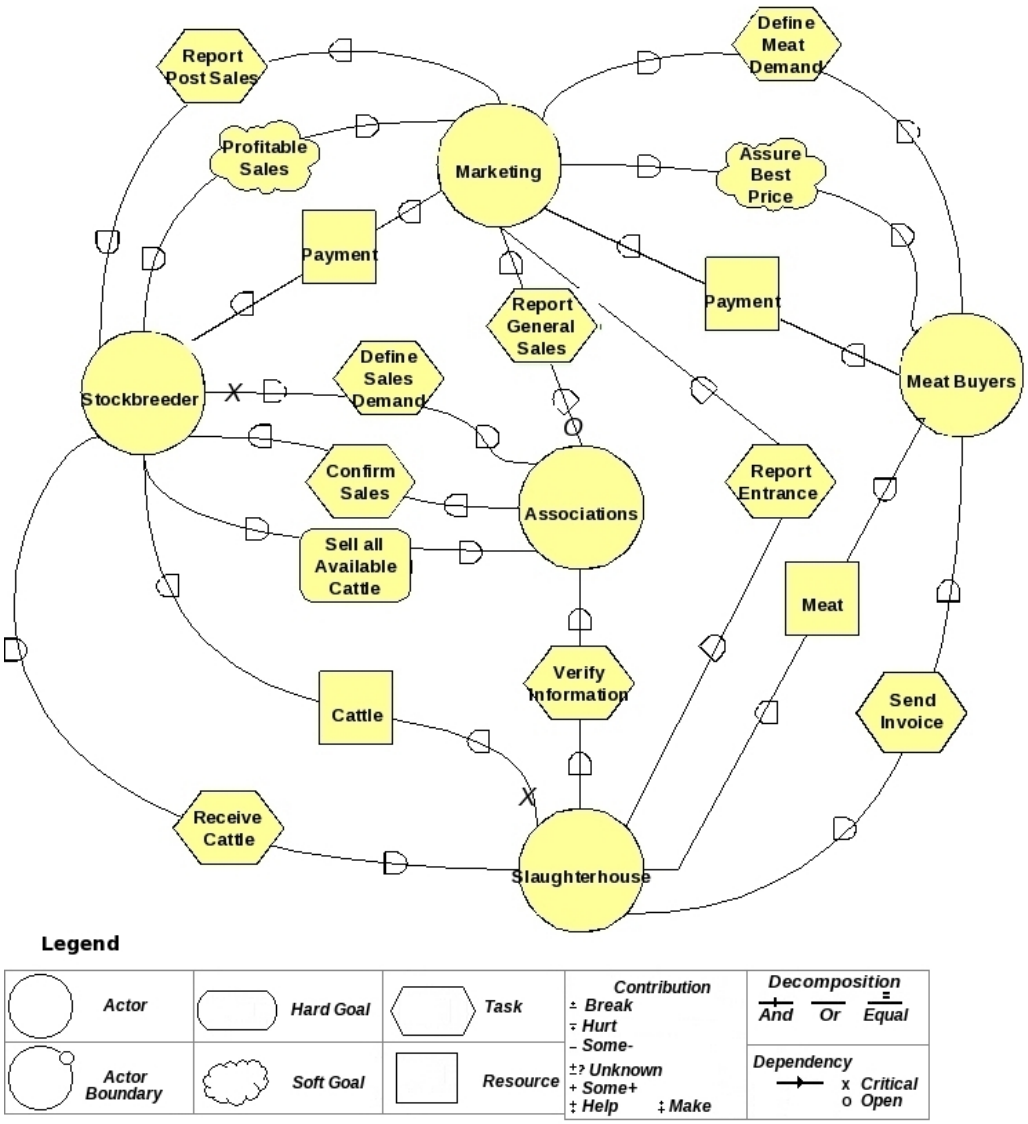

Figure 4.4: i* Strategic Dependency Model example based on the UGRT case study

composite system) or a PrivateGoal (an agent-specific goal that can be achieved by the composite system). Goals are linked to Agents by the Responsible and Wish relationships. An Agent (a processor for some actions that have choice on their behavior, e.g. a human being) is a specific type or Object, other Objects are Event (an instantaneous object that happens at the instance level, e.g. send a remainder to a borrower) and Entity (autonomous object which instances can exist independently from other object instances, e.g. a book). An Object ensures one or many Requirements. An Operation (actions related to objects which applications define state transitions) is linked to Object through Output/Input relationship. An Agent must be capable (Capability relationship) of performing (Performs relationship) an Operation.

KAOS is composed of the following elements:

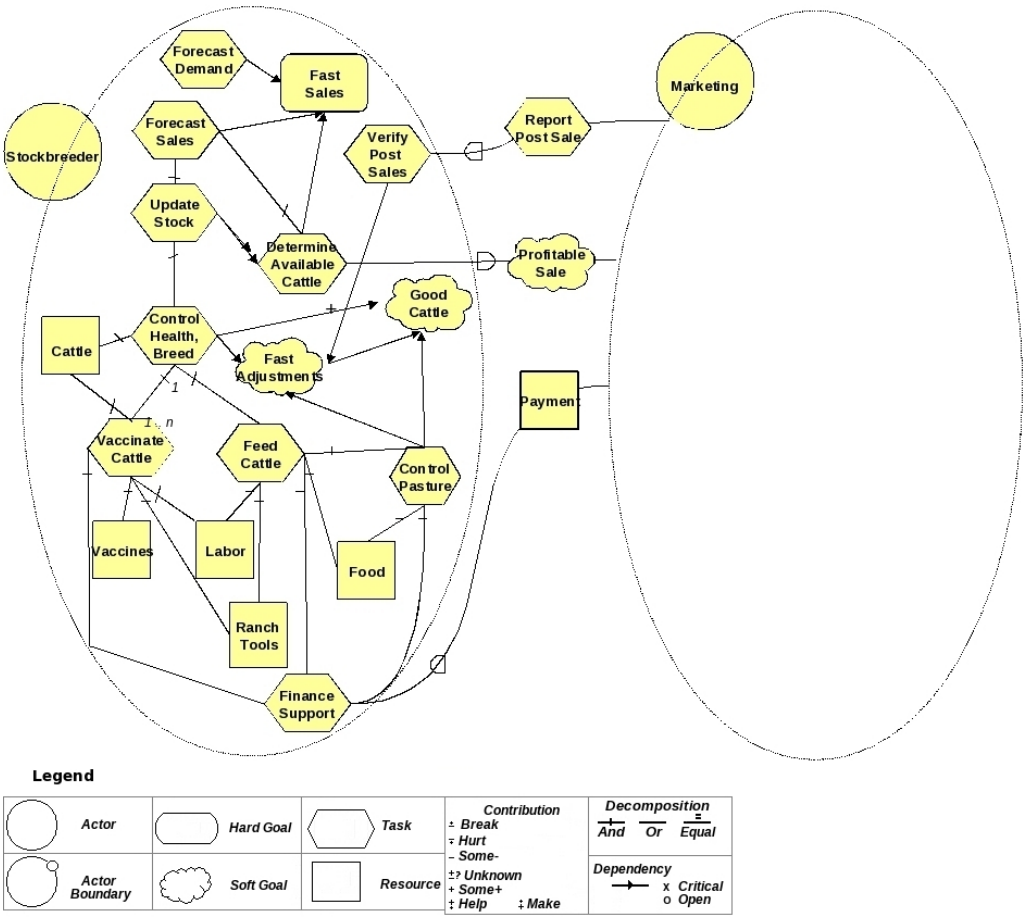

Figure 4.5: i* Strategic Rationale Model example based on the UGRT case study

- **A Specification Language** based on an ontology (which the main classes are Object, Operation, Agent, Goal, Requisite, Requirement, Assumption and Scenario) and on language constructs (for declaring and formally defining a concept). The language covers divers paradigms like semantic nets for knowledge representation and automatic reasoning methods for requirement specification.

- **A Method** for requirements elaboration starting by high level Goal identification, its precise definition and the assessment of a positive/negative contribution to the goal through a refinement process until all requisites can be assigned, followed by the identification of the Objects involved and Operations to apply for Goal achievement. The Operationalization represents the pre and post conditions on objects for assuring that all requisites are met. And finally, the Responsibility assigns operations to agents and helps define the boundary of the system.

- **A Meta Level Knowledge** offers a taxonomy associated to heuristic rules that facilitates Goal, Objects and Operation specification, guidance and selection of alternatives. This knowledge is domain independent and is used to guide and validate the

elaboration process.

KAOS language is supported by the Objectiver tool (Objectiver) [24] that has been used in many industrial projects. Objectiver allows to model, reuse fragment models, visualize, navigate and validate the proposed KAOS models as well as to create and publish reports (see [Al-Subaie et al., 2006] evaluation for more information).

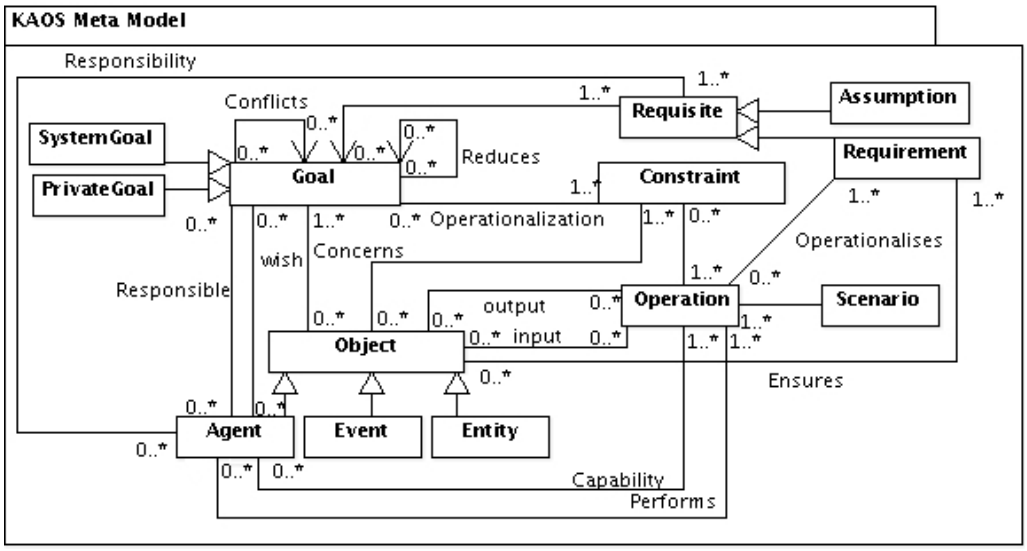

Figure 4.6: KAOS Meta Model adapted from [Dardenne et al., 1993, Heaven et al., 2004]

Figure 4.7 presents an example of KAOS Goal Model based on UGRT case study. Stockbreeder and Marketing (Agents) wish to “Increment economic revenue”. This expectation is decomposed in several sub-goals and sub-expectations which Stockbreeder and Marketing (Agents) are responsible. The Expectations “Improve cattle breeding” and “Profitable sales” are conflict goals because the former needs money investments that affect the later.

4.3.2.3 Map [Rolland et al., 2000]

Map “is a representation system that was originally developed to represent a process model expressed in intentional terms” [Rolland, 2007]. Map expresses user requirements by two concepts: intentions or goals that represent the objectives to achieve and the strategies or ways to achieve a goal. Each Map model has two particular intentions: Start and Stop for starting and finishing Map execution. This model offers a refinement mechanism for different detail levels. Figure 4.8 shows the Map UML meta-model with the key concepts and their relationships.

A *Map* can be composed of several sections which can be *source* and *target* intentions connected by a *strategy*. An *intention* is composed of a Verb, a Target and Parameters where the later is formed by facultative and/or repetitive elements proposed by [Prat, 1997]. For example, the verb “remain” is facultative followed by “quality” and optionally followed by

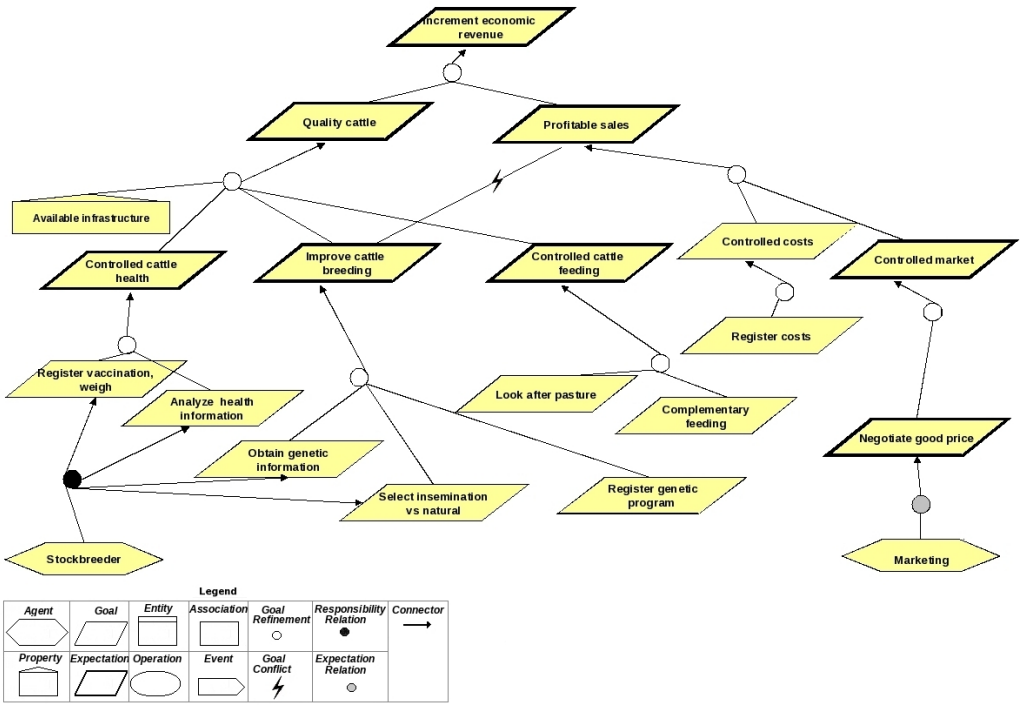

Figure 4.7: KAOS Goal Model example based on the UGRT case study

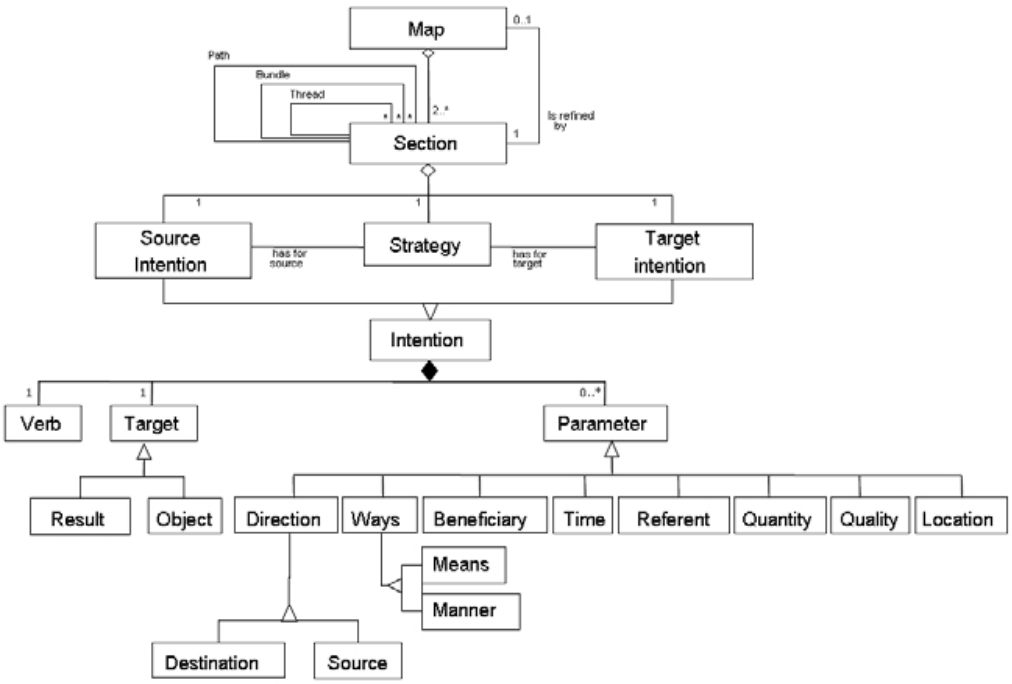

Figure 4.8: Map Meta Model [Rolland, 2007]

"referent, location and time". A *strategy* "is an approach, a manner or a means to achieve an intention" [Rolland, 2007] A *section* is a triplet (source intention, target intention, strategy). A section expresses the achievement of a target intention using a strategy that can be carried out when the source intention is executed.

Figure 4.9 shows an example of a Map based on the UGRT case study: (Start, Improve cattle breeding, by cattle insemination) is a section where "Start" and "Improve cattle breeding" are the source and target intentions and "by cattle insemination" is the strategy.

Relationships between sections are exemplify in Figure 4.9 using the Map model and they could be:

- *thread* or OR relationship: exists when a target intention can be attained by several ways from the same source intention, each way forming a section: (Start, by cattle insemination, Improve cattle breeding), (Start, by cattle health, Improve cattle breeding) and (Start, by cattle feeding, Improve cattle breeding) from our example.

- *path*: is the precedence/succession relationship between sections: from our example, (Start, by cattle insemination, Improve cattle breeding) and (Improve cattle breeding, by quality cattle, Get profitable sales) is a path.

- *bundle*: is an exclusive OR relationship when only one of the sections can be used for achieving the target intention (in a thread several sections can be used). For example, either section (Get profitable sales, by price margin, Stop) or section (Get profitable sales, by volume, Stop) can be used, but not both.

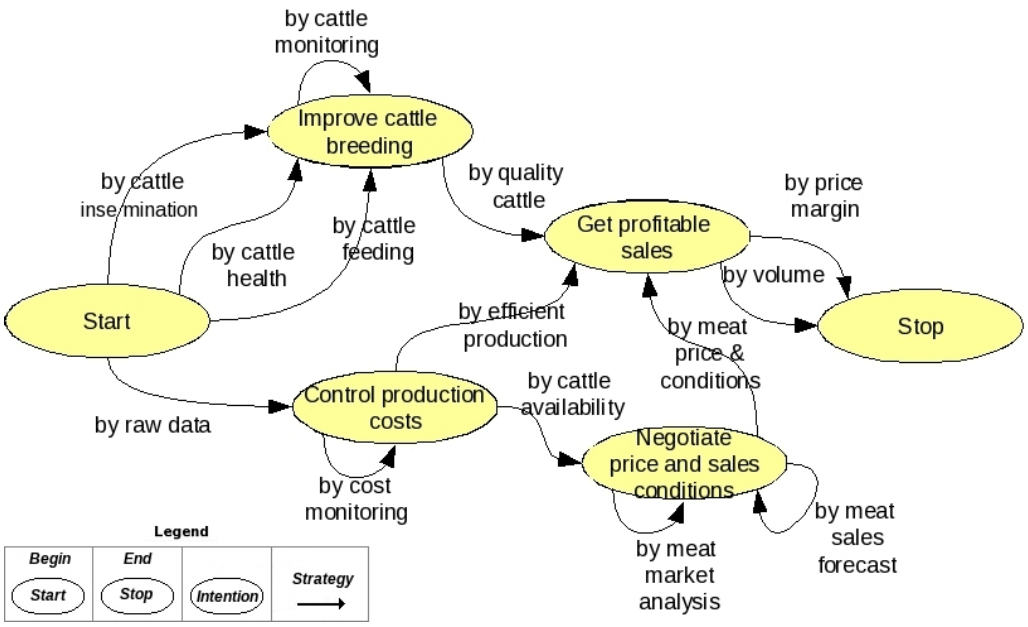

Figure 4.9: Map Model example based on the UGRT case study

From the tools point of view, the development of a "Map editor" is pointed out in Centre de Recherche en Informatique (CRI) [6]. It aims to "adapt a guided approach for user

requirements" by modeling, formalizing objectives and allowing personalized search. For the time being, the tool is available for academic use only.

4.3.3 Scenario, Service, Value based approaches

Other approaches are based on the identification of systems with scenarios, services and values to guide their transformation into requirements. This section groups these three model approaches as influence to RE and as source of insights for VO RE.

4.3.3.1 Scenario based: CREWS [Maiden, 1998]

A Scenario is a description of the world, in a context and for a purpose, focusing on task interaction. It is intended as means of communication among stakeholders, and to constrain requirements engineering from one or more viewpoints (usually not complete, not consistent, and not formal)[Jarke et al., 1998b]. Scenarios help to clarify requirements through examples of the usage of the existent or future system [Rolland et al., 1998a]. They are generally described in natural language nevertheless, Maiden [Maiden et al., 2007b] has proposed the use of graphical symbols and multimedia (video, text, sound and images) for enriching the description.

Scenarios have given rise to research interest, like in [Jarke et al., 1998a] where a compilation covers scenario capturing, management, formal and informal representation, coupling with other RE methods like prototyping and Human Computer Interaction (HCI) among others. In [Rolland et al., 1998a] a survey of research works is presented. Furthermore, the use of scenarios has evolved to current areas of interest, like in [Haynes et al., 2004] where it is proposed the use of scenario base techniques for evaluating collaborative systems and in [Liang et al., 2006] where approaches for transforming scenario-based models to state-based models are compared.

Originated from the ESPRIT research project and supported by the European Union in 1998, Cooperative Requirements Engineering With Scenarios (CREWS) is based on scenarios where requirements are mainly those of the system user [Jarke et al., 1998a]. The main concepts are *actor* that represents the user role in the system and *use case* that describes the sequence of actions that the system must accomplish with events that start and end, agents that are involved and objects that are used. Templates are provided for describing the scenario in natural language. Scenarios are widely used and accepted due to few restrictions in natural language expression that today is assisted by technologies for natural language processing (NLP) [Mich et al., 2002].

The CREWS-SAVRE tool helps the semi-automatic generation of scenarios from a normal course use case (actions) where requirements can be identified. Alternative courses of scenarios (events) for this use case are generated for exploring more scenarios.

The Analyzing Requirements Trade-offs: Scenario Evaluations (ARTScene) [Maiden et al., 2007b] proposes the use of multimedia (video, text, sound and images) in mobile devices (Personal Digital Assistants (PDAs), smart phones and wireless technology) for eliciting requirements in the stakeholders workplace.

Figure 4.10 shows the scenario UML metamodel. A *scenario* is described by one or many actions and is characterized by an *initial state* that defines a precondition for the scenario to be triggered and a *final state* that defines the state reached at the end of the scenario. Two types of scenarios can be conceived: *normal* and *exceptional*. The former guides to the final state and the latter to a state considered as a failure.

Actions can be *atomic* and *flow of actions*. Atomic actions are interactions from one agent to another affecting an object. An *object* could be an *agent* or a *resource* that can participate in different interactions. Flow of actions is composed of many actions and helps to define the interaction sequencing.

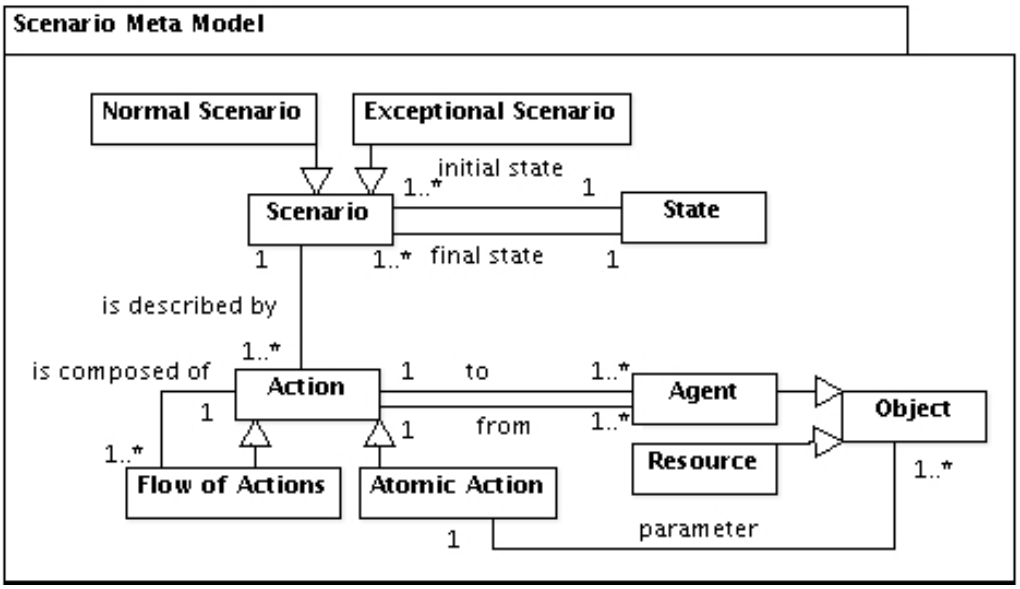

Figure 4.10: Scenario Meta Model [Rolland et al., 1998b]

Figure 4.11 shows an example of the Scenario Model based on UGRT case study. The Scenario "Sell available cattle to Stockbreeders Associations" from the Stockbreeder (Agent) is described by 6 actions to be performed.

4.3.3.2 Service based: Service Value Networks [Basole et al., 2008]

Service Value Networks (SVN) approach represents the organizations' activities in a holistic way for helping decision makers understand their position in the network. The model allows to visualize the service ecosystems as a value network giving the same meaning to products and services. In [Basole et al., 2008] the representation base is the same as the ones used in most social networks [Freeman, 2000]: circles represent actors and lines represent the connections among actors.

The SVN model adds the concept of *service* to provide and specify the connections according to *organizations* that have a *role in the service*. The possible roles in the network are: enablers (auxiliary, tier 2 and tier 1), service provider and consumer. The relations among organizations can be: auxiliary, principal and bilateral. In [Basole et al., 2008], En-

Scenario 1	Sell available cattle to Stockbreeders Association

Action
1. Stockbreeder prepares the list of available cattle to the Stockbreeders Association
2. Stockbreeder sends the list to the Local Association
3. Stockbreeders Association verifies cattle demand to Stockbreeder
4. Stockbreeders Association proposes date and time for shipment
5. Stockbreeder confirms cattle, date, time and place for shipment
6. Stockbreeders Association registers shipment

Scenario 1.2	Stockbreeder prepares the list of available cattle to the Stockbreeders Association

Action
1. Stockbreeder updates cattle stock of the ranch: quantity, type of animal (calf, veal, heifers, steers, cow, bull), weight, age and breed
2. Stockbreeder updates Slaughterhouse cattle reception parameters
3. Stockbreeder sorts out the list based on its cattle stock and Slaughterhouse parameters

Figure 4.11: Scenario Model example based on the UGRT case study

ablers “help create, design, initiate and deploy the service” as: Auxiliary enablers “are essential to the network, but not specific to one industry” like financial institutions, infrastructure providers; Tier 2 enablers “provide goods and services to Tier 1 enablers” like material suppliers; Tier 1 enablers “provide direct goods and services to the service provider” like producers, manufacturers. Service provider is the “primary contact point for a consumer” and a Consumer purchases the final product or uses the service. An organization can provide several services. Unfortunately, this approach does not have a UML meta model for describing its structure.

Figure 4.12 presents an example of the “SVN for the Meat Market”. Transport and Associations are Auxiliary Enablers to Stockbreeders and Slaughterhouse which are Tier 2 Enablers. Marketing is a Tier 1 Enabler to Supermarket Chains which are Consumer Providers.

A factor limiting SVN model is that only visualizes a service ecosystem. Accordingly, the approach only justifies ICTs roles for linking and coordinating the activities among actors. As a result of this, no method for eliciting IS requirements is given non a tool is available except for visualizing a complex network [Basole, 2008].

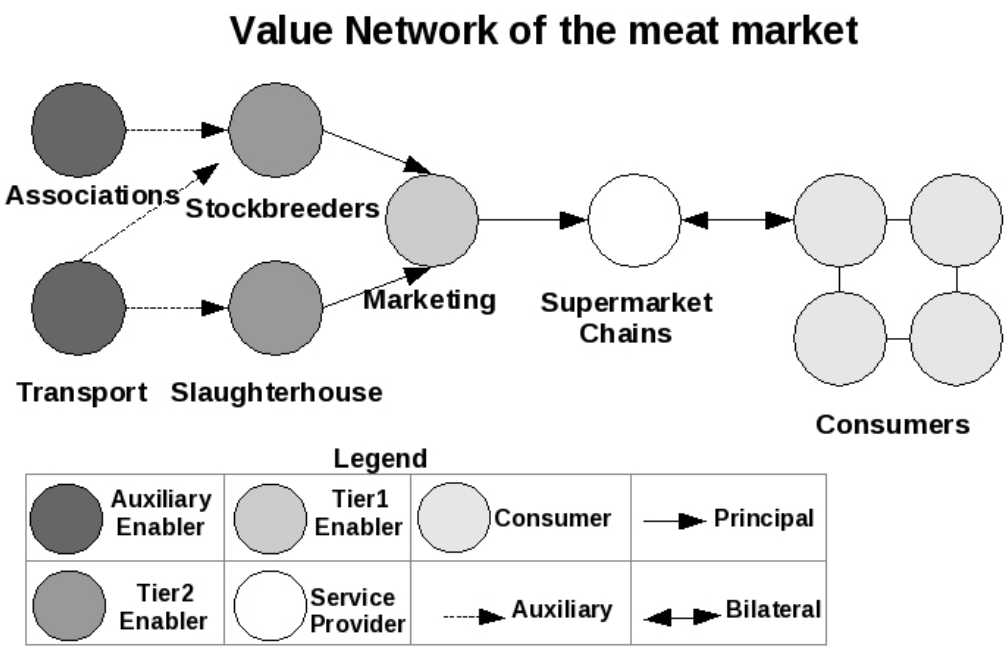

Figure 4.12: SVN Model example based on the UGRT case study

4.3.3.3 Value based: e^3 value [Gordijn, 2002]

As mentioned in Chapter 3, value creation is considered an important strategic driver. The objective of e^{3}value methodology (e^{3}value) [9] is to identify the reciprocal economic value exchanges among ISs actors in the electronic commerce domain. The model basic concepts are *actors* (economic independent entities), *market segment* (breaks the market formed by actors that share common properties), *value objects* (services, products or experiences that have value for at least one actor), *value ports* (means for demanding a service), *value interfaces* (in and out actor ports for offering or receiving a value object), *value activities* (activities that generate a benefit or increment the economic value of the actor that performs them) and *value transfers* (used to connect two value ports representing the potential resource commerce).

e^{3}value has been used in various domain as banking and energy supply. The authors claim that e^{3}value helps to explore innovative ideas for e-business allowing to forecast the revenue of the enterprises and the actors involved. The graphic design is guided by e^{3}value model assigning business rules and analyzing the strengths and weaknesses. Extensions like e^{3}control, e^{3}strategy, e^{3}boardroom, e^{3}service and e^{3}alignment have been added to complete the method.

Figure 4.13 shows e^{3}value meta model. An *actor* is composed of *composite actors* that group one or more *value interface* and *elementary* actors that can perform one or more *value activity*. A *market segment* consists of actors with common properties. Actors have one or many *value interface* to receive or give one or many *value objects*.

Figure 4.14 shows a value exchange graph for the UGRT case study. There is a set of Stockbreeders that exchange value objects with the Slaughterhouse, Marketing and a set of

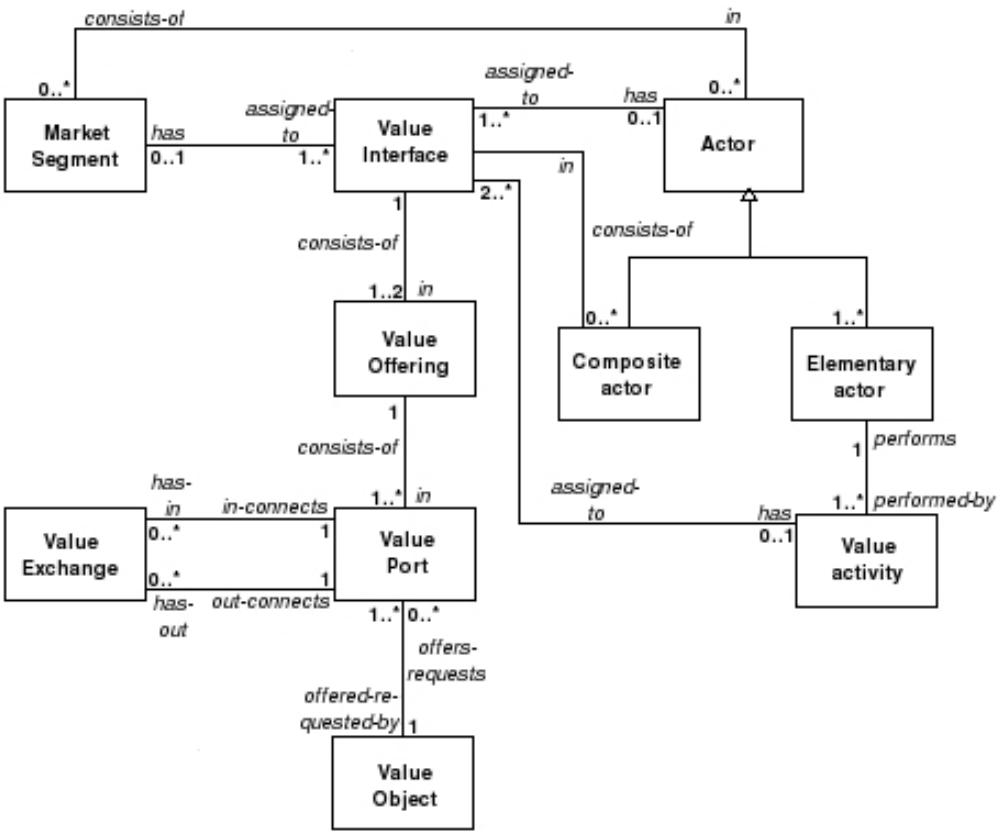

Figure 4.13: e^3 value Meta Model [Gordijn et al., 2003]

Associations. Marketing exchanges value objects with a set of Supermarket chains. Value exchange is depicted by an arrow. A Marketing service is exchanged between Marketing and the Stockbreeder and a Marketing fee between the Stockbreeder and Marketing, in turn, Tier services and Tier fees.

4.3.4 Model based approaches: a comparative analysis

Table 4.1 draws up a comparative analysis of the six approaches presented in previous sections according to the reference framework described in 4.3.1, especially GORE and scenario techniques have been successfully used in RE. All these approaches refer to the RE elicitation problem guided by goals, scenarios, services or values. They use different models based on divers concepts like dependency, intention, value generation or service provision. All the approaches support actors interactions, but certain only consider internal interactions or with the environment. Finally, some approaches propose methods and tools to facilitate the different phases of RE process. Some methods and tools are used in the industrial context like KAOS and e^{3}value.

Most of the studied approaches propose relevant concepts for VOs. We can observe in particular the dependency among actors of i*, the top-down approach for goal identifi-

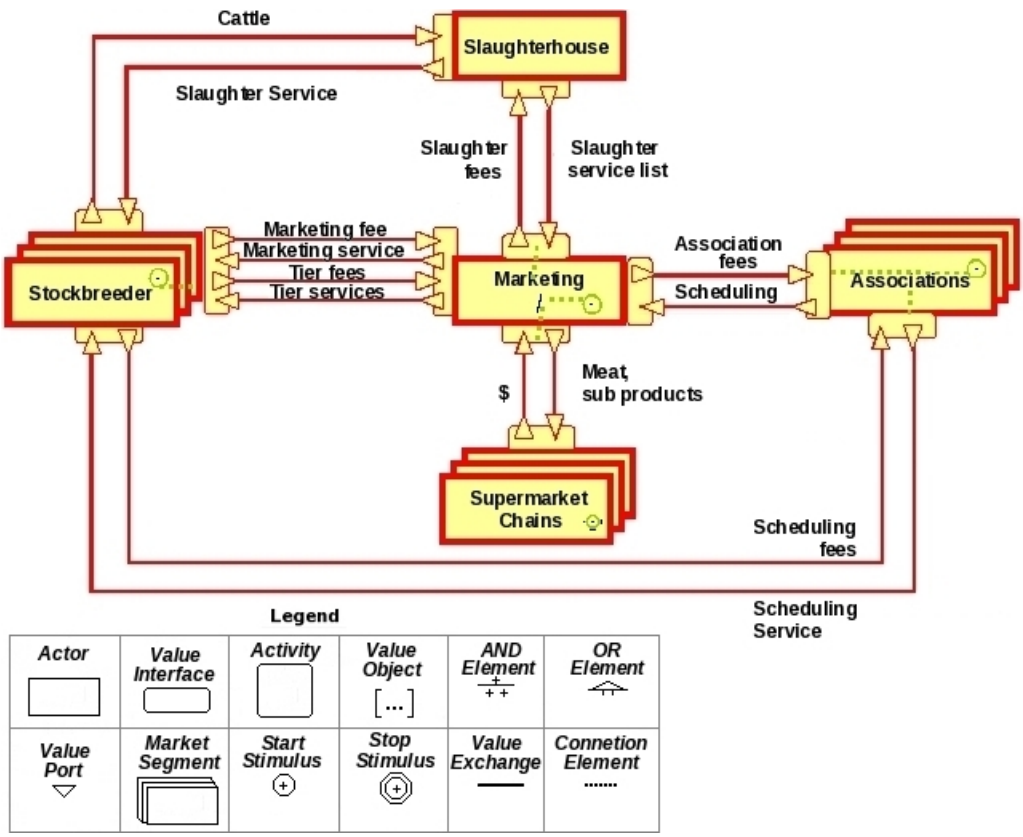

Figure 4.14: e^3 value Model example based on the UGRT case study

cation of KAOS, the market segment of e^{3}value and the role typology proposed by SVN. Our proposition presented in the next chapter, integrates these different concepts and approaches.

Many research work have highlighted the properties that characterize a virtual organization. Some of these approaches are interested in collaborative aspects (see [Kanter, 1994, Robinson et al., 2005] in Section 3.2.5), others emphasize business processes ([Cheng et al., 2005, Barnett et al., 1994]), or identify the common benefits [Marshal et al., 1999], or the physical dispersion [Tripathy et al., 2007]. Specific works dedicated to small and medium-size companies, offer methods (Section 3.3) and technology platforms (Section 3.4) supporting collaboration among these companies. Several modeling languages dedicated to RE have been proposed to represent organizations (Chapter 4): i* [Yu, 1997], KAOS [van Lamsweerde et al., 1998], CREWS [Maiden, 1998], MAP [Rolland et al., 2000], e^{3}value [Gordijn, 2002], SVN [Basole et al., 2008]. The SoS approach to RE of [Lewis et al., 2009] offers the view of independent systems working together but not forming a VO (see Subsection 3.2.4.3). They are in general RE models not originally conceived for VO, wherefore they partially cover the different levels of analysis in order to state all stakeholders expectations: the alliance creation to share competencies and offer a service, the intra, inter and extra organizational relationships, the common goal as well

Table 4.1: Comparative analysis of six model based approaches

	i* cadre (Yu, 1997)	**KAOS** (Lamsweerde *et al.*, 1998)	**CREWS** (Maiden, 1998)	**MAP** (Rolland *et al.*, 2000)	**e^3value** (Gordijn,2002)	**Service Value Network** (Basole *et al.*,2008)
Characterize						
Target	Organization	Domain	Comportment	Domain	Domain	Domain
Fundamentals	Goal	Goal	Scenario	Goal	Service	Service
Interaction	Intra, Inter	Intra, Inter	Intra, Inter	Intra, Inter	Inter, Extra	Inter, Extra
Approach	Top-down	Top-down	Top-down	Top-down	Top-down	Top
Modeling						
Type of Language	Semi-formal, Formal (Jureta et al., 2006)	Semi-Formal, Formal	Informal, Semi-Formal	Semi-Formal	Semi-Formal Formal (Weigand 2009)	Informal
Models	Dependency, Rationale	Responsibility[M1] Object[M2],Operational[M3]	Scenario use	Intention	Value generation	Service provision
Concepts	Actor, Goal, Soft Goal, Resource, Task	[M1]Goal, Soft goal, Agent [M2]Object, Association [M3]Function, Event	Actor, Use case	But, Strategy	Actor, Market Segment, Activity, Stimulus, Exchange, Interface,Connection	Actor, Service, Service role
Relations	Dependency, Contri-bution, Decomposition	Refinement, Conflict Relation, Connector	Non	Strategy	Exchange,Connectio n	Auxiliary, Principal, Bilateral
Refinement	Yes	Yes	Yes	Yes	Non	Non
Methodology						
Methodology	Tropos	Kaos	Crews	Heuristics based	e^3 value	Non
Scope	Elicitation, Modeling and Requirement Analysis	All	Elicitation, Modeling and Requirement admin.	Elicitation and Modeling	Elicitation and Modeling	Non
Perimeter	Evaluated	Industrial	Evaluated	Evaluated	Industrial	Proposed
Tool						
Tool	TAOM-Tool	Objectiver	Crews-Savre	Map editor	e^3 value tool set	No
Evaluation	Strongly	Fully	Slightly	Slightly	Partially	Not concerned

as the individual goals. Therefore, the motivation of this research work is to organize VO requirements around concepts that offer a model based RE methodology devoted to VO, which is detailed in the next chapters.

CHAPTER 5

A 360˚ vision for VO: general framework

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5.1 Introduction

We have defined a VO as an alliance among independent companies (Section 3.1). We have also stated that ICT generates opportunities and challenges for new forms of organizations and that RE is a crucial and difficult stage of the information system development cycle.

5.2 VO characteristics

If a VO is formed by *"several independent real companies"*[Priego-Roche et al., 2009a] it is unquestioned the analysis of at least two groups of characteristics covering the organization entity. The first group is related to each organization forming the VO (*individual*) and the second group is related to the set of organizations forming the VO (*collective*) as shown in 5.1.

- **Individual**. Each organization has its own *administrative structure* that does not change with the alliance and guarantees the organization independence. It has *inner objectives* that motivate it to explore the alliance. Despite working in the same industrial domain (automobile, agroindustrial, etc.) each organization has different *specializations, competences and business processes*. As regards to their location, they might be *geographically dispersed*.

- **Collective**. The set of organizations has a *commitment* for working together. They define the *objectives* to be achieved, the direction towards their efforts will be targeted. They agree to *share* their specializations, competences and business processes, so they have to *integrate* them to the new organization. Alliance *duration* is established by a time period or objective achievement basis. *Boundaries* that approach or recede organizations are dynamic and flexible depending on the arisen situations.

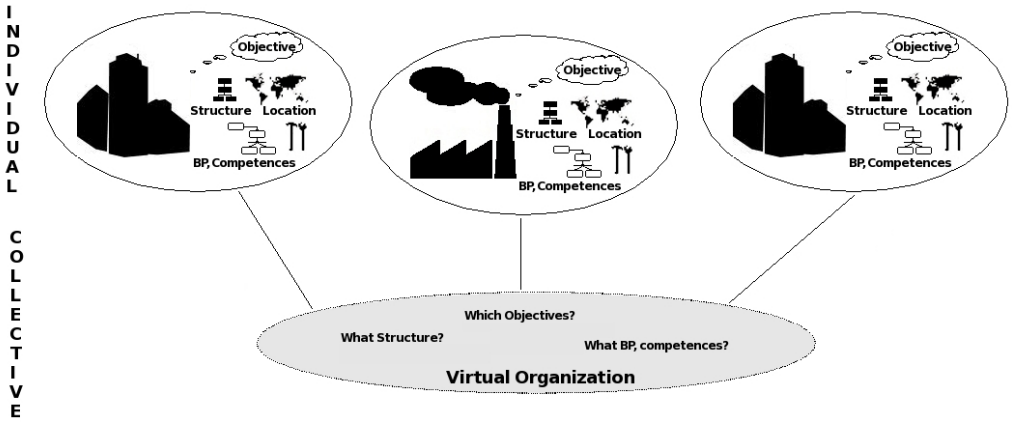

Figure 5.1: Individual vs Collective characteristics

These concepts emerge from the organization itself or from the VO formation. However, they have different impact or behavior inside the organization and in the relationships with other organizations. A resume of these concepts is shown in Table 5.1, we can observe that *Individual* concepts have a greater certainty than *Collective* ones because they are usually known or already exist. On the contrary, the challenge is defining them for the non existing VO. The governing structure has to be defined, objectives have to be assented by all organizations forming the VO, different resources have to be made available to the VO, they have to be connected for surpassing location challenges, a clear duration cycle has to be defined. Even if the individual concepts exist or are defined, another challenge is to make them coexist with the new organization whether by creating, adapting or using them.

Several authors agree that the identification of requirements is difficult for a “traditional” organization [Kotonya et al., 1998, Cheng et al., 2007]. Among the factors that obstruct this task for an organization we can list:

- **Individuals** involved have different vocabularies, backgrounds and cultures which can lead to misunderstanding or misinterpretation of requirements. Firstly, concepts and terms have different meaning to people, one challenge is to set up a common language that the group of individuals or stakeholders (shareholder, user, customer, external authority, project manager, business analyst) can use and understand. Secondly, the description of what the system should do, its behavior, the constraints, the outputs has to be clear: what people say is not always what they really mean. Thirdly,

Table 5.1: Individual vs Collective concepts

Concept	Individual	Collective
administrative structure	exists	to be defined
objectives	exist	to be assented
specializations, competences and business processes	exist, to be developed or adapted	to be integrated
location	might be geographically dispersed	to be defined
duration	unlimited	to be defined
boundary	known	to be defined

each person has his/her own experience, training and knowledge that influence problems conception. And finally, the set of different patterns involving beliefs, values and practices leads to verify if the proposed solutions fit in people's values and behaviors. Undoubtedly, people have different views of what the system should do for them, therefore it originates a wide source of requirements [Hsieh, 2006].

- **Environment** is always changing, accordingly, the organization and its ISs have to adapt to new demands from government and Regulator Organization (imposing laws, rules), clients (changing behavior, needs, capabilities), technology (better protocols, new language, platforms). RE has to support IS flexibility to react opportunely to environmental change.

- **Context** generates many user situations where the system will operate. The situational information that is relevant to the application and its users has to be educed. It includes individuals as well as the organization. Individuals information involves location (where you are), identity (who you are with and what objects are around you), activity (what is happening in the situation) and time (when you are using it) [Dey et al., 2000]. Organizational information is linked to the domain where the organization is embedded (health, bank, etc.)

Figure 5.2 shows two worlds to be linked and the RE challenge to be solved. On one hand, the traditional organization world is in a larger and open space from which the specification of what to implement has to be given. On the other hand, the IS world is in a more constraint space where only one technical specification of the system is implemented. Consequently, a precise abstraction of what ISs to build has to be elicited with the guide of RE.

IF RE is usually a complex task for a "traditional" organization, such task requires more effort for a VO due to the large number of organizations involved while keeping their strate-

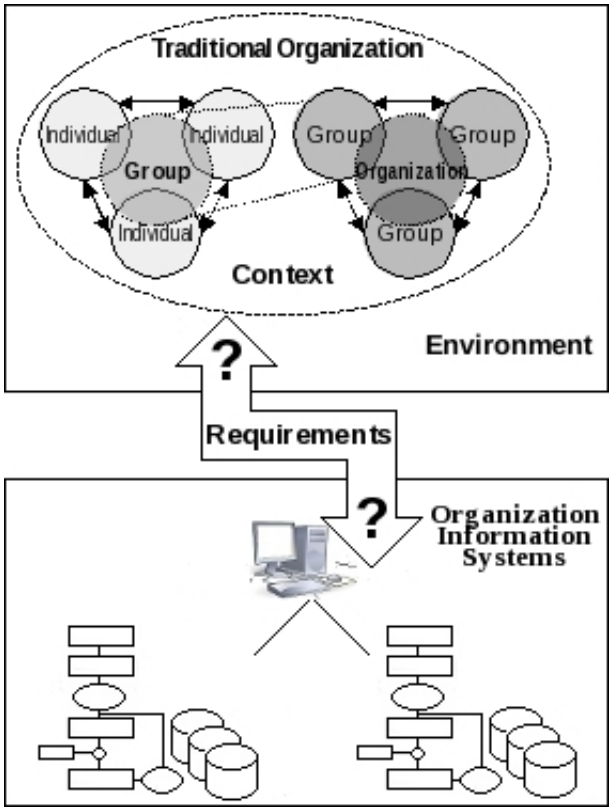

Figure 5.2: Requirement engineering challenge for a traditional organization

gic, managerial and operational independence. Consequently additional factors have to be considered to link the VO world and the IS world (see Figure 5.3):

- **Size**: a set of organizations to be taken into account vs only one organization in traditional RE elicitation.
- **Governance**: another approach has to be put into practice for coordinating the new VO world structure while preserving each already established organization structure.
- **Heterogeneity**: like with individuals, organizations have different strategies, know hows, cultures, processes that have to be coordinated and consented. Problems that arise from the alliance have to be conciliated among divers actors.

Therefore, RE for VOs has to guide the process and set a clear boundary of what should be elicited within a wider context space and with larger clients capability needs for supporting the alliance. For limiting the scope of RE for VOs, the 360° VisiOn establishes and explores a multi view framework to understand a VO and to provide specific models of the knowledge needed to help the member organizations to identify the alliance and to elicit the VO IS's requirements. This vision allows to analyze the VO from different angles and to complement other proposals like [ECOLEAD, 2005, Barki et al., 2005, Lewis et al., 2009,

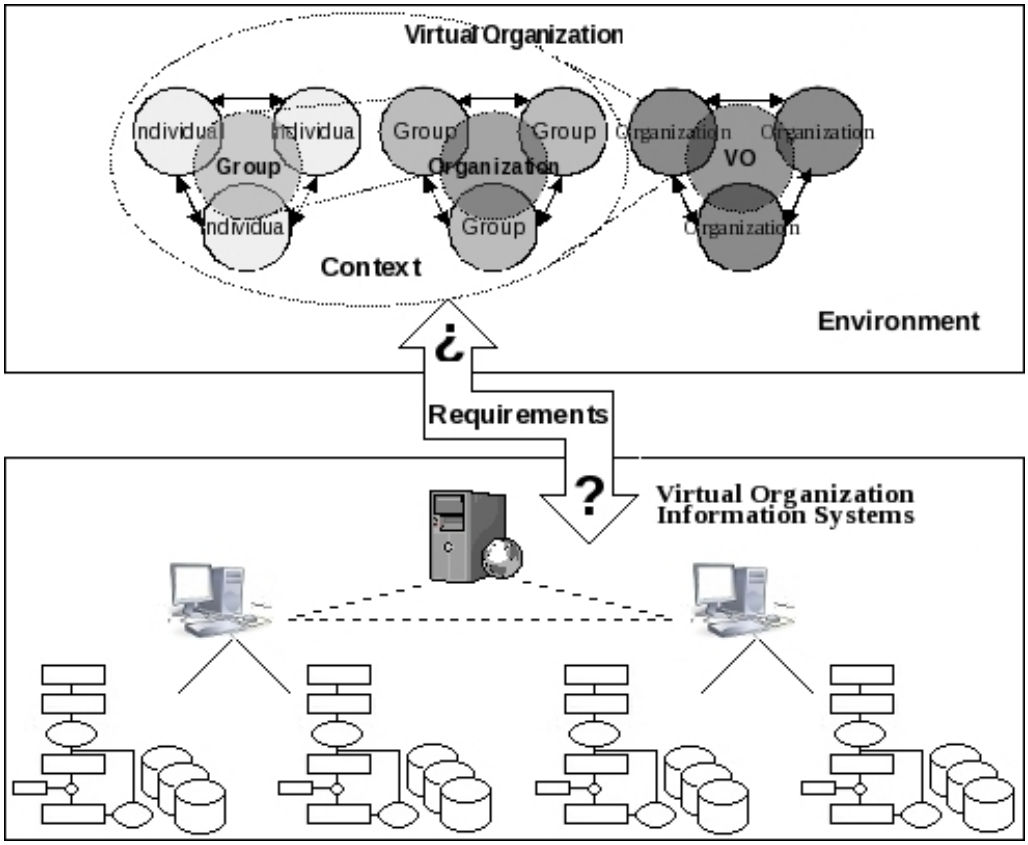

Figure 5.3: Additional requirement engineering challenges for a virtual organization

Camarinha-Matos et al., 2008]. The **360° VisiOn** starts from structuring two points of view shown in Figure 5.4 that will particularly cover a set of aspects for characterizing a VO:

- **a Vertical** view of the VO in a top-down manner. Based on [Nurcan et al., 2002], this view considers a set of specific concepts a VO must question in order to implement the tailored VO business processes which in turn must be supported by ISs. This conceptualization is achieved through the *Intentional*, *Organizational* and *Operational* levels.

- **a Horizontal** view of the VO in an inside-outside manner. Based on the fact that a VO interacts with a changing environment and within a specific organizational context (3.2.3), this view focuses on concepts emerged from the *Intra*, *Inter* and *Extra* organizational levels.

5.3 Aspects exploration

To explore VO IS we propose three key concepts to look into the Vertical and Horizontal views previously introduced and detailed in the following sections:

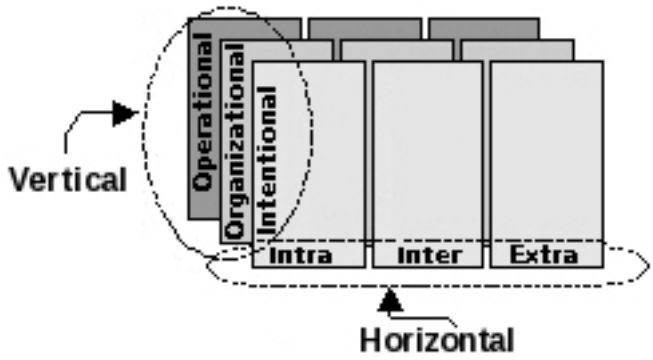

Figure 5.4: The points of view of the 360° VOvision

Alliance establishes the agreement to facilitate a constructive relationship among organizations while preserving their independence for continuing their own projects. This requires the identification of the actors needed to be involved and the service they want to offer.

Collaboration establishes the compromises each organization agrees to give to the VO. Organizations integrate competences and resources to assure service delivery.

Objectives establishes the goals organizations want to achieve. Goals could answer customer's needs (integral services), satisfy companies' objectives (to share costs, benefits, to create more effective processes) [Goldman et al., 1995], make new business (new markets, new products or services) or confront difficulties (absence of knowledge).

5.4 The vertical aspects of analysis

For reasoning about organizational impact of change, [Nurcan et al., 2002] represent an organization as a set of objectives that are implemented by business processes which in turn are supported by information systems. We have adapted this representation to complement VO reasoning guided by alliance, collaboration and objectives. These vertical levels of analysis are shown in Figure 5.5 and are classified as follows:

- **Intentional** level, where strategic alliance, collaboration definition and common objectives are emphasized.
- **Organizational** level, where formalization of the business processes is carried out.
- **Operational** level, where the actions for executing the proposed business processes are detailed, describing the structure and behavior of the IS.

Intentional

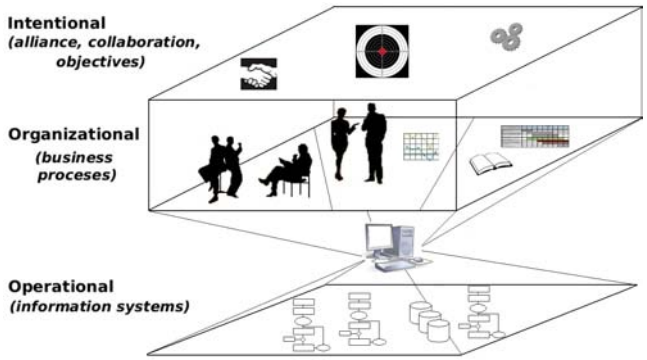

Figure 5.5: The VO vertical view (adapted from [Nurcan et al., 2002])

It represents the organization from a business point of view questioning WHY. It describes the organizations' alliance (the will for working together), the objectives (what they want to achieve or to avoid), the collaboration (see Chapter 3.2) and the ISs' influence to support the organization. Chapters 6 and 8 cover this level for VOs.

Organizational

According to [Morley et al., 2005] a business process is "a set of activities undertaken with a defined purpose. The responsibility for performing all or part of the activities by an actor corresponds to a role. When executing, a process involves resources and may generate or be affected by internal or external events. The activities layout corresponds to the process structure". A business process may consist of automated and/or manual activities [WFMC, 1999] that usually cross organizational units and generally help us answer WHAT. The proposal to link the Intentional level to the Organizational level is presented in Chapter 7.

Operational

ISs are the informational support of the organization's business processes that help to answer HOW. For doing so, system analysts use methods and tools for translating the organizational needs into suitable ISs. The technology dimension known as ICTs, involves the technical infrastructure of software and hardware installations that would allow business process automation. They comprise [Longépé, 2003, Winter et al., 2006]:

- *Software architecture* as the computing translation of the business process. The ISs formed by functional artifacts, are translated to computer systems which in turn are composed of applicative artifacts like software services and data structures.
- *Technology infrastructure* as the specification of the elements that will support the applicative artifacts like local and long-distance networks, hardware platforms, basic software like operating system, DBMS, middle-ware and primary, secondary and tertiary technological infrastructures.

Table 5.2 describes the different *alliances, collaborations and objectives* to be set up at the Intentional level, aligned to the Organizational Business Processes (BPs) and supported

Table 5.2: Intentional, Organizational and Operational levels

Dimension	Intentional	Organizational	Operational
alliance	among the organization's functional actors	to built up the BP and to work together	to develop or adapt the IS
collaboration	the organization's compromises to assure VO provisioning	the adapted BP to support collaboration with other organizations	the collaborative IS to support the BP
objective	what the organization wants to achieve	the BP contribution to the organization objective	the IS alignment to the BP contribution and therefore to the organization objective

by the IS at the Operational level.

5.5 The horizontal levels of analysis

Emphasizing that organizations are not isolated, an analysis of their relationships in the VO is necessary to find the related concepts that support their links. We consider important to understand the circumstances and elements that surround the IS to be developed or adapted and to use this understanding to better apply RE for VOs. Therefore, we propose three views of the VO that allows us structure this understanding by examining *alliance, collaboration and objectives*: first, each organization that composes the VO; second, the VO itself and third the environment that surrounds the VO. These horizontal levels of analysis are shown in Figure 5.6 and are classified as follows:

- **Intra-organizational** level focuses on the relationships inside each organization forming the VO and consists in analyzing the interaction among the administrative and production structure, the business processes, etc.

- **Inter-organizational** level focuses on the relationships among the organizations providing the service, in particular those forming the VO to specifically determine the collaboration compromise for working together and the common objective to achieve.

- **Extra-organizational** level focuses on the organizations providing the service and the external environment which consists in analyzing the Regulator Organization, Complementor Organization and Competitor Organization and their influence and effects toward the VO.

Intra-organizational

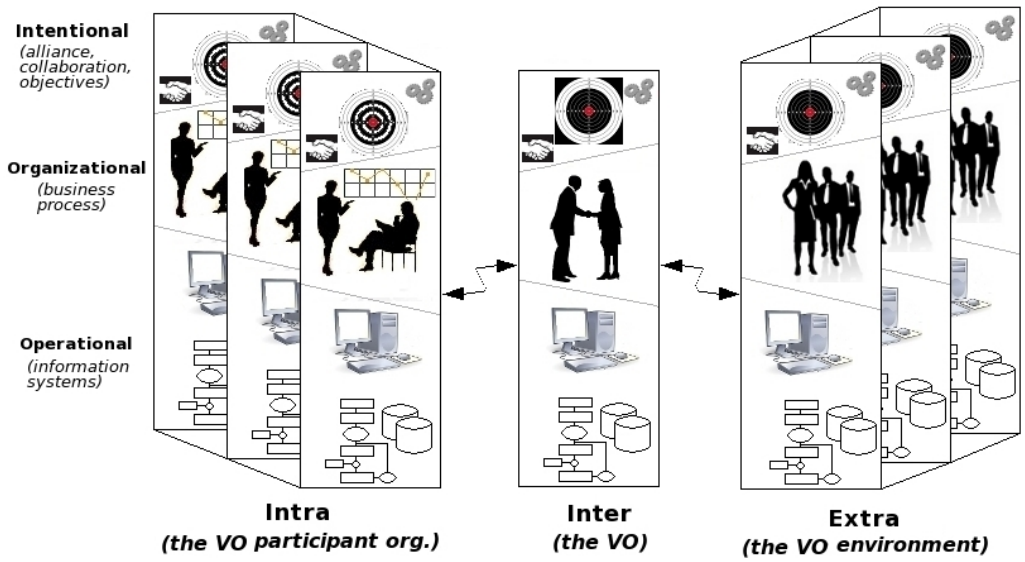

Figure 5.6: The VO horizontal view

The intra-organizational level corresponds to the singleton organization as potential Member Organizations (Member Organizations) of the VO, this includes its traditional structure and inner environment. Firstly, functional Actors and Committees that take part in the primary and support activities [Porter et al., 1985] of each organization must be considered. Secondly, the organization balances the capabilities and resources to make available to the VO. Last but not least, each organization has goals to achieve (reduce cost, face competition, knowledge transfer) that motivate its participation in a VO alliance.

Inter-organizational

This level involves first, the organizations that participate in providing a service what triggers specific roles to be fulfilled. Secondly, two or more organizations that form a VO becoming allied to do business together through the integration of competences and resources. This alliance changes the relationships among them to a new collaborative strategy linked by a common goal, expecting more than the service provisioning. Organizations, though, might become Member Organizations if they accept to join the alliance or Contributor Organizations (Contributor Organizations) if they do not accept. The latter, are potential Member Organizations that can enlarge the VO alliance.

Extra-organizational

As any organization, a VO is not an isolated entity, it operates in its particular environment and interacts with a variety of entities. Therefore, this level has an external orientation focusing on the relationship between the VO and its outer environment and involves VO's outside organizations influences, threats and opportunities. Adapting the environment definition of [Checkland, 1981], we can state that the VO environment is the wider system of which the VO is a part. To survive in a dynamic environment, the VO has to revise its strate-

Table 5.3: Intra, Inter and Extra levels

Dimension	Intra	Inter	Extra
alliance	to accomplish VO demands establishing the necessary relationships within the organization's actors	among the organizations to provide the service and decide to form a VO and to work together while keeping each organization independence	awareness of environment organizations to accomplish regulatory and complementary requisitions
collaboration	compromises for assuring provisioning	compromise for providing what accorded	compromise for enlarging VO possibilities
objective	what each organization wants to achieve	the shared objective among the organizations forming the VO	awareness of environment organizations objectives

gies regarding External Organizations (External Organizations): Competitor Organizations (that offer or might offer the same service in the same market), Complementor Organizations (that add value to the service provided by the VO [Brandenburger et al., 1996] or produce a product that "sometimes only works with the other company's product" [Grove et al., 1996, p. 29]) and Regulator Organizations (authorities that control organizations behavior with laws and rules). This environment might present constraints or opportunities to analyze in order to minimize their negative effects or maximize their positive results.

Table 5.3 describes the different *alliances, collaborations and objectives* necessary to strengthen along the tree levels proposed above. First, an intra-organizational alliance among actors of each singleton organization for assuring the compromises made to the VO. Second, an inter-organizational alliance among organizations forming the VO for working together and providing the accorded skills, resources, competencies while keeping their independence. And third, an extra-organizational alliance with environment organizations to accomplish regulations or enlarge the alliance.

Brooks stated that "the software product is embedded in a cultural matrix of applications, users, laws, and machine vehicles. These all change continually, and their changes inexorably force change upon the software product"[BrooksJr, 1986]. We consider that the VO's ISs are embedded in the vertical and horizontal levels presented in this chapter: if one of them changes there might be changes in the VO's ISs. These levels are the baseline to structure our 360° VisiOn proposal detailed in following chapters.

5.6 Research Approach

This research work is intended to support the modeling of a VO allowing various actors (shareholder, user, project manager, business analyst) to obtain all necessary knowledge to conceive collaborative information systems through a VO IS engineering method. More

precisely, this work aims to facilitate:

- setting up agreements among the different Member Organizations by identifying the set of properties linked to their alliance (identification of Member Organizations, collaboration, objectives, etc.),
- formalizing requirements, a necessary step for defining organizational processes and consequently the adapted collaborative IS.

For doing so, our research approach described bellow and shown in Figure 5.8 is the following:

- To characterize: based on research on business management (Section 3.2) and VO projects (Section 3.3), the intentional characteristics of a VO which are identified, classified and formalized [Sousa et al., 2005]. Properties formalization is carried out with UML diagrams, an accepted standard for covering conceptual elements [Booch et al., 1999]. To define the VO more precisely, we propose to identify from each aspect, a set of sub-aspects, criteria and sub-criteria (Figure 5.7). Some of these criteria relate to the VO in general (generic criterion), other criteria are specific to the Member Organization, the Contributor Organization or the External Organization.

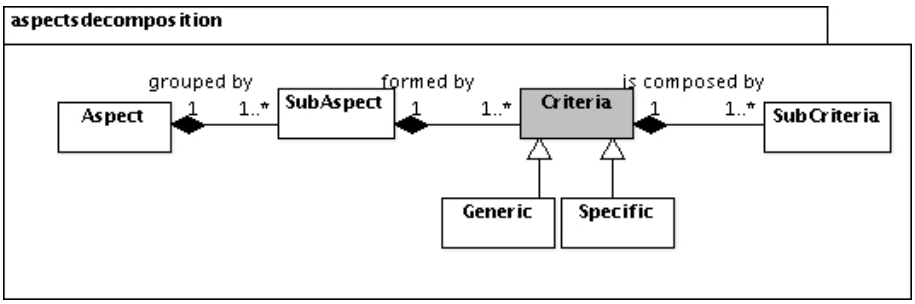

Figure 5.7: Aspects decomposition

  Each aspect (or one of its sub-aspects) is formalized by a class diagram (example Figure 6.3). A criterion is represented by a stereotyped class. Sub-criteria are represented either by simple attributes, or by associations linking the criterion class to the value class, describing the sub-criterion possible values.

- To Model: simple graphic and textual models are proposed to help actors understand and communicate their knowledge. These two model approaches have proved to be effective for this task [Freeman, 2000, Brandes et al., 2001, Petre, 1995, Grönniger et al., 2007, Albert et al., 2002, Basole et al., 2008]. The charts used in this proposal are inspired by the SVN modeling language [Basole et al., 2008]. An instance example of these models, resulting from our case study, is represented in the form of prototype screens (example Figure 6.4). From this instantiation it is possible to deduce automatically simple graphic models (example Figure 6.10).

- To Instrument: a prototype software platform to capture and manage the characteristics as much as the models is provided like ECOLEAD, SMEcoll, Tropos or Objectiver tools.
- To Validate: the 360° VisiOn models and methodology guided by Nadine Mandran member of Mobile Ambient Reactive Versatile Experiments in LIG (MARVELIG). The objective was to verify the concepts, relations and the graphical models proposed. The results of this validation are explained in Chapter 8.

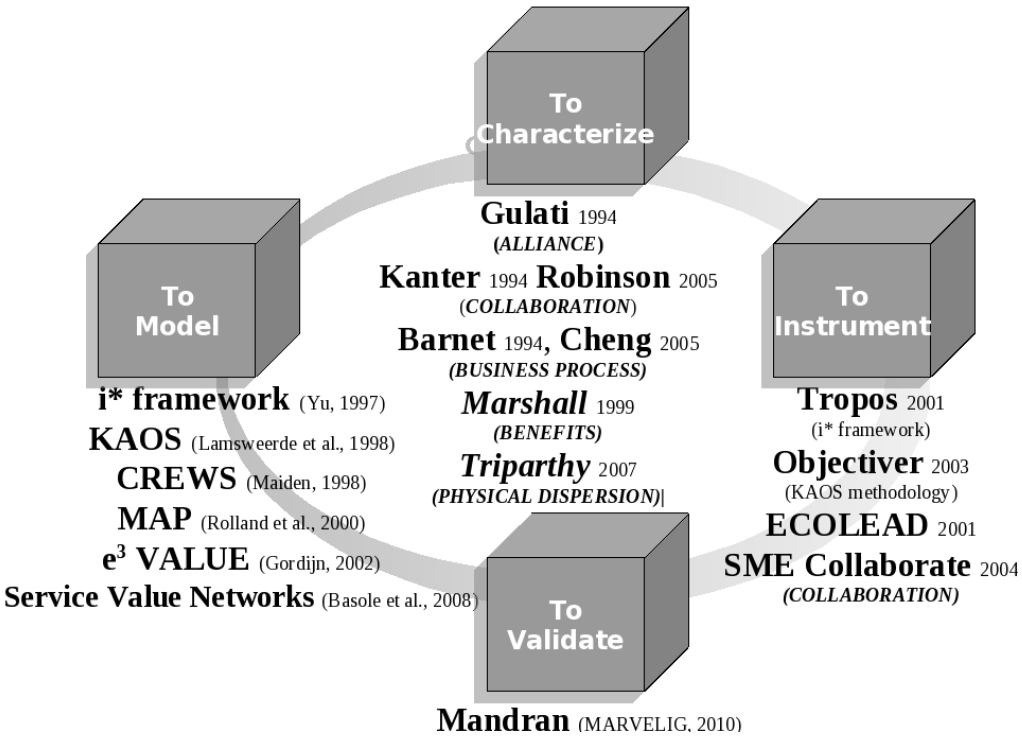

Figure 5.8: Research approach

Next chapter presents the 360° VisiOn proposed in this thesis, the Intentional aspects characterization and models. The later are decompose based on Figure 5.7, they are represented in a graphical and textual prototype tool using the UGRT case study described in Chapter 2.

CHAPTER 6

A 360˚ vision for VO: intentional level aspects

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The intentional characterization is an essential starting point for the organizational and operational modeling of a collaborative IS for a VO.

As stated by [Camarinha-Matos et al., 2003] (see section 3.2.5.4) a VO life-cycle is composed by identification, formation, operation/evolution and dissolution/termination. We suggest analyzing the VO according to three relevant aspects that support the formation phase of a VO through collaboration alliance [ECOLEAD, 2005] (Figure 6.1):

Alliance Identification of the agreement, actors and services offered. The alliance establishes a way to facilitate a constructive relationship preserving organization's independence for continuing their own projects. Actors identification (stakeholders, users, organizations, etc.) is a recommended way for starting eliciting IS requirements [Hickey et al., 2003]. Service identification defines the general output expected from these actors and their role in the service generation.

Collaboration Willingness characterizes the compromises each Member Organization plans to give to the VO in terms of its availability to the new relationship, the investments willing to make, the elements to be coordinated and the regulation of the expected behavior that would assure VO members good performance.

Common Objective characterizes the shared goal and the directions to be followed for achieving it. The latter could answer customer's needs (integral services), satisfy companies' objectives (to share costs, benefits, to create more effective processes) [Goldman et al., 1995], make new business (new markets, new products or services) or confront difficulties (absence of knowledge).

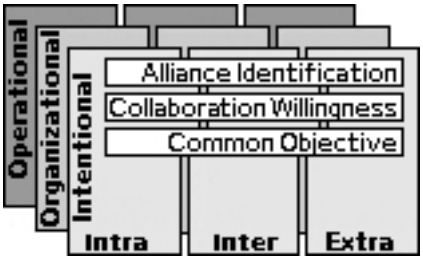


Figure 6.1: The 360° vision for analyzing a Virtual Organization

Table 6.1 summarizes the Intentional proposal detailed in this chapter. It is composed of three aspects (Alliance Identification, Collaboration Willingness and Common Objective) that are analyzed from three horizontal levels introduced in Chapter 5 (Intra, Inter and Extra organizational). The next three sections detail these aspects following the research approach described in Section 5.6 firstly, each aspect is characterize and formalized with UML diagrams (e.g. Figure 6.3), secondly textual and graphical models (e.g. Table 6.2) are proposed and finally, they are instrumented with a prototype tool (e.g. Figure 6.4). The prototype was developed during the internship of Romain VERDUCI, a second year student of the Institut Universitaire de Technologie 2 de Grenoble (IUT2) [19]. Appendix C details the different open source tools used.

Table 6.1: The proposal summary

360° VisiOn: Intentional			
Aspect	**Intra**	**Inter**	**Extra**
Alliance			
Identification *Characterizes the VO in terms of actors, services offered and alliance setup*			
	Functional Actors and Committees, their role and services offered to accomplish VO service	Members and Contributors Organizations, their role, the services offered to the VO and the alliance setup for keeping each Member Organization independence	External Organization, their influence and effects to the VO and the VO alliance for accomplishing their regulatory and complementary requisitions
Collaboration			
Willingness *Characterizes the compromises among actors for working together based on commitment*			
	Functional actors compromises for accomplishing their role in the VO and adapting to new demands	Member Organizations collaboration compromise for providing the service and engagements to the VO	Enlarging VO possibilities by new organizations or accomplishing environmental impositions
Common			
Objective *Characterizes actors goals that motivate the alliance*			
	A Member Organization internal objectives aligned to its operational objectives	The common objective among the Member Organizations	External Organization' specific regulatory and complementary objectives

6.1 Alliance Identification

The Alliance Identification Aspect is composed of three sub-aspects detailed below and illustrated in Figure 6.2. In general is stated that a set of *organizations offer* a service and they may form a VO by subscribing an *alliance*. To explore the Inter level we consider the end consumer the reason of the existence of a network of organizations prepared to provide the service. At the Inter level, each organization's functional actors that take part of service delivery and at the Extra level, the environmental organizations that influence the service.

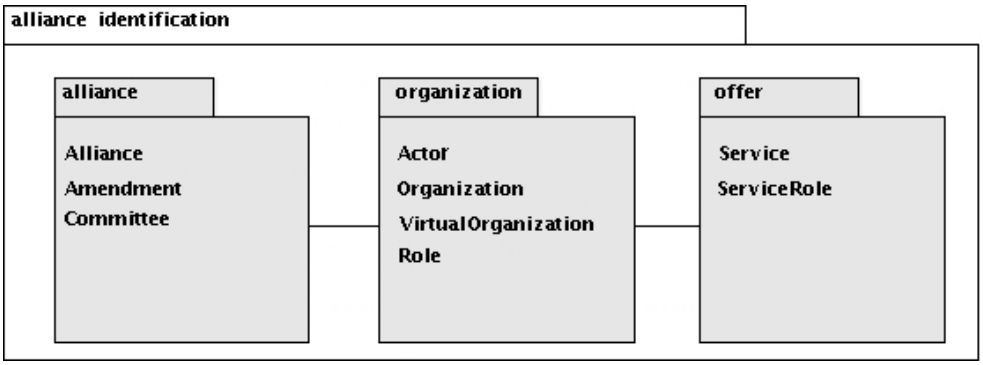


Figure 6.2: The 360° vision Alliance Identification aspect

6.1.1 Organization

The ***Organization***'s goal is to identify and characterize the organizations (independently of their participation in the VO) as well as the VO. It is composed of two criteria formalized in Figure 6.3.

- *Organizations*. Each organization is characterized by a *name*, a *description*, a *location* (city, state, postal code, country, electronic address), a *size*, a *constitution* (singleton organization or group of organizations) and an *activity sector*. The *size* is given based on a scale from Small to Large, while taking into account the number of employees, the turnover, the market share and the organization peculiarities. The peculiarities describe common properties to consider (e.g. "Manual Work: due to low production, small Stockbreeders don't have modern infrastructure"). A singleton organization is not composed of other organizations (e.g. Freight Trucking). A group organization is a subsidiary of a holding organization which controls or guides the groups' activities (e.g. Stockbreeders Associations are seventeen associations grouped by region). *Activity sectors* (*specific and general*) characterize the organization in its business context; we use those proposed by North American Industry Classification System (NAICS) [23]. The sectors are characterized by a *code*, a *name* and a *description*; they are related to activities (example of general activity sector: Agriculture, Forestry and Fishing; example of specific activity sector: Livestock production).

- *Actor*. At the Intra horizontal level, an organization is formed by Actors that have

a *name*, a *position* and an *intra role*. The latter can be Primary or Support [Porter et al., 1985] and corresponds to the actor's responsibility for the activities that directly or indirectly help to produce or provide the service. They are in turn linked by a *relation* that differentiates the flows between them inside the organization.

- *Virtual Organization*. A VO has a *name*, a *description*, *creation date*, a *location*, a *size* and a *specific activity sector*. Rather than establishing a physical location for a VO like for a traditional organization, an electronic address may be maintain as presence in the business domain. The *size* can be based on the organizations' size. The VO is composed of organizations (at least two) that form an alliance for providing a service. According to the Inter horizontal level, they are the organizations that provide a service (detailed in sub-aspect Offer 6.1.2) and are classified as:

  - a Member Organization that agrees to joint the alliance and accordingly, to acquire compromises and rewards beyond the service offered,
  - a Contributor Organization that does not agree to joint the alliance however interacts directly with the VO either soliciting or rendering services, it is a potential Member Organization that may extend the VO boundaries.

  At the Extra horizontal level, the External Organizations are environmental organization that can control or influence the VO or the service and demand awareness of the external environment. They have an *extra role* and a *description*, the former is classified as:

  - a *Competitor Organization* that offers or might offer the same or substitute VO's service in the same market, they threaten the VO and/or the service
  - a *Complementor Organization* that adds value to the service provided by the VO [Brandenburger et al., 1996]
  - a *Regulator Organization* is an authority that controls the behavior of the VO and/or the service with laws and rules

  All these roles have a duration set by starting and termination dates.

Figure 6.4 illustrates an instance of this aspect for an organization and Figure 6.5 for a VO. For the former, the top screen characterizes each organization (size, location, etc.) for example the Stockbreeder, the bottom screen lets users associate Member Organizations activity sectors. For the latter, the top screen allows users to assign organizations to a VO (here the Regional Stockbreeders Union of Tabasco), either as a Member Organization (e.g. Freight Trucking, Meat Marketing, Slaughter House, Stockbreeders and Stockbreeders Associations), as a Contributor Organization (e.g. Supermarket Chains) or as External Organization (Government, Leather Articles Producers and Meat Importers). Finally, the VO is shown in the lower screen with its description and its creation date.

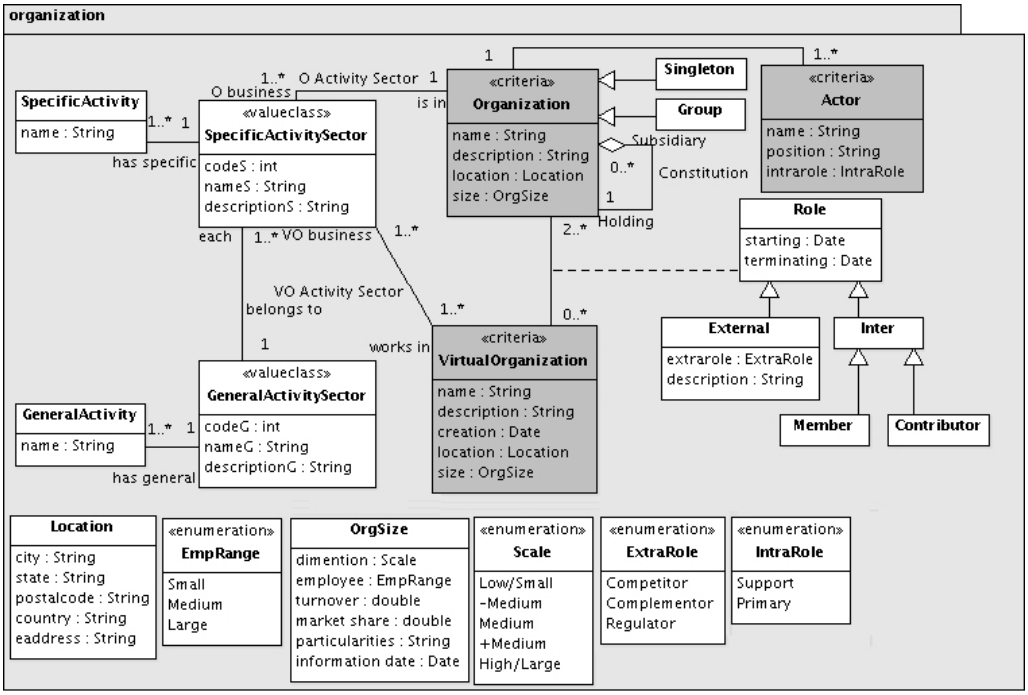


Figure 6.3: Organization sub-aspect

6.1.2 Offer

The ***Offer***'s aim is to identify and characterize the services offered by the organizations and the roles the organizations play to produce these services. It is composed of two criteria shown in Figure 6.6, graphically represented in Table 6.2 and described as follows:

- *Services*. A VO provides one or more services without making a distinction between a physical product (like the meat for example) or a service (like the distribution of the meat) [Levitt, 1972] including a network of organizations up to the ones that use or consume the service. A Service has a *name* and a *description*.

- *Role*. Each Member Organization or Contributor Organization has an *inter role* in the achievement or the consumption of the service. It can be a role of provisioning or using the service (this means the relationship of the Member Organization or the Contributor Organization to the service). These roles also have an *influence* to the service that can be essential (without it the service can not be achieved) or secondary (furthermore, it facilitates service achievement). The identified roles come from the work of [Basole et al., 2008]:

  – a *service provider* provides the service to consumers and has direct contact with them. It depends on many providers to conceive, operate and make possible the use of the service by service consumers,

  – a *direct provider* supplies the service providers with the products and services directly related to the service,

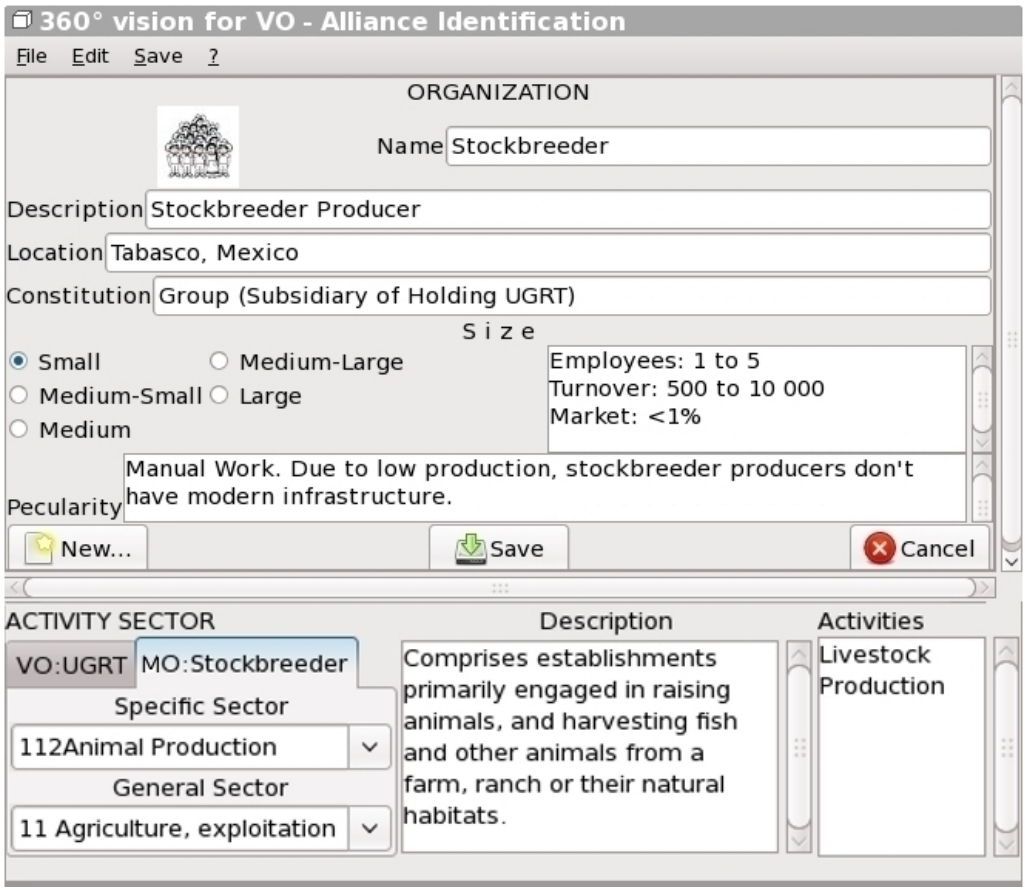


Figure 6.4: Organizations identification instance: Stockbreeder

- an *indirect provider* supplies the direct suppliers with raw materials and services,
- an *auxiliary provider* supplies all other actors of the network with essential services which are not directly related to the industrial field,
- a *service consumer* is the end entity that buys and uses the service. They are the essence of the service existence and the point of departure for the service conception.

Each Member Organization or Contributor Organization also has a *relation* that differentiates the flows between organizations in the service:

- a *principal* relationship between actors provisioning the service (from direct and indirect providers),
- an *auxiliary* relationship from actors which support the service (from auxiliary providers to other actors in the service),
- and a *bilateral* relationship between the service provider and the service consumer.

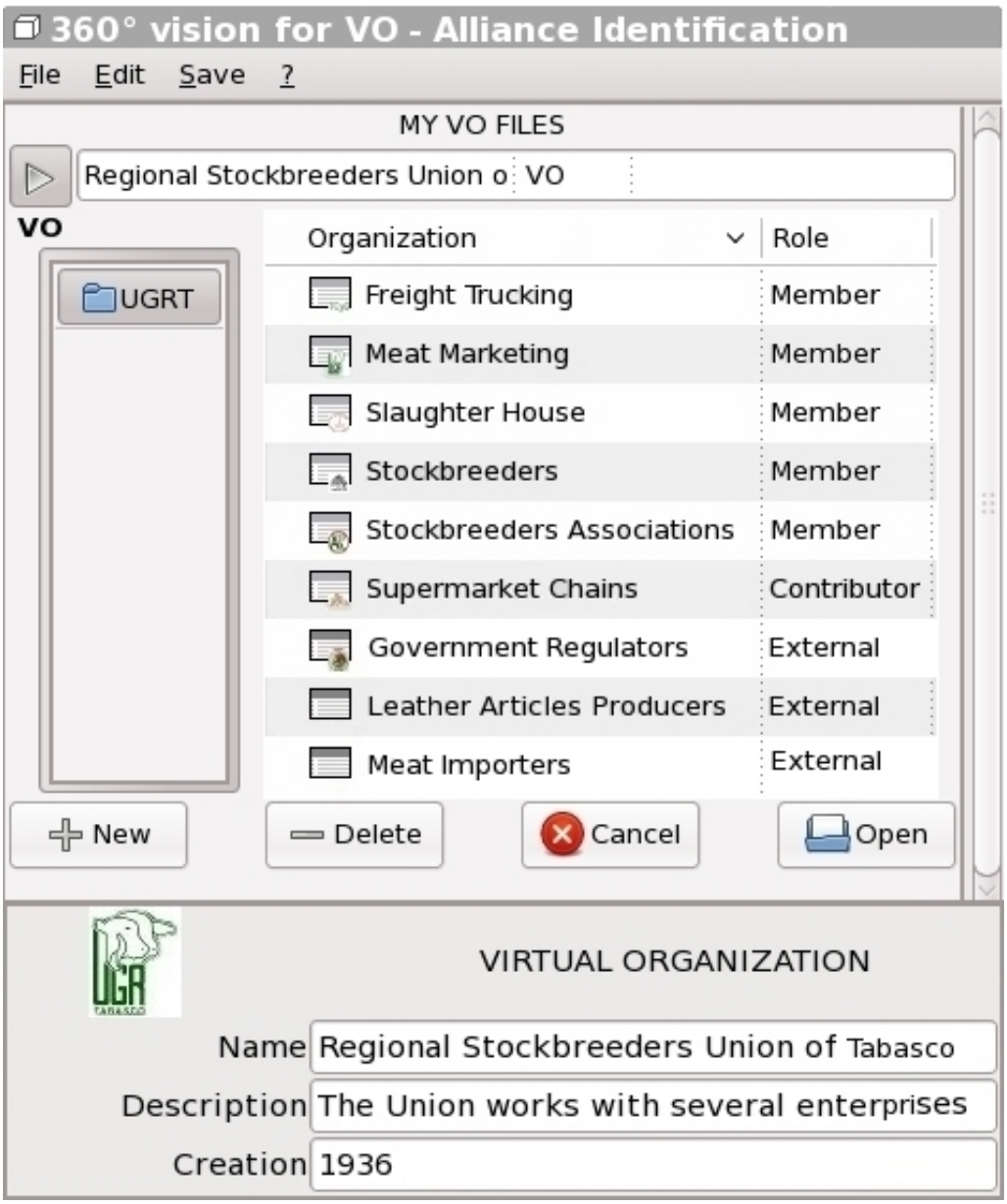


Figure 6.5: Organizations identification instance: the UGRT

Table 6.2 presents the graphical representation of the Alliance Identification aspect inspired by [Basole et al., 2008] for the three horizontal levels: Inter, Intra and Extra. Circles represent Actors, Committees, Organizations, the different filling patterns of the circles represent the organizations' roles in the service. Superposed circles represent a group of committees and organizations, single circles, represent an singleton committee and organization. The Committee Intra concept is explained in the following section. The service provided by the organization network is represented by a thick continuous line ellipse and the VO alliance by a thick dotted line ellipse. The Intra, Inter and Extra relationships are

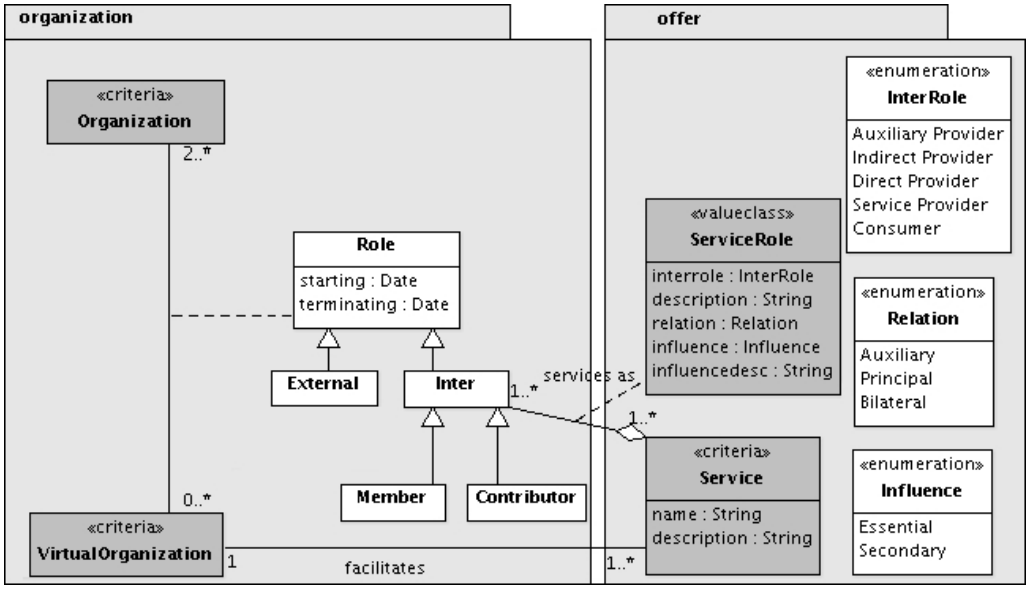


Figure 6.6: Offer sub-aspect

represented by arrows with three different styles (rhombus, symmetric and line) and by a line pattern for each relationship.

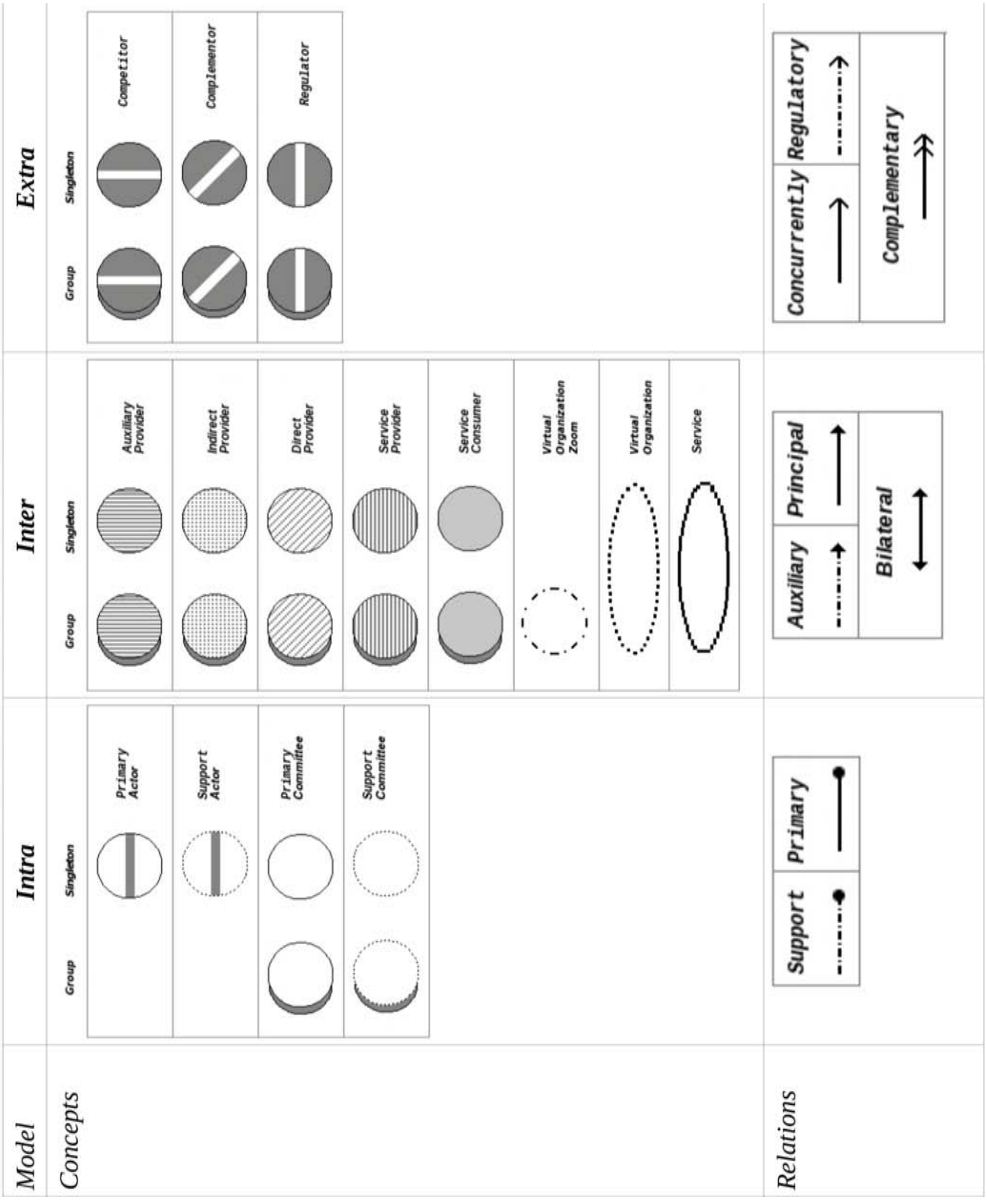
Figure 6.7 illustrates an instance of this aspect for a VO. The consented service is "Conditioning and sale of quality bovine meat" described as "Livestock raising, harvesting, packing and hauling to selling centers". One of the Member Organization is the Stockbreeder who has two roles: one as "Indirect Provider" of "grass fed livestock", which has an "essential" influence in the service, and another one as "Auxiliary Provider" to "Transport live cattle in low capacity trucks". It can be pointed out that a Service Role concerns indistinctly a Member Organization (Slaughterhouse, Stockbreeders Associations, Meat Marketing, Stockbreeders and Freight Trucking) or a Contributor Organization (Supermarket Chains and Meat Consumers) as shown in the tabs.

6.1.3 Alliance

Alliance is an agreement between at least two organizations that provide the service and that accept to work together in a VO. This agreement has to be clearly defined for guaranteeing collaboration among organizations. The alliance sets the accorded rules among Member Organizations for establishing VO functioning. We are not concerned for fusions or acquisitions where the objective is to form a single organization but for those where independence is preserved despite the alliance. Usually organizations establish contact with other organization in an informal way followed by discovering a business compatibility, as consequence, a series of negotiations take place for exploring alliance possibilities and finally, an agreement is endorsed for regulating their relationship as presented in Section 3.2.4. We propose two criteria described below and formalized in Figure 6.8.

- *Alliance*. We consider to address a VO alliance by: a *name*, a *description*, a *dura-*

Table 6.2: Graphical notations of the Intentional 360° vision for VO: Alliance Identification



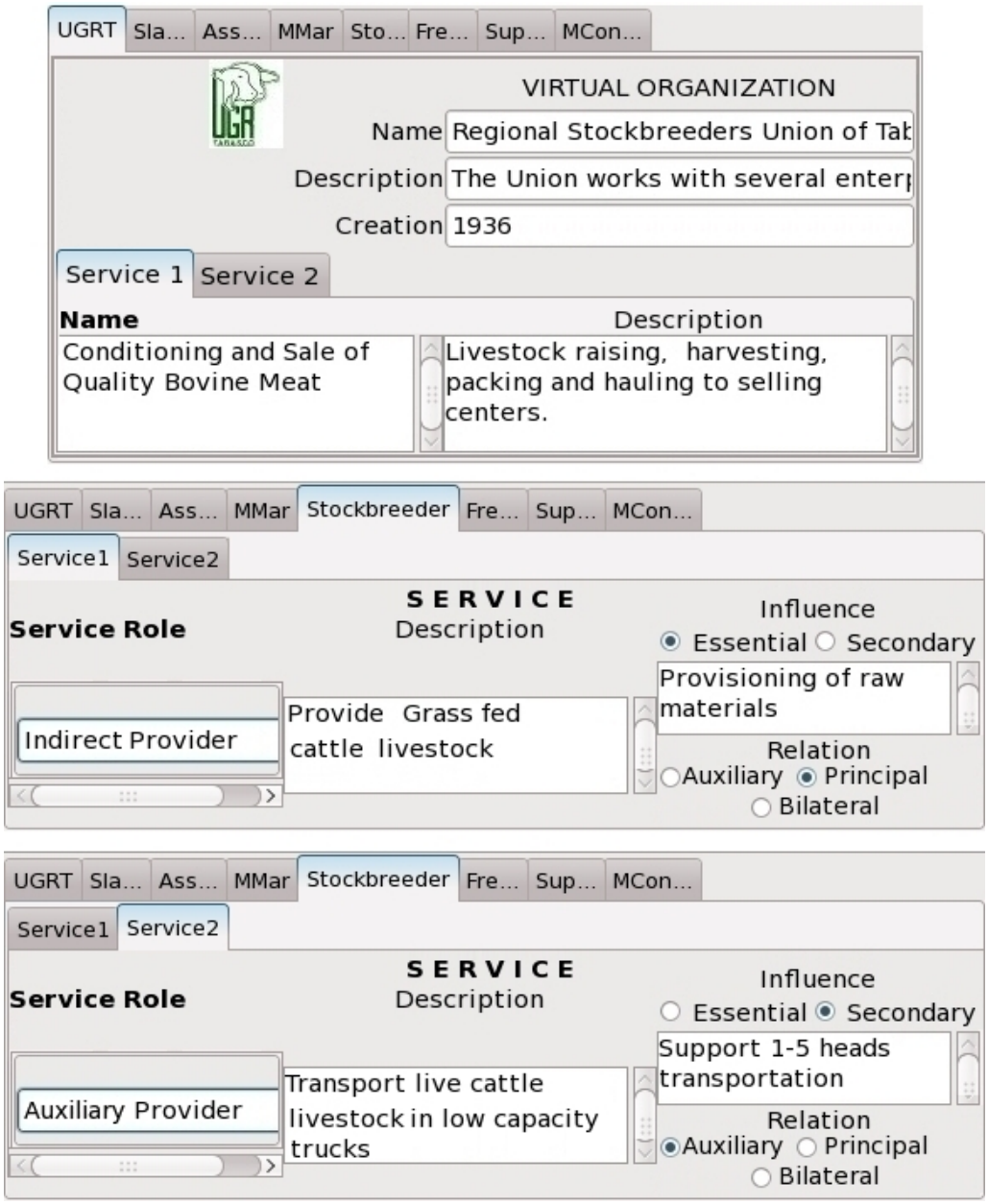


Figure 6.7: Offer identification instance: the UGRT service

tion which is based on a period of time or a project and determined with or without clear starting and ending dates or events and a *power*. *Duration* is linked to the dynamism of the VO [Camarinha-Matos et al., 2005]: in a long term alliance, partners are not changed and often lead to a stable relationship; on the contrary, the relationship becomes dynamic with a frequent change of partners in a short term alliance. Each organization has a *power* for guiding, deciding, establishing rules or taking the initiative for participating in the different stages of VO's life cycle, it is the influence

an organization has to impose its will to other Member Organization. There are two alternatives: strong-week meaning that there is a leader organization or equal where all members have same participation power. The former, eases partner replacement and thus alliance duration tends to be shorter. The latter, implies less interest in replacing partners and consequently a long term alliance tendency [Burn et al., 1999]. A *facade* to be expose between the VO and its clients or users: screen (only the VO is viewed), semi-screen (the VO and all or some organizations are viewed) and mirror (only the organizations are clearly viewed) [Burn et al., 1999]. An *alliance alternative* that describes the product or service interactions among Member Organization and outlines the communications needs of the VO: inter-functional where each organization actively interacts in the service or product generation (like design activities) and aims organizations interconnection; subcontract aiming services or products delegation and communication is done through a single organization; chain: where a service or product passes to the next organization in the flow before being consumed, an organization communicates only to the next organization in the line; and complementary that increases service value by third party organizations, these organizations communicate at vertical and global levels to provide a consumer service.

- *Amendment* establishes Member Organization's responsibilities and rights for defining expectations, making and executing decisions. On one hand Actors who are organization individuals responsible of service activities. On the other hand a *Committee* structure formed by people that would assure VO functioning: the *executive committee* with power for deciding and supervising; *auditors or third party surveillance* in charge of verifying agreements respect; *coordinators* responsible of project administration and deliverance, dates and other compromises respect; *working groups* responsible of carrying out project tasks. A Committee can be Singleton or Group (composed of several committees). An Actor in a Committees is linked by a Member Organization of the VO. As Actors, a Committee is responsible of activities that indirectly or directly help service provisioning (Support or Primary). Table 6.2 shows the graphical notation for Committee and its relations at the Intra level and Table 6.3 summarizes the properties described.

  The alliance can be formalized to define what parties expect and accord. Some examples of this formalization are: an oral contract, a letter of intent or a contract. For the former [Mazzeschi, 2001] proposes a consortium agreement, [Camarinha-Matos et al., 2005] a contract and/or a complementing collaboration agreement and [Wilson et al., 2006] a TrustCoM framework based on [Camarinha-Matos et al., 2003] VO life cycle. A Contract document usually has three clause sections written in natural language and is signed by all parties involved: the *agreement parties* (where parties are presented); *terms and conditions* (where main and secondary rendered services are described) and *planning* (where services are detailed) [Programme, 2007].

  To avoid interest conflicts usually a *settlement* is described in annexes. First of all, they consist of VO *life cycle clauses* like including a new organization, excluding an existing Member Organization, rescinding or terminating the alliance for example.

Followed by the *failure to perform conditions* and *arbitration* clauses. The former states the consequences of not executing or respecting compromises like clause violation, compromise evaluation metrics, penalties. The latter, for dispute management in case of conflict like setting jurisdiction and applicable laws for contracts. Finally, *confidentiality* and *data protection clauses* for defining what each organization is willing to preserve, to share, to secure. Within each organization, contracts are built for aligning employees, managers, shareholders interests to the organization's. These contracts should not interfere with the VO agreement but support it, if conflict arises, they have to be clarified.

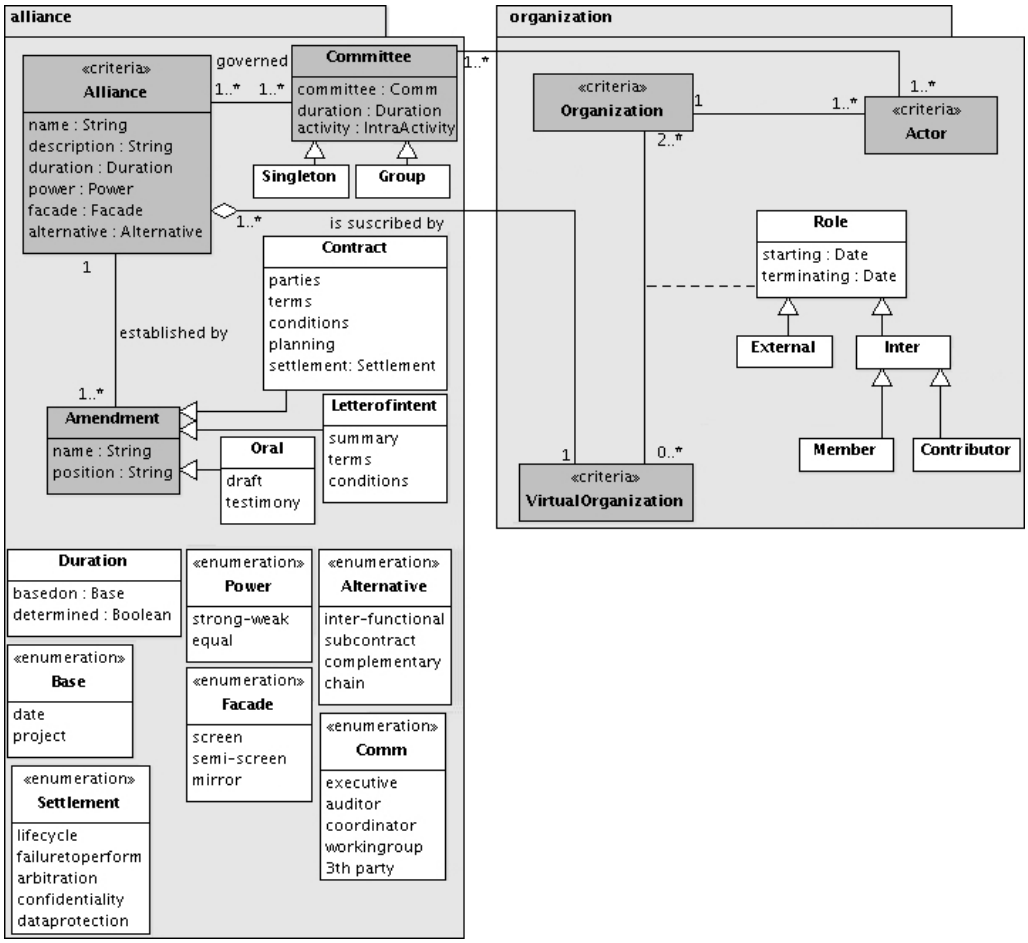


Figure 6.8: Alliance sub-aspect

Figure 6.9 illustrates an instance of this sub-aspect. The top part allows users to describe VO general agreement in terms of the alternative, duration, power and facade. In this example, the VO is inter-functional where communication among all Member Organizations is needed; the duration is on date basis; it is consented that all organizations have the same power for making decisions and that only some of them will be viewed by its clients (semi-screen facade). The VO governance starts to be outlined by an engagement contract and

Table 6.3: Alliance sub-aspect summary

Alliance				
Duration				
	Description		**Options**	
Base on	The metrics used to define the limits to continue the alliance		*Date*: a time interval	*Project*: a proposed plan to do something
Limit	Dates or events have a clear starting and ending		*Yes*: with a clear starting and ending	*No*: with no clear starting or/and ending
Power				
Power	Describes the hierarchical relationship among organizations		*Equal*: All members have same power	*Strong-weak:* One powerful member
Facade				
Option	**Screen**	**Semi Screen**	**Mirror**	
Description	Only the VO is viewed	The VO and all or some organizations are viewed	Only the organizations are viewed	
Alternative				
Option	**Inter-functional** (Swatman et al., 1992)	**Subcontract** (Speier, 1998)	**Chain** (Speier, 1998)	**Complementary** (Brandenbuger et al. 1995)
Communication among organizations	All organizations need to communicate among them	Communication is done through a single organization	An organization communicates only to the next organization in the line	Organizations communicate at vertical and global levels to provide a consumer service

by selecting the divers teams (e. g. executive committee).

From the properties described above, graphic representations can be generated in the form of models. For example, Figure 6.10 shows the set of organizations which form the VO alliance of our case study based on an adaptation of [Basole et al., 2008]'s modeling language: the Member Organizations (Stockbreeders, Stockbreeders Associations, Slaughterhouse, Freight Trucking, Marketing) and the Contributor Organizations (Supermarket Chains and Meat Consumers) all of which compose the service "Conditioning and Sale of Quality Bovine Meat". The roles of each organization or organizations group and their relationships are also illustrated.

Figure 6.11 shows the graphic representation with the External Organizations: Meat Importers, Leather Articles Producers and Government Regulators, which are Competitors, Complementors and Regulators respectively.

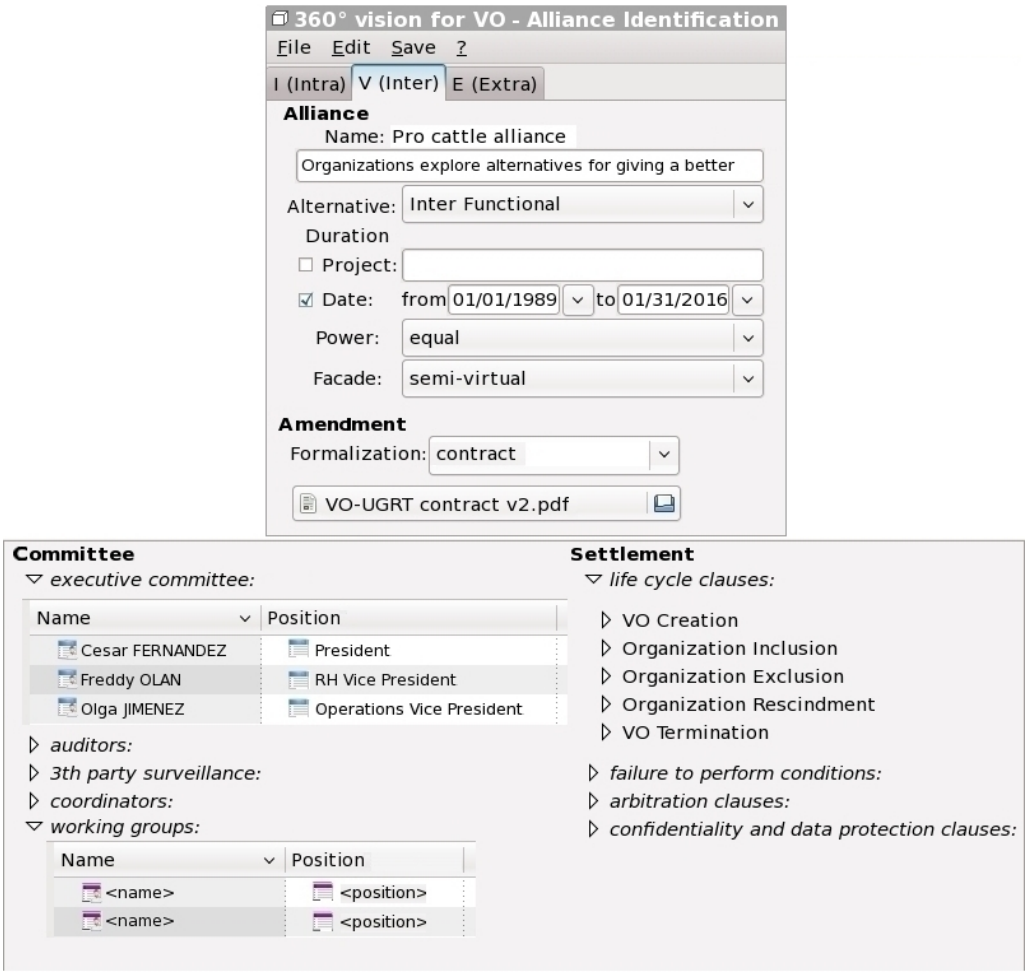


Figure 6.9: Alliance identification instance

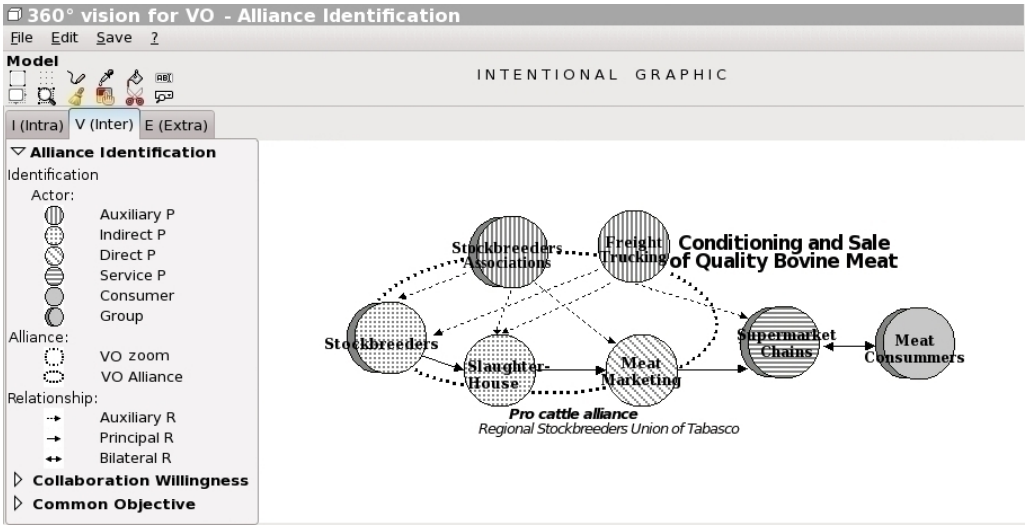


Figure 6.10: Graphic representation of the Regional Stockbreeders Union VO

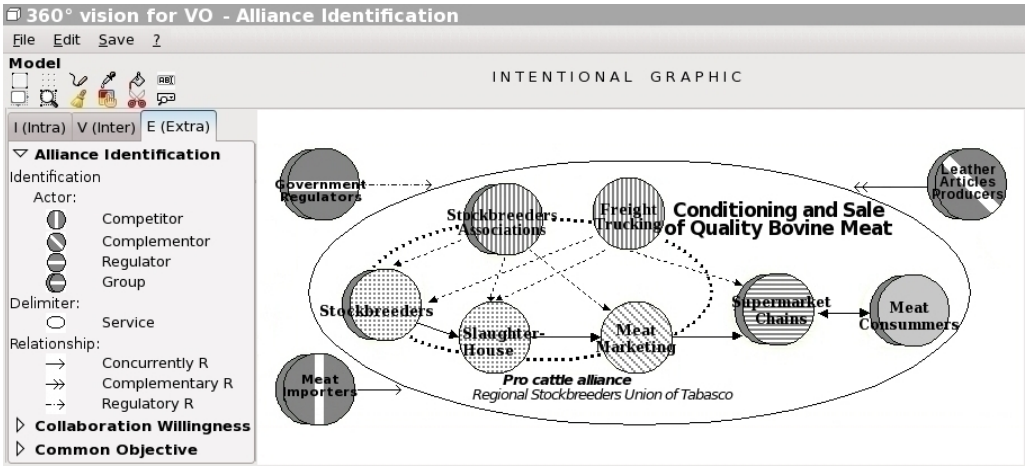


Figure 6.11: Graphic representation of the Regional Stockbreeders Union VO and external organizations

6.2 Collaboration Willingness

Besides the service conceived in the Alliance Identification aspect, where all organizations (Member and Contributors) involved in the service provisioning have a defined role (Service, Direct, Indirect, or Auxiliary Provider and Service Consumer), the Collaboration Willingness aspect arises Member Organizations responsibilities to the VO as well as advantages from the relationship. The alliance formed among the Member Organizations allows to explore collaboration not only for service provisioning but to find other means that benefit the Member Organizations like better logistic coordination, resources optimization. The alliance implicates Member Organizations to tighten their collaboration, the three sub-aspects composing the Collaboration Willingness aspect are detailed below and shown in Figure 6.12:

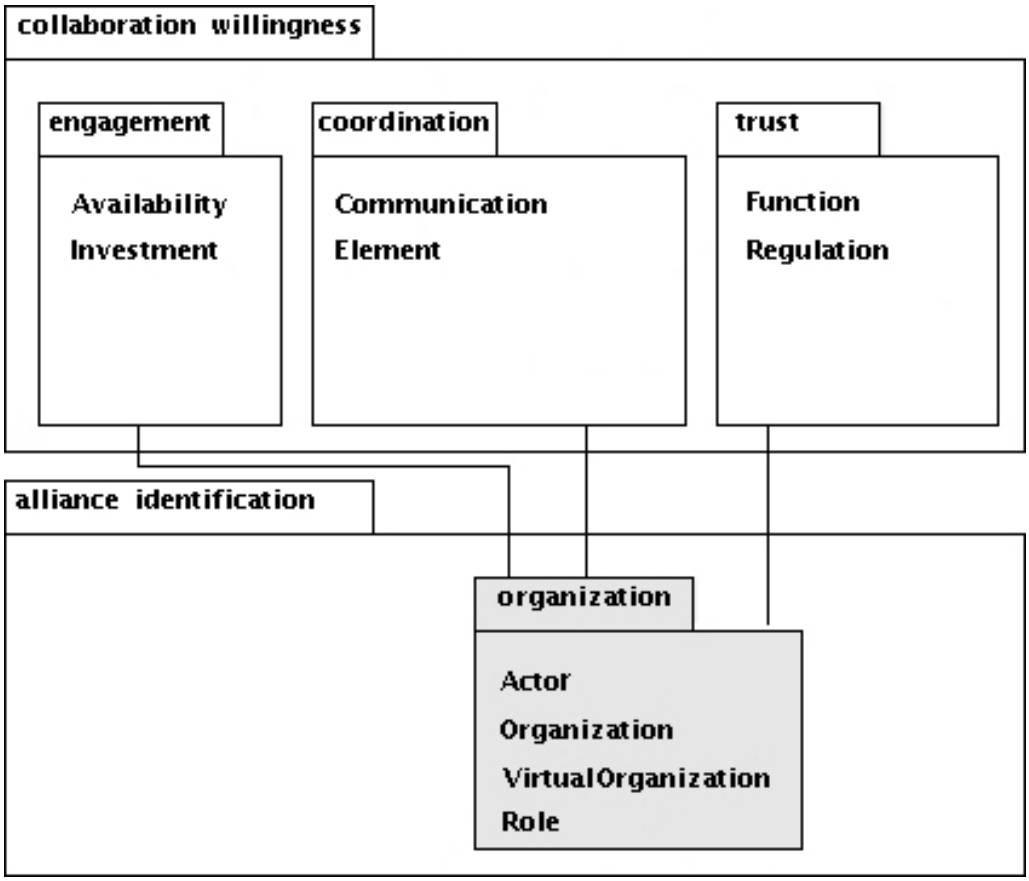


Figure 6.12: The 360° vision Collaboration Willingness aspect

6.2.1 Engagement

Engagement qualifies the availabilities and investments each Member Organization is ready to engage (see Figure 6.13.

- The *availability* that the Member Organization is ready to give is described by a

time reserved for the relationship, a *priority* the Member Organization assigns to this project compared to other projects and the Member Organizations's *adaptability* to changes. All these attributes can have a value estimated by a scale from Low, Medium-Low, Medium, Medium-High, to High.

- The *investments* concern the elements that each Member Organization devotes to the VO, for example financial or material assets, human, relational or organizational capital. This typology is suggested by [Parung et al., 2006]. An *investment* thus has a *type* (for example financial credit), a *frequency* which can be constant, sporadic or event-triggered, and an *impact* (direct or indirect). Investments are described by sentences such as *Give a contribution for each slaughtered cattle* and by measurement objects (calculations and constraints).

In Figure 6.13, the *availability* criterion is represented in UML, the class has three attributes: time, priority and adaptability. Each instance of this class is related to investments which are related to measurements.

Table 6.4 presents the graphical representation of the Collaboration Willingness aspect at the Inter level, for the Engagement sub-aspect the square delineated by continuous lines represent the *availability*; the square delineated by dotted lines do so for *investments*. The Inter-Commitment relation links both criteria from the Member Organization to the VO and vice versa.

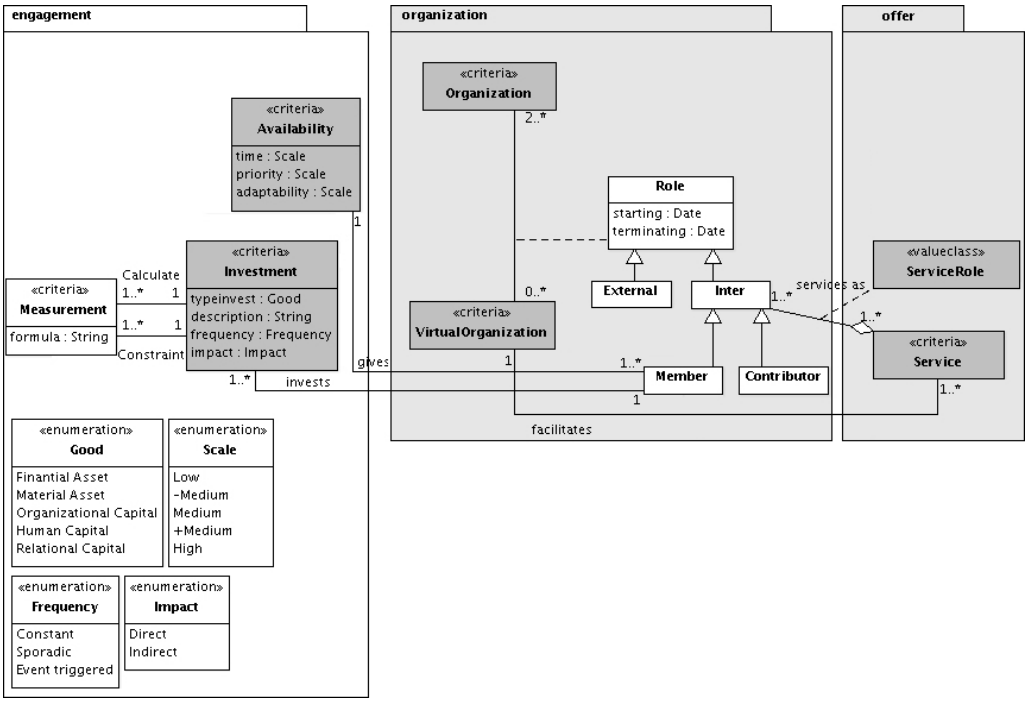
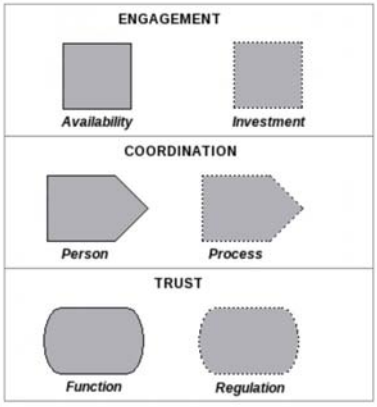


Figure 6.13: Engagement sub-aspect

Figure 6.14 illustrates an instance of the Engagement Model for the Member Organization "Stockbreeder" in terms of *availability* (6.14a) and *investments*. Figure 6.14b shows

Table 6.4: Graphical notations of the Intentional 360° vision for VO: Collaboration Willingness

Model	***Inter***
Concepts	
Relations	

a financial type investment in the form of a ”Contribution for each slaughtered cattle“ and fixed by an “average cost”. This contribution is event-triggered (when the cattle is slaughtered) and has a direct impact on the VO. The second *investment* is ”Live Cattle“ (6.14c) to be ”slaughtered“ it is demanded to comply all three parameters for approving this investment: the type of cattle, its weight and quality. The third investment is the ”Cattle File“ (6.14d) which commits the Stockbreeder to ”make available the information of each animal” especially for complying sanitary norms like food recalls. Figure 6.20 shows a chart for the Engagement where the arcs bind the Stockbreeder Member Organization with the VO. The *availability* as well as the three *investments* are represented following the graphical representation introduced above. For the *investments*, an icon inside the square illustrates its type.

6.2.2 Coordination

Coordination characterizes the way the Member Organizations are organized to work together (see Figure 6.15). This is based on the work of [Malone, 1988, Davidow et al., 1992, den Hengst et al., 2001, Laurillau, 2002], to characterize inter-organizational coordination which is composed of the following two criteria:

- *Elements* involved that must be coordinated. Contrary to an investment, the coordinated elements remain the property of its organization. Each *Element* has a *de-*

scription and a *dependence* (coupled, uncoupled) on another Member Organization on the coordination process for determining the frequency of interactions needed. An element can be a person or a process. The coordination of people requires knowing their profiles (preferences, personal information) and their work team (size, role). Process coordination implies specifying the task to carry out (planning, design) by characterizing its execution type (routine, non routine) and the information concerned (data, texts, messages, images, voice).

- *Communication* of each element is characterized based on Computer Supported Cooperative Work (CSCW) [Roseman et al., 1992] and Denver [Salvador et al., 1996] models. We describe *communication* through answering the questions *where*, *when* and *how* in terms of space, time and movement. Space includes a place (remote or local) for defining the distance among participants and a state of presence (physical or virtual) for determining the immediate vicinity among them. Time includes a frequency (it can be constant, recurring, sporadic or event-triggered) and a real-time moment (synchronous like in a telephone call with immediate feedback) or not (asynchronous like an e-mail). Movement includes accessibility (mobile or fixed) and a direction (transmission, interaction, reception) of the communication. This characterization determines the specific IS that offers the necessary functions of electronic communication to organize the interacting elements to work collaboratively.

Figure 6.15 proposes a coordination model where the criterion element is represented by a class. A Member Organization can have one or more *elements* (people or process) to coordinate. Each element coordinated by a Member Organization is characterized in terms of space, time and movement by an instance of the Communication class.

Figures 6.16 and 6.17 illustrate two instances of the coordination model. The ”Stockbreeder“ has two elements to coordinate: a person type, manager (Figure 6.16) and a process type, inventory (Figure 6.17). The Manager has to coordinate with the Stockbreeders Associations (a coupled dependency) in order to ”propose the cattle to be slaughtered“. The Manager is in a small team and has the role of contacting the Stockbreeders Associations. The contact can be done remotely, virtually and asynchronous(sending an e-mail or leaving a message for example) at event triggered basis (when there is cattle ready to be slaughtered). The Inventory process is related to ”update ranch cattle stock“, the Stockbreeder does not need to interact with another Member Organization for doing it (an uncoupled dependency). One of the task is to verify for each type of animal the quantity, weight, age and breed, being a routine data to have available. This process is done locally and requires a physical presence. Generally, this process is done monthly (constant frequency), requires mobile access and data is transmitted to the inventory file.

A graphic instance inspired from Basole's model is proposed in Figure 6.20. The element types to coordinate are framed by pentagons, continuous sides for people and dotted sides for processes as presented in the graphical representation of Table 6.4.

6.2.3 Trust

Trust among partners plays a decisive role in the alliance [Handy, 1995, Kanter, 1994] from group [Iacono et al., 1997] to virtual organization perspective [Kasper-Fuehrer et al., 2001, Ibrahim et al., 2006]. In [Saunders et al., 2004] conceptualizes it as Benevolence (acting in good will), Integrity (adherence to an accepted moral code), Competence (expectation of technically competent role performance) and Predictability (acting in accordance to an expected behavior). We propose to describe it using the following criteria (see Figure 6.18):

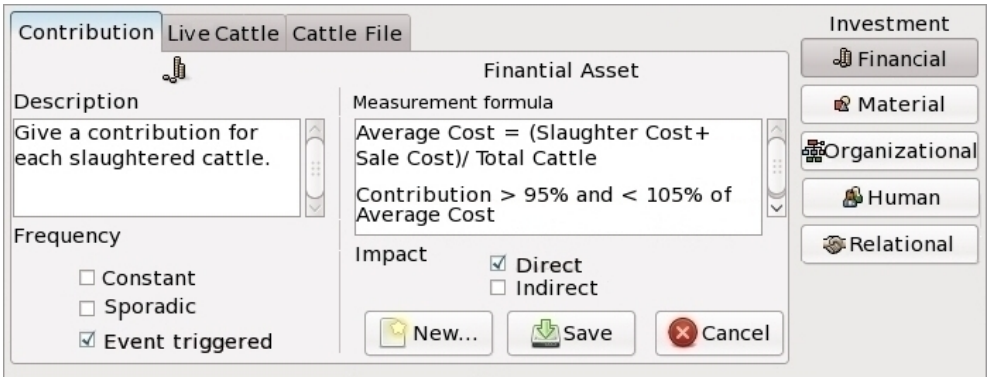
- *Functions* are the control activities required to be vigilant and need to be regulated. A function carried out by one or many Member Organizations is characterized by a *name*, a *description*, an *agreement* among all Member Organization on the importance of these functions, an *achievement* (optional or obligatory) and an *execution*. According to [Fenneteau et al., 2005], the execution of these functions can be done either by giving entire freedom of action (indicating the independence of each Member Organization to achieve its responsibilities), or by controlling them.

- *Regulation* of the functions ensures the good performance of the VO. A regulation is characterized by the *type* of element to control (for example active material) and its *description* (for example cattle), a *visibility* (if the Member Organization supervises the execution of its proper functions, we talk about self-regulation; if it must debrief to other Member Organization, we talk about surveillance), a *control frequency* (constant, sporadic, event-triggered) and *penalization* in case of violating the control function (penalty, no penalty, warning). Regulation is quantified through a set of calculations and constraints.

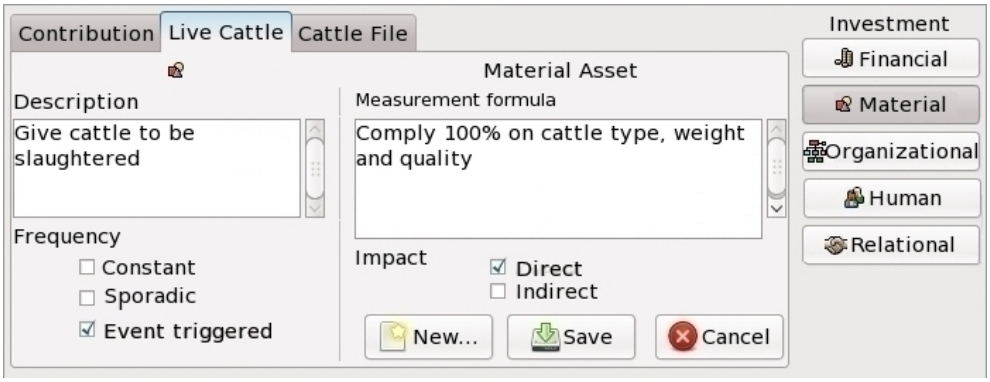
Figure 6.18 represents the Trust model. Each Member Organization (through its various roles played in a VO) can have or not functions to control. The function criterion is represented by a class formed by the attributes: name, description, agreement, achievement and execution. The regulation function is characterized in terms of type, description, visibility, frequency and penalization. Figure 6.19 proposes an instance of the Member Organization "Stockbreeder" and its agreed function "Cattle Classification" described as "Cattle weight control and evaluation". This function is obligatory and can be done by the Stockbreeder. It controls a material asset (cattle) and consists in verifying a "weight standard per cattle type" (250 Kg as minimum and 350 Kg as maximum weight for calves, for example) and classifying cattle quality (first and second class cattle). The Stockbreeder is responsible of both controls in a self-regulation basis, with an event-triggered frequency (when the cattle is going to be slaughtered) and there is a warning if the standards are not met.

Figure 6.20 shows the collaboration willingness graphic representation the Stockbreeder and the VO (the graphical notations are given in Table 6.4). The Trust functions to be controlled are represented by rectangles with rounded corners attached to legends describing them ("Cattle Classification" and "Meat Standard").

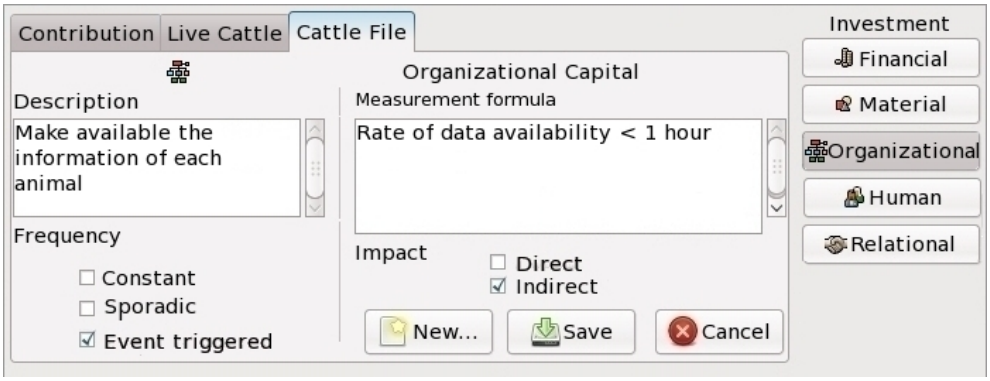
(a) Availability



(b) Investment: Contribution



(c) Investment: Live Cattle



(d) Investment: Cattle File

Figure 6.14: Engagement instance

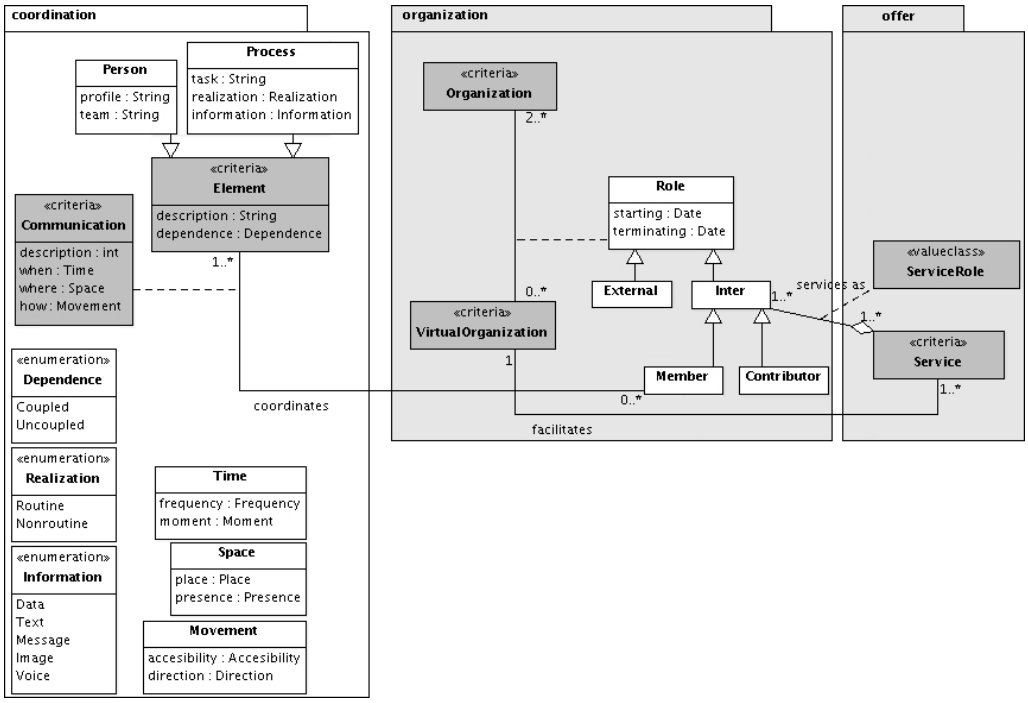


Figure 6.15: Coordination sub-aspect

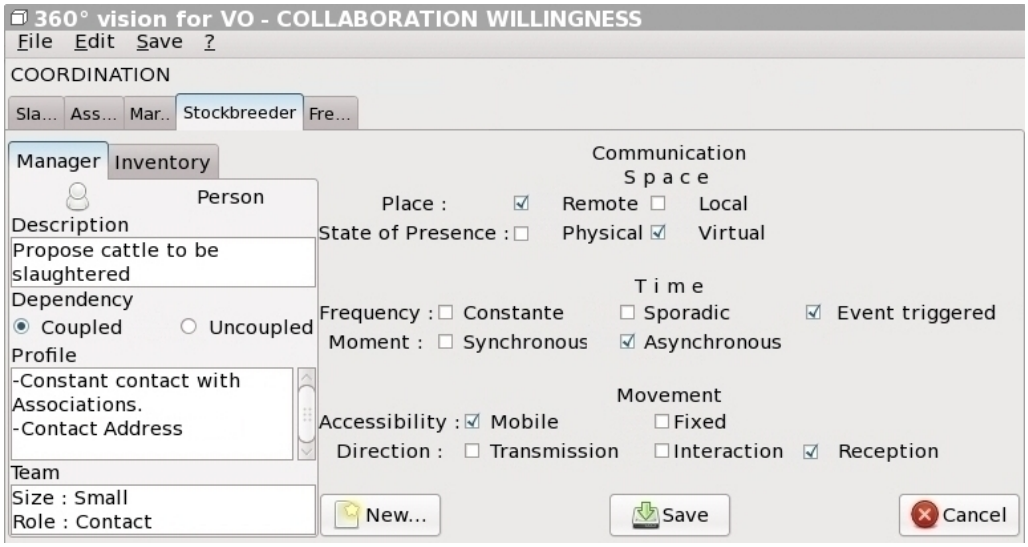


Figure 6.16: Coordination instance: manager

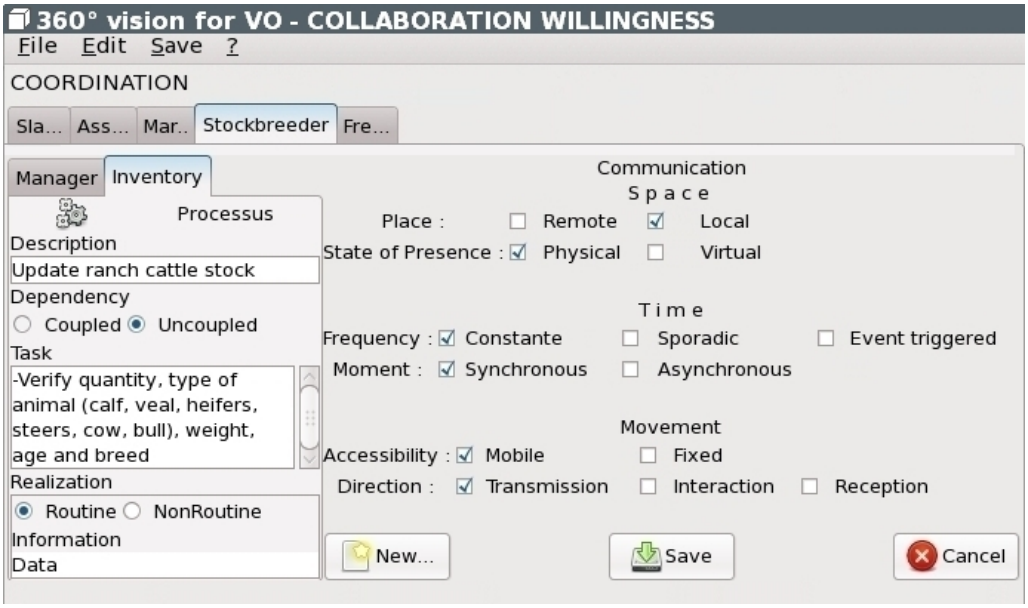


Figure 6.17: Coordination instance: inventory

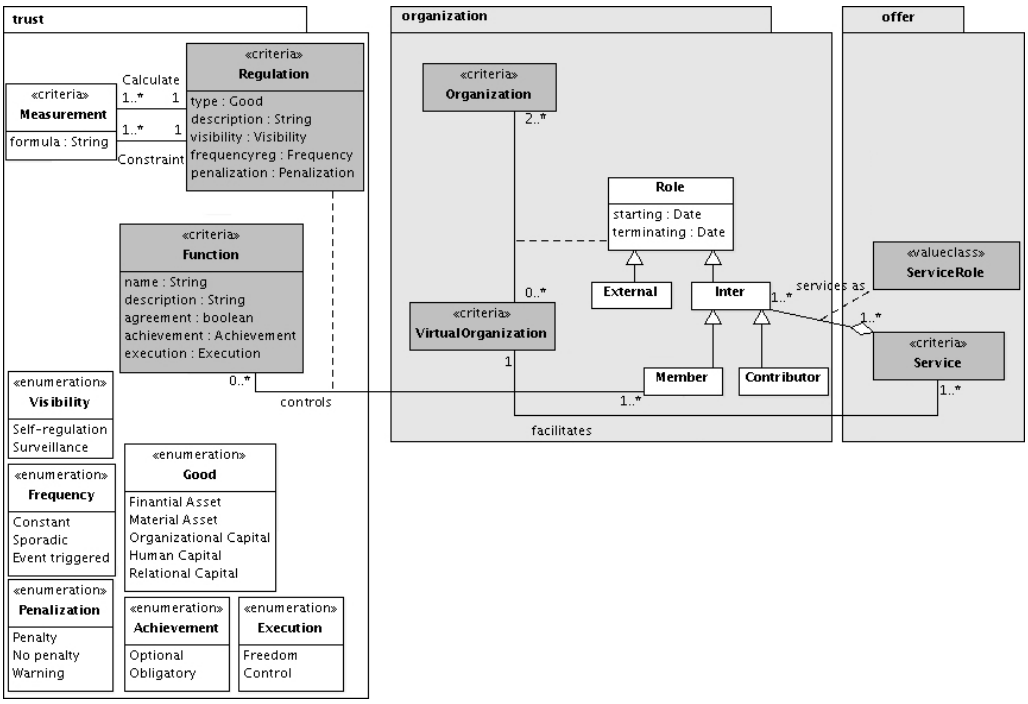


Figure 6.18: Trust sub-aspect

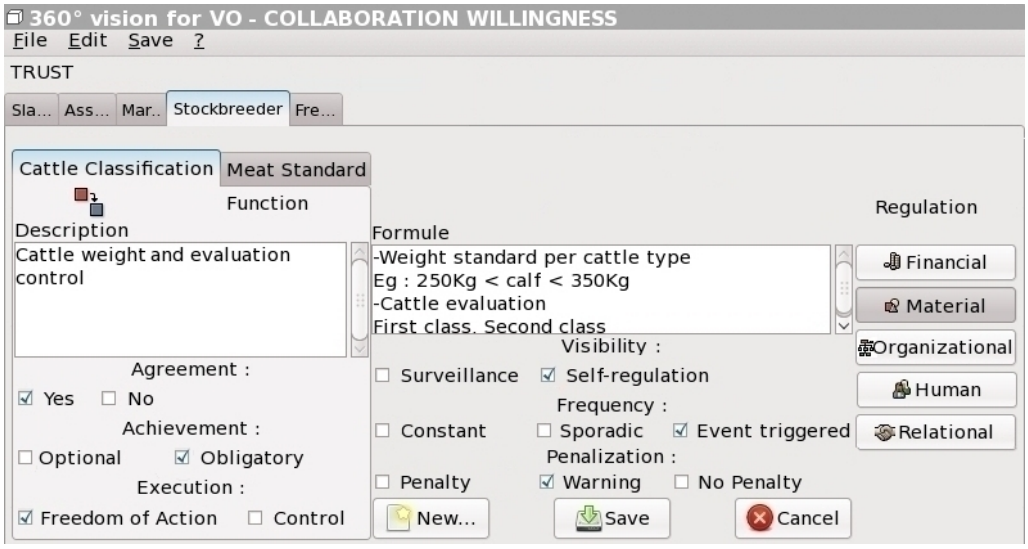


Figure 6.19: Trust instance

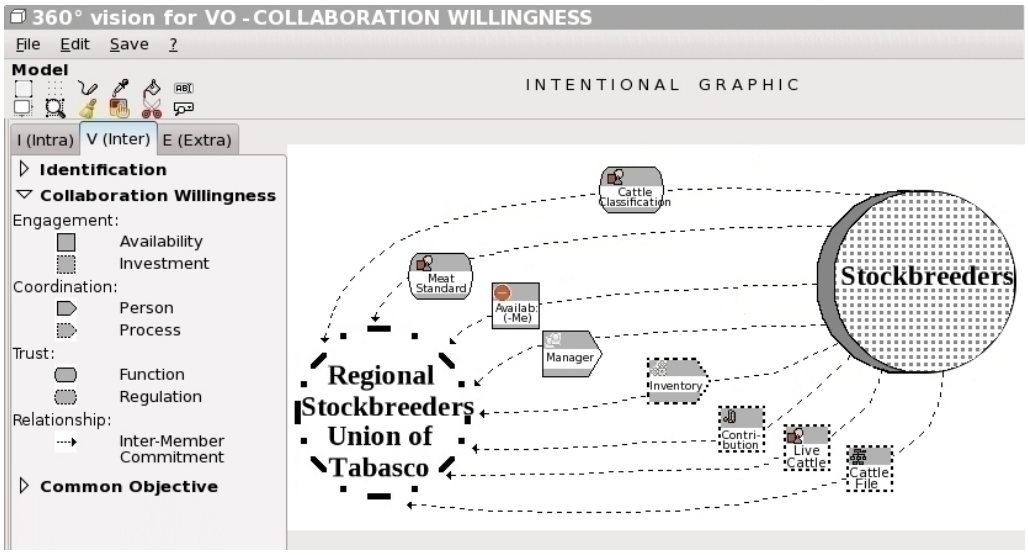


Figure 6.20: Collaboration Willingness graphic representation: Stockbreeder

6.3 Common Objective

`Common Objective` aspect is an achievement relationship characterizing the shared goal and the directions to be followed for realizing it. Usually, objectives emerge from situations that could be classified in opportunities (circumstances favoring the alliance) or problems (difficulties that justify exploring the alliance). Common Objective aspect is composed of two sub-aspects detailed below which criteria are formalized in the UML diagram of Figure 6.21.

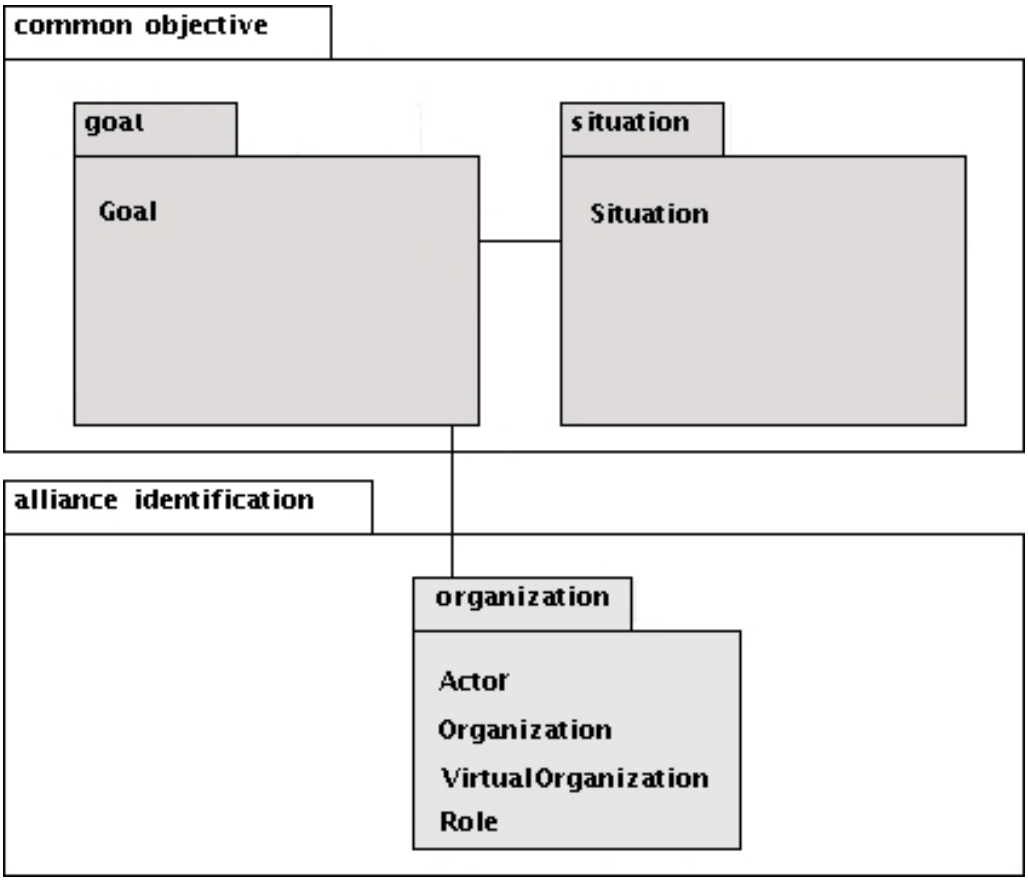


Figure 6.21: The 360° vision Common Objective aspect

6.3.1 Goal

Goals are the reasons that justify the courses of action of organizations (Inter level) to form a VO. These organizations also have to identify the VO common objectives (Inter level) to reach a consensus. As stated in 4.3.2 objectives can guide to identify the systems goals, to understand why they are important to the system and to transformed them into requirements. The ***goal*** sub-aspect is describe as follows:

- A common ***goal*** is the result of Member Organizations consensus for defining the VO

aim and justifying the steps to be followed in the alliance, see the UML model in Figure 6.22. Although each Member Organization has agreed on a common goal in the VO, they have internal goals from individuals and departments forming the organization up to higher organizational levels.

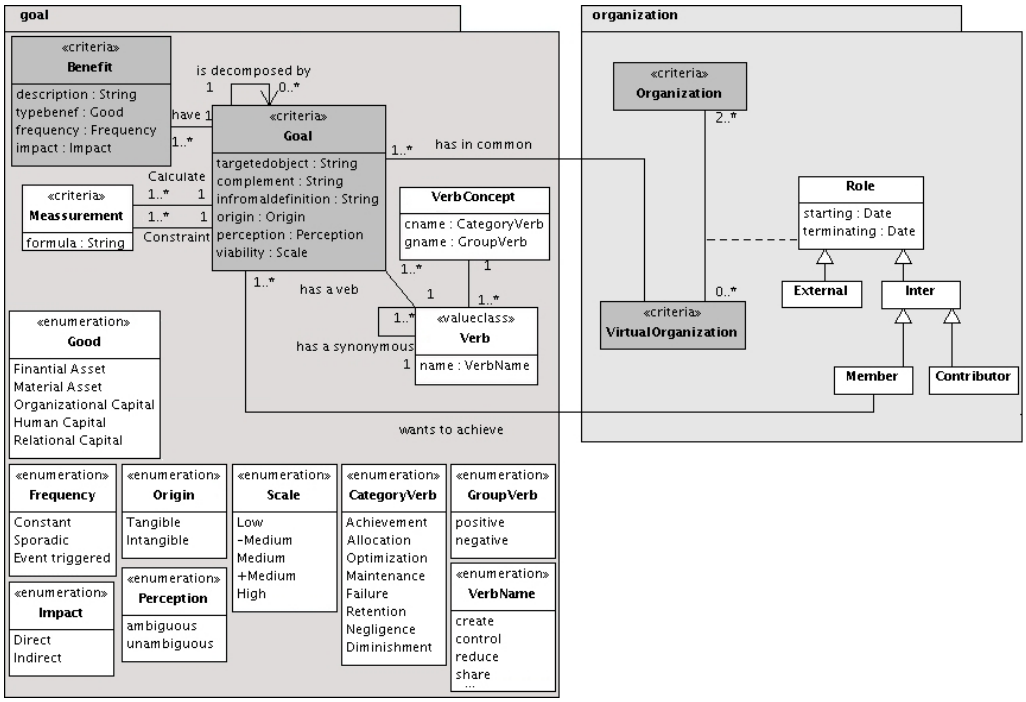


Figure 6.22: Goal sub-aspect

Based on KAOS [Dardenne et al., 1993] we define a *category of verb* covering the expected transition states for achieving the goal, this category is formed by two *groups of verb* shown in Table 6.5 along with its synonyms: positive and negative.

- Positive verbs aim to be pro active, they are categorized by:
  - Achievement when the goal seeks a change from an initial state E_1 to a different final state E_2 in a time period
  - Allocation when the goal seeks to distribute something to each member of the group at a state $E_{1/n}$
  - Maintenance when the goal seeks to keep the initial state E_1 through time
  - Optimization when the goal seeks to improve or to reach a better state E_{1+} through time
- Negative verbs correspond to the opposite actions, they are categorized by:
  - Failure when the goal seeks to recover an initial state E_1 in a time period
  - Retention when the goal seeks to hold something and not to distribute it at the members of the group at a state $E_{1/1}$

  * Negligence when the goal seeks not to keep the initial state E_1 through time but ignore it $E_{1?}$
  * Diminishment when the goal seeks to diminish or to reach a worsen state E_{1-} through time

A goal is linked to a verb (for example, create) which is linked to a verb category (for example, Achievement). A category of verbs is linked to the same kind of verbs [Perez-Medina et al., 2010].

A *targeted object* denotes the result of the action of the verb (cost, service or product differentiation, market, competences) [Goldman et al., 1995] classified as financial or material assets and human, relational or organizational capital [Parung et al., 2006]. A complement details the goal in order to clarified it. Table 6.6 shows the goal ontology.

An *informal definition* [Dardenne et al., 1993] describes the goal in natural language using the verb, the targeted object and the complement. An origin differentiates between intangible targeted objects (intellectual or spiritual like ideas, hopes) or tangible targeted objects (physical or material like money, products).

A goal *perception* determines if the goal can or can not be clearly defined (non ambiguous, ambiguous). Adapting [Checkland et al., 1999, Yu, 1997] definitions of ”hard“ (non ambiguous) and ”soft“ (ambiguous) we define the former as possible to realize with a clear satisfaction criteria, the latter as complex and confused but possible to explore its structuration without a clear satisfaction criteria.

A *viability* estimates goal achievement possibility: is it possible to realize it?, what is the estimated scale for fulfilling it (from Low to High)? Each goal has measurement objects (calculations and constraints) for evaluating it.

For refinement purposes, a goal can be decomposed or not into many goals [Yu, 1997, van Lamsweerde et al., 1998] what allows structuring them at different levels of concern.

A VO has a common goal that unites all Member Organization. A Member Organization wants to achieve its own organizational goals that hopefully the VO will help fulfill or that might enter in conflict with the VO, in the latter case, negotiations have to be carried out in order to find acceptable solutions. Moreover, the VO has to act according to the External Organizations (like Government Regulators), which in turn have their own objectives.

- The expected ***benefit*** of a common work represents the foreseen goal yield. It is formed by a *description*, a *type* (the financial or material assets, the human capital [Parung et al., 2006]), a *frequency* for attaining it (constant, sporadic or event-triggered) and an *impact* on the goal (direct or indirect).

Table 6.7 shows examples of goals for each group of verbs: Satisfy targeted markets demands, marbling for north customers, lean for others (Achievement); Retain actual clients (Retention); Increase domestic market share by 10% (Optimization).

Table 6.5: Goal Ontology Verbs

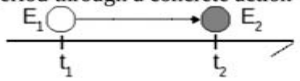
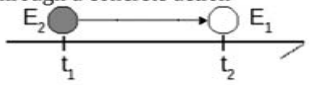
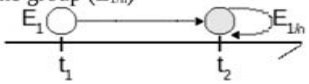
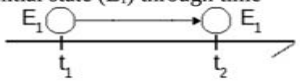
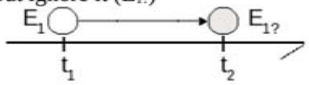
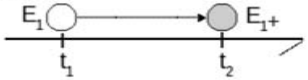
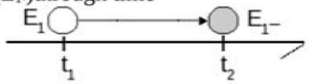
Goal					
Category Verb (CV) Description *Based on (Dardenne et al., 1993)* ***Positive***	***Verb*** Based on (Lamsweerde *et al.*, 1998) *(Goldman, 1995)*				***Category Verb (CV) Description*** *Based on (Dardenne et al., 1993)* ***Negative***
	Verb Concept				
	CV	***Group Verb Positive***	***CV***	***Group Verb Negative***	
when the goal seeks a change from an initial state (E_1) to a different final state (E_2) in a time period through a concrete action 	*Achievement*	achieve, acquire, create, make, offer, open, produce, provide, satisfy, supply	*Failure*	avoid, cancel, close, destroy, get rid of, eradicate, fail, lack, lose, outsource, ruin	when the goal seeks to recover an initial state (E_1) in a time period through a concrete action 
when the goal seeks to distribute something (E_1) to each member of the group ($E_{1/n}$) 	*Allocation*	allocate, apportion, disburse, dispense, distribute, diversify, redistribute, reapportion, share, spread	*Retention*	contain, hold, keep, withhold, resist, retain, support	when the goal seeks to hold something (E_1) of the group ($E_{1/1}$)
when the goal seeks to keep the initial state (E_1) through time 	*Maintenance*	complete, control, ensure, find out, keep, know, monitor, preserve, track maintain,	*Negligence*	disregard, neglect, forget, ignore, overlook	when the goal seeks not to keep the initial state (E_1) through time but ignore it ($E_{1?}$) 
when the goal seeks to improve or to reach a better state (E_{1+})through time 	*Optimization*	Increase, grow, improve, maximize, adapt, configure, speedup	*Diminishment*	annul, decrease, diminish, deteriorate, drop, lower, minimize, neutralize, reduce, restrict, shrink	when the goal seeks to diminish or to reach a worsen state (E_{1-})through time 

Table 6.6: Goal Ontology

Goal									
Verb Based on (Lamsweerde *et al.*, 1998) *(Goldman, 1995)*				***Targeted Object*** *(Parung et al., 2006)*					***Complement***
Verb Concept									
				Asset		***Capital***			
CV	***Group Verb Positive***	***CV***	***Group Verb Negative***	***Financial***	***Material***	***Human***	***Relational***	***Organizational***	
Achievement	achieve, acquire, create, make, offer, open, produce, provide, satisfy, supply	*Failure*	avoid, cancel, close, destroy, get rid of, eradicate, fail, lack, lose, outsource, ruin	revenues, investment costs: (payroll, operating, advertisement, maintenance) expenses: (administrative, utility, insurance)	product, material, stock, plant, machines used in the process, tools and equipment, transportation	competences, skill, education level, experience, management time, numbers of employees, employees efforts	distribution channel, customers data, customer relations, brand, image, numbers of contracts	market shares, patents, designs, track record, data bases, systems and procedures, innovation	gives more information about the objective using adjectives, precising data
Allocation	allocate, apportion, disburse, dispense, distribute, diversify, redistribute, reapportion, share, spread	*Retention*	contain, hold, keep, withhold, resist, retain, support						
Maintenance	complete, control, ensure, find out, keep, know, monitor, preserve, track maintain	*Negligence*	disregard, neglect, forget, ignore, overlook						
Optimization	Increase, grow, improve, maximize, adapt, configure, speedup	*Diminishment*	annul, decrease, diminish, deteriorate, drop, lower, minimize, neutralize, reduce, restrict, shrink						

Table 6.7: Goal examples

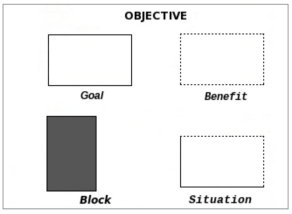
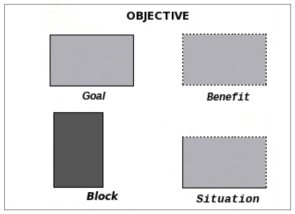
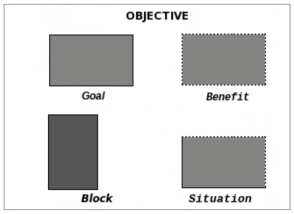
Goal examples			
C V	***Informal Definition*** *(Positive)*	***C V***	***Informal Definition*** *(Negative)*
Achievement	**Produce** high quality bovine meat **Satisfy** targeted markets demands (marbling for north customers, lean for others) **Create** direct sale points of meat cuts **Acquire** national acknowledgment **Open** new international markets	*Failure*	**Avoid** cattle meat import effects **Eradicate** contagious diseases **Outsource** non core businesses **Get rid** of unprofitable customers that buy less than 1,000 a year **Close** unprofitable businesses
Allocation	**Share** production costs **Diversify** cattle products sales (horn, bone) **Redistribute** meat buyers	*Retention*	**Resist** North American Free Trade Agreement (NAFTA) impact **Retain** actual clients **Support** diversification projects
Maintenance	**Maintain** sanitary conditions **Monitor** production costs **Track** each animal history	*Negligence*	**Disregard** non core projects **Overlook** expensive distribution channels **Ignore** non bio feeding methods
Optimization	**Increase** domestic market share by 10% **Increment** net income **Maximize** buyers portfolio	*Diminishment*	**Reduce** environmental impact with meat production (eg. water recycling) **Minimize** production costs **Neutralize** competitors impact

Following our three levels proposal, there is a Common Objective to elicit by level. Table 6.8 presents the graphical representation of the Common Objective aspect, all concepts have a rectangle shape, the rectangle delineated by continuous lines represents the *goal*; the rectangle delineated by dotted lines do so for *benefits* and the rectangle delineated by two dotted and two continuous lines represent the *situation* (this sub-aspect is described in the following section). In order to represent more than one *goal*, *benefit* or *situation*, rectangles can be overlapped using the Block shape which is represented by a thin rectangle colored with intense gray. Each rectangle has a filling color to identify the level of concern: white for Intra, light gray for Inter and dark gray for Extra level. Each level has two different relationships: one for Goal Refinement that allows to joint several sub-goals and another for Goal Achievement (see examples in Figures 6.23 and 6.24). The Intra-Achievement relation links the goals of a Member Organizations, the Inter-Achievement relation do so for the VO and the Extra-Achievement for the known goals of an External Organization.

As stated above, each Member Organization is an independent organization that has goals to achieve, generally aligned to its operational objectives (Intra-level objectives). Figure 6.23 shows the high level goals the Member Organizations of the UGRT VO want to achieve and Figures 6.24 and 6.25 show the hierarchical refinement of each Member Organization goal explained in the following paragraphs:

- *Stockbreeders Associations* have goals to comply the UGRT and their operational needs, these goals are to ”Control Stockbreeders Memberships“, ”Assign the most

Table 6.8: Graphical notations of the Intentional 360° vision for VO: Common Objective

Model	***Intra***	***Inter***	***Extra***
Concepts			
Relations			

Cattle Shipment“ and ”Promote Improvement Programs“. Regarding ”Cattle Shipment”, Associations have to “Know” what Stockbreeders can offer and for doing so, it is important to keep constant contact with them, and to “Negotiate” the shipment (see Figure 6.24a).

- *Freight Trucking* objectives and its refinement are shown in Figure 6.24b: “Meat Transport Regulations”, “Transport All Live Cattle Requested”, and “Transport Requested Meat Cuts”.

- *Stockbreeders* want to ”Sell all Available Cattle“ they have ready for the meat market, ”Control Ranch Budget“ and “Have Quality Cattle” what is demanded by the meat market, these goals refinement is depicted in Figure 6.24c.

- *Slaughterhouse* objectives are “Meet Meat Labeling Regulations” in order to allow product traceability, meat recalls, etc., “Maintain TIF Certification”, for complying sanitary norms, and “Slaughter all Cattle Scheduled” for satisfying demand (see Figure 6.25a.

- *Meat Marketing* attains to “Balance Offer vs Demand” between the meat customers and the Stockbreeders, “Neutralize Competitors Impact” in order to protect the group interests, and “Increase Buyers Portfolio” to avoid dependence on a single meat buyer (see Figure 6.25b).

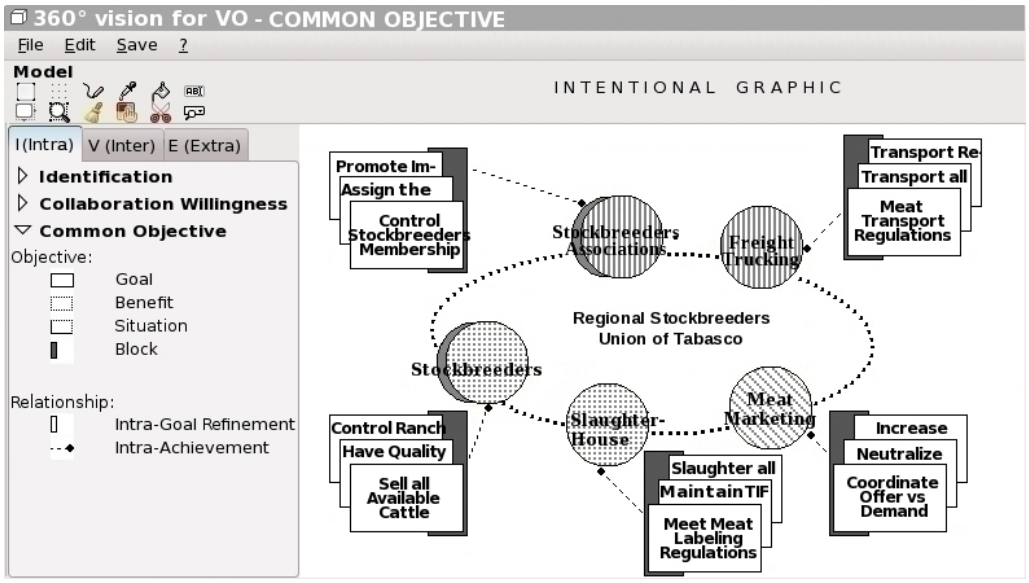
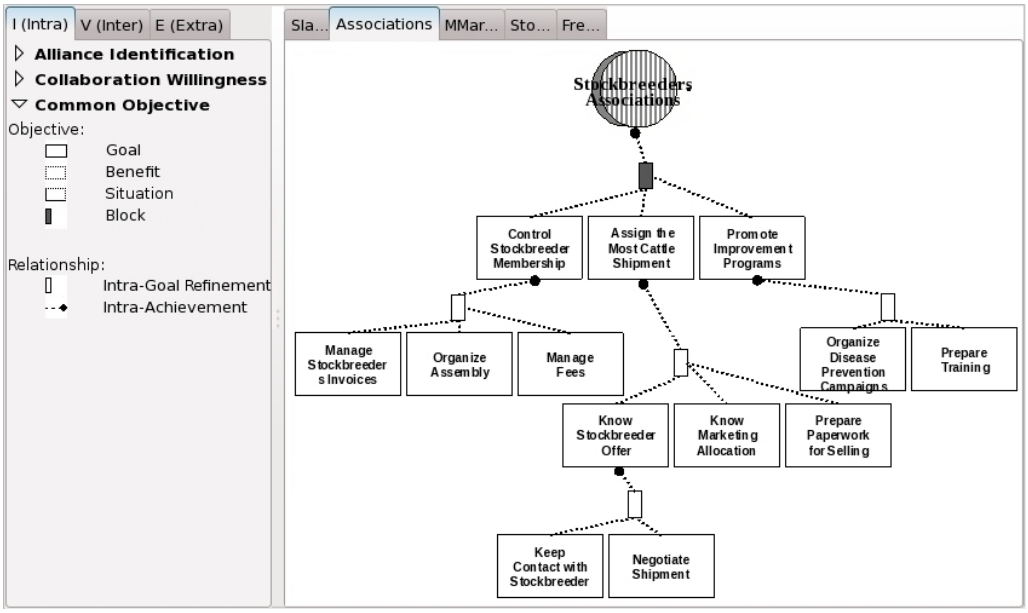
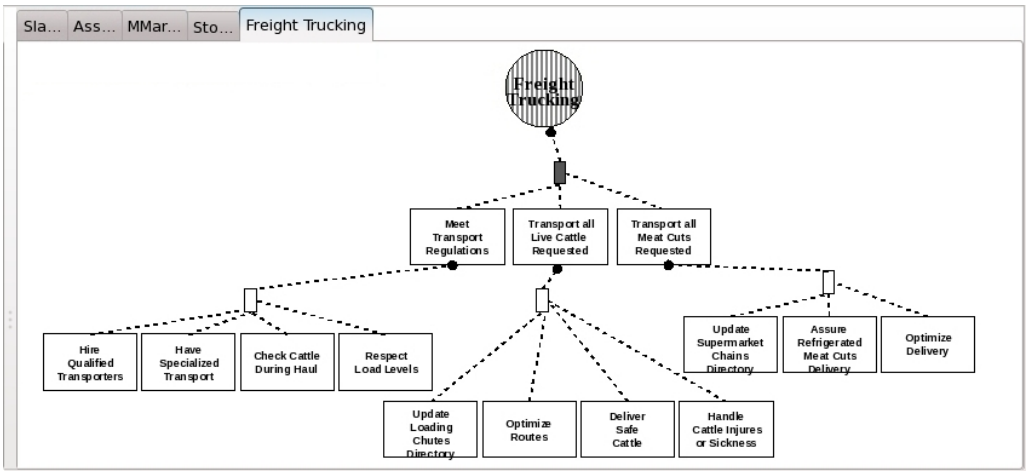


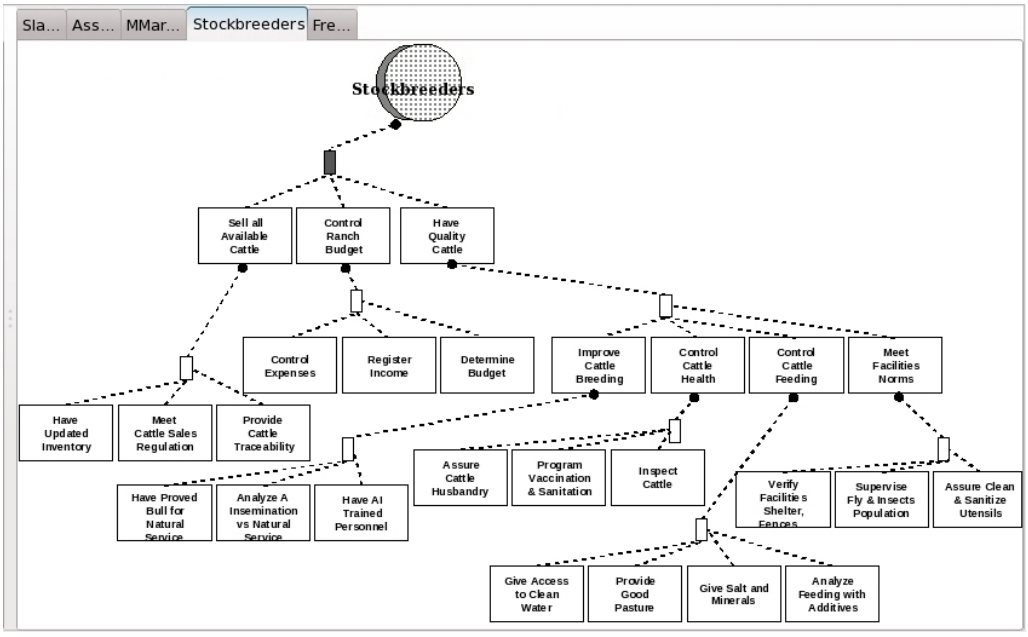
Figure 6.23: Graphic representation of UGRT Member Organizations Goals



(a) Stockbreeders Associations

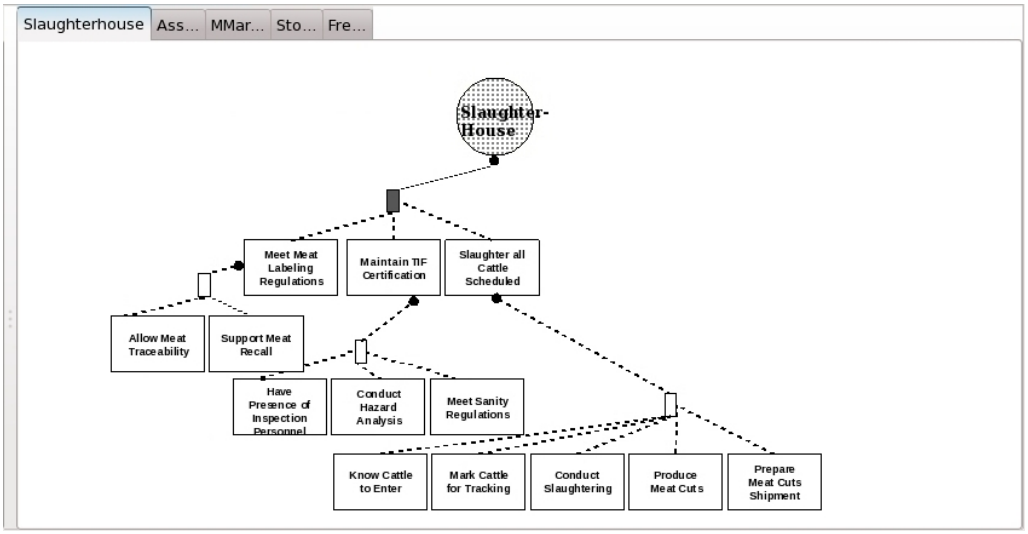


(b) Freight Trucking

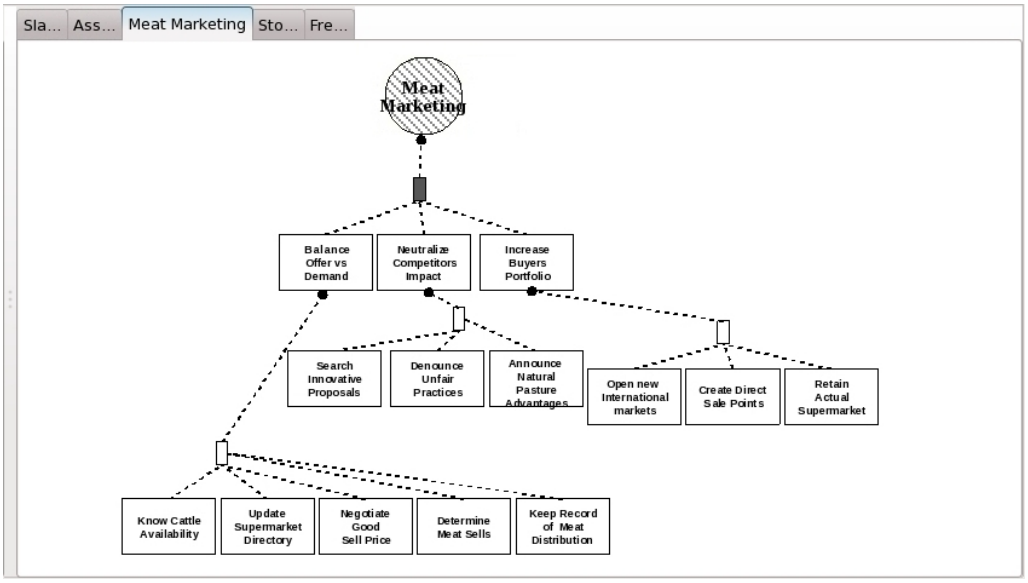


(c) Stockbreeders

Figure 6.24: Intra Goals refinement examples (part I)



(a) Slaughterhouse



(b) Meat Marketing

Figure 6.25: Intra Goals refinement examples (part II)

The VO has common objectives (Inter level objectives) that justify all Member Organizations to work together, the instance of these objectives for the UGRT is shown in Figure 6.26: “Share production costs” and “Increment net income” (the Situation criteria is explained in next sub-section). The objectives refinement is depicted in Figure 6.27, for the “Increment net income” objective for example, each organization agrees to “Collect historical data” which is composed of two sub-goals: “Analyze Indirect Cost” and “Analyze Direct Costs”.

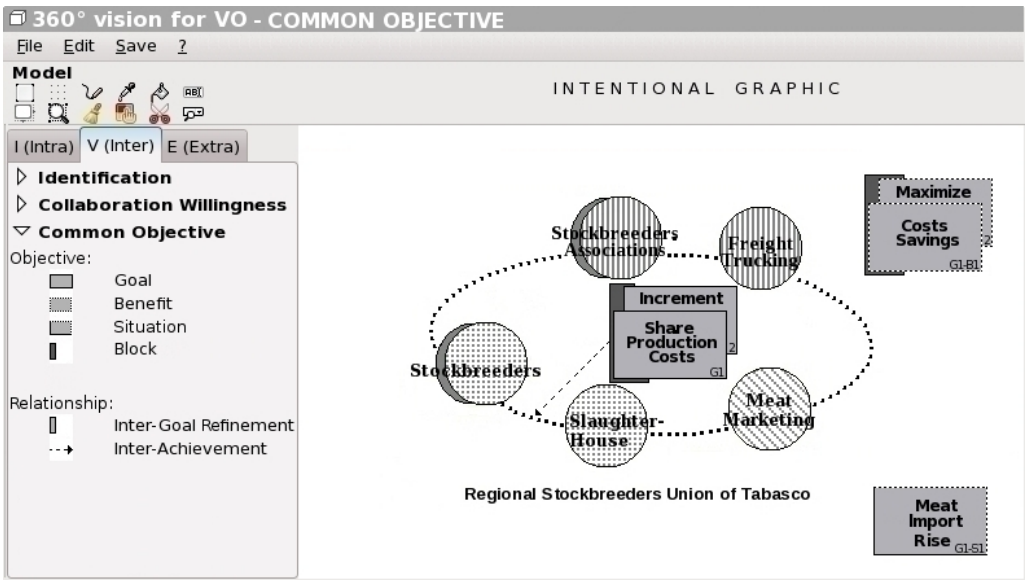


Figure 6.26: Graphic representation of UGRT Common Objective

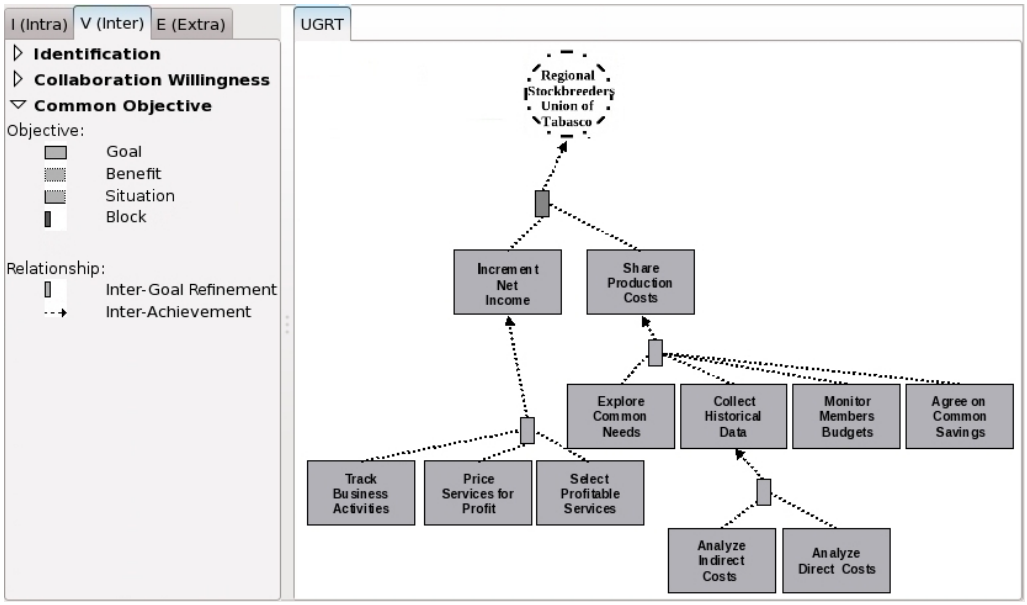


Figure 6.27: Inter Goals refinement

Previously, we have stated that organizations are not isolated entities because they have to interact with its external environment, and we have classified these External Organizations in Competitor, Complementor and Regulator Organizations. Besides exploring the Extra-level objectives for enlarging the VO scope, we can justify them because:

- although it might be difficult to have a clear knowledge of Competitor Organizations' objectives because of the limited data available, exploring its identification can help to understand competitors and predict their behavior [Armstrong et al., 2007, Fleisher et al., 2003].
- there is a positive impact to continuous improvement on service quality and value when Complementor Organizations relate their goals [Noonan et al., 2003, Wong, 1999]
- in almost any domain, there is an impact in the system requirement caused by laws and regulations that can constrain or influence how organizations operate [Otto et al., 2007, Siena et al., 2008], therefore it is necessary to comply to these regulations which might be ignored as strategic goals for the Member Organizations or the VO.

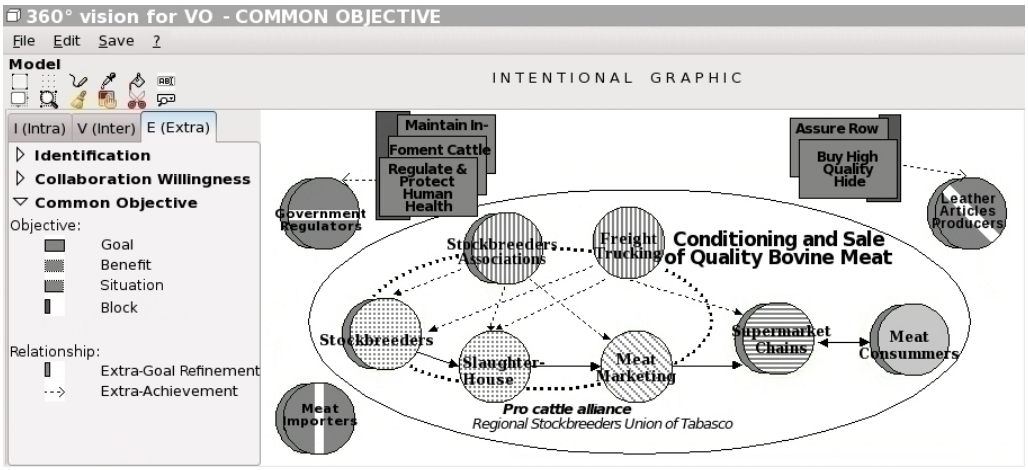


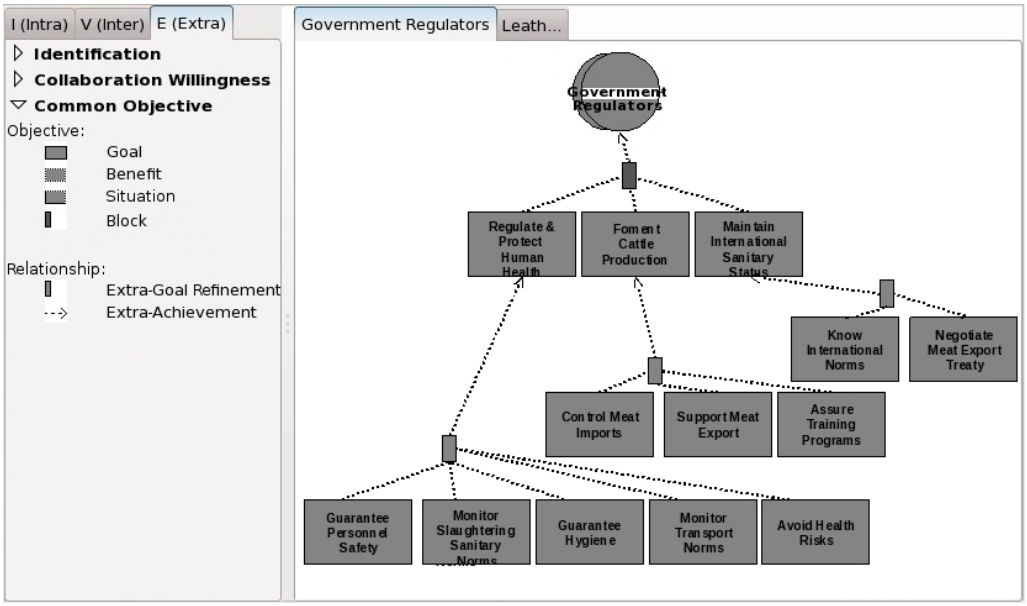
Figure 6.28: Graphic representation of the External Organizations Objectives

We illustrate two External Organizations objectives of our case study in Figure 6.28. The External Organizations objectives are depicted in Figure 6.29 and explained in the following paragraphs:

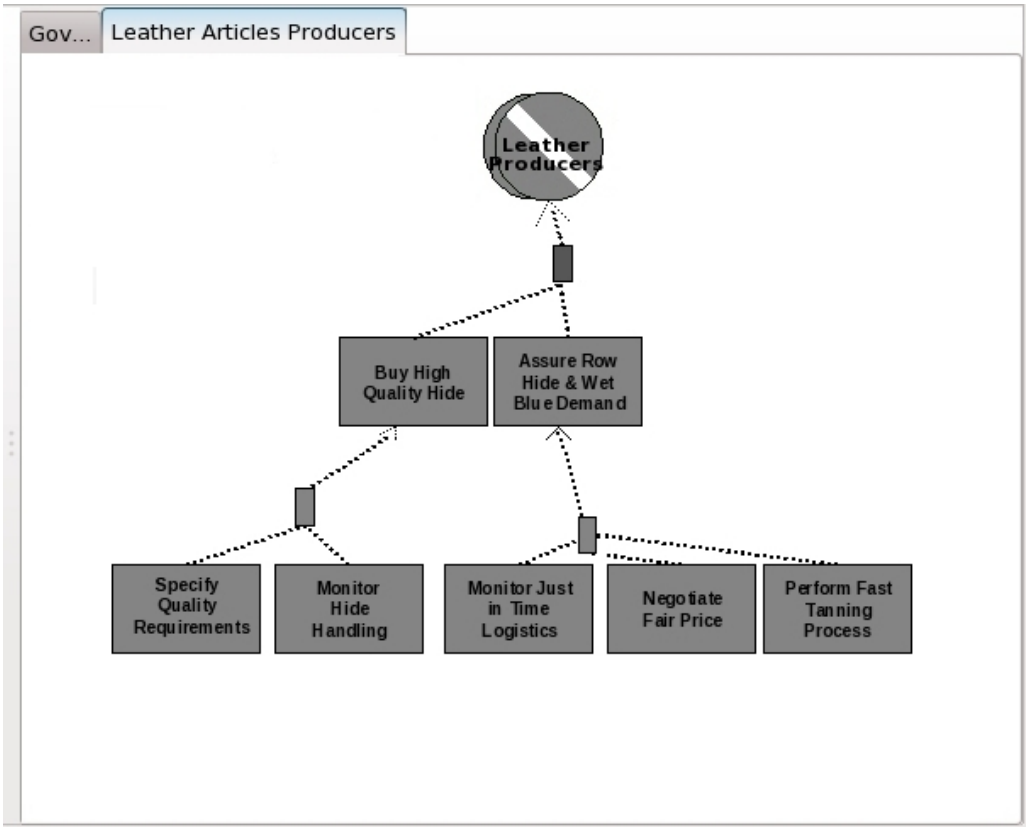
- *Government Regulators*. Especially in the food domain, there are government organizations responsible for ensuring the safety and wholesomeness of meat, therefore, norms regarding human health, food safety standards, and inspection programs are established. For the UGRT case study these objectives are expressed by the "Regulate & Protect Human Health" and "Maintain International Sanitary Status" goals,

these goals regard the whole meat production chain, from animal health to meat consumption. Another government axis is to promote economic development in the region which is expressed by “Foment Cattle Production”. Figure 6.29a shows these goals refinement.

- *Leather Articles Producers* is an important Complementor Organization for the UGRT. Their objectives are “Buy High Quality Hide”, and “Assure Row Hide & Wet Blue Demand”. For the UGRT is necessary to know this objectives in order to assure that the Stockbreeders prevent scratches in hides mainly caused by barbed wire-hide and ticks. Figure 6.29b details the sub-goals for the Leather Producers.



(a) Government Regulators



(b) Leather Articles Producers

Figure 6.29: Extra Goals refinement example

6.3.2 Situations

Understanding **Situations** leads to better adapted solutions, see the UML model in Figure 6.30. They can be classified in ***opportunities*** and ***problems*** that combine the factors that favor or obstruct goal achievement. Situations have a *description*, a *repercussion*, as Member Organizations decide to let go the opportunity or as a result of the problem. Finally, the means for taking advantage of the opportunity or for facing the problem where each Member Organization lists its *strengths* (aptitudes, competences) and *weaknesses* (shortcoming, deficiencies) that should be improved or avoided.

- An ***opportunity*** is described by a conjectural *circumstance* that facilitates objective achievement, a *tendency* that determines if is a novel (innovative) or an already known (imitative) circumstance, a *reference* describes either the innovation or the imitation to introduce precising the *source* (who's idea is it? or who has done it before!, for example). We also analyze the *risks* (foreseeing contretemps, inconveniences) usually higher in innovative circumstances than in imitative ones. Risks are scaled from Low to High. A *perception* of the circumstance (non ambiguous, ambiguous) answers the questions Is it a clear circumstance? Is it confuse?

- A ***problem*** is a difficulty that can justify the objective throughout the alliance. In this type of circumstances a reactive action is mainly expected. It is described by a problematic or not desirable circumstance in terms of a *cause* that provokes it. We determine the problem *impact* towards the Member Organization performance (direct, indirect). We precise the real or foreseeing *existence* of this problematic circumstance.

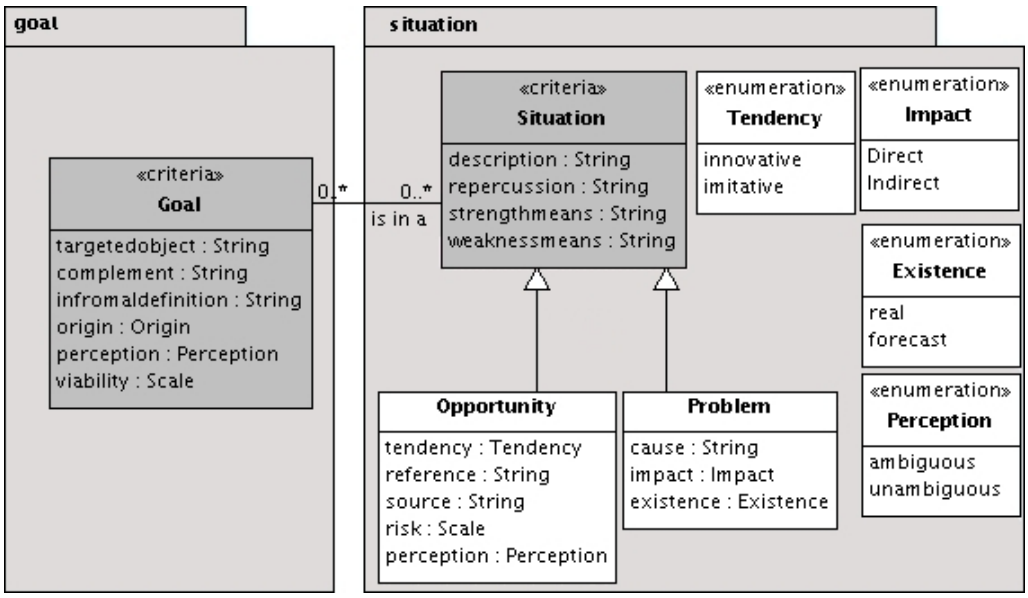


Figure 6.30: Situation sub-aspect

Figure 6.26 shows the common objective graphic representation among organizations forming the VO according to Table 6.8. Each objective is represented by a rectangle with a short description legend, these rectangles can be overlapped to represent more than one objective. There are two objectives represented in the figure: ”Share production costs“ and ”Increment net income‘. Benefits are represented by dotted lines rectangles, “Cost savings” and “Maximize use of transportation equipment”. Situation is described as “Rise of meat imports”. Benefits and Situations are labeled to ease their search in the description screen of a common objective (e.g. G1-B1, G1-S1 meaning that Goal 1 has a Benefit 1 and a Situation 1).

Complementing the instance presented in Figure 6.26, Figure 6.31 proposes an instance of the VO common objective ”Share production costs“, which is a tangible objective (related to material objects), with a clear satisfaction criteria and an estimated achievement possibility of 50%. One of the benefits is ”Maximize use of transportation equipment“ is described as financial, with an event-triggered frequency and a direct impact. The Situation ”Rise of meat imports“, lists the strengths and weaknesses the VO has to face the problem mainly caused by the NAFTA treaty. This model can be used at any of the three levels proposed to better describe the objectives.

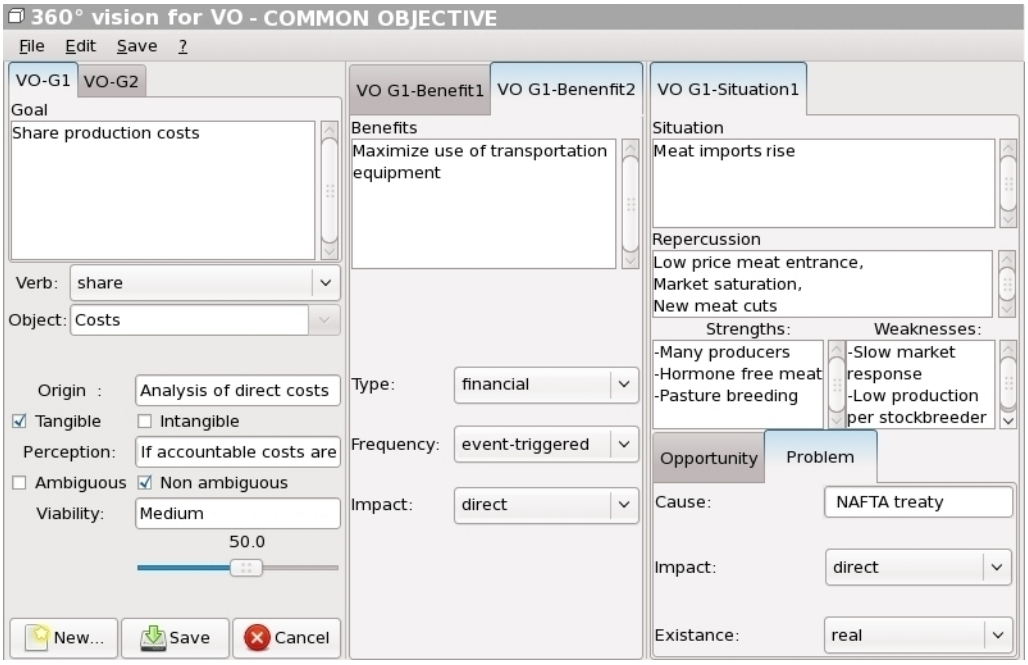


Figure 6.31: Common Objective instance

6.4 The intentional method cycle

Using the Map model described in Section 4.3.2.3, we present in Figure 6.32 the 360° VisiOn cycle explained in this chapter. The tree main Aspects (Alliance Identification, Collaboration Willingness and Common Objective) are represented as intentions. Sub-Aspects are represented as strategies for achieving the intention, thus Alliance Identification can be achieved by actor, offer and alliance. We can observe that the proposed cycle is not linear, from each aspect, an improvement strategy is considered for continuing exploring it and a sufficiency strategy allows to explore another aspect. We can question whether the intentional completeness is achieved and thus stop, or we can continue to discover Alliance Identification, Collaboration Willingness or Common Objectives.

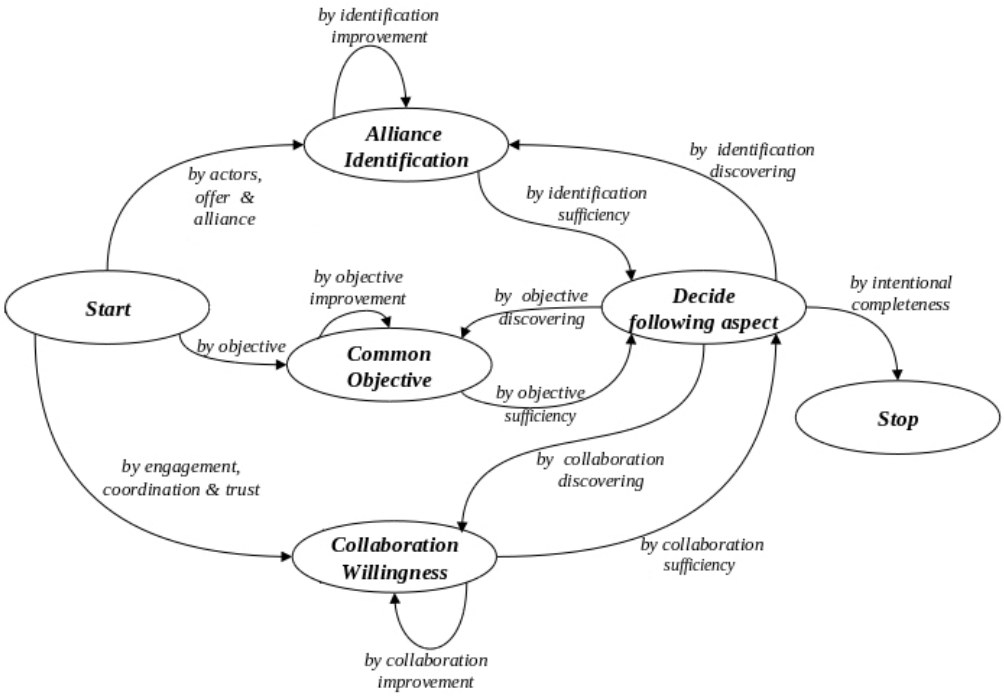
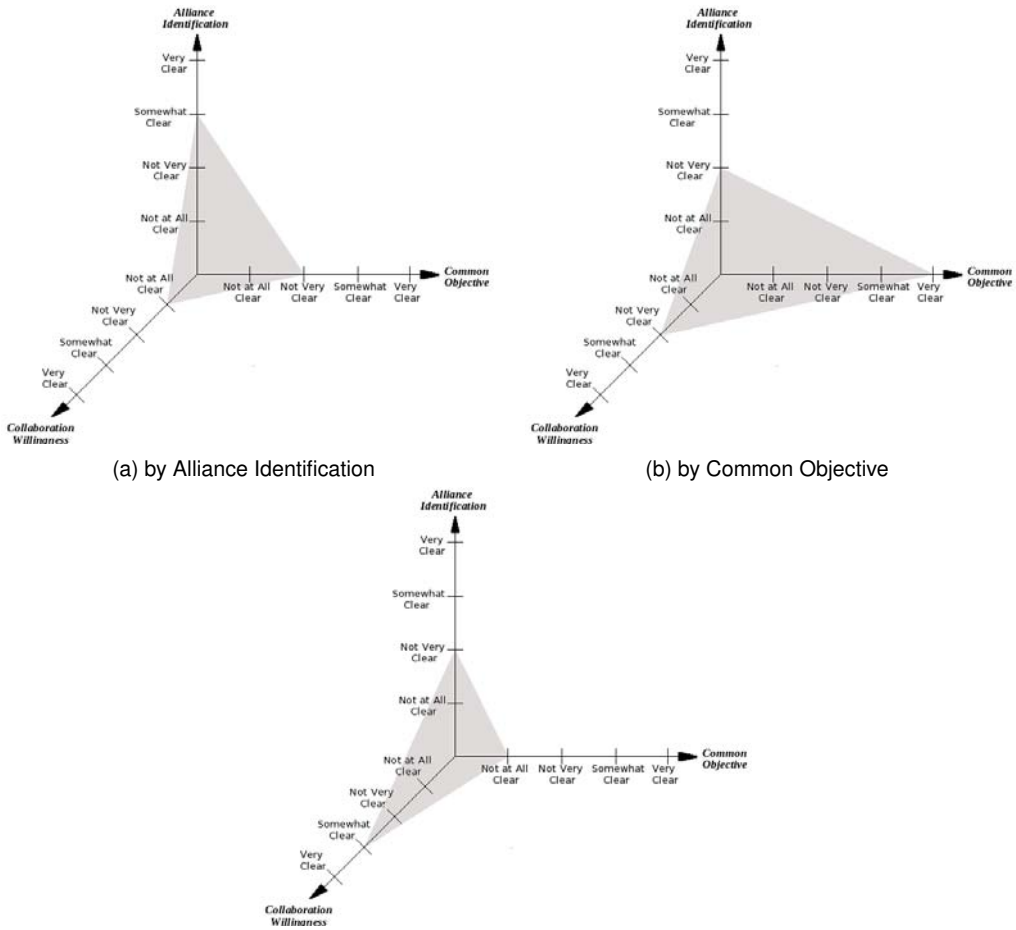


Figure 6.32: The 360° vision cycle using the MAP

The methodology is presented as a sequence of intentions with iteration back to previous intentions. From the *Start* intention, the following sequence will depend on the knowledge we have about the instances of *Alliance Identification*, *Collaboration Willingness* and *Common Objective*. We use a scale of Not at All Clear, Not Very Clear, Somewhat Clear and Very Clear to determine this knowledge. If as shown in Figure 6.33a, there is more clear information about the organizations, the offer or the alliance, then we will be directed to the *Alliance Identification* intention. For example, if we know that we want to sell bovine meat, we can start describing the service. Figure 6.33b shows a very clear *Common Objective* and Figure 6.33c, a Somewhat Clear *Collaboration Willingness*. For the research proposals calls for example (case (a)), we might have a defined group of different organizations applying for funding, in order to compete, they will have to adapt their objectives to match those

given by the funding institution proposal. Some other times there is chemistry between or among organizations with a general objective of working together, so they start by exploring collaboration alternatives (case (b)). Another case (case (c)) could be one organization willing to apply for funding and looking for partners to join it, organizations will have to define and agree on the common objectives that at the beginning might not be very clear.



(a) by Alliance Identification

(b) by Common Objective

(c) by Collaboration Willingness

Figure 6.33: Examples of guidance dominance

In this chapter we have presented the 360° VisiOn. At the Intentional level, the proposal aims to identify the VO and its participant organizations (Alliance Identification), characterize the collaboration (Collaboration Willingness) and define the objectives (Common Objective). The proposal includes graphical and textual models which are illustrated with the UGRT case study. The next chapter establishes a way to transform our proposal to the organizational level.

CHAPTER 7

Towards the Organizational Level

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The 360° VisiOn models provide a clearer understanding of a VO from an intentional perspective, and business processes do so from an organizational perspective to structurally describe the corresponding activities. Therefore, the Organizational level aims to formalize the business processes of the VO. Business Process Modeling permits organizations to understand and communicate their internal business processes in a formal or semi-formal graphical notation. The main graphical business process modeling notations available are UML with its class, sequence, collaboration, etc. diagrams [Russell et al., 2006, Engels et al., 2005] and Business Process Modeling Notation (BPMN) with its Business Process Diagram (BPD). Business Process Management (BPM) allows organizations to analyze, model, execute and monitor their business process. We use BPMN as a target model notation to represent the 360° VisiOn models at the organizational level.

7.1 Business Process Modeling Notation

Efforts for standardizing BPMN are carried out by the Object Management Group (OMG) in order to "provide a notation that is readily understandable by all business users, from the business analysts that create the initial drafts of the processes, to the technical developers responsible for implementing the technology that will perform those processes, and finally, to the business people who will manage and monitor those processes" [OMG, 2010b]. With tools like BPMN we can state that once the business process is designed, the process implementation is easier. In this section we are only interested in BPMN modeling. Figure 7.1 shows the complete BPMN notation given by [3] that will be detailed in the following paragraphs and illustrated in an example based on the UGRT case study.

BPMN defines a BPD as a graph composed of simple graphical elements that are organized into specific categories for supporting complexity by adding additional information or variations without changing the diagram's look-and-feel (see Figure 7.1 for the

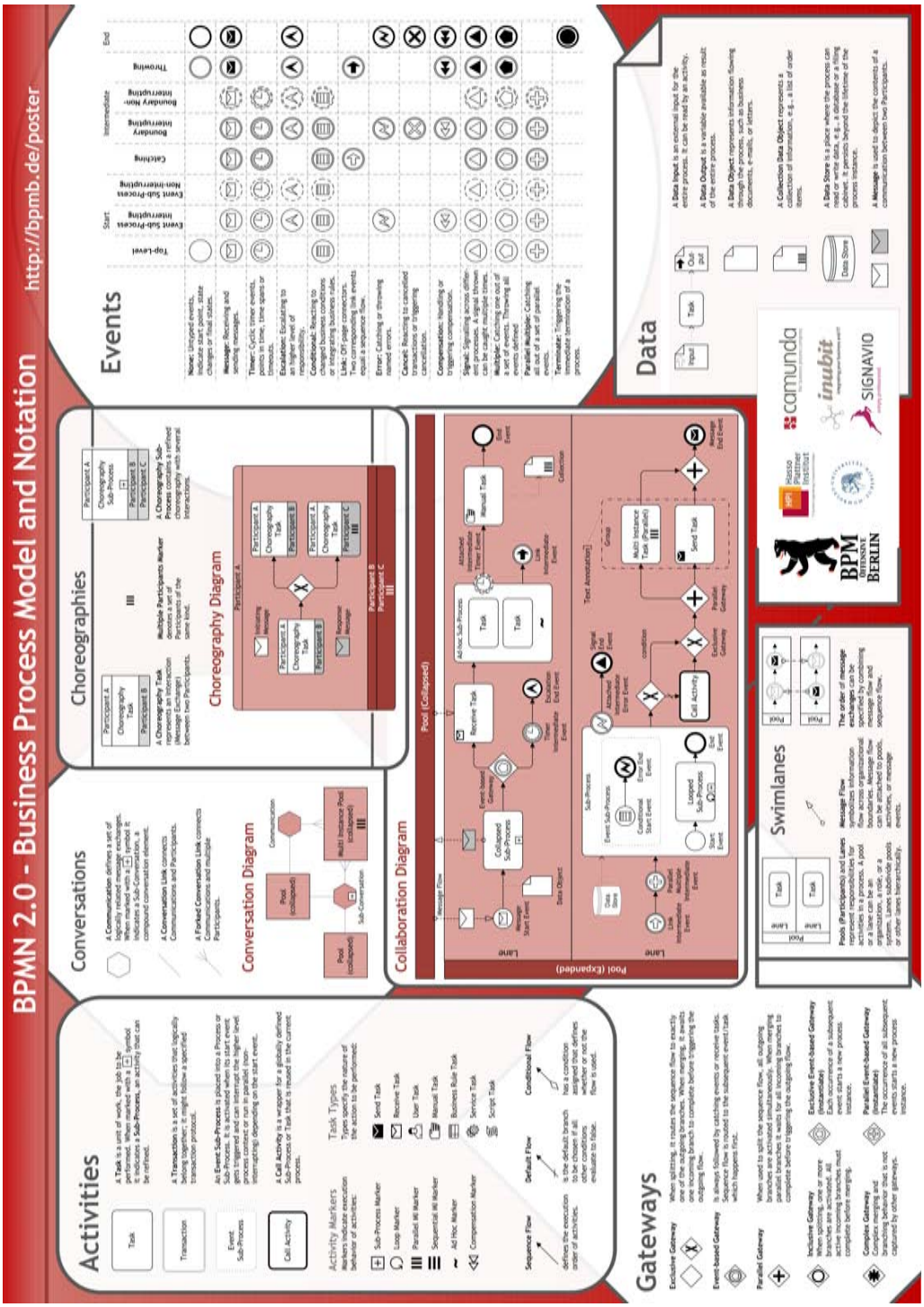


Figure 7.1: The BPMN 2.0 Business Process Model and Notation [BPM-Offensive Berlin]

different icons that better describe an element). The basic categories of elements are [White, 2004, White et al., 2008, OMG, 2010b]:

- ***Flow Objects*** "are the main graphical elements to define the behavior of a Business Process" [OMG, 2010b], these elements may be:
  - *Events*: is something that occurs during the sequence of actions of a business process. There are three types of Events: Start (indicates where a Process or Choreography will start), Intermediate (it occurs between a Start Event and an End Event, they will affect the flow of the Process or Choreography) and End (indicates where a Process or Choreography will terminate). Events are based on when they affect the flow of the process, generally they have a trigger and a result identified by markers.
  - *Activities*: can be a Task (which is a unit of work) or a Sub-Process (which is an activity that can be decomposed). Activities can also be Transactions (Sub-Process supported by a protocol that insures agreement on whether the activity should be completed or canceled), Event Sub-Process (has a Start Event with a trigger that executes the process when activated) and Call Activity (transfers the control to the called globally defined Sub-Process or Task when activated). They can have Loop, Parallel, Sequential, Ad Hoc (with a flexible ordering execution) or Compensation Markers that indicate the activity execution behavior.
  - *Gateway*: is used to control the Sequence Flow and it determines branching, merging, forking and joining of paths. Markers indicate the control behavior (Exclusive, Inclusive, Parallel, etc.) of the Gateway.
- ***Data*** is a way to model items that are created, manipulated, transformed and used during the execution of a Process. These items can be either physical items (money) or information items (a bank statement) for example.
  - *Data Object* represents information flowing through the process (like documents, e-mails, letters), it states which Activities require to be performed and/or what they produce. They can represent a singular object or a collection of them (marked by a three small vertical bars in bottom center of the Data Object representation).
  - *Data Input* is an external information entering to the entire process. It can be read by an activity.
  - *Data Output* is a variable information resulting from the entire process.
  - *Data Store* provides a mechanism for Process to read or write stored information that will persist beyond the lifetime of the Process' scope.
  - *Message* is used to depict the contents of a communication between two Participants.
- ***Connecting Objects*** are the ways of connecting the Flow Objects among them, they are composed of the following elements:
  - *Sequence Flow* shows the order that Activities will be performed in a Process and in a Choreography. They can be Normal (flows that do not start from an Intermediate Event attached to the boundary of an Activity), Uncontrolled (a flow

that is not affected by any condition), Conditional (a flow that has a condition verified at run-time), Default (a flow that will be used only if all the other outgoing conditional flows are not true at run-time), Exception (a flow that occurs outside the normal flow of the Process and is based upon an Intermediate Event attached to the boundary of an Activity that occurs during the performance of the Process).

  - *Message Flow* is used to represent the flow across organizational boundaries. It can be attached to pools, activities or message events.

- ***Swimlanes*** are the ways of grouping the primary modeling elements to represent responsibilities for activities in a process which can be an organization, a role, or a system.

  - *Pool* is the graphical representation of a Participant in a Collaboration. It may have internal details.
  - *Lane* is a sub-partition within a Pool.

- ***Artifacts*** are elements that can be added to a diagram to provide the context appropriated to a specific modeling situation. A modeler or modeling tool may extend a BPMN diagram and add new types of Artifacts to a Diagram respecting the Sequence Flow and Message Flow connection rules. The current version of the BPMN specification pre-defines at this point three types of BPD Artifacts, which are:

  - *Association* is used to associate Artifacts with flow objects and the inputs and outputs of activities.
  - *Group* is a grouping of graphical elements that are within the same Category for documentation or analysis purposes, it does not affect the Sequence Flow.
  - *Annotation* is a way for a modeler to give additional information for the BPD reader.

We can observe in Figure 7.1 that the elements described above may be used in more than one type of the diagrams described below:

- *Process* diagrams include the elements defined above for describing the organization's sequence of activities.

- *Collaboration* diagram specifies two or more Participants and the Message exchange between them. These diagrams include Pools and Message Flow between the Pools, they allow all combination of Pools, Process and Choreography. Pools may include Process diagrams or not, called the latter "black box".

- *Conversation* diagram is an informal description of a Collaboration that shows the logical relation of Message exchange. It includes two additional graphical elements exclusive to this view:

  - Conversation Node elements that define a set of logically related message exchanges (*Conversation*, *Sub-Conversation* marked by a small plus sign in bottom center of the graph, and *Call Conversation* that identifies a place in the Conversation where a global Conversation is used.
  - Conversation Link that connects Conversation either to one Participant (*Conversation Link*) or to multiple Participants (*Forked Conversation Link*).

- *Choreography* is a scalable model of Participant interactions designed to allow standalone. The specific elements are:
  - Choreography Task represents the Message exchange between two Participants, it can have the Loop, Parallel or Sequential Marker. There can be a set of Participants of the same kind represented by the Multi Participant Marker.
  - Choreography Sub-Process contains a refined Choreography with several interactions, it is marked by a small plus sign in bottom center of the graph.

Based on the Scenario example given in Figure 4.11, to illustrate the use of BPMN within a Collaboration diagram between Stockbreeders and Stockbreeders Association, we have developed the BPD for the Scenario 1 “Sell available cattle to Stockbreeders Association” and the Scenario 1.2 “Stockbreeder prepares the list of available cattle to the Stockbreeders Association”. The Stockbreeder is responsible of preparing the list of cattle willing to sell. For doing so, he/she has to identify each animal of the herd (group “Obtain Identifier”) by giving the New Bovine Data related to its birth information (date, weight, breed, sex, father and mother identifiers) and “Assign Identifier” for new animals and “Retrieve Identifier” for animals already registered. At a certain date, Stockbreeders proceed to weight their cattle, this information is stored in a database for being analyzed by the “Obtain Stock” task taking into account the business rules given by the Slaughterhouse (not shown in the diagram) that specify for each type of animal calf, veal, heifers, steers, cow or bull the weight for being sold, from this task the list of “Cattle Stock for Sale” is obtained. The Stockbreeder Association is responsible of Preparing Cattle for Shipment, it “Receives Stock” from the Stockbreeder and the “Cattle Demand” from Marketing (not shown in the diagram) to “Verify Cattle Offer and Demand”. With this information a Shipment Proposal can be made to the Stockbreeder. This example illustrates what can be represented in BPMN and gives indication of the BPMN models to be obtained from the Intentional level.

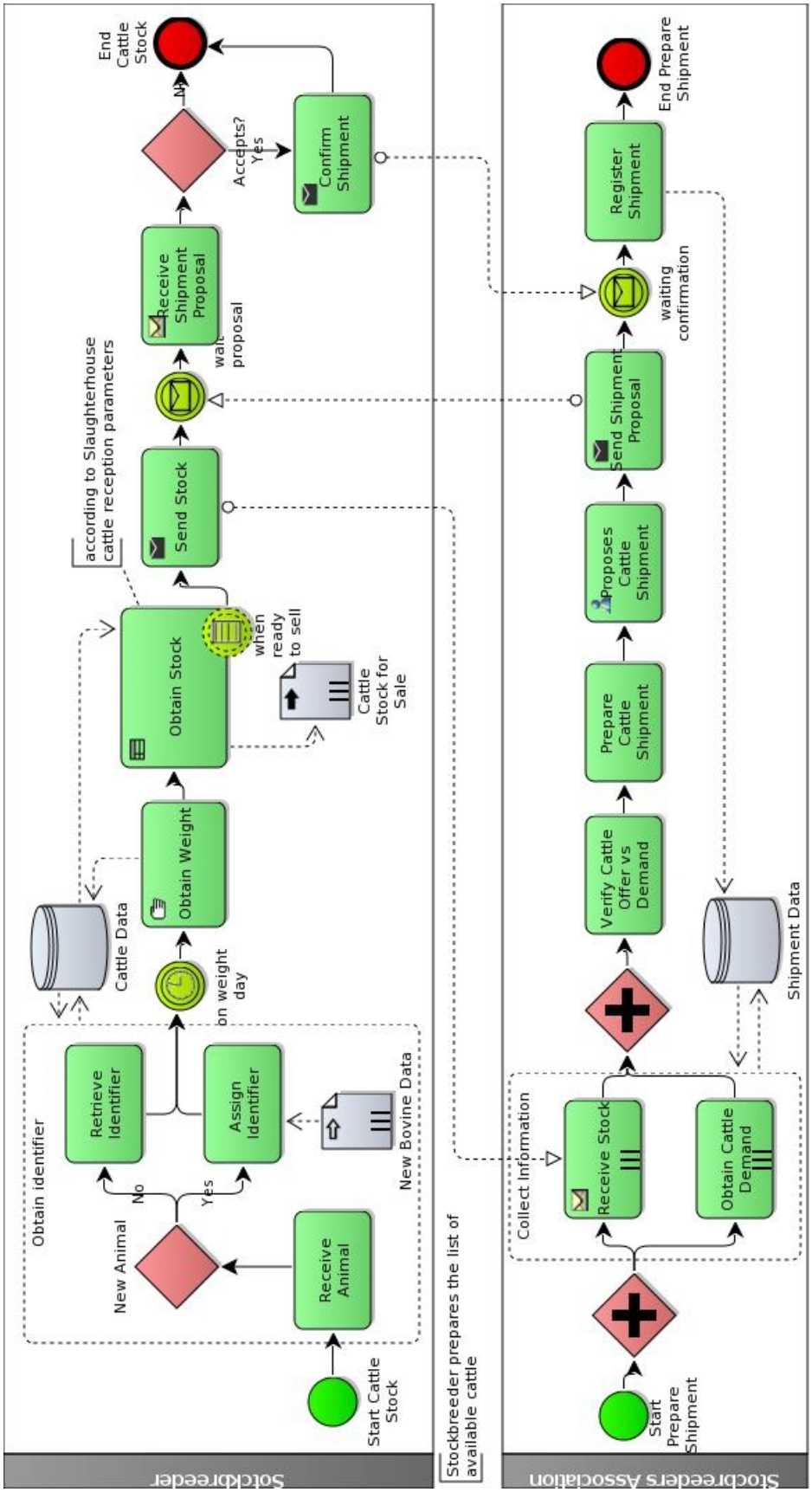


Figure 7.2: A BPMN example based on the UGRT case study

7.2 From Intentional to Organizational

Once the alliance is identified (Section 6.1), each Member Organization determines the resources willing to give and expecting to receive from the alliance (Section 6.2) as well as the common objective that creates a tight relationship among them for working together (Section 6.3). This approach does not necessarily follow an order (Section 6.4) and as soon as the Intentional level is considered completed, it is required to define the Member Organizations business processes offered to the VO to satisfy the service and to contribute to the consented objectives. The Intentional level aims answering WHY a VO will be created, this step will allow to define WHAT BP will support the VO. The link from the Intentional level to the Organizational level is proposed to be carried out by a transformation process from the proposed aspects of the 360° VisiOn to the BPMN. The transition from the BP (WHAT) to the IS (HOW) to be implemented is not concerned in this thesis, however we can cite the joint efforts of the OMG [25] which includes UML and the Business Process Management Initiative (BPMI) [4] to map the graphical objects of BPMN to Business Process Execution Language (BPEL), a standard for process execution.

A VO can facilitate many services, we represent one service with one BPMN diagram. Based on [WFMC, 1999] we state a high level BP as the description of a set of one or more linked procedures representing the know how of each organization which collectively satisfy the defined service. The complete BPMN notation summarized in Figure 7.1 and explained in Sub-Section 7.1 is the basis of the translation from the 360° VisiOn to BPMN. The translation process can be seen as a partial function mapping from 360° VisiOn Criteria domain $\mathbb{C}$ to the BPMN Construct $\mathbb{B}$ domain.

$$f : \mathbb{C} \longrightarrow \mathbb{B}^* \tag{7.1}$$

In general, the strategy followed consist in analyzing each criteria of the intentional aspects and mapping it to the more suitable BPMN constructs, so the function *f* takes the form:

$$f(\textbf{360}^\circ\ \textbf{vision}Criteria) = \textbf{BPMN}Construct^* \tag{7.2}$$

As it can be seen, one $\mathbb{C}$ construct can be mapped to a collection of $\mathbb{B}$ constructs. We explain in the following sub-section both domains notations. The BPD used to represent the BPMN models were designed with the open source Yaoqiang BPMN Editor [1] that supports BPD 2.0.

7.2.1 Notation

To reference the $\mathbb{B}$ domain we use the Extensible Markup Language (XML) semantic name-space defined by the OMG in [OMG, 2010a] and exemplify in the non-normative technical report [OMG, 2010a]. We have adapted this name-space to the context of our study and we have lightened it to ease the XML reading.

[1] http://sourceforge.net/projects/bpmn/

For representing the $\mathbb{C}$ domain, in this sub-section we define the notation conventions used to formalize the model transformation, each symbol of the notation is linked to an object of the UML class diagram which we reference to its corresponding model. The UML meta-models are in Figures 6.3, 6.6 and 6.8 and a simplified version is given in Figure 7.3 to facilitate the comprehension of the transformation process.

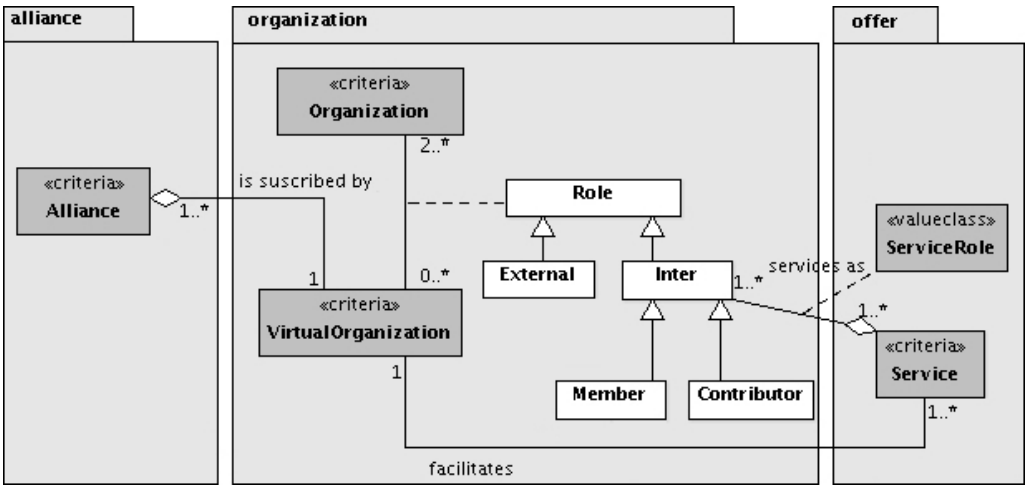


Figure 7.3: A simplified Alliance Identification meta-model

The virtual organization is denoted by VO; it facilitates one or more services. Member organizations, contributor organizations and external organizations are denoted by the sets O_m, O_c and O_e respectively. A virtual organization service VOS will be denoted as a tuple (MO_s, CO_s, EO_s, SR_s) where

- MO_s is the part of the virtual organization related with members that facilitate the service,
- CO_s is the part of the virtual organization related with contributors that facilitate the service and
- EO_s is the part of the virtual organization related with externals that influence the service.
- SR_s is the collection of Service Roles for the service.

MO_s, CO_s, EO_s and SR_s do not have direct representations in the UML meta-models of Figure 7.3; nevertheless for formalization purposes, they will be considered as $\mathbb{C}$ constructs that could be built from the UML meta-models.

MO_s is represented by a tuple (O_{ms}, SR_{ms}) where

- $O_{ms} = \{o_{ms1}, ..., o_{msi}\} \subseteq O_m$, is the set of member organizations that participate in the service, and

- $SR_{ms} = \{sr_{ms1}, ..., sr_{msi}\} \subseteq SR_s$ is the set of roles of member organizations in the service and sr_{msa} corresponds to the service role served by o_{msa}.

CO_s is represented by a tuple (O_{cs}, SR_{cs}) where

- $O_{cs} = \{o_{cs1}, ..., o_{csj}\} \subseteq O_c$ is the set of contributor organizations that participate in the service, and
- $SR_{cs} = \{sr_{cs1}, ..., sr_{csj}\} \subseteq SR_s$ is the set of roles of the contributor organizations in the service and sr_{csa} corresponds to the service role served by o_{csa}.

EO_s is a set of external organizations $\{o_{es1}, ..., o_{esk}\}$.

SR_s is a set of service roles $\{sr_1, ..., sr_n\}$.

We will use the dot notation in order to get the attribute values of the $\mathbb{C}$ constructs used in the f function definition. For example, $VOS.name$ refers to the name of the Virtual Organization Service; $VOS.Alliance$ refers to the Alliance object associated to the virtual organization; $MO_s.O_{ms}$ refers to the set of member organizations participating in the service. In particular, each service role has access to all its targeted service roles through the reference $sr.target$, so the reference $sr.target(n)$ refers to the n-th targeted service role.

We will use an auxiliary function g similar to f, whose need will be clearly evident in the next subsection.

$$g : \mathbb{C} \longrightarrow \mathbb{B}^* \tag{7.3}$$

We also use the following operators:

- **if** <condition> **then** <value> for expressing conditionals,
- **+** for string concatenation.

Finally, different font styles are used to distinguish elements in BPMN and XML constructs: **bold** for operators, `typewriter` for variables, *italic* for functions, and ** FOR COMMENTS that clarify the construct.

7.2.2 Mapping the Alliance Identification aspect

This sub-section aims to define the rules for assigning the Criteria of the Alliance Identification aspect (section 6.1) to the BPMN constructors from the simplified UML meta-model given in Figure 7.3.

Rule 1: One Service facilitated by the VOS is represented by one BPMN Collaboration Diagram which contents are determined by the application of all the following rules, from Rule 2 to Rule 11.

Rule 2: One MO_s is represented by one BPMN Pool contained within a BPMN Process.

Rule 3: One CO_s is represented by one BPMN Pool contained within a BPMN Process.

Rule 4: One EO_s is represented by one BPMN Pool contained within a BPMN Process.

Rule 5: The BPMN Pools obtained by the application of Rules 2 to 4 are included in the representation of the BPMN Collaboration construct.

It is important to note that the BPMN Process created by Rules 2 to 4 will allow to nest the organizations in a BPMN Pool. The MO_s and CO_s BPMN Process are decomposed in the Sub-Section 7.2.3 which allow to organize and categorize their activities, this decomposition does not regard the EO_s.

Following is the figure of the f function when applied to a VOS object (Figure 7.4). We use the BPMN Text Annotations to indicate the rules applied to obtain the BPMN constructors.

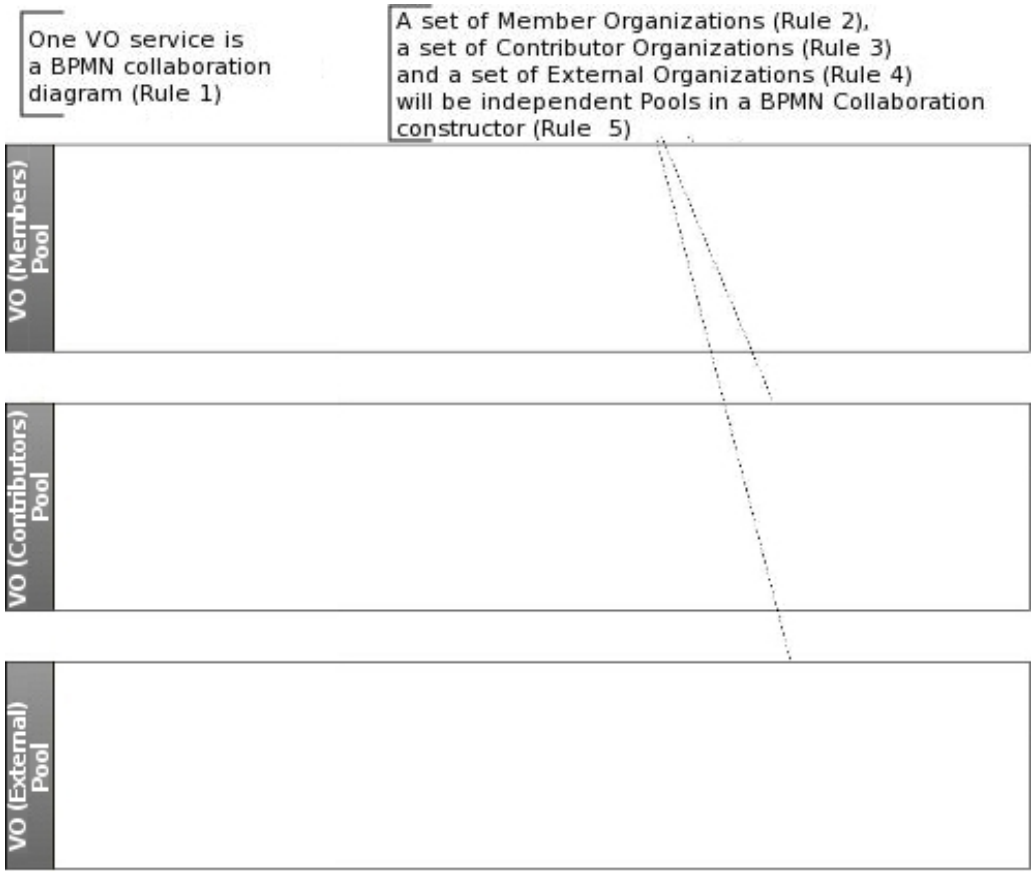


Figure 7.4: A BPD with Annotations to show the mapping Rules 1 to 5

Recalling that the constructs of our $\mathbb{C}$ domaine is the virtual organization service VOS denoted as a tuple (MO_s, CO_s, EO_s, SR_s). The corresponding f definition that creates the collaboration diagram representing one service facilitated by the VO is

$$f(VOS) = f((MO_s, CO_s, EO_s, SR_s)) = \tag{7.4}$$

<definitions name=VOS.name> **NAME OF THE VO SERVICE
$f(MO_s)$ + $f(VOS.A)$ **MEMBERS IN THE SERVICE (7.5) AND VO FACADE (7.6)
$f(CO_s)$ **COMPLEMENTORS IN THE SERVICE (7.7)
$f(EO_s)$ **EXTERNAL IN THE SERVICE (7.8)
$f(SR_s)$ **SERVICE ROLES (7.9)
<collaboration>
<participant name=VO.name+"Members" processRef="Members Services"/>
<participant name=VO.name+"Contributors" processRef="Contributors Services"/>
<participant name=VO.name+"External" processRef="External Services"/>
$g(SR_s)$ **SERVICE ROLES (7.11)
</collaboration>
</definitions>

In this definition, the expression $f(MO_s)$ + $f(VOS.A)$ (7.5 and 7.6) returns the BPMN construct corresponding to the participation of a member organizations in the service. Only when the VO is viewed by the contributor and external organizations, the facade (screen or semi-screen) is considered as a member organization by the expression $f(VOS.A)$ (7.6). $f(MO_s), f(CO_s)$, $f(EO_s)$ (7.5, 7.7, and 7.8) return the BPMN constructs established in Rules 2 to 4. Their definitions are given by rules 6 to 9, where rules 6 and 7 establish the elaboration of the BPMN Pool associated to a MO_s, rules 8 and 9 establish the elaboration of the BPMN Pools associated to a CO_s and a EO_s respectively. $f(SR_s)$ and $g(SR_s)$ (7.9 and 7.11)return the BPMN constructs established in rules 10 and 11, to set the flows of the service roles in the service.

Rule 6: One Member Organization is represented by one BPMN Lane which includes a reference to its service role description.

Rule 7: The VO facade is represented by one BPMN Lane inside the MO_s (7.5) BPMN Pool if and only if facade is screen or semi-screen.

Rule 8: One Contributor Organization is represented by one BPMN Lane which includes a reference to its service role description

Rule 9: One External Organization is represented by one Lane which includes a reference to its service role description

Figure 7.5 illustrates the mapping of Rules 6 to 9 to BPMN providing a Text Annotations. The corresponding f definitions are next.

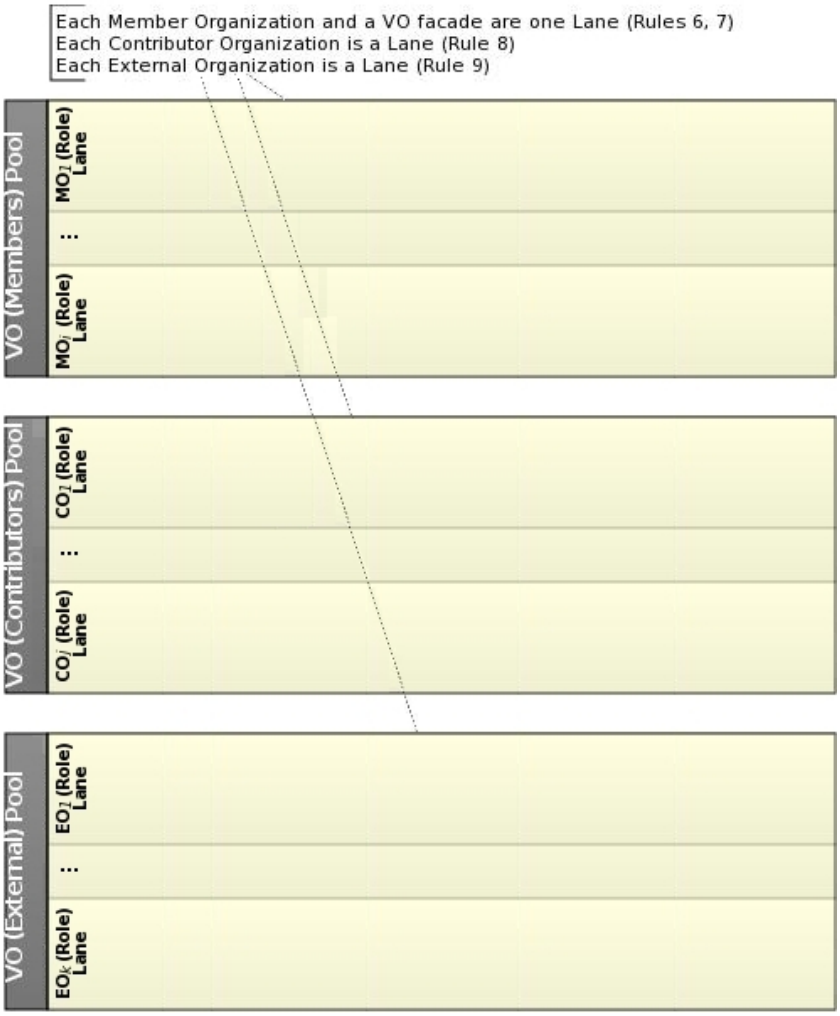


Figure 7.5: A BPD with Annotations to show the mapping Rules 6 to 9

The f that generates the process for the Member Organizations is

$$f(MO_s) = f((\{o_{ms1}, ..., o_{msi}\}, \{sr_{ms1}, ..., sr_{msi}\})) = \tag{7.5}$$

```
<process isExecutable="false" name="Members Services">
    <laneSet name=V0.name+"(MemberslaneSet)">
        <lane name=o_ms1.name rolename=sr_ms1.interrole>
            <flowNodeRef> sr_ms1.description </flowNodeRef>
        </lane>
                ⋮
        <lane name=o_msi.name rolename=sr_msi.interrole>
            <flowNodeRef> sr_msi.description </flowNodeRef>
        </lane>
    </laneSet>
</process>
```

where the name attribute of the process ("Members Services") corresponds to the processRef attribute of the member participant in the collaboration tag of definition (7.4)

The f that generates the lane for the VO facade is

$$f(A) = \tag{7.6}$$

```
if facade = "screen" or "semi-screen" then
    <lane name=facade+"Facade"> </lane>
        <flowNodeRef> "Manage VO Facade" </flowNodeRef>
</lane>
```

The f that generates the process for the Contributor Organizations is

$$f(CO_s) = f((o_{cs1}, ..., o_{csj}, sr_{cs1}, ..., sr_{csj})) \tag{7.7}$$

```
<process isExecutable="false" name="Contributors Services">
    <laneSet name=V0.name+"(ContributorslaneSet)">
        <lane name=o_cs1.name rolename=sr_cs1.interrole>
            <flowNodeRef> sr_cs1.description </flowNodeRef>
        </lane>
                ⋮
        <lane name=o_csj.name rolename=sr_csj.interrole>
            <flowNodeRef> sr_csj.description </flowNodeRef>
        </lane>
    </laneSet>
</process>
```

where the name attribute of the process ("Contributors Services") corresponds to the processRef attribute of the contributor participant in the collaboration tag of definition (7.4)

The f that generates the process for the External Organizations is

$$f(o_{e1}, ..., o_{ek}) = \tag{7.8}$$

```
<process isExecutable="false" name="External Services">
    <laneSet name=V0.name+"(ExternalLaneSet)">
        <lane name=o_e1.name rolename=o_e1.extrarole>
            <flowNodeRef> o_e1.description </flowNodeRef>
        </lane>
                ⋮
        <lane name=o_ek.name rolename=o_ek.extrarole>
            <flowNodeRef> o_ek.description </flowNodeRef>
        </lane>
    </laneSet>
</process>
```

where the name attribute of the process ("External Services") corresponds to the processRef attribute of the external organizations in the collaboration tag of definition (7.4)

To conclude the first part of the transformation process, rule 10 and 11 define the BPMN constructs establishing the relations between the service roles played by the organizations participating in the service.

Rule 10: For each ServiceRole there is one Activity Object stereotyped with its RoleName. This Activity Object contains two BPMN constructors: one sub-Process and several sequenceFlows.

Rule 11: For each ServiceRole there is a collection of messageFlows, one for each collaboration between service roles associated to organizations that are not in the same pool.

Figure 7.6 illustrates the mapping of Rules 10 and 11 to BPMN providing a Text Annotations.

The f that generates the sub-Process for all Organizations is

$$f(SR) = f(\{sr_1, ..., sr_l\}) = \tag{7.9}$$

<subProcess name=$\mathtt{sr}_1$.`description` />
<subProcess name=$\mathtt{sr}_2$.`description` />
⋮
<subProcess name=$\mathtt{sr}_l$.`description`> />
$f(sr_1)$ **SERVICE RELATIONS BY SERVICE ROLE (7.10)
⋮
$f(sr_l)$

The f that generates the sequenceFlow between organizations in the same pool is

$$f(sr) = \tag{7.10}$$

if `sr.servicesas` **=** `sr.target(1).servicesas` **then**
<sequenceFlow sourceRef=`sr.description`
targetRef=`sr.target(1).description`/>
⋮
if `sr.servicesas` **=** `sr.target(n).servicesas` **then**
<sequenceFlow sourceRef=`sr.description`
targetRef=`sr.target(n).description`/>
where a service role has n targets

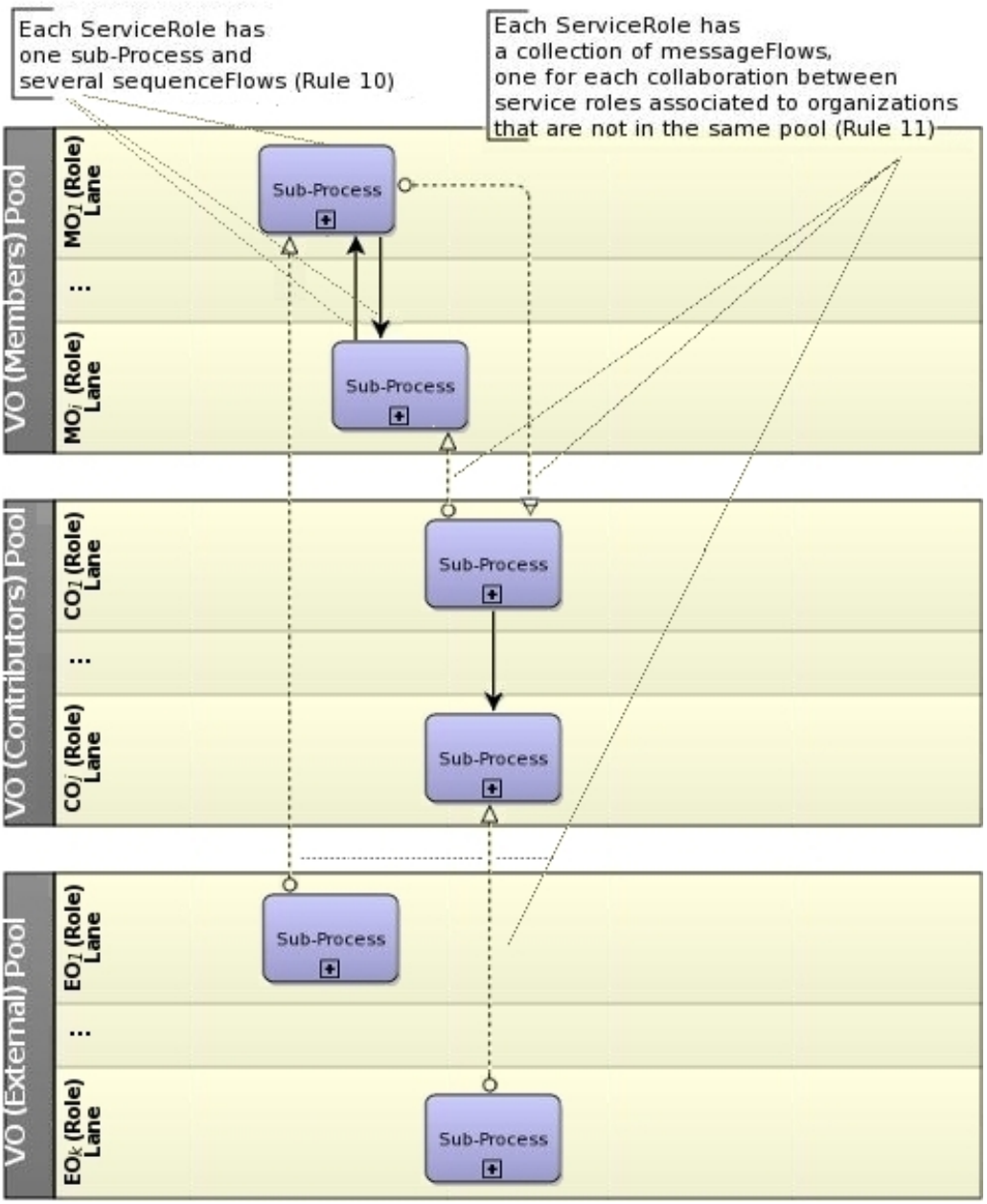


Figure 7.6: A BPD with Annotations to show the mapping Rule 10 and 11

The auxiliary function g (similar to $f(SR)$) that prepares the messageFlows between the pools is

$$g(SR) = g(\{sr_1, ..., sr_x\}) = \tag{7.11}$$

$g(sr_1)$ **SERVICE RELATIONS BY SERVICE ROLE (7.12)

$\vdots$

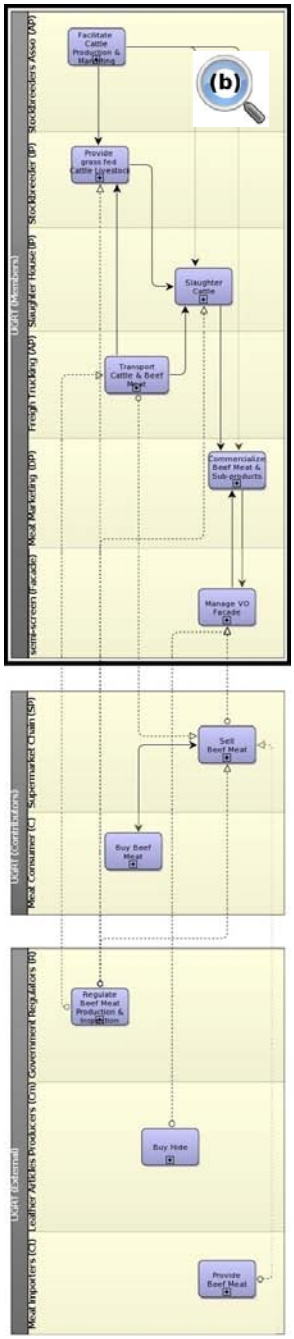
$g(sr_x)$

The implementation of this definition is established by the auxiliary function g, that generates the messageFlow between organizations in different pools

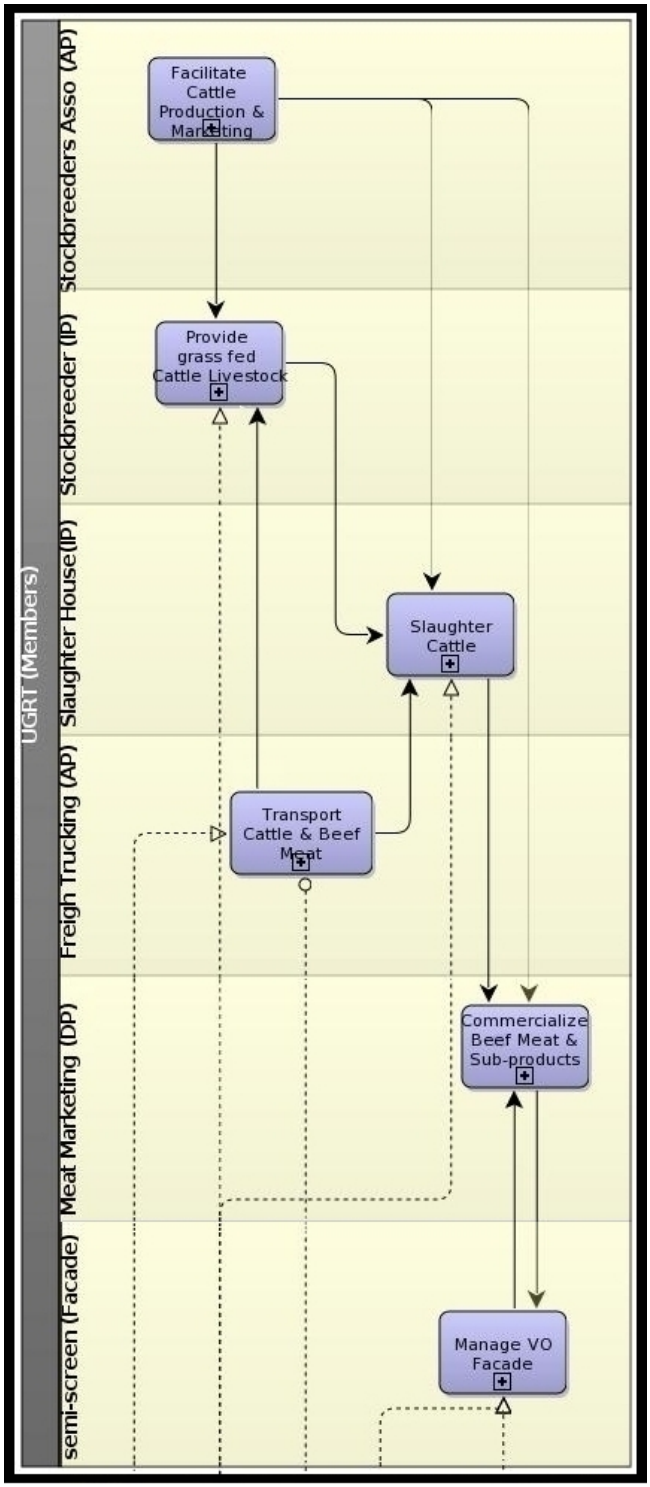
$$g(sr) = \tag{7.12}$$

if `sr.servicesAs` **<>** `sr.target(1).servicesAs` **then**
<messageFlow sourceRef=$\mathtt{sr}_1$`.description`
targetRef=`sr.target(1).description`/>
⋮
if `sr.servicesAs` **<>** `sr.target(y).servicesAs` **then**
<messageFlow sourceRef=$\mathtt{sr}_y$`.description`
targetRef=`sr.target(y).description`/>
where a service role has y targets

The 360° VisiOn model of Figure 6.10 representing the service "Conditioning and Sale of Quality Bovine Meat" of the UGRT case study is mapped to its corresponding BPMN diagram in Figures 7.7 and 7.8. The Member Organizations (Stockbreeders Associations, Stockbreeders, Slaughterhouse, Freight Trucking and Meat Marketing) and the "semi-screen Facade" are in the pool "UGRT Members". Each of them has the service offered represented as a sub-Process inter-connected with sequenceFlows The other pools are for the "UGRT Contributors" (Supermarket Chains and Meat Consumers) and "UGRT External" (Government Regulators, Leather Articles Producers and Meat Importers). They have a sub-Process named as the service role: "Provide grass fed Cattle Livestock" for the Stockbreeder presented in the model of Figure 6.7. The XML semantic name-space adapted from the OMG [OMG, 2010b, OMG, 2010a] for this service, resulting from the concatenation of rules 1 to 11 can be seen in A.1. To facilitate the reading of the XML we have included comments with links to the related functions.

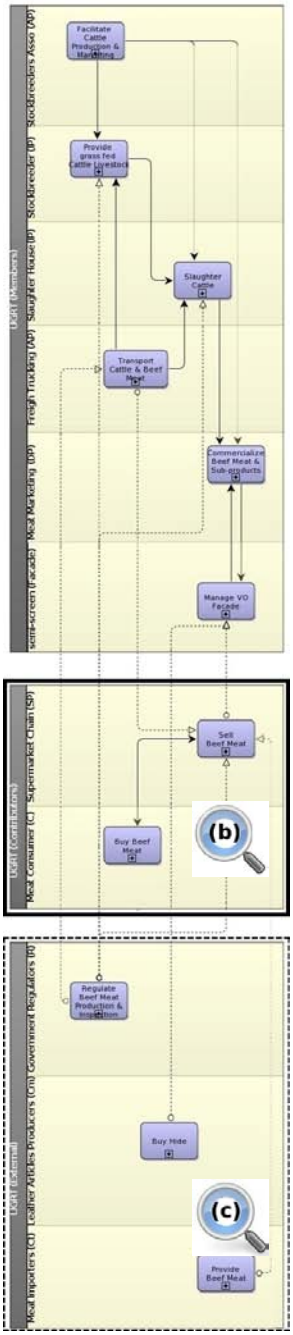


(a) Conditioning and Sale of Quality Bovine Meat

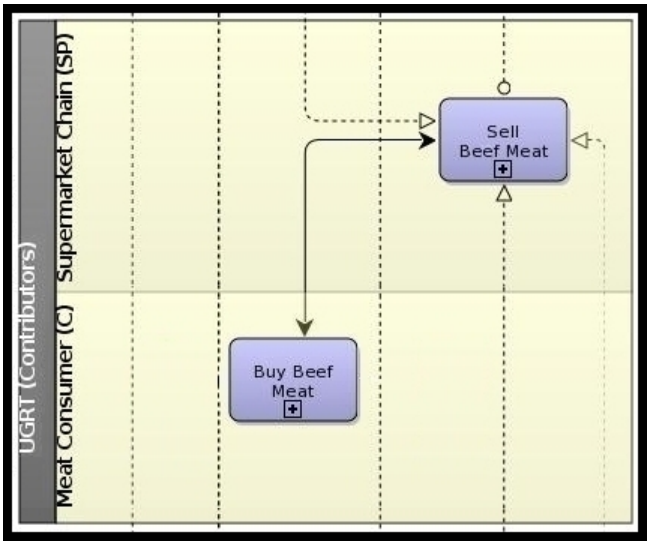


(b) zoom of the UGRT Member Organizations and its facade

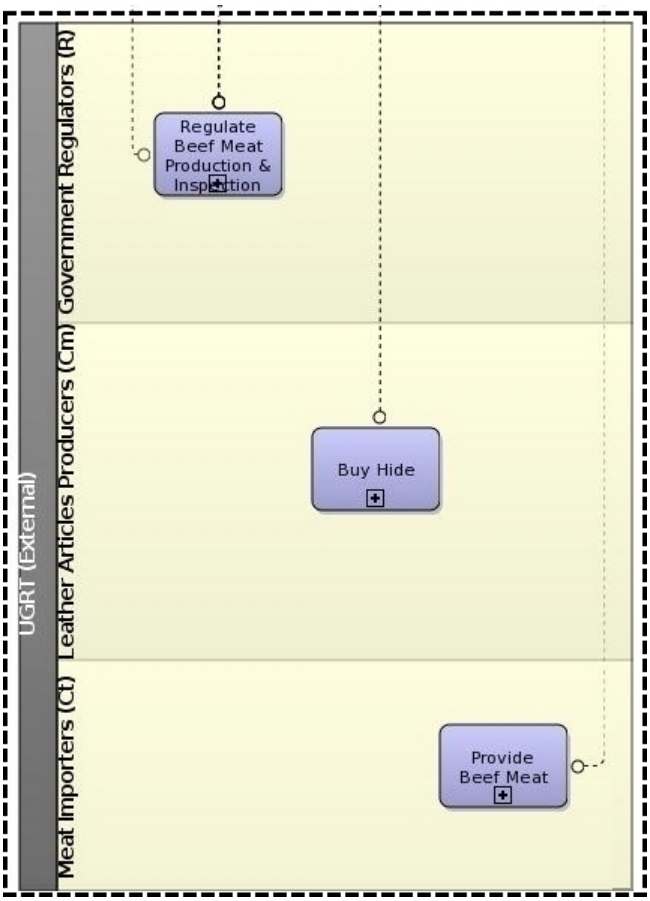
Figure 7.7: BPMN Service example: the UGRT case study



(a) Conditioning and Sale of Quality Bovine Meat



(b) zoom of the UGRT Contributor Organizations



(c) zoom of the UGRT External Organizations

Figure 7.8: BPMN Service example: the UGRT case study (cont. . .)

7.2.3 Mapping the Collaboration Willingness aspect

As stated in 6.2, the alliance formed among the Member Organizations arises responsibilities towards the VO as well as advantages from the relationship. This sub-section aims to define the rules for assigning the criteria of the Collaboration Willingness aspect (section 6.2) to the BPMN constructors. The UML meta-models are in Figures 6.13, 6.15 and 6.18, and a simplified version is given in Figure 7.9 to facilitate the comprehension of the transformation process.

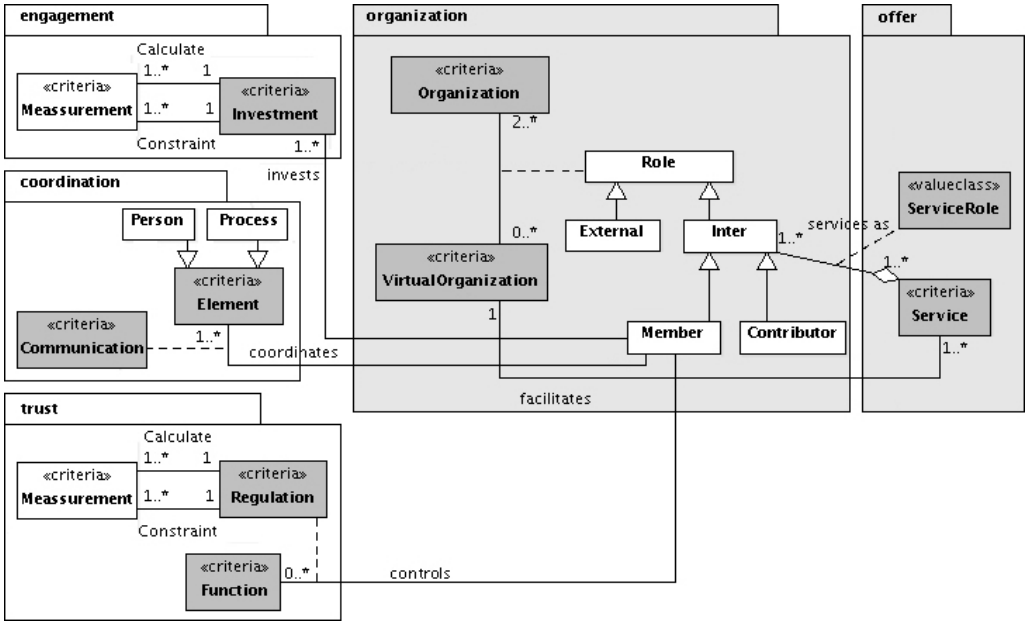
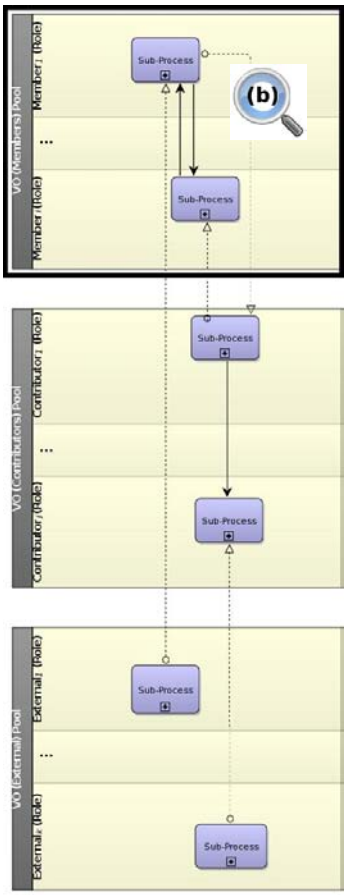
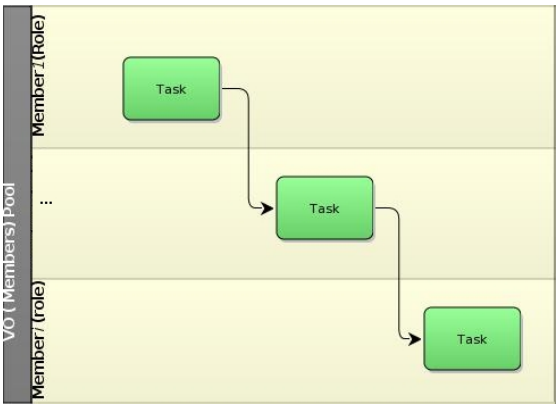


Figure 7.9: A simplified Collaboration Willingness meta-model

As shown in Figure 7.10 the BPMN of the VO Service was defined in 7.2.2 and this section aims to define the BPMN for the Member Organizations in the alliance which implicates a tightened collaboration though, we are interested in extracting their business processes. The following rules will be illustrated and explained through an example based on the instances given in Section 6.2.



(a) The VO Service



(b) Collaboration Willingness for the Member Organizations

Figure 7.10: Towards BPMN Collaboration

From the Engagement sub-aspect, we start the BPD construction with the Investment criteria, as explained in the Sub-Section 6.2.1, Investments are the elements each Member Organization gives to the VO, though

Rule 12: Each Investment is represented by a BPD Collaboration construct that contains five more BPD constructors: startEvent, businessTask, dataObject, Task and endEvent with their respective sequenceFlows.

Figure 7.11 shows the general BPD which constructs are related as follow:

- From the Member Organization giving the element, they are
  - **Multiple Start Event** representing the frequency for giving the element. It can be triggered by a **Timer Start Event** when there is a specific cycle or time-date or by a **Conditional Start Event** when a condition becomes true.
  - **Business Rule Task** that accomplishes the ”giving“ action complying with the Calculations and Constraints

  - **Data Object** that represents the Goods (Assets or Capital) to be given.

- To the Member Organization receiving the element, they are

  - **Task** receiving and handling the element

  - **End Event** that finishes the collaboration process

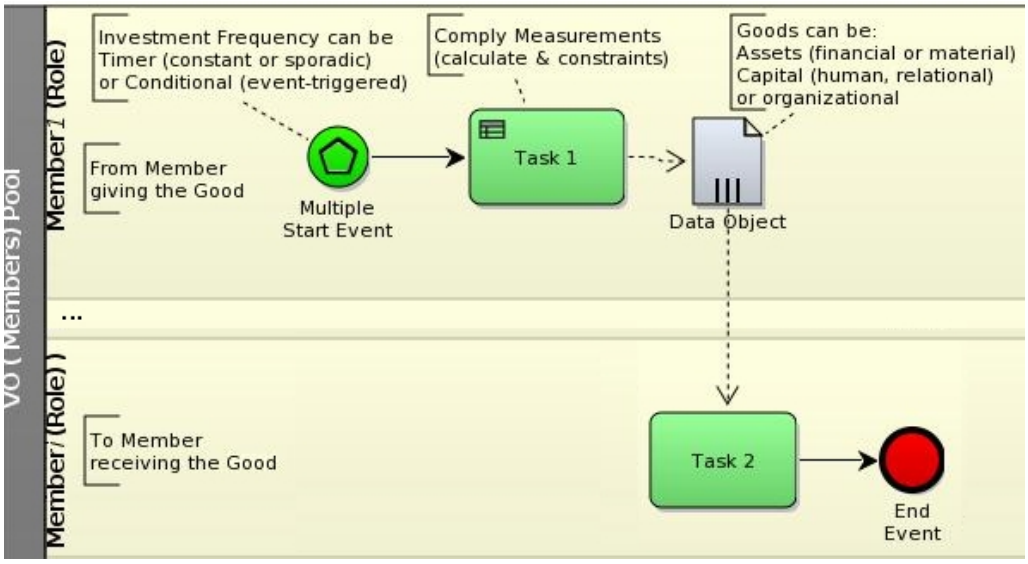
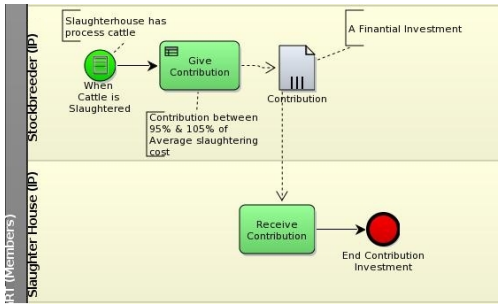
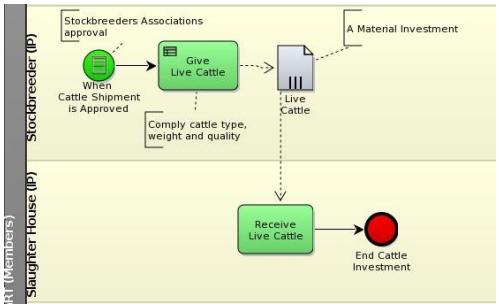


Figure 7.11: A BPD general case to show the Investment mapping to BPMN

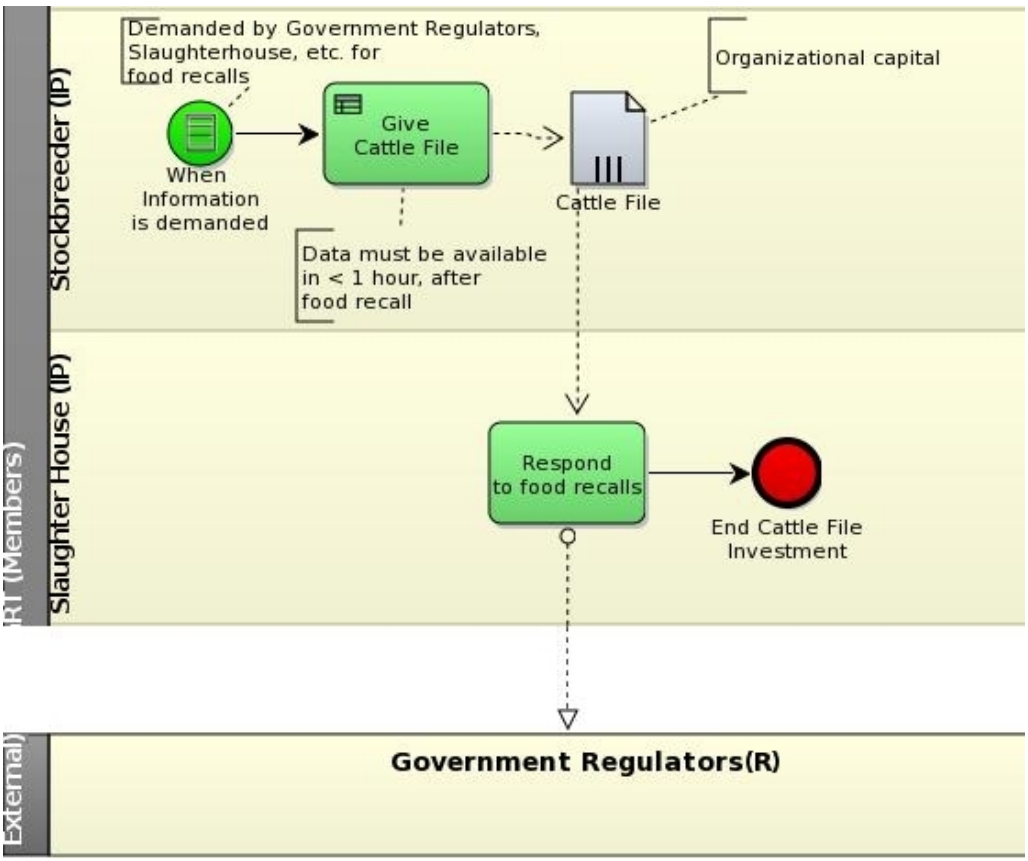
The examples given in 6.14b, 6.14c and 6.14d are mapped to the general BPD of figure 7.12 for the ”Contribution“, ”Live Cattle“, and ”Cattle File“ respectively. The latter for example, starts when there is a food recall, and the cattle file information is demanded, which obliges the Stockbreeder to give the information requested in less than one hour, the Cattle File is sent to the Slaughterhouse.



(a) Contribution



(b) Live Cattle



(c) Cattle File

Figure 7.12: BPD Investment examples: from the Stockbreeders

Sub-section 6.2.2 explains the Coordination sub-aspect and gives an example of coordination between the Stockbreeders and the Stockbreeders Associations for the ”Manager“ element who proposes the cattle to be slaughtered (see Figure 6.16). The rule is stated as follow:

Rule 13: Each Element is represented by a BPD Collaboration construct that contains several BPD constructors

Figure 7.13 shows the Collaboration Element corresponding to BPD, which constructs

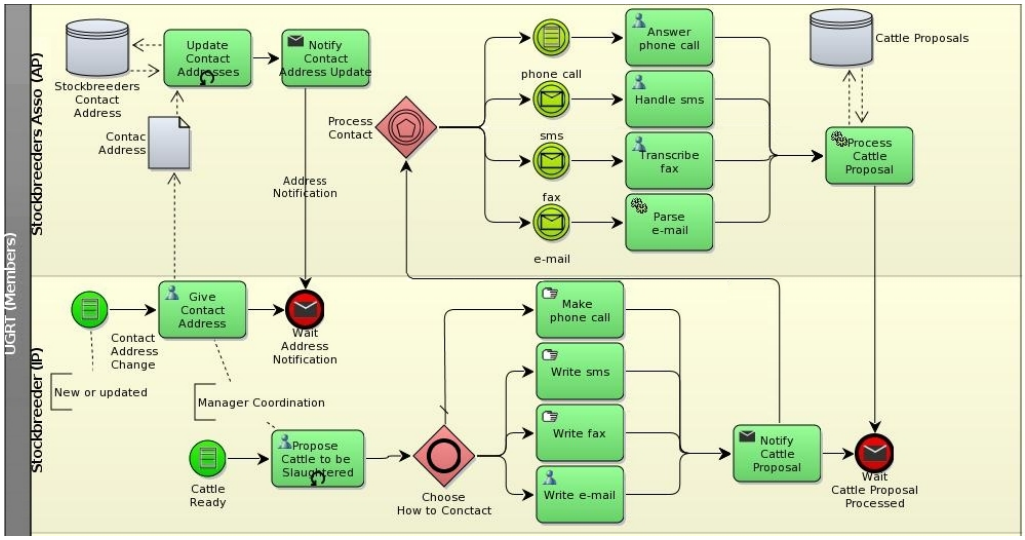


Figure 7.13: BPMN Coordination example: the Stockbreeder's Manager

are related as follow:

- From the Stockbreeder starting the coordination process
  - **Conditional Start Event** representing the coordination frequency
  - **Task** for the description of the coordination
  - **Inclusive Gateway** to allow the possible communication alternatives, stating the default Flow if possible
  - **Task** for handling the possible communication alternatives
  - **Send Task** to coordinate with other users
- To the Stockbreeders Associations
  - **Event Gateway** for catching the received message
  - **Intermediate Event** for receiving the messages
  - **Task** for handling the received message
  - **Task** for processing the message

Sub-section 6.2.3 explains the Trust sub-aspect and gives an example of the "Cattle Classification" function to be regulated by the Stockbreeder (see Figure 6.19). Functions are the control activities required to be vigilant and need to be regulated. The rule is stated as follow:

Rule 14: Each Function is represented with a BPMN Process constructor with several other constructors

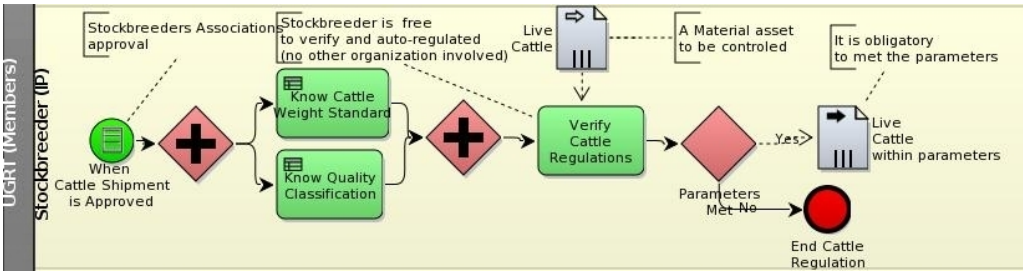


Figure 7.14: BPD Trust example: the Stockbreeder's Cattle Classification

Figure 7.14 shows the Trust corresponding to BPD, which constructs are related as follow:

- It involves the Stockbreeder only because Freedom of Action is stated, which implies that no other member controls the regulation
  - **Conditional Start Event** representing the regulation frequency (When Cattle Shipment is Approved)
  - **Business Rule Task** relates each formula to be taken into account (Know Cattle Weight Standard and Know Quality Classification)
  - **Data Object** that represents the Goods (Assets or Capital) to be regulated (Live Cattle)
  - **Task** that performs the regulation (Verify Cattle Regulations)
  - **Exclusive Gateway** to decide the following actions (Are Paramenters Met?)

Regarding the mapping of the Common Objective aspect, BPMN does not link the Business Objectives to the BP, it assumes that a BP exists because it helps to achieve a business goal. In [Recker et al., 2005] is presented an analysis of some BPMN limitations to describe particular real-world processes due to a lack of resources to represent them (for example, lane and pools are used indistinctly to represent an organizational entity, an application system, or a set of them) or constructs redundancy (for example an organizational entity is represented by a lane or a pool, which leads to user confusion to best represent the real-world). We encounter a similar case for mapping the Common Objective to a BPMN constructor because they are not available, we will need further research to adopt additional constructs from the intentional level to compensate this deficiency. Nevertheless, we can use the Text Annotation Artifact to name the Objective the BP helps to achieve, though we defined the following rule:

Rule 15: A Goal can be represented by a Text Annotation

In this chapter we have formalized the transformation of the Alliance Identification models to BPMN by a partial function explained in 7.2.2, which can also facilitate the automatization of the transformation process. In Sub-Section 7.2.3, we have also shown a way to transform the Collaboration Willingness models to BPMN based on a general case for each

sub-aspect. We have provided transformation examples in forms of Collaboration and non-executable Process diagrams using BPD to link the intentional models to BPMN constructs. The need of a transformation process is evident when doing iterative modeling, because generally, models have to be completed and refined by different users at different levels. Usually, one user defines the high-level model (in our case the Intentional level), then s/he gives it on to another user at a lower-level (the organizational level). We expect that the adapted XML semantic name-space presented in 7.2 facilitates the modeling work at the organizational level in order to achieve business process completness and refinement.

CHAPTER 8

The 360° vision for VO validation

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In order to evaluate the 360° VisiOn proposal of this thesis, we have led an experiment with IS experts to evaluate the concepts, relations and models as well as the method stages and sequences.

These experiments were accomplished with the help of Nadine MANDRAN (a Centre National de la Recherche Scientifique (CNRS) engineer in Human and Social Sciences Methodologies) who is in charge of experimental design at MARVELIG [21] a hotbed scientific experimental platform of Grenoble Informatics Laboratory (LIG) [20] for prototype deployment and test in pervasive computing. MARVELIG objectives are: to build up a memory of the prototypes developed by the research teams, to take advantage of each team technical and methodological capacities, to provide advice and support for experimentation and to disclose research products. These experiments are based on user centered design concepts and attitudes measurement research like [Maguire, 2001, Schuman et al., 1996, Berthier, 2000, Kovacs et al., 2004].

8.1 Experiment set up

The experiments were carried out to evaluate the 360° VisiOn from a qualitative point of view with two main objectives:

- to verify the methodology's concepts, relations and models,
- to have experts' opinion on the proposed methodology.

For achieving our objectives, we have based the experiments on two axis of the research approach followed (see Figure 5.8):

- The characterization of the VO:
  - to measure the concepts and relationships as well as their descriptions in terms of clearness and completeness,
  - to measure the utility of each aspect of the methodology.
- The model representation of the VO at the intentional level:
  - to measure the graphic notations of the concepts and relationships in terms of utility and usability,
  - to measure the guidance process and the difficulties encountered.

8.1.1 Hypothesis

Table 8.1 describes the hypothesis established for the experiments. The 360° VisiOn proposal was grouped by four elements to be tested called Test Points: concepts and relations, graph and textual models, the usability and the usefulness of the proposal. Each hypohtesis is related to the protocol through a Reference

8.1.2 Protocol

The aim of the experiments was to evaluate the dictionaries as well as the models through a scenario These experiments were conducted through a qualitative approach to emerge the non forseen (unseen) weak points, the strong points and the improvement ideas [Runeson et al., 2009]. The Table 8.2 shows the profile of the 8 people participating in the experiments. All of them had experience in systems analysis and design, six people had also experience in IS development and test, and six of them had already used an information systems methodology. Regarding VOs, only half of them knew the term and were able to give a definition.

Table 8.2: IS experts profile

People	Age	Sex	Profile
8	27 average age (24 minimum, 29 maximum)	2 women, 6 men	7 PhD students, 1 lecturer

We carried out the experiment using a focus group with a scenario format. The general idea of a focus group is “that each participant can act to stimulate ideas in the other people present, and that, by a process of discussion, the collective view becomes established which is greater than the individual parts”. The scenario gives “detailed realistic examples of how users may carry out their tasks in a specified context”[Maguire, 2001].

There were a total of 8 people participating in the experiment which was handled in four sessions (see Table 8.3) of 3 to 5 people each, the size of the groups allowed each person

Table 8.1: Group experiment hypothesis

360° VisiOn: *group experiment hypothesis for IS experts*			
Test points	**Ref**	**Hypothesis**	**Description**
Concepts and relations	H1	Concepts and relations definitions are clear	Concepts and relations are easy to understand
	H2	Concepts and relations dictionaries are complete	The concepts and relations dictionary have all necessary elements
Graph & Textual Models	H3	The graph and textual models are clear	Models are easy to understand
	H4	The graph and textual models are complete	Models have all necessary elements
Usability	H5	Participants can use the concepts and relations dictionaries	The concepts and relations dictionary are easy to use and fulfill participant needs
	H6	Participants can use the graph and text models	Models are easy to use
	H7	Participants need to define the alliance	After the identification of organizations and service, participants find necessary to define the alliance
	H8	Participants need to define the collaboration among organizations	After the Alliance Identification, participants find necessary to define the collaboration among the organizations
	H9	Several iterations are needed for a complete model representation of a VO	Testers have to revise the concepts and relations and to add them to the model in order to achieve model completeness
	H10	Participants propose the same solution	After using the given material participants propose the same diagram for representing the VO Alliance Identification, Collaboration and Objectives
Usefulness	H11	Models facilitate RE elicitation for VO	Testers believe that this model representation of a VO can guide RE elicitation, reduce time and avoid misunderstandings
	H12	Models are effective	Testers can represent a VO faster and easily with the models provided
	H13	Models cover all RE concepts and relations for VO	All concepts and relations are easy to understand with their graph representation

to give their own comments during the oral assessment see Figure 8.1. The protocols were divided in four parts, one per stage of the 360° VisiOn: Alliance Identification (AI see Table 8.4), Collaboration Willingness (CW see Table 8.5) and Common Objectives (CO see Table 8.6); and a fourth part devoted to the Stages Sequence of the method.

Figure 8.1: Participants in one of the sessions

Table 8.3: Experiment sessions with 8 participants

	Time	Group	Size	Protocol followed
Session 1	3h	1	4	Protocol 1 (AI I & II)
Session 2	2h30	2	4	Protocol 1 (AI I)
Session 3	3h	1 & 2	5*	Protocols 2 (CW) and 3 (Stages Sequence)
Session 4	2h30	1 & 2	3**	Protocols 2 (AI II & CW) and 3 (Stages Sequence)

**people from Session 1 and one person from Session 2*

***people from Session 2*

The material given to the participants during the sessions was divided as follows (see Appendix B):

- Questionnaires. We administer three questionnaires to prepare qualitative responses for data analysis.
  - Participants working habits (*Ibid.*, B.14). This questionnaire was given to the participants before starting the experiment to know how they conduct the development of an information system and what they know about VOs.

  - Alliance Identification usage (*Ibid.*, B.15 and B.16). This questionnaire was given at the end of Session 1 and 3 to measure the perceived usability of the Alliance Identification proposal.
  - Collaboration Willingness usage (*Ibid.*, B.17 and B.18). This questionnaire was given at the end of Session 2 and 4 to measure the perceived usability of the Collaboration Willingness proposal.

- Dictionaries:
  - Alliance Identification concepts (*Ibid.*, B.1, B.2, and B.3) and relationships (*Ibid.* B.8).
  - Collaboration Willingness concepts (*Ibid.*, B.4, B.6, and B.5) and relationships (*Ibid.* B.9)
  - Common Objective concepts (*Ibid.*, B.7) and relationships (*Ibid.* B.10)

- Graphical Notations (intentional level only):
  - Alliance Identification (*Ibid.*, B.11)
  - Collaboration Willingness (*Ibid.*, B.12)
  - Common Objective (*Ibid.*, B.13)

- Scenario. For testing the 360° VisiOn we prepared a wedding planner scenario inspired from the idea of organizing a well known event (a wedding) where specialized people are needed. This example sets up the core aspects presented in the methodology: Alliance Identification, Collaboration Willingness and Common Objectives.
  - Part I (*Ibid.*, B.4.1). It describes each of the actors involved in the wedding event, first the couple that wants to get married, followed by the wedding planner, and other companies (wardrobe retailer, reception hall lender, cater company, stationary company, flower designer, photography studio, music performer, video, transportation, accommodation, and bank). The objective was to use the dictionary, graphs and relations to build the Alliance Identification model at the inter-organizational level.
  - Part II (*Ibid.*, B.4.2). The previous scenario was complemented with a more detailed description of four companies in order to apply the dictionary, graphs and relations to build the Collaboration Willingness model of one of the firms at the inter-organizational level.

The material obtained from the sessions was:

- Focus group audio and video recordings
- Focus group pictures
- Evaluated dictionaries

- Cardboard model representations
- Administered questionnaires

Tables 8.4, 8.5 and 8.6 describe the protocols with the activities carried out during the experiments, some of the activities are related to the hypothesis to be tested, and the material needed. All the activities have an estimated time and the people responsible for its performance.

8.2 Experiment development

As shown in Table 8.4, the experiments of Session 1 and 2 (Table 8.3) started by handing in the Working habits questionnaire, afterwards, we showed some slides for giving our VO definition, a brief presentation of the research approach described in Section 5.6, the objective of an Intentional Characterization for a VO, and finally, the instructions of the exercise to be done in the session.

The continuation of the experiment was done in Sessions 3 and 4 (Table 8.3). Due to time constraints during Session 2, participants did not analyze and comment the Alliance Dictionary, so we brought them up to date in Session 4. Following, we remind participants the scenario given in Sessions 1 and 2 and showed them our model proposal, and we give them the instruction for the session's exercise.

Following section details the exercises done and the results obtained from the discussions with the participants.

8.3 Experiment results

8.3.1 Concepts and Relations Dictionaries clearness and completeness

Recalling the hypothesis

H1 Concepts and relations definitions are clear

H2 Concepts and relations dictionaries are complete

We hand in the concept (B.1 to B.5) and relations (B.8 and B.8) dictionaries to the participants and demand them to note each description with 1 (Very Clear), 2 (Somewhat Clear), 3 (Not Very Clear) or 4 (Not at All Clear). The results are described as follow:

1. There were pointed out ambiguous terms and unclear definitions in the dictionaries given to the participants and even the layout of the dictionary was subject of comments.
    - The Alliance Identification dictionary:

Table 8.4: Group experiment protocol 1/3

360° VisiOn: *group experiment protocol for IS experts*					
Stage	**Ref**	**Description**	**≈Time**	**Who**	**Material**
Welcome		Presentation of the experiment general context	5 min	Luz María & Nadine	Work Habit Questionnaire, Slide show
Alliance Identification (AI) part I material presentation	H1	Reading and assessment of AI concept dictionary for organizations and service	20 min	Participants	AI dictionary I
	H3	Description of the AI model for organizations and service: graph and relations	5 min	Participants	Slide show, graphical notation & stickers, whiteboard markers, paper sheet, adhesive
		Narration of the "weeding planner" scenario	5 min	Luz María	Sideshow, scenario
		Instructions and clarification of given material	5 min	LuzMaría	Slide show
AI part I experiment development	H5 & H6	Participants take the given material and instantiate the AI organizations and service model for the scenario	40 min	Participants	Given material
	H7	Participants are guided to think about the alliance need	15 min	Nadine	
Coffee break			5 min	Everybody	
AI part II material presentation	H1	Reading and assessment of AI concept dictionary for alliance	4 min	Participants	AI dictionary II
	H3	Description of the AI graph and text models for alliance	3 min	Luz María	Slide show, alliance graph and text models
		Instructions and clarification of given material	3 min	Luz María	Slide show
AI part II experiment development	H5 & H6	Participants take the given material and instantiate the AI alliance model for the scenario. They fill in the text model and the VO graph	30 min	Participants	Given material
AI discussion and results presentation	H9 & H10	Participants present the designed AI model	10 min	Participants	AI evaluation grid
	H8	Participants are guided to think about the need of collaboration	15 min	Nadine	
	H2 & H4	Participants answer a questionnaire for the AI proposal	5 min	Participants	AI Usability Questionnaire
Total time			170min		

Table 8.5: Group experiment protocol 2/3

360° VisiOn: *group experiment protocol for IS experts*					
Stage	**Ref**	**Description**	**≈Time**	**Who**	**Material**
Welcome		AI organization and offer summary, scenario reminder	5 min	Luz María & Nadine	Slide show
AI part II (if experiment 1/2 not completed)		Alliance material presentation, experiment development and discussion and results presentation	30 min	Participants	as described in protocol 1/2
AI solution		The designed AI alliance model is presented	8 min	Luz Maía	Slide show with AI proposed models
Collaboration Willingness (CW) material presentation		Introduction to CW	5 min	Luz Maía	CW Slide show
	H1	Reading and assessment of CW concept dictionary	10 min	Participants	CW dictionary
	H3	Description of the CW graph and text models	5 min	Luz María	Slide show, graphical notation & stickers, whiteboard markers, paper sheet, adhesive
		Extended narration of 4 organizations of the "weeding planner" scenario	5 min	Luz María	Sideshow, extended scenario
		Instructions and clarification of given material	4 min	Luz María	
CW experiment development	H5 & H6	Participants take the given material and instantiate the CW model for one organization of the scenario	30 min	Participants	Given material
CW discussion and results presentation	H9 & H10	Participants present the designed CW model for the given organization and the VO	15 min	Participants	CW evaluation grid
	H2 & H4	Participants answer a questionnaire for the CW proposal	5 min	Participants	CW Usability Questionnaire
Coffee break			8 min	Everybody	

Table 8.6: Group experiment protocol 3/3

360° VisiOn: *group experiment protocol for IS experts*					
Stage	**Ref**	**Description**	**≈Time**	**Who**	**Material**
Common Objectives (CO) material presentation		Introduction to CO	5 min	Luz Maía	CO Slide show
	H1	Reading and assessment of CO concept dictionary	10 min	Participants	CO dictionary
	H3	Description of the CO graph and text models	4 min	Luz María	Slide show, graphical notation
		Extended narration of 4 organizations of the "weeding planner" scenario	4 min	Luz María	Sideshow, extended scenario
		Instructions and clarification of given material	4 min	Luz María	
CO experiment development	H5 & H6	Participants take the given material and instantiate the CO model for one organization of the scenario	30 min	Participants	Given material
CO discussion and results presentation	H9 & H10	Participants present the designed CO model for the given organization and the VO	8 min	Participants	CO evaluation grid
	H2 & H4	Participants answer a questionnaire for the CO proposal	5 min	Participants	CO Usability Questionnaire
360° VisiOn stages sequence		Participants take the given material and propose the sequence of stages to be followed in order to complete the methodology	15 min	Participants	AI, CW and CO post-its, whiteboard markers, paper sheet
	H11, H12 & H13	Stages sequence discussion and results presentation	10 min	Participants	Post-its with aspects
Total time			190min - 225min		

- Some terms were ambiguous though needed to be changed and in some cases participants suggested new names. In the case of virtual, semi-virtual and real facade for example, the terms were noted as confusing: *"a `Virtual Facade` makes me think of the Virtual Organization itself and, why a facade would be real?, it might be clearer to use screen for only viewing the VO and mirror when all Member Organizations are viewed"* (Individual 5).
- Some definitions were not clear and needed to be complemented, in some cases due to the participants background: *"in my domain I only use `Service Provider` and `Service Consumer`"* (Individuals 3 & 4), *"all organizations in the chain are `Service Consumer`, so why the need of having other relationships?"* (Individual 5), *"if we provide something is because someone will receive it"* (Individual 4). As well as for the `Alliance` concept, the same participants conceived that there was an alliance between two organizations as long as there was a relationship between them, it was difficult for them to think of an alliance between more than two organizations (Individuals 3, 4 & 5). As another example, some participants did not't understand if a `Competitor` was considered versus the VO or versus the Service (Individuals 3 & 5).
- In some cases the order of the concepts caused confusion because intuitively they knew they were linked, they recommended to *"describe a term before is used in another description"* (Individual 8) or to *"use italics to know that it will be defined later"* (Individual 7).
- The format of the dictionary was difficult to read and understand for the `Intra, Inter and Extra` levels concepts *"I needed two readings: up & down and from left to right"* (Individual 2), *"It is good to have a formal definition of terms, but a schema might help to read the dictionary"* (Individual 8).
- The relationship dictionary needed to be complemented with other graphic elements: *"I understand the theoretical meaning, but I don't understand how you link the elements. You must name the arrow's start and end "* (Individual 2).
- It was not clear why there were two roles for the `Indirect and Direct Provider` and only one relationship (called `Principal`) from both of them, the participants expected a correlation between the roles and the relationships (Individual 1, 4, 7 & 8): *"It is weird that we have two different roles, but that we don't have two different relationships"* (Individual 8).
- The representation of the `Bilateral` relationship at the Inter level with a two edged arrow cause some confusion: *"we can think that the `Service Consumer` will provide the `Service`, it means that both (`Service Provider and Service Consumer`) have the same type of relationship "* (Individual 4). Although, the `Bilateral` relationship was considered *"important to know who has contact with consumers"* (Individ-

ual 4 & 7).

  - There were some comments about ergonomics: *"Use of capital letters or italics to reference terms in the dictionary will clarify the definitions"* (Individuals 7 & 8). One participant suggested to revise the relationships taking into account the Human Computer Interaction (HCI) recommendations of [Bastien et al., 1993, Moody, 2009] (Individual 7).
  - Individual 3 determined two roles for the Catter Company in the service, and proposed a clear way to represent them by overlaping the graphs as shown in Figure 8.2

- The Collaboration Willingness dictionary:
  - It was questioned the relevance of the `Priority` term, two points of view were encountered: *"We are engaged to do something, but we don't give a priority, either we do it or not"* (Individual 1 & 3). *"This allows the VO to offer this (which is responsible for) to be done by a second organization, if necessary, the VO has then the choice"* (Individual 4 & 8). *"An organization can collaborate, but it will not leave apart other engagements already has. You can not give to all compromises the same priority"* (Individual 4). Must participants believed that this concept needed clarification.
  - It was pointed out that the description of 'electronic communication' in the `Communication` term was restrictive: *"I did not't understand why there is an 'electronic communication' in the definition?, For communicating, it is not necessarily done by an electronic mean. It restricts the communication"*, the same participant also expressed that *"the definition is not sufficient. We should take the roles of sender-receiver in the 'direction' term"*(Individual 8). They perceived a formal and an informal communication.
  - It was not clear why an `Investment` could have and '`Indirect Impact`': *"If I invest something, is because there is a direct impact"* (Individual 1 & 5), *"Probably it is linked to the service of the VO or to the roles in the VO"* (Individual 4).
  - The aspect of `Trust` was not clear at all: *"I was lost in all the levels of definition"* (of the dictionary) (Individuals 5 & 8)
  - Several terms (like `Time, Impact`) did not have a description but a justification of the term, or a continuity of the sentence, which difficult their comprehension (Individuals 1, 6, 7 & 8).

2. The participants' remarks lead us to the following improvements in all dictionaries:

   - To change the name of two terms: Individual Organization for Singleton Organization, and Virtual, Semi-virtual and Real Facade for Screen, Semi-screen and Mirror Facade (Alliance Identification Dictionary).
   - To add three definitions: the Intra, Inter and Extra levels (Alliance Identification Dictionary).

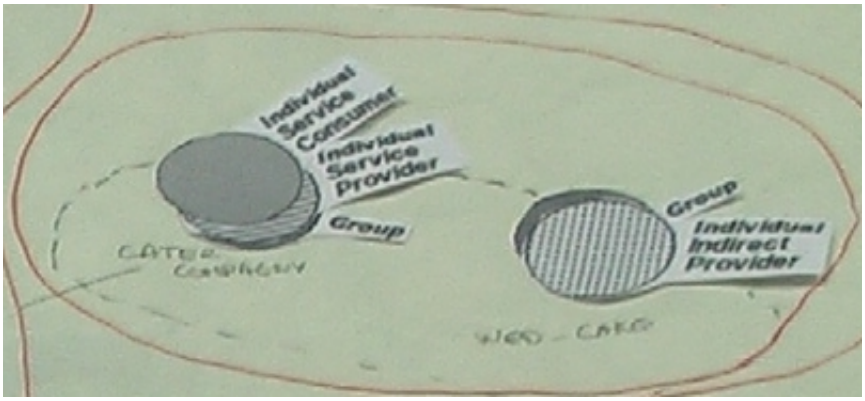


Figure 8.2: The Alliance Identification Model: an organization with several roles

- To complement several definitions.
- To improve the layout of the tables used to present the dictionary using gray backgrounds, and italic, bold and typewriter fonts, the concepts connection and the ergonomics in general.
- The relationship dictionary was improved with a graphical representation composed not only of arrows but the graphic source and destination elements.

8.3.2 Graph and Textual Models clearness, completeness and usability

The hypothesis tested were

H3 The graph and textual models are clear

H4 Models are easy to understand

H5 Participants can use the concepts and relations dictionaries

H6 Participants can use the graph and text models

We prepare two complementary exercises for evaluating the Alliance Identification and the Collaboration Willingness aspects. In addition to the dictionaries, we hand in legends and stickers of these two graphic notations aspects (B.11 and B.12), the part I and II of the wedding planner scenario (B.4.1 and B.4.2), cardboards and whiteboard markers.

For the Alliance Identification we ask each participant to read the scenario and to instantiate the inter level organizations and their relationships using the stickers, and to name the service offered.

For the Collaboration Willingness aspect we ask participants to read the second part of the scenario and to model the collaboration of one member organization using one or two graph elements of the Engagement, Coordination and Trust sub-aspects. The feedback given by the participants after both exercises is summarized as follow:

1. While using the graph elements, there was the need of reviewing some concepts.

- The Alliance Identification model instantiation:
  - The Group of organizations concept was used in different ways:
    - as organizations offering the same service: *"It was difficult to know when to use it. Is Transportation one company or several companies?, because it provides several transport means (limousine, coaches, etc) makes me think on several companies, but finally I choose a Group representation"* (Individual 3).
    - as organizations offering a similar global service: *"We can change the abstraction of the Group concept and have photographer, video, etc. (Wedding Studio, Wedding Video) in a group that provides media. I used it this way, because they provide the same service"* (Individual 4).
    - as legaly based organizations: another participant expressed *"I did not't want to have photography and video in the same group, because I thought that they were not in the same company, so from the legal point of view it was not possible"* (Individual 5). There was a debate about this concept pertinence: *"It is not important to know that there is a group or not, what is important is that they can give a service"* (Individual 2), *"To me, it is important to know if there is a group or not, because this way I know that if one organization fails, I have others to count on"* (Individual 8).
  - To avoid a bias toward a `Service Role` for a particular organization, the example of one of the service roles was removed from the concepts dictionary: *"In the dictionary it was the only role with an example, so it was difficult to find for the Bank a different role in the scenario than the one given in the example"* (Individual 8).
  - Although all participants define the `Service Consumer` as Joe & Maria, the terms `Provider` from the roles `Auxiliary, Indirect, Direct and Service` were difficult to separate due to some people's working background in service oriented programming: *"when we talk of Providers we always think of Consumer on the other side of the relationship"* (Individual 4), nevertheless, *"I have only one service consumer: Joe & Maria, I built the model from the point of view of the final consumer"* (Individual 3 & 4).
  - To start modeling from the `Service Consumer` point of view facilitated the task, but sometimes it was not evident: *"It must be clear that for building the model, we should start from the Service Consumer point of view"* (Individual 5). *"To find the 'right'point of view was difficult, I was lost thinking of the organization that provides the gown and that offers other services like alterations, so I said to myself, I have to go back to the main objective: organize the wedding"* (Individual 8).
  - Other ergonomics recommendations were given to *"propose different forms, colors and textures to differentiate actors in the graph represen-*

tation" (Individual 7).

- The Alliance Identification relationships:
  - It was considered to establish named relationships between organizations: *"Should they be named for explaining what they do?, for example with the Florist, I saw that there was a 'flower reservation' from the Service Provider to the Florist and 'provide the flowers' from the Florist to the Service Provider. It was easier for me to see it this way. Or, say in the dictionary that the relation means a provider-consumer relationship"* (Individual 2).
  - In some cases it was perceived that the Service Provider was not the only one to have contact with the consumer, so it was important to specify it in the roles definitions, or that an organization can play two different roles: *"I found that there were many arrows to draw because I see that other organizations in the scenario had a link with the Service Consumer, e.g. Chantal's Bridal for the gown, Transport for the limousine, etc"* (Individual 7). *"I think that there are two types of relationships: one the wedding planner in charge of directing the other organizations activities (chose the venue, etc.) like an orchestration and another relation at another level, with Direct Provider organizations having contact with the client, should they be Service Provider at the same time?."* (Individual 2).
  - Some participants needed to do a draft of the models before drawing the relationships *"I did a hierarchy, to clarify the actors and establish their relationships"* (Individual 8).
- The Alliance Identification Service name:
  - Six out of eight participants defined the Service with a short sentence, however one of them said *"I had problems to define the Service, because I saw each organization as independent, so each of them gives a service, there is a service aggregation of transport, catering, etc. It was complicated for me to describe in one sentence the whole service "* (Individual 2).
  - The two participants that did not name the service was due to forgetfulness and they mentioned *"we do the documentation afterwards"* (Individual 4 & 5).
- The VO's alliance was not clear to represent:
  - Some participants believed that only Direct Providers could form a VO and the remaining roles should be excluded (Individuals 1, 4 & 5).
  - Some participants preferred two different models: *"It was complicated to represent (the alliance) in the same model, I would prefer to do it in two different diagrams one for the actors and another for the alliance "* (Individual 2). Nevertheless, when participants saw our solution they agreed on having the alliance in the same model.
- The Collaboration Willingness instantiation and its relationships:
  - Some participants did not represent some elements because they did not understand them: *"I used only the things I understood"* (Individual 1 & 3),

"I didn't use `Regulation`*, because I don't understand it"* (Individual 1, 6 & 8).

- Participants found more difficult to use this model than the previous one and that needed more knowledge about the business. *"It is more specific, so it is more complicated, it demands many things. The first part it was easier (Alliance Identification), it was a general view . . . It is important to define it (Collaboration Willingness)"* (Individual 5). *"I felt that I was at a lower level vs the Alliance Identification model, and also that I didn't know the business enough for working at this level"* (Individual 8).
- The relationships in the model were not easy to express: *"There was some explanation missing"* (Individuals 6, 7 & 8).

2. General improvements were pointed out from the model instantiation:

   - Several concepts of the dictionaries had to be reviewed like terms changed, better descriptons, concepts connections, dictionaries layout.
   - The relationship dictionaries were improved, for example, the source and destination elements were included.
   - Although all participants reread the dictionaries while constructing their models, it arise the idea of developing a tutorial to learn how to build the models step by step using examples.

8.3.3 Models utility

The hypothesis tested were

H7 Participants need to define the alliance

H8 Participants need to define the collaboration among organizations

H9 Several iterations are needed for a complete model representation of a VO

H10 Participants propose the same solution

At the end of Sessions 1 & 2 we ask participants if they needed to define the alliance and the collaboration, other comments were extracted from the analysis of the models proposed by the participants and the questionnaires administered to them.

1. It was seen that there is an alliance for creating a VO. *"An alliance is a VO"* (Individual 5) *"It is done an alliance for achieving a particular objective"* and *"For me, 4yourWed is the result of an alliance. We do an alliance, and we have 4yourWed as a representation of the VO"* (Individual 4).

2. It was clear the need of modeling the collaboration, in general participants considered that each relationship between the organizations was a collaboration and that was important to define it. *"This exercise (Collaboration Willingness) is clearly a continuity of the prior exercise (Alliance Identification)"* (Individual 8).

3. Six out of eight participants considered that they would need between one and five iterations to complete the models, with a learning phase.

4. Participants found different ways of doing their models, specially for the Collaboration Willingness. *"I did a sequence diagram, with the objective of increment the client base. There is a function that demands to be regulated and the arrows are bidirectional"* (Individual 5). *"I separate the model in three parts: Engagement, Coordination and Trust. I draw a line for each one and I stuck an element for each of them"* (Individual 4). *"I used only the things I understood"* (Individual 1 & 3). Two models of the Alliance Identification are shown in Figures 8.3, and 8.4. Six participants produced similar models to the former, varying the number of organizations represented in the graph and the relationships between them. The latter Figure shows how another participant considered necessary to represent the relationship between each two organizations in addition to the service relationship proposed by our method. Two models of the Collaboration Willingness are shown in Figures 8.5 and 8.6.

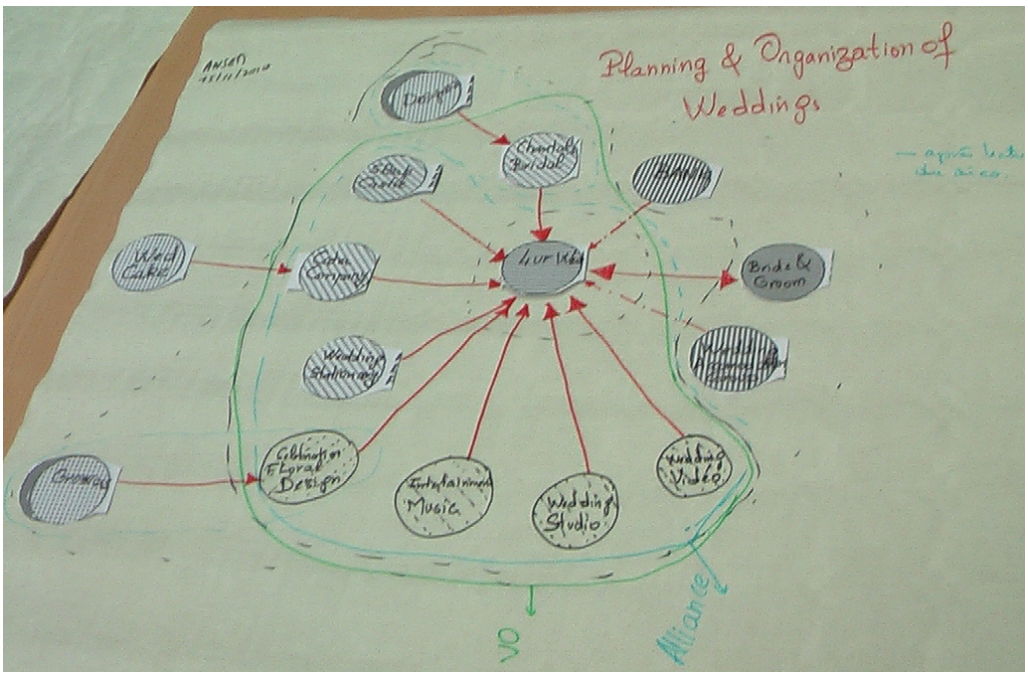


Figure 8.3: The Alliance Identification Model of one participant

8.3.4 Participants opinion about the methodology

The hypothesis tested were

H11 Models facilitate RE elicitation for VO

H12 Models are effective

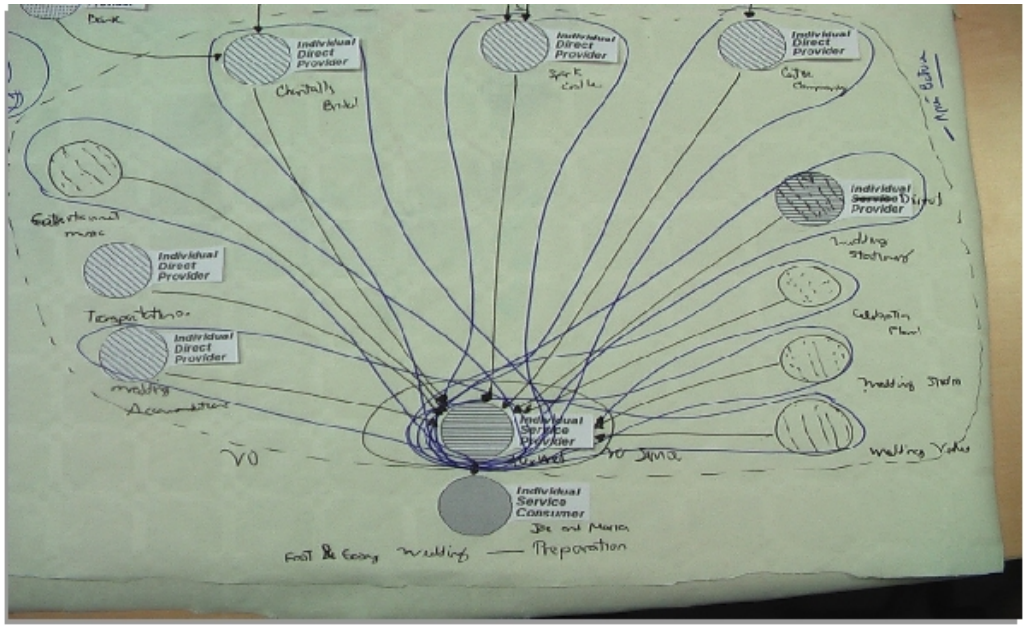


Figure 8.4: The Alliance Identification Model of another participant

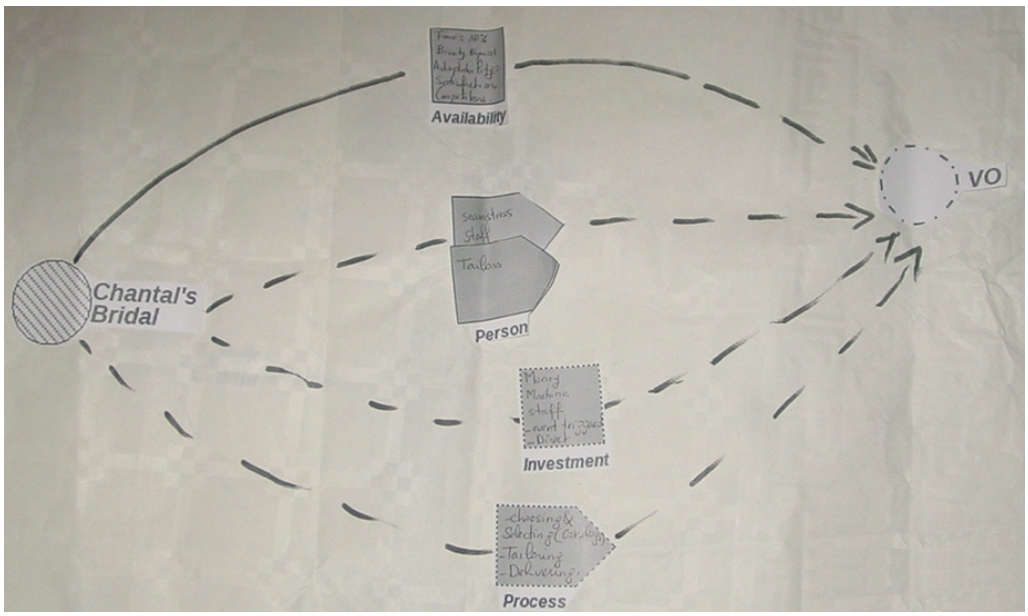


Figure 8.5: The Collaboration Willingness Model of one participant

H13 Models cover all RE concepts and relations for VO

Due to time constraints, we did not evaluate the Common Objective dictionary as planned, instead, we explained to the participants the Common Objective aspect and briefly discussed with them the concepts. All participants agreed that it was necessary to define the objectives. Knowing the three aspects of the 360° VisiOn and having used two of them,

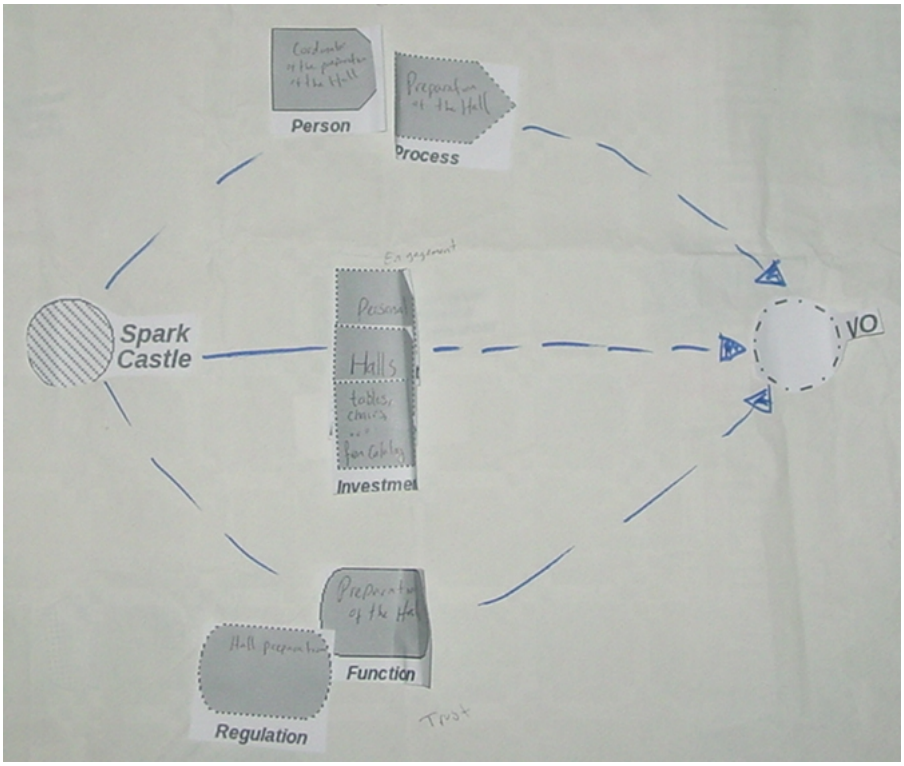


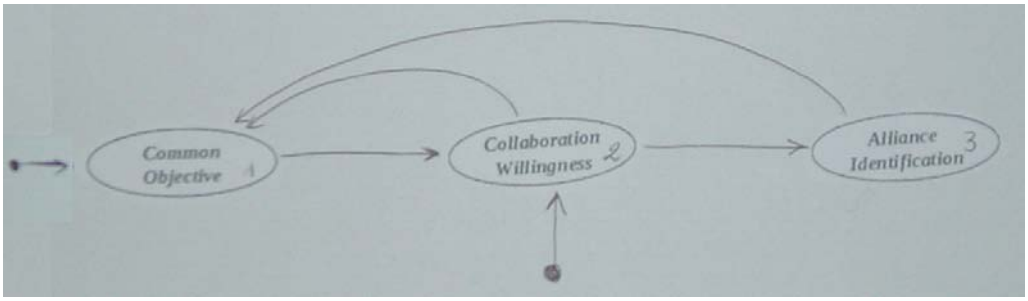
Figure 8.6: The Collaboration Willingness Model of another participant

we hand in the three aspects stickers and a white sheet to participants, and asked them to define the aspects sequence for the elicitation process. We resume in the following paragraph this discussion and the questionnaires administered.

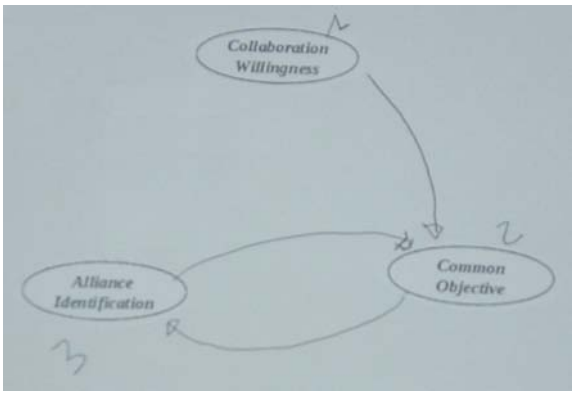
1. Most of participants agreed that the method guides the RE elicitation for the VO. Five said that they will recommend start the elicitation process by the Common Objective aspect, two by the Alliance Identification and two others by the Collaboration Willingness. Three participants gave two indistinct points of start: two participants proposed beginning either by the Common Objective or the Alliance Identification, one participant proposed starting by the Collaboration Willingness or the Common Objective. They explained that they will select the sequence to follow depending on the situation and the knowledge for instantiating an aspect. Four proposals are shown in Figure 8.7: 8.7a, 8.7b, 8.7c, and 8.7d.

2. Six out of eight participants considered the method easy to learn *"because the formalisms are simple and coherent"* (Individual 8). To learn and use the method, four participants estimated that they needed some minutes, three participants estimate some hours and one participant some days.

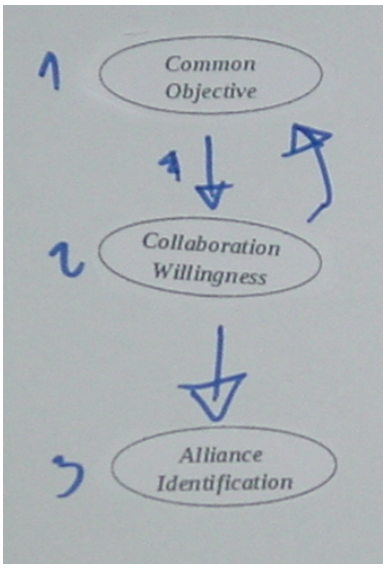
3. Seven out of eight participants agree that the 360° VisiOn had all the necessary concepts for the RE elicitation process, only one participant mentioned that there were too many concepts involved.



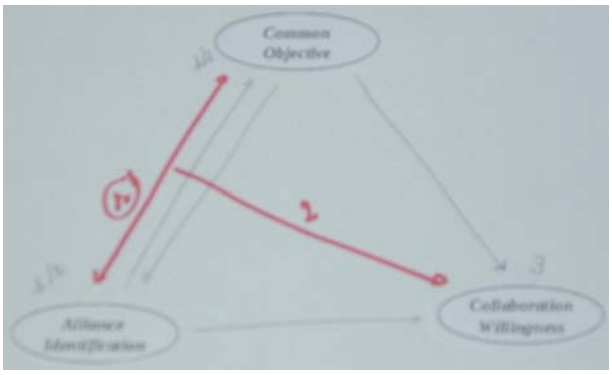
(a) Individual 1



(b) Individual 3



(c) Individual 4



(d) Individual 8

Figure 8.7: Aspects sequence

8.4 Conclusion

In this chapter we have presented the focus group experiment done with the help of MARVELIG to evaluate the 360° VisiOn. This experiment helped us to improve our concepts

and relationships dictionaries which final versions are in the Appendix B and to verify our models. Among the dictionaries improvements we can list: changes in some terms and descriptions, addition of several definitions, tables enhancement for an easy-to-use concepts dictionary. We also had Human Computer Interaction (HCI) recommendations to improve the look and feel of our models, and some participants expressed the need of a tutorial to illustrate the method. Nevertheless, these two recommendations are not implemented yet due to datelines constraints. During the evaluation sessions we allowed participants to experience the method and to give us feedback for future improvements.

CHAPTER 9

Conclusions and Future Research

Contents

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Virtual Organizations (VO) have emerge as a new type of inter-organizational relationship for dealing with emerging challenges (new competitors, new markets, new customer needs). Information and communication technologies play a fundamental role facilitating cooperation, communication and collaboration among the VO members. Therefore, we define a VO as "an alliance for integrating competences and resources from several independent real companies, that are geographically dispersed. This integration is possible throughout the layout of an information systems infrastructure to satisfy customer's requirements, or to take advantage of a business opportunity without having to form a new legal entity" [Priego-Roche et al., 2009a].

Nevertheless, the specification of IS becomes a crucial and difficult stage of the information system development cycle. The formal identification and representation of requirements for a single organization has been researched to a large extent along with several elicitation proposals. However, these proposals are not adequate for covering the major challenges of RE for VO. These challenges are: a large number of organizations and people involved, differing backgrounds and cultures of the people concerned, need of a collaborative alliance, need of integration / interoperability strategies, new information systems development, organizational independence preservation and external environment influences.

9.1 Main contribution of the thesis

In this thesis, we explore the work done in the management field and VO projects to identify, classify and formalize the intentional characteristics of a VO. We also analyze model driven techniques (models and approaches) in the RE field to apply and adapt the VOs key concepts and propose the *360° vision for VO* method for eliciting VO requirements.

The framework presented in this thesis analyzes the VO from two complementary approaches: vertical and horizontal. The vertical approach includes the following levels: intentional (collaboration alliance), organizational (business processes), and operational (information systems). Each vertical level is horizontally analyzed based on three dimensions: intra-organizational (participant organizations internals), inter-organizational (participant organizations relationships), and extra-organizational (external environment relations).

We have identified and formalized a set of aspects to identify the VO and its participant organizations (Alliance Identification), characterize the collaboration (Collaboration Willingness) and define the objectives (Common Objective). These aspects are the basis for a VO modeling and for designing a collaborative information system to share competencies and resources. A VO case study along with a modeling tool prototype are included to illustrate the framework at the intentional level. We have also proposed a formalization to transform the intentional models to business processes at the organizational models mapped to BPMN constructs.

Finally, we have presented the experiment results carried out with MARVELIG, the hotbed scientific experimental platform of LIG for prototype deployment and test in pervasive computing. This experiment has allowed us to evaluate the VO characterization as well as the models.

9.2 Future Research

The *360° vision for VO* proposed in this thesis has many axes to continue the research at short and long term.

- Short term:
  - **360° VisiOn validation.** We have validated the method with academic users, which some of them had working experience. A way to improve and validate the 360° VisiOn is to carry out at least two other experiments with people having a business background and people in the industrial field.
  - **Graphic interface recommendations.** During the experiments it was suggested to review the graphic notations to ease communication with stakeholders and support the design of the modeling process [Bastien et al., 1993, Moody, 2009].
  - **Tool support.** A tool is needed to draw and verify the models in order to comply all 360° VisiOn criteria and also to facilitate the models evaluation. At the moment, we have developed a prototype tool that only handles the Alliance Identification models therefore, a full tool support is required.
- Long term:
  - **Models validation.** We have illustrated the models with a case study from the agroindustry, and with the wedding industry in the user experiment. We will extend and validate the models in other industry sectors like health and education, and other collaboration forms (consortium, distribution, outsourcing, etc.).
  - **Goals refinement.** In the Common Objective aspect, goals are refined independently at each horizontal level (inter, intra, extra). It is important to establish

the links between the three horizontal levels of objectives to highlight the possible conflicts between Member Organizations' goals and allow re-negotiate or redefine the objectives.

- **Levels refinement.** In this work, we have fully covered the intentional level and partially covered the organizational level. However, the link between both levels was done having in mind the inter-organizational relationships. We need to validate if this characterization is complete and coherent to bridge the horizontal relationships: on the one hand the internal relationships of each organization to prepare what is needed by the VO and on the other hand, the external relationships to comply what is demanded from the VO by the external organizations.
- **Activity patterns.** We have proposed a partial transformation function from the intentional to the organizational models. We want to explore the use of the activity patterns (Approval, Question-answer, Uni-/Bi-directional Performative, Information Request, Notification, and Decision Making) proposed in [Thom et al., 2009] to transform the intentional models to a corresponding BPMN business processes diagram and benefit of the know how described by these patterns.
- **Serious games.** We plan to explore the use of role games for developing the intentional models. The objective is to obtain these models in a ludic and cooperative way by gathering the different actors involved to play.

CHAPTER 10

French translation

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10.1 Introduction

10.1.1 Le contexte

Le travail de recherche décrit dans ce mémoire s'inscrit dans le domaine de l'ingénierie des besoins dirigée par les modèles. Plus spécifiquement, il est dédié à l'élicitation des besoins des systèmes d'information (SI) pour les organisations virtuelles (OV).

Pour répondre à un marché de plus en plus concurrentiel, les organisations cherchent de nouvelles stratégies pour survivre. Une façon de mieux répondre à des opportunités d'affaires ou à des menaces consiste à s'organiser sous la forme d'une organisation virtuelle (OV). Une OV est une alliance entre des organisations indépendantes qui a pour but l'intégration des compétences et des ressources à travers une infrastructure de système d'information. Ce terme a été utilisé pour la première fois par Mowshowitz en 1986 [Mowshowitz, 1986]. La possibilité de collaboration et de permutation entre les organisations qui peuvent satisfaire un besoin en produisant des biens ou des services, permet aux consommateurs d'ignorer la complexité des processus sous-jacents. Par conséquent, le progrès des technologies de l'information permet un niveau élevé de coordination qui peut être assuré par l'exécution, à partir de différents lieux, des processus nécessaires pour satisfaire les demandes des clients.

Nous définissons une OV comme « une alliance qui a pour but d'intégrer les compétences et les ressources de plusieurs entreprises réelles indépendantes, qui se trouvent dispersées géographiquement. Cette intégration est possible à travers une infrastructure d'information numérique disposée pour satisfaire les besoins des clients, ou

saisir une opportunité sans avoir recours à la formation d'une nouvelle entité légale » [Priego-Roche et al., 2009a]. Néanmoins, la spécification des SI, déjà primordiale et difficile pour des organisations classiques, devient une étape cruciale du cycle de développement du système d'information d'une OV. L'identification formelle et la représentation des besoins pour une seule organisation ont été étudiées par de nombreux auteurs. Toutefois, ces propositions ne sont pas suffisantes pour couvrir les grands défis d'ingénierie des besoins pour une OV : un grand nombre d'organisations et de personnes impliquées, de milieux et de cultures différents, le besoin d'une alliance de collaboration, le besoin de stratégies d'intégration / interopérabilité, la conception de nouveaux systèmes d'information, la préservation de l'indépendance organisationnelle et les influences de l'environnement extérieur.

L'étude de cas utilisée pour construire et valider notre proposition est issue d'un regroupement d'associations d'éleveurs de Tabasco, au Mexique (abattoir, société d'emballage, société coopérative de consommation, etc.) travaillant dans le domaine de l'industrie du bétail, comme illustré à la figure 2.1. Cette OV offre des services multiples et des produits à ses membres dans un fort esprit de coopération afin d'augmenter le rendement économique de la production d'élevage.

10.1.2 Les questions et les objectifs de recherche

L'ingénierie des besoins pour l'OV ajoute de la complexité à l'ingénierie des besoins traditionnelle : de nombreuses organisations et acteurs impliqués, la structure de gouvernance de la nouvelle OV et l'hétérogénéité des organisations et des acteurs. Par conséquent, les questions de recherche sont :

- **Quelles sont les caractéristiques d'une OV ?**
  Il est difficile de parvenir à un consensus général sur le terme, la définition et les caractéristiques d'une OV. Le domaine de la gestion offre une riche source de formes d'organisations innovantes qui tirent parti des opportunités du marché ou des progrès technologiques, ces organisations sont évidemment décrites du point de vue de la gestion. Dans notre travail, nous examinons le concept d'OV en ayant à l'esprit que les technologies de l'information et de la communication (TIC) sont une vaste plateforme qui facilite la collaboration inter-organisationnelle.

- **Comment pouvons-nous définir les besoins du SI pour une OV ?**
  L'ingénierie des besoins est déjà difficile pour une organisation « traditionnelle » en raison des personnes concernées, de l'environnement changeant et du contexte dans lequel le système fonctionnera. Par conséquent, elle est encore plus difficile pour une OV car elle implique un ensemble d'organisations d'origines diverses, ayant besoin de travailler de manière coordonnée tout en préservant leur indépendance. Notre défi consiste à structurer et caractériser d'une manière claire et complète l'ensemble des besoins des organisations concernées.

- **Quels sont les modèles et les méthodes que nous pouvons offrir pour aider à définir les besoins d'une OV ?**
  Notre intérêt est centré sur l'ingénierie des besoins dirigée par les modèles, et le

défi consiste à définir les besoins d'une OV en tenant compte non seulement d'une organisation, mais aussi d'un ensemble d'organisations. La proposition consiste à explorer, recueillir et visualiser les informations qui définissent les besoins des divers actionnaires, utilisateurs, analystes, etc.

- **Comment pouvons-nous guider le processus d'élicitation des besoins pour une OV ?**
  La structuration du processus d'élicitation facilite la compréhension de l'OV, l'identification de ses divers acteurs et leurs possibilités de collaboration. La méthode proposée devra comprendre un guide non-linéaire pour découvrir et améliorer l'information visualisée dans les modèles, ainsi que pour parvenir à la complétude de ces modèles.

10.1.3 Les contributions

Le principal aboutissement de cette thèse est de proposer une approche qui facilite l'élicitation des besoins du système d'information d'une OV. Notre approche contribue au domaine de l'ingénierie des besoins par :

1. une caractérisation des OV basée sur l'alliance qui définit précisément les concepts à prendre en compte ;
2. des modèles graphiques et textuels simples d'ingénierie de besoins pour représenter l'OV ;
3. un outil pour assister la modélisation ;
4. une démarche validée pour guider le processus d'ingénierie des besoins qui comprend en autre une transformation partielle du niveau intentionnel au niveau organisationnel.

10.2 Structure de la thèse

La thèse est composée d'une étude de cas (chapitre 2), d'un état de l'art (chapitres 3 et 4), d'une proposition (chapitres 5, 6 et 7), d'expérimentations permettant la validation des résultats (chapitre 8) et des conclusions et perspectives de travail (chapitre 9). Les chapitres sont résumés ci-dessous :

- Le chapitre 2 décrit l'étude de cas de l'Union régionale des éleveurs de Tabasco SCL (UGRT). Nous présentons l'ensemble des organisations formant l'OV et les interactions entre elles. L'UGRT regroupe plusieurs entreprises travaillant dans le domaine de l'industrie du bétail. Cette OV offre de nombreux services et produits à ses membres dans un fort esprit de coopération afin d'augmenter le rendement économique de la production d'élevage. Elle est composée de plusieurs entreprises (abattoir, société d'emballage, société coopérative de consommation, etc.) illustrées par la figure 2.1. Parmi elles, les éleveurs sont considérés comme membres de l'organisation et

possèdent les droits d'utiliser les services offerts par les entreprises, ils sont groupés dans des associations locales d'éleveurs. Ces organisations sont utilisées pour illustrer notre démarche et les modèles proposés. Cette étude de cas a été présentée dans trois publications [Priego-Roche et al., 2009b, Priego-Roche et al., 2009a, Priego-Roche et al., 2010].

- Le chapitre 3 présente l'état de l'art sur les OV sous les points de vues de la gestion, des Systèmes de Systèmes (SoS) et des plates-formes logicielles dédiées aux OV.

  - En ce qui concerne les travaux issus de la gestion, nous avons examiné les concepts de stratégie et d'alliance en tant que sources de caractérisation des OV. Certaines de ces approches sont dédiées aux aspects collaboratifs (voir [Kanter, 1994, Robinson et al., 2005] dans la section 3.2.5), d'autres insistent sur les processus métier ([Cheng et al., 2005, Barnett et al., 1994]), l'identification des objectifs communs [Marshal et al., 1999], ou la dispersion géographique [Tripathy et al., 2007].
  - Les travaux sur les SoS explicitent les défis liés à la complexité des multi-systèmes contre un mono-système. Le Tableau 3.1 montre une comparaison de chaque critère dans l'étude de cas de l'URT.
  - Finalement, nous avons étudié certains projets des technologies de l'information et la communication (TIC) et des plates-formes dédiés aux petites et moyennes entreprises pour former une OV et soutenir la collaboration entre ces entreprises. Des tableaux de comparaison sont donnés pour résumer les similitudes et les différences des projets et des plates-formes : le Tableau 3.2 pour les projets SMEcoll et ECOLEAD, et le Tableau 3.3 pour les plates-formes BEinGRID, TrustCoM et SYNERGY.

- Le chapitre 4 présente un état de l'art des travaux issus de l'ingénierie des besoins par les modèles [Priego-Roche et al., 2010]. Une analyse comparative de six méthodes particulièrement utilisées pour modéliser les besoins des organisations est présentée par le tableau 4.1 : i* [Yu, 1997], KAOS [van Lamsweerde et al., 1998], CREWS [Maiden, 1998], MAP [Rolland et al., 2000], e^{3}value [Gordijn, 2002], SVN [Basole et al., 2008].Ces langages de modélisation sont résumés dans le tableau 4.1. Toutes ces approches adressent le problème de l'élicitation des besoins à travers des buts, des scénarios ou des services. Elles proposent différents modèles s'appuyant sur des concepts divers comme la dépendance, l'intention, la génération de la valeur ou l'approvisionnement de service. Toutes ces approches supportent l'interaction entre les acteurs, mais certaines seulement considèrent les interactions internes ou avec l'environnement. Enfin, quelques approches proposent une démarche et des outils pour faciliter les différentes étapes du processus, dont certaines sont utilisées dans des contextes industriels comme KAOS ou e^{3}value. Parmi les approches étudiées, la plupart proposent des concepts et des démarches pertinents dans le contexte des organisations virtuelles. Notons en particulier le concept de dépendance

entre acteurs de i*, la démarche top-down d'identification des buts de KAOS, le concept de segment de marché dans e^{3}value et la typologie de rôles d'acteurs proposée dans SVN. Notre proposition intègre ces différents concepts et démarches.

- Le chapitre 5 explique le cadre multi-vue de notre proposition, appelée vision à 360˚. Cette proposition est introduite dans deux articles [Priego-Roche et al., 2009c, Priego-Roche et al., 2009a] afin de préciser toutes les attentes des parties prenantes : la création de l'alliance pour partager les compétences et offrir un service, les relations intra, inter et extra organisationnelles, l'objectif commun ainsi que les objectifs individuels. Comme dans [Nurcan et al., 2002], nous considérons trois niveaux d'abstraction verticaux :

  - le niveau **intentionnel**, où il s'agit de définir précisément l'alliance stratégique, la collaboration et l'objectif commun de la collaboration,
  - le niveau **organisationnel**, où les processus métier mis en jeu pour atteindre l'objectif commun sont formalisés,
  - le niveau **opérationnel**, où les actions nécessaires pour exécuter les processus métier sont détaillées, en décrivant la structure et le comportement attendus du système d'information.

  Des points de vue différents sont nécessaires pour faciliter l'identification des besoins des SI des OV. Notre proposition classifie ces besoins suivant trois dimensions horizontales :

  - Élicitation des besoins **intra-organisationnels** : il s'agit ici de se focaliser sur la dimension interne de l'organisation virtuelle, en particulier les relations entre les acteurs fonctionnels (individus ou groupes) des organisations participantes. Ce niveau concerne la structure traditionnelle de l'organisation et étudie ses buts internes alignés aux objectifs opérationnels. L'élicitation intra-organisationnelle analyse les forces que mettent en jeu les organisations : leurs compétences, leurs ressources, leurs capacités, leurs processus métier internes, etc., donc de manière générale, tout ce que chaque organisation possède et peut mettre à disposition de l'organisation virtuelle.
  - Élicitation des besoins **inter-organisationnels** : il s'agit ici de considérer les liens entre les organisations qui forment l'organisation virtuelle. Ce niveau concerne la nouvelle stratégie de collaboration entre plusieurs organisations avec un but commun, cet objectif n'étant pas obligatoirement, corrélé à ceux des autres organisations. Il est nécessaire à ce niveau d'étudier principalement les relations entre les diverses organisations participantes. Les mots clés qui décrivent ce niveau sont Alliance, Collaboration et Objectifs. L'alliance établit le compromis entre les organisations et la collaboration traite des moyens pour atteindre ce compromis.
  - Élicitation des besoins **extra-organisationnels** : il s'agit d'étudier l'environnement externe de l'organisation virtuelle, plus précisément les

influences des acteurs hors de l'organisation virtuelle quels que soient leur nature et l'impact de leurs influences. L'élicitation extra-organisationnelle analyse l'environnement externe qui impose des règlements, offre des opportunités autant que des risques, oblige les organisations à s'adapter au marché, à faire face à la concurrence ou à rechercher de nouvelles alliances.

- Le chapitre 6 détaille les 3 aspects du niveau intentionnel de la vision à 360˚ et présente les modèles graphiques et textuels proposés. Les 3 aspects sont les suivants :
  - **l'identification de l'alliance** : elle caractérise l'OV, l'accord, les acteurs et les services offerts. L'alliance établit un moyen de faciliter une relation constructive en préservant l'indépendance de chaque organisation pour poursuivre son propre projet. L'identification des acteurs (parties prenantes, utilisateurs, organisations, etc) est une méthode recommandée pour démarrer l'élicitation des besoins [Hickey et al., 2003]. L'identification du service définit les résultats généraux attendus de ces acteurs et leur rôle dans la production de services.
  - **la volonté de la collaboration** : elle caractérise les compromis de chaque organisation membre (OM) pour établir l'alliance, sa disponibilité, les investissements que l'organisation est prête à engager, les éléments devant être coordonnés et la régulation du comportement attendu qui assure de bonnes performances des membres de l'OV.
  - **l'objectif commun** : il représente le but partagé et les directions à suivre pour l'atteindre. Ces dernières peuvent concerner la réponse à des besoins clients (services intégraux), la satisfaction des objectifs des entreprises (partager les coûts, les bénéfices, créer des processus plus efficaces)[Goldman et al., 1995], la saisie d'opportunités d'affaires (nouveaux marchés, nouveaux produits ou services), ou la confrontation face à une difficulté (absence de connaissance). Généralement, les objectifs émergent de situations qui peuvent être soit des opportunités (des circonstances qui favorisent l'alliance), soit des problèmes (des difficultés qui justifient l'alliance).

  Deux de ces aspects (Identification de l'Alliance et Volonté de la collaboration) ont été introduits, caractérisés et instanciés dans [Priego-Roche et al., 2009a, Priego-Roche et al., 2010].

- Le chapitre 7 propose un ensemble de règles et de fonctions pour transformer les modèles intentionnels de la vision à 360˚ en des processus métier du niveau organisationnel. La transformation des modèles d'identification de l'alliance en processus décrits en BPMN est faite par une fonction partielle expliquée dans la sous-section 7.2.2, qui peut également faciliter l'automatisation du processus de transformation. Dans la sous-section 7.2.3, nous avons également montré une façon de transformer les modèles de la volonté de la collaboration en concepts de BPMN. Nous avons fourni des exemples de transformation sous la forme de diagrammes de collaboration et de schémas non exécutables permettant de lier les modèles intentionnels à

des constructions BPMN. La nécessité d'un processus de transformation est évidente pour une modélisation itérative où les modèles doivent être complétés et affinés par les utilisateurs à différents niveaux.

- Le chapitre 8 décrit la validation qualitative des concepts, des relations et des modèles proposés dans la vision à 360˚. Cette expérience réalisée avec l'aide de la plate-forme MARVELIG (pépinière d'expérimentations scientifiques du LIG), nous a permis d'améliorer les dictionnaires de concepts qui sont présentés dans l'annexe B et de valider les modèles intentionnels. Parmi les améliorations aux dictionnaires, nous pouvons citer : des changements dans certains termes et descriptions, l'ajout de plusieurs définitions, l'amélioration des tables pour faciliter l'utilisation du dictionnaire de concepts. Nous avons également eu des recommandations pour améliorer la notation graphique et pour illustrer la méthode en fournissant un tutoriel.
- Le Chapitre 9 conclut les travaux de recherche de la thèse et dresse quelques perspectives. Nous les présentons ci-dessous.

10.3 Conclusions et perspectives

Les organisations virtuelles (OV) sont apparues comme un nouveau type de relations inter-organisationnelles pour faire face aux nouveaux défis (nouveaux concurrents, nouveaux marchés, nouveaux besoins des clients). Les technologies de l'information et de la communication jouent un rôle fondamental en facilitant la coopération, la communication et la collaboration entre les membres des OV. Cette thèse propose un ensemble de critères permettant de caractériser au niveau intentionnel les différentes organisations participantes à une OV ainsi que leurs interrelations. Ces critères sont utilisés dans des modèles graphiques et textuels. Le niveau intentionnel sert de point de départ pour la représentation de processus métier au niveau organisationnel.

10.3.1 Principales contributions de la thèse

Dans cette thèse, nous explorons les travaux réalisés dans le domaine de la gestion, des projets et des plates-formes dédiés aux OV, pour classifier et formaliser les caractéristiques intentionnelles d'une OV. Nous analysons également les approches à base de modèles dans le domaine de l'ingénierie des besoins pour appliquer et adapter les concepts clés d'une OV et proposer une vision à 360˚ pour éliciter les besoins des OV. Le cadre présenté dans cette thèse analyse les OV à partir de deux visions complémentaires : verticale et horizontale. L'approche verticale comprend les niveaux intentionnel (alliance de la collaboration), organisationnel (processus métier), et opérationnel (systèmes d'information). Chaque niveau est analysé suivant trois dimensions : intra-organisationnelle (la partie interne des organisations participantes), inter-organisationnelle (les relations entre les organisations participantes), et extra-organisationnelle (les relations avec l'environnement extérieur).

Nous avons identifié et formalisé un ensemble d'aspects afin de caractériser l'OV et ses organisations participantes (Identification de l'Alliance), de caractériser la collaboration (Volonté de la Collaboration) et de définir les objectifs (Objectif commun). Ces

aspects constituent une base conceptuelle pour modéliser les OV et concevoir les systèmes d'information collaboratifs pour partager les compétences et les ressources. Une étude de cas d'une OV et un prototype d'outil de modélisation sont proposés pour illustrer le cadre au niveau intentionnel. Nous avons également proposé une formalisation pour transformer les modèles intentionnels en des processus métier décrits en BPMN. Enfin, nous avons présenté les résultats de l'expérience réalisée avec MARVELIG, pépinière d'expérimentations scientifiques du LIG. Cette expérience nous a permis d'évaluer la caractérisation de l'OV ainsi que les modèles.

10.3.2 Perspectives

La vision à 360˚ pour les OV proposée dans cette thèse présente de nombreuses perspectives à court et long terme.

- À court terme :
  - **Validation de la vision à 360˚**. Nous avons validé la méthode dans le milieu universitaire en informatique. Une façon d'améliorer et de valider la vision à 360˚ est de réaliser au moins deux autres expériences avec des personnes issues du monde industriel.
  - **Recommandations liées à l'interface graphique**. Au cours des expériences il a été suggéré de revoir les notations graphiques pour faciliter la communication avec les parties prenantes et le support du processus de modélisation [Bastien et al., 1993, Moody, 2009].
  - **Outil pour assister la méthode**. Un outil est nécessaire pour dessiner, vérifier et faciliter l'évaluation des modèles proposés. À l'heure actuelle, nous avons développé un prototype qui gère uniquement les modèles d'identification de l'alliance. Par conséquent, un support complet est nécessaire.
- À long terme :
  - **La validation des modèles**. Nous avons illustré les modèles par une étude de cas de l'agro-industrie, et de l'organisation des mariages dans l'expérience avec les utilisateurs. Nous allons étendre et valider les modèles dans d'autres secteurs comme la santé et l'éducation, et avec d'autres formes de collaboration (consortium, distribution, sous-traitance, etc.)
  - **Raffinement des objectifs**. L'aspect objectif commun décrit dans la section 6.3, propose un raffinement des objectifs au niveau horizontal (inter, intra, et extra-organisationnel) de façon indépendante. Il est désormais important d'établir les liens entre les objectifs des trois niveaux pour mettre en évidence les conflits entre les organisations membres et permettre de renégocier ou de redéfinir les objectifs.
  - **Niveaux de raffinement**. Dans ce travail, nous avons entièrement couvert le niveau intentionnel et partiellement le niveau organisationnel. Cependant, les

liens entre ces deux niveaux ont été caractérisés en tenant compte des relations inter-organisationnelles. Il est nécessaire maintenant de valider si cette caractérisation est complète et cohérente afin de lier les relations horizontales : d'une part les relations internes de chaque organisation pour préparer ce qui est nécessaire à l'VO et d'autre part, les relations externes pour se conformer à ce qui est exigé de l'OV par les organisations externes.

- **Patrons d'activité**. Dans le chapitre 7, nous avons proposé une fonction de transformation partielle des modèles intentionnels vers des modèles organisationnels. Nous voulons explorer l'utilisation des patrons d'activité (approbation, questions-réponses, uni-/bi-directionnel, demande d'information, notification et prise de décision) proposés dans [Thom et al., 2009] pour bénéficier du savoir-faire décrit par ces patrons.
- **Jeux sérieux**. Finalement, nous envisageons d'explorer l'utilisation des jeux de rôles de simulation pour la construction des modèles intentionnels. L'objectif est d'obtenir les modèles de manière ludique et coopérative, en faisant jouer les différents acteurs impliqués.

APPENDIX A

To the organizational level

Contents

A.1 XML definition name-space 185

A.1 XML definition name-space

This appendix presents the XML definition name-space for the transformation functions of Section 7.2.

The UGRT model shown in Figures 7.7 and 7.8 has the following XML definition name-space:

```
<definitions name ="Conditioning and sale of quality bovine meat"> **VO SERVICE (7.4)
  <process isExecutable="false" name="Members Services"> **VO MEMBERS (7.5)
    <laneSet name="UGRT (MemberslaneSet)">
      <lane name="Stockbreeders Associations (AP)" rolename="Auxiliary Provider">
        <flowNodeRef> "Facilitate Cattle Production and Marketing" </flowNodeRef>
      </lane>
      <lane name="Stockbreeders (IP)" rolename="Indirect Provider">
        <flowNodeRef> "Provide grass fed Cattle Livestock" </flowNodeRef>
      </lane>
      <lane name="Slaughterhouse (IP)" rolename="Indirect Provider">
        <flowNodeRef> "Slaughter Cattle" </flowNodeRef>
      </lane>
      <lane name="Freight Trucking (IP)" rolename="Auxiliary Provider">
        <flowNodeRef> "Transport Cattle and Beef Meat" </flowNodeRef>
      </lane>
      <lane name="Meat Marketing (DP)" rolename="Direct Provider">
        <flowNodeRef> "Commercialize Beef Meat and Sub-products" </flowNodeRef>
      </lane>
      <lane name="semi-screen Facade"> **VO FACADE (7.6)
        <flowNodeRef> "Manage VO Facade" </flowNodeRef>
      </lane>
    </laneSet>
  </process>
  <process isExecutable="false" name="Contributors Services"> **VO CONTRIBUTORS (7.7)
```

```
    <laneSet name="UGRT (ContributorslaneSet)">
      <lane name="Supermarket Chains (SP)" rolename="Service Provider">
        <flowNodeRef> "Sell Beef Meat" </flowNodeRef>
      </lane>
      <lane name="Meat Consumers (C)" rolename="Consumer">
        <flowNodeRef> "Buy Beef Meat" </flowNodeRef>
      </lane>
    </laneSet>
  </process>
  <process isExecutable="false" name="External Services"> **VO EXTERNAL (7.8)
    <laneSet name="UGRT (ExternallaneSet)">
      <lane name="Government Regulators (R)" rolename="Regulator">
        <flowNodeRef> "Regulate Beef and Meat Production and Inspection" </flowNodeRef>
      </lane>
      <lane name="Leather Articles Producers (Cm)" rolename="Complementor">
        <flowNodeRef> "Buy Hide" </flowNodeRef>
      </lane>
      <lane name="Meat Importers (Ct)" rolename="Competitor">
        <flowNodeRef> "Provide Beef Meat" </flowNodeRef>
      </lane>
    </laneSet>
  </process>
    <subProcess name="Facilitate Cattle Production and Marketing"> </subProcess>
**ORGANIZATION'S SERVICE (7.9)
    <subProcess name="Provide grass fed Cattle Livestock"> </subProcess>
    <subProcess name="Slaughter Cattle"> </subProcess>
    <subProcess name="Transport Cattle and Beef Meat"> </subProcess>
    <subProcess name="Commercialize Beef Meat and Sub-products"> </subProcess>
    <subProcess name="Manage VO Facade"> </subProcess>
    <subProcess name="Sell Beef Meat"> </subProcess>
    <subProcess name="Buy Beef Meat"> </subProcess>
    <subProcess name="Regulate Beef and Meat Production and Inspection"> </subProcess>
    <subProcess name="Buy Hide"> </subProcess>
    <subProcess name="Provide Beef Meat"> </subProcess>
    <sequenceFlow sourceRef="Facilitate Cattle Production and Marketing" targetRef="Provide
grass fed Cattle Livestock"/> **ORGANIZATION'S SERVICE (7.10)
    <sequenceFlow sourceRef="Facilitate Cattle Production and Marketing" targetRef="Slaughter
Cattle"/>
    <sequenceFlow sourceRef="Facilitate Cattle Production and Marketing"
targetRef="Commercialize Beef Meat and Sub-products"/>
    <sequenceFlow sourceRef="Provide grass fed Cattle Livestock" targetRef="Slaughter Cattle"/>
    <sequenceFlow sourceRef="Slaughter Cattle" targetRef="Commercialize Beef Meat and
Sub-products"/>
    <sequenceFlow sourceRef="Transport Cattle and Beef Meat" targetRef="Slaughter Cattle"/>
```

<sequenceFlow sourceRef="Transport Cattle and Beef Meat" targetRef="Provide grass fed Cattle Livestock"/>

<sequenceFlow sourceRef="Buys Beef Meat" targetRef="Sell Beef Meat"/>

<sequenceFlow sourceRef="Sell Beef Meat" targetRef="Buys Beef Meat"/>

<sequenceFlow sourceRef="Manage VO Facade" targetRef="Commercialize Beef Meat and Sub-products"/>

<sequenceFlow sourceRef="Commercialize Beef Meat and Sub-products" targetRef="Manage VO Facade"/>

<collaboration> **VO SERVICE (7.4)

<participant name="UGRT(Members)" processRef="Members Services"> **VO SERVICE (7.4)

<participant name="UGRT(Contributors)" processRef="Contributors Services">

<participant name="UGRT(External)" processRef="External Services">

<messageFlow "Sell Beef Meat" targetRef="Manage VO Facade"/> **ORGANIZATION'S SERVICE (7.12)

<messageFlow "Buy Hide" targetRef="Manage VO Facade"/>

<messageFlow "Transport Cattle and Beef Meat" targetRef="Sell Beef Meat"/>

<messageFlow "Regulate Beef and Meat Production and Inspection" targetRef="Transport Cattle and Beef Meat"/>

<messageFlow "Regulate Beef and Meat Production and Inspection" targetRef="Provide grass fed Cattle Livestock"/>

<messageFlow "Regulate Beef and Meat Production and Inspection" targetRef="Slaughter Cattle"/>

<messageFlow "Regulate Beef and Meat Production and Inspection" targetRef="Sell Beef Meat"/>

<messageFlow "Provides Meat Beef" targetRef="Sell Beef Meat"/>

</collaboration>

</definitions>

APPENDIX B

Validation

Contents

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In this appendix we present the material given to the people participating in the experiments. The concepts and relationships dictionaries were validated and used during the sessions, the graphic notations were used by the participants to elaborate their own model based on the scenario and three questionnaires were applied to collect information about the experiments.

B.1 Concepts dictionary

Table B.1: 360° VOvision concepts dictionary: AI 1/7

Alliance Identification: *determines ORGANIZATIONS that facilitate a SERVICE in a subscribed ALLIANCE*

Level	Concept	Refinement	Description	1	2	3	4	*
	Intra		Level focused on the relationships inside each organization forming the *Virtual Organization*					
Intra	*Actor*		an individual responsible of *Service* activities					
	Committee		a functional division, composed of *Actors* and responsible of *Service* activities					
	Organization		the business *Actors* and *Committees* involved in the *Service* provisioning					
	Set of Committees or Organizations	Singleton	is composed of only one *Committee* or one *Organization*					
		Group	is composed of more than one *Committee* or *Organization*					
	Actor or Committee Role	Primary	responsible of activities that directly help produce or provide a *Service* (logistics, operations, marketing and sales, client service)					
		Support	responsible of activities that indirectly help *Service* provisioning (finance, human resources, procurement)					

** 1: Very Clear, 2: Somewhat Clear, 3: Not Very Clear, 4: Not at All Clear*

Table B.2: 360° VOvision concepts dictionary: AI 2/7

Alliance Identification: *determines ORGANIZATIONS that facilitate a SERVICE in a subscribed ALLIANCE*

Level	Concept	Refinement	Description	1	2	3	4	*
	Inter		Level focused on the relationships among the organization providing a *Service*					
Inter	*Service*		products or facilities offered by an organization network and ready to be consumed or used					
	Organization Service Role		organization's participation in *Service* achievement or consumption					
		Service Consumer	uses or buys the final *Service* offered by the organization network and is the starting point of the service conception					
		Service Provider	provides the *Service* to *Service Consumers* and has direct contact with them					
		Direct Provider	supplies the *Service Providers* with the products and *Services* directly related to the *Service*					
		Indirect Provider	supplies the *Direct Providers* with raw materials and *Services*					
		Auxiliary Provider	supplies all other organizations with essential services which are not directly related to the *Service* industrial field					
	Virtual Organization (VO)		an alliance for integrating competences and resources from several independent real companies, that are geographically dispersed. This integration is possible throughout the layout of an information systems IS infrastructure to satisfy customer's requirements, or to seize a business opportunity without having to form a new legal entity. The VO hides *Service* complexity to the *Service Consumer*					
	Member Organization		an organization involved in the *Service* that accepts to join the VO alliance and accordingly, to acquire compromises and rewards beyond the *Service* offered (like sharing costs)					
	Contributor Organization		an organization involved in the *Service* that does not accept to join the VO alliance, however, it interacts with the VO either soliciting or rendering *Services*. It is a potential Member Organization that may extend the VO boundaries					
	Extra		Level focused on the relationships between the organizations providing the *Service* and the external environment					
Extra	*External Organization*		organizations that do not participate in the *Service*. They are in the external environment and might influence the VO and/or the *Service*					
		Competitor	organizations that offer or might offer the same or substitute *Services* in the same market					
		Complementor	organizations that increment *Service* value					
		Regulator	authorities that control organizations behavior with laws and rules					

** 1: Very Clear, 2: Somewhat Clear, 3: Not Very Clear, 4: Not at All Clear*

Table B.3: 360° VOvision concepts dictionary: AI 3/7

Alliance Identification: *determines ORGANIZATIONS that facilitate a SERVICE in a subscribed ALLIANCE*

Level	Concept	Refinement	Description	1	2	3	4	*
Inter	*Alliance*		is an agreement between at least two organizations that provide a *Service* and that accept to work together forming a VO					
		Date	is a time interval used to define the duration of the VO alliance					
		Project	is a proposed plan that defines the alliance duration of the VO					
	Power		describes the influence an organization has to impose its will to other Member Organization for guiding, deciding or establishing rules in the VO					
		Equal	assigns the same participation power to all Member Organization in the VO					
		Strong-weak	describes the existance of one powerful leading Member Organization in the VO					
	Facade		is the face to be exposed between the VO and its clients or users					
		Screen	only the VO is viewed					
		Semi-screen	the VO and all or certain organizations are viewed					
		Mirror	only all Member Organization are viewed					
	Interaction Alternatives		describes the product or service interactions among members. Outlines the communications needs of the VO					
		Inter-functional	each organization actively interacts in the service or product generation (like design activities). All organizations need to communicate among them.					
		Sub-contract	aims services or products delegation. Communication is done through a single organization.					
		Chain	when a service or product passes to the next organization in the flow before being consumed. An organization communicates only to the next organization in the line.					
		Complementary	increases service value by third party organizations. Organizations communicate at vertical and global levels to provide a consumer service					

** 1: Very Clear, 2: Somewhat Clear, 3: Not Very Clear, 4: Not at All Clear*

Table B.4: 360° VOvision concepts dictionary: CW 4/7

Collaboration Willingness: *characterizes the compromises each Member Organization has to the VO*								
Level	**Concept**	**Refinement**	**Description**	**1**	**2**	**3**	**4**	*
Intra	*Engagement*		Qualifies the *Availabilities* and *Investments* each Member Organization is ready to give to the VO					
	Availability		describes the responsibility assumed by a Member Organization, it is estimated from Low to High in terms of:					
		Time	measures the period reserved for the relationship					
		Priority	measures the preferential status assigned to the VO compared to other projects					
		Adaptability	measures the disposition to accept changes					
	Investment		concerns WHAT each Member Organization devotes to the VO in terms of:					
		Goods	is something that has economic utility to the VO: *Assets:* financial (money) or material (machine) *Capital*: human (experience), relational (clients portfolio) or organizational (patents)					
		Frequency	the number of times an *Investment* is made: constant, sporadic or event-triggered					
		Impact	the effect the *Investment* has on the VO: direct or indirect					

** 1: Very Clear, 2: Somewhat Clear, 3: Not Very Clear, 4: Not at All Clear*

Table B.5: 360° VOvision concepts dictionary: CW 5/7

Collaboration Willingness: *characterizes the compromises each Member Organization has to the VO*

Level	Concept	Refinement	Description	1	2	3	4	*
Intra	*Coordination*		Characterizes the way the Member Organizations are organized to work together in the VO. It is determined by *Elements* and *Communication*					
	Elements		determines WHAT must be coordinated:					
		Person	involves the Member Organizations' individuals that interact in the service, it comprises their profile (preferences, personal information) and their work teams (size, role)					
		Process	involves the series of tasks that interact in the service, it comprises its execution frequency (routine, non routine) and the information concerned (data, texts, messages, images, voice)					
	Communication		answers HOW *Element's* interactions are carried out in order to work collaboratively. It helps determining the necessary communication means by asking:					
		Where (space)	*-place* to define the distance among participants: remote or local *-state of presence* to define the immediate vicinity among participants: physical or virtual					
		When (time)	*-frequency* to determine the number of times communication is done: constant, recurring, sporadic or event-triggered *-moment* to define the period of time communication arises: synchronous (with immediate feedback like a phone call) or asynchronous (like an email)					
		How (movement)	*-accessibility* to set the approach provided to communicate: mobile or fixed *-direction* to define the communication conveyance: transmission, interaction, reception					

** 1: Very Clear, 2: Somewhat Clear, 3: Not Very Clear, 4: Not at All Clear*

Table B.6: 360° vision for VO concepts dictionary: CW 6/7

Collaboration Willingness: *characterizes the compromises each Member Organization has to the VO*								
Level	**Concept**	**Refinement**	**Description**	**1**	**2**	**3**	**4**	*
Intra	*Trust*		describes the alliance accord to watch over Member Organizations behavior					
	Function		involves the series of control activities required to establish alertness for assuring the compromises well execution. E.g. payment reception, weight assignment.					
	Regulation		of functions ensures VO good performance. Is described as:					
		Goods	is something (WHAT) that has to be regulated in the VO: *-Assets:* financial (money) or material (machine) *-Capital:* human (experience), relational (clients portfolio) or organizational (patents)					
		Control	defines HOW Goods are going to be regulated: *-self-regulation*: if the Member Organization supervises the execution of its proper functions or *-surveillance*: if it must debrief to other Member Organization *-control frequency* determines the number of times the control must be carried out: constant, sporadic, event-triggered *-penalization* to be inflicted in case of violating the control function: penalty, no penalty, warning					

** 1: Very Clear, 2: Somewhat Clear, 3: Not Very Clear, 4: Not at All Clear*

Table B.7: 360° VOvision concepts dictionary: CO 7/7

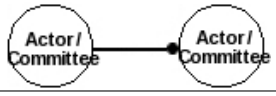
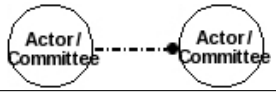
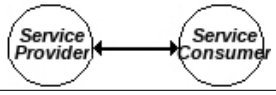
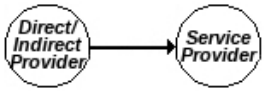
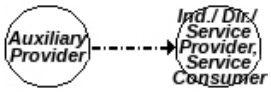
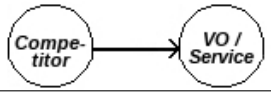
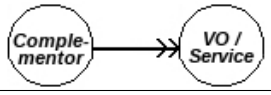
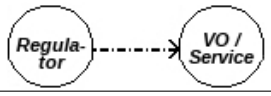
Common Objective: *characterizes the shared goal*

Level	Concept	Refinement	Description	1	2	3	4	*
Intra	*Member's Goal*		is the internal objective each Member Organization has and it is aligned to the operational objectives. If a Member's Goal is in conflict with the *Common Goal*, conciliation is needed. It is expresed as *Goal*					
Inter	*Common Goal*		is the objective shared by all Member Organizations. It is described by *Goal* and *Benefit*					
	Goal		is the aim that justifies the steps to be followed in the alliance. It is expressed by:					
		Verb	expresses the action to be performed: achieve, allocate, maintain, etc.					
		Goods	determines the targeted object towards the action is performed, it can be: *-Assets:* financial (money) or material (machine) *-Capital*: human (experience), relational (clients portfolio) or organizational (patents)					
		Complement	gives more information about the *Goal* using adjectives or precising data (e.g. 10%)					
	Benefit		the foreseen goal yield					
	Situations		are the combination of circumstances which its understanding leads to adapted solutions. They help state the means for taking advantage of the *Opportunity* or for facing the *Problem*. Each Member Organization lists its strengths (aptitudes, competences) and weaknesses (shortcoming, deficiencies) that should be improved or avoided.					
	Opportunity		conjectural circumstance that facilitates *Goal* achievement					
	Problem		is a difficulty that can justify the objective throughout the alliance					

** 1: Very Clear, 2: Somewhat Clear, 3: Not Very Clear, 4: Not at All Clear*

B.2 Relationships dictionary

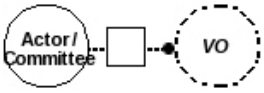
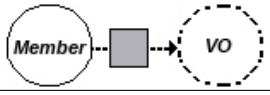
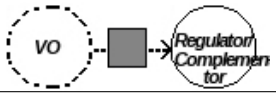
Table B.8: 360° VOvision relationships: AI 1/3

Alliance Identification: *shows organizations links in the service and the VO*								
Level	**Concept**	**Representation**	**Description**	**1**	**2**	**3**	**4**	*
Intra	*Primary*		links Actors and Committees in the organization that directly provide a service					
	Support		links Actors and Committees in the organization that indirectly help to provide a service					
Inter	*Bilateral*		links Service Provider organizations and Service Consumers					
	Principal		links Direct and Indirect Provider organizations that indirectly or directly supply the service to Service Provider organizations					
	Auxiliary		links Auxiliary Provider organizations supporting the service for Direct, Indirect, and Service Providers and for Service Consumers					
Extra	*Concurrently*		links Competitor organizations that threat the VO and/or the service					
	Complementary		links Complementary organizations that increment the service value					
	Regulatory		links Regulator organizations that control the behavior of the organizations in the service					

** 1: Very Clear, 2: Somewhat Clear, 3: Not Very Clear, 4: Not at All Clear*

Table B.9: 360° VOvision relationships 2/3

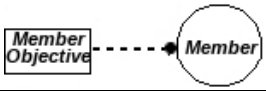
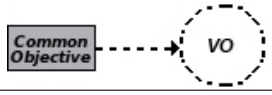
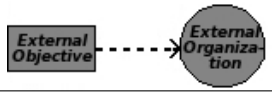
Collaboration Willingness: *shows divers actors compromises in the VO through the graphic notations in Table B.12*

Level	Concept	Representation	Description	1	2	3	4	*
Intra	*Intra-Commitment*		shows compromises from/to each Actor or Committee for accomplishing the Member Organization compromises to the VO					
Inter	*Inter-Member Commitment*		shows compromises from/to each Member Organization to/from the VO					
	Inter-Contributor Commitment		shows compromises from/to each Contributor Organization to/from the *Service*					
Extra	*Extra-Commitment*		shows compromises from/to the VO to/from the Regulator Organizations or Complementor Organizations					

** 1: Very Clear, 2: Somewhat Clear, 3: Not Very Clear, 4: Not at All Clear*

Table B.10: 360° VOvision relationships 3/3

Common Objective: *shows divers actors objectives in the VO*

Level	Concept	Representation	Description	1	2	3	4	*
Intra	*Intra-Achievement*		links the internal objectives of a Member Organization					
Inter	*Inter-Achievement*		links the shared objectives by all Member Organizations to the VO					
Extra	*Extra-Achievement*		links the known external objectives of a External Organizations					

** 1: Very Clear, 2: Somewhat Clear, 3: Not Very Clear, 4: Not at All Clear*

B.3 Graphic notations

Table B.11: Graphic notations of the Intentional 360° VOvision: Alliance Identification

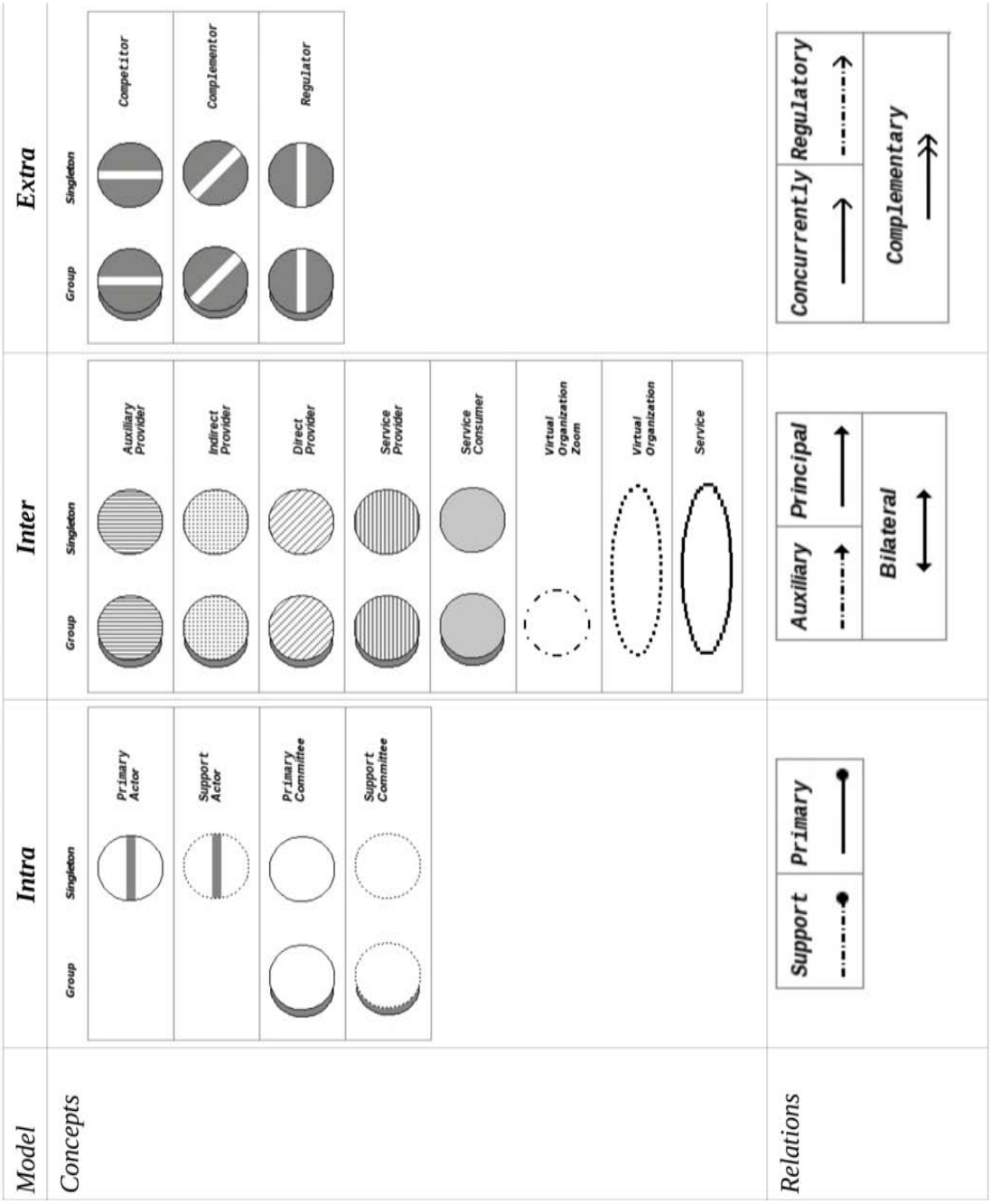
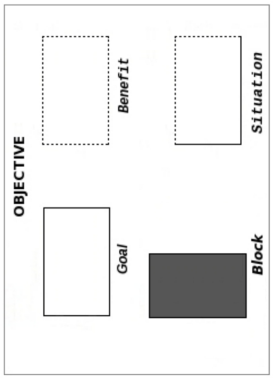
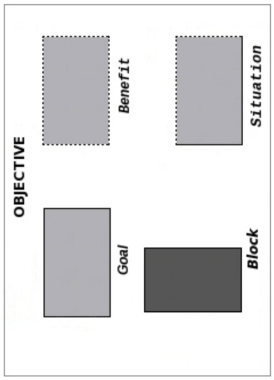
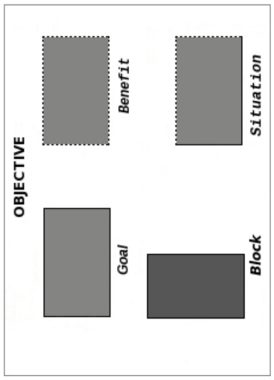
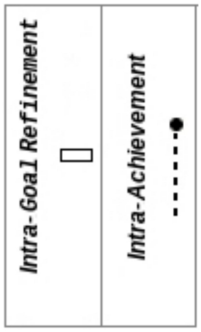
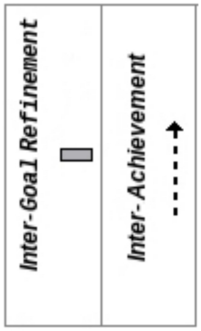
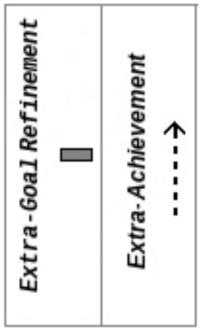


Table B.12: Graphic notations of the Intentional 360° VOvision: Collaboration Willingness

Model	Intra	Inter	Extra
Concepts	ENGAGEMENT: Availability, Investment; COORDINATION: Person, Process; TRUST: Function, Regulation	ENGAGEMENT: Availability, Investment; COORDINATION: Person, Process; TRUST: Function, Regulation	ENGAGEMENT: Availability, Investment; COORDINATION: Person, Process; TRUST: Function, Regulation
Relations	Intra-Commitment	Inter-Member Commitment; Inter-Contributor Commitment	Extra-Commitment

Table B.13: Graphic notations of the Intentional 360° VOvision: Common Objective

Model	Intra	Inter	Extra
Concepts			
Relations			

B.4 Scenario

B.4.1 Wedding Planner Scenario (Part I)

Background[1]

4urWed (For Your Wedding) is a Wedding Planner (WP) who assists with planning and organization of weddings within a fixed budget . 4urWed wants to offer a complete service for wedding events: from advice and assistant to performance of all details needed just to the post activities like all rented materials and facilities check up. It assembles many different businesses under one single insignia. With this service a couple does not waste time in organizing a wedding and dealing with many suppliers, two full time people are responsible for carrying out the service and being in contact with the bride and groom. Among the services included by the WP there is website available with private access to: a detailed order notification (by phone, email) for tracking all the wedding activities, an automatic check list remainder for scheduling appointments like visiting venues, choosing decoration, trying the gown, testing food. Following are the specialized businesses offering different types of services with respect to a wedding product or activity specification.

Chantal's Bridal is a 16 years bride and groom wardrobe retailer that offers a wide variety of wedding clothing and accessories of 30 designers from Italy, France, Spain and USA. For brides: wedding gowns, veils, shoes, and accessories (bouquet, hair accessories, jewelry). For grooms: tuxedo, shirt, vest, shoes and accessories (cuff links and studs, ties, bows, cummerbunds). Special designed bridal gowns orders take 4 months to be manufactured, nevertheless rush deliveries can be arranged with a premium. They offer a qualified seamstress service for sizing, tries and alterations if necessary. Tuxedo orders take 2 months to be delivered, also rush deliveries are offered as well as a qualified tailor for alterations.

Spark Castle offers a set of reception halls with small rooms for 25 people to expansive rooms up to 500 people in different setting venues (gardens, country houses and covered rooms). Some of the venues include a ceremony site (chapel, mosque, synagogue) with an officiant. Spark Castle provides tables, chairs, linen, chair coves, crockery and cutlery from an extensive catalog. They include personnel and transport for assembling the tables as requested. They are not limited to wedding events (which represents 50% business income) but also corporate, Christmas and birthdays can be arranged.

Cater company provides catering for events from small and intimate dinner to expansive parties for over 500 guests. It has a talented team of chefs for cooking a customized menu with locally sourced products and a trained and well presented staff to serve dinner and special drinks. This firm is planning to increment its income from wedding events from 30% to 60%. They usually work with Wed-cake which is a cake confectioner specialized in wedding cakes.

Wedding Stationery offers many styles for unique creation stationery details like invitations, RSVP cards, order of service, menu, directions cards, thank you cards, table plans,

[1] http://www.jeevescatering.com/index.php, http://www.lamarweddingcenter.com, http://www.couture-cakes.co.uk/index.html, http://www.maweddingguide.com/mawedding/Boston-Wedding-Planner.htm, http://www.blueivyevents.com/

etc. It also offers calligraphy for addressing invitations, a guest list management that includes the guest list elaboration, invitations delivery, the RSV control and seating places.

Celebration Floral Design has a team of floral designers that can work on large scale to provide ceremony decoration, centerpieces and bouquets. Flowers are shipped directly from growers, guaranteeing freshness.

Wedding Studio is formed by highly talented photographers that offer up to five hours coverage for taking the wedding images. They offer a package that includes two family albums with 20 pictures each for the bride and for the groom, a wall portrait, a DVD with all the pictures and a web hosting service for sharing the photos with family and friends.

Wedding Video offers recording the entire ceremony including vows and reception. Three DVDs are given with the bride and groom's pictures slide show, interviews and background music selected by the couple.

Entertainment music are professionals entertainers engaged to get the party started and to cheer up for hours to come offering music for all tastes (discos, DJ's, bands, jazz, chamber music). It also includes lighting system, plasma TV and amusement accessories (maracas, confetti, hats, etc.).

Transportation offers vehicles for the bride and groom like limousine and carriage and coaches and trolleys for guests.

Wedding Accommodation Group offers sleeping accommodation and parking for guests near the wedding venue.

Bank is an organization that executes, register and tracks transactions that involve real payments from the account opened by the bride and groom to deposit the budget.

Scenario:

Consider that *Joe and Maria* are planning to get married. They have a fixed budget in a common saving bank account for covering expenses. For organizing a wedding they've found out that there is a long check list with more than 50 items and an investment of 250 hours minimum! So, they decide to hire a wedding planner for organizing their wedding.

4urWed wants to deliver the bride and groom their dreamed wedding. Couples can choose a full service package or a customized package selecting only the services they want. All business are autonomous with self-organizing teams of people, *4urWed* will bring together the suitable firms to meat Joe and Maria wedding expectations within their established budget handled by secure online money transfers.

B.4.2 Wedding Planner Scenario (Part II)

Chantal's Bridal, Spark Castle, Cater Company firms have agreed to create a virtual organization with *4urWed* they want to enlarge their customer base, give special offers to customers like a cash back card with 2% of their purchases, they also want to join efforts on personnel recruiting, training and transfer according to events needs in order to better manage the ups and downs of personnel availability and human resources costs.

Chantal's Bridal already works with other two wedding planners which represents 40% of its annual profits, the other 60% comes from direct sales to customers however, it plans to increment sales at a 10% annual rate by exploring other means.

Spark Castle will be for the first time working with a wedding planner, it finds interesting to have access to a larger market and believes that it will boost bookings. Today, weekends are the must booked, it plans to find other formulas for having reservations during weekdays.

Cater Co. wants to continue supporting local food suppliers and to preserve its reputation as fresh and organic catering.

B.5 Questionnaires

Table B.14: Participants working habits in information systems

360° Vision

Thèse de Luz Maria Priego Roche - Sigma

Prénom	date

La dernière fois que vous avez développé un logiciel ou un système quelles étaient les grandes étapes par lesquelles vous êtes passé

Avez-vous l'habitude d'utiliser des méthodes de conception de systèmes d'information ou de développement logiciel ?

Pourquoi en utilisez vous ?

Lesquelles ?

Pourquoi, n'en utilisez vous pas ?

Avez vous déja entendu parler des organisations virtuelles ?

○ 1.oui ○ 2.non

Si oui, pouvez vous en donner une définition ?

Table B.15: Alliance Identification usage

360° Vision

Thèse de Luz Maria Priego Roche - Sigma

Prénom	**date**

Globalement qu'avez vous pensez de cet exercice et de sa réalisation ?

Qu'est ce qui a été le plus facile ?

Qu'est ce qui a été le moins facile ?

Pourquoi ?

Par rapport à l'exercice que vous venez de réaliser, vous êtes

○ 1.Très satisfait ○ 2.Plutôt satisfait ○ 3.Plutôt pas satisfait ○ 4.pas du tout satisfait

Pour répondre à la consigne, l'utilisation du matériel fourni (dictionnaire, graphe, ...) a été

○ 1.Très facile ○ 2.plutôt facile ○ 3.plutôt pas facile, ○ 4.pas du tout facile

pourquoi ?

Si vous pensez qu'il vous manque des concepts ou des relations, lesquels rajouteriez vous ?

Considerez vous que les concepts d'organisations et de services sont ...

○ 1.Tout à fait utiles ○ 2.plutôt utiles ○ 3.plutôt pas utiles ○ 4.pas du tout utiles

Considerez vous que le concept d'alliance est

○ 1.Tout à fait utile ○ 2.plutôt utile ○ 3.plutôt pas utile ○ 4.pas du tout utile

A votre avis , combien d'itérations sont nécessaires pour compléter le modèle ?

○ 1.aucune, le premier modèle est le bon ○ 2.entre 1 et 5 ○ 3.entre 5 et 10 ○ 4.plus de 10

○ 5.ne sais pas

pourquoi ?

Table B.16: Alliance Identification usage (cont . . .)

360° Vision

Thèse de Luz Maria Priego Roche - Sigma

Est ce que vous pensez que cette méthode peut vous faire gagner du temps ?

○ 1.Oui, tout à fait ○ 2.Oui, plutôt ○ 3.Non, plutôt pas ○ 4.Non, Pas du tout

Est-ce que vous pensez que cette méthode peut vous éviter des erreurs ?

○ 1.Oui, tout à fait ○ 2.Oui, plutôt ○ 3.Non, plutôt pas ○ 4.Non, Pas du tout

Est ce que vous pensez que cette méthode nécessite une phase d'apprentissage ?

○ 1.Oui, tout à fait ○ 2.Oui, plutôt ○ 3.Non, plutôt pas ○ 4.Non, Pas du tout

Vous pensez que la phase d'appropriation de cette méthode demande ...

○ 1.quelques minutes ○ 2.quelques heures ○ 3.quelques jours ○ 4.quelques semaines
○ 5.plus longtemps

Seriez vous prêt à utiliser cette méthode dans votre contexte professionnel ?

○ 1.Oui, tout à fait ○ 2.Oui, plutôt
○ 3.Non, plutôt pas ○ 4.Non, Pas du tout

Seriez vous prêt à décrire le fonctionnement de la méthode à une tierce personne ?

○ 1.Oui, tout à fait ○ 2.Oui, plutôt ○ 3.Non, plutôt pas ○ 4.Non, Pas du tout

Est ce que vous auriez eu besoin de conseil en cours d'utilisation ?

○ 1.Oui, tout à fait ○ 2.Oui, plutôt ○ 3.Non, plutôt pas ○ 4.Non, Pas du tout

360° Vision

Thèse de Luz Maria Priego Roche - Sigma

Prénom **date**

Globalement qu'avez vous pensez de ce 2ème exercice et de sa réalisation ?

Qu'est ce qui a été le plus facile ?

Qu'est ce qui a été le moins facile ?

Pourquoi ?

Par rapport à l'exercice que vous venez de réaliser, vous êtes

- ○ 1.Très satisfait
- ○ 2.Plutôt satisfait
- ○ 3.Plutôt pas satisfait
- ○ 4.pas du tout satisfait

Pour répondre à la consigne, l'utilisation du matériel fourni (dictionnaire, graphe, ...) a été

- ○ 1.Très facile
- ○ 2.plutôt facile
- ○ 3.plutôt pas facile,
- ○ 4.pas du tout facile

pourquoi ?

Si vous pensez qu'il vous manque des concepts ou des relations, lesquels rajouteriez vous ?

Considerez vous que les concepts de collaboration est ...

- ○ 1.Tout à fait utile
- ○ 2.plutôt utile
- ○ 3.plutôt pas utile
- ○ 4.pas du tout utile

Considerez vous que les objectifs des organisations sont nécessaires pour le modèle ?

- ○ 1.Tout à fait nécessaires
- ○ 2.plutôt nécessaires
- ○ 3.plutôt pas nécessaires
- ○ 4.pas du tout nécessaires

A votre avis , combien d'itérations sont nécessaires pour compléter le modèle ?

- ○ 1.aucune, le premier modèle est le bon
- ○ 2.entre 1 et 5
- ○ 3.entre 5 et 10
- ○ 4.plus de 10
- ○ 5.ne sais pas

360° Vision

Thèse de Luz Maria Priego Roche - Sigma

pourquoi ?

Considérez vous que ce modéle facilite l'identification des besoins des systèmes d'informations ?

- ○ 1.Tout à fait d'accord
- ○ 2.plutôt d'accord
- ○ 3.plutôt pas d'accord
- ○ 4.pas du tout d'accord
- ○ 5.ne sais pas

Considérez vous que ce modéle guide l'identification des besoins des systèmes d'informations ?

- ○ 1.Tout à fait d'accord
- ○ 2.plutôt d'accord
- ○ 3.plutôt pas d'accord
- ○ 4.pas du tout d'accord
- ○ 5.ne sais pas

Par rapport à l'identification des besoins, quels sont les concepts qui vous manquent ?

Est ce que vous pensez que cette deuxième étape de la méthode peut vous faire gagner du temps ?

- ○ 1.Oui, tout à fait
- ○ 2.Oui, plutôt
- ○ 3.Non, plutôt pas
- ○ 4.Non, Pas du tout

Est-ce que vous pensez que cette deuxième étape de la méthode peut vous éviter des erreurs ?

- ○ 1.Oui, tout à fait
- ○ 2.Oui, plutôt
- ○ 3.Non, plutôt pas
- ○ 4.Non, Pas du tout

Est ce que vous pensez que cette deuxième étape de la méthode nécessite une phase d'apprentissage ?

- ○ 1.Oui, tout à fait
- ○ 2.Oui, plutôt
- ○ 3.Non, plutôt pas
- ○ 4.Non, Pas du tout

Vous pensez que la phase d'appropriation de cette deuxième étape de la méthode demande ...

- ○ 1.quelques minutes
- ○ 2.quelques heures
- ○ 3.quelques jours
- ○ 4.quelques semaines
- ○ 5.plus longtemps

Seriez vous prêt à utiliser cette deuxième étape de la méthode dans votre contexte professionnel ?

- ○ 1.Oui, tout à fait
- ○ 2.Oui, plutôt
- ○ 3.Non, plutôt pas
- ○ 4.Non, Pas du tout

Seriez vous prêt à décrire le fonctionnement de cette deuxième étape de la méthode à une tierce personne ?

- ○ 1.Oui, tout à fait
- ○ 2.Oui, plutôt
- ○ 3.Non, plutôt pas
- ○ 4.Non, Pas du tout

Est ce que vous auriez eu besoin de conseil en cours d'utilisation ?

- ○ 1.Oui, tout à fait
- ○ 2.Oui, plutôt
- ○ 3.Non, plutôt pas
- ○ 4.Non, Pas du tout

APPENDIX C

Prototype tools

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This appendix describes the software tools used by the intern to develop the prototype tool for the 3360° VOvision. The main selection criteria was to use open source software, easy to assemble and use.

C.1 Programming languages

- *PHP 5.0* is an open source general purpose scripting language mainly used to develop dynamic web pages via a HTTP server, this version has integrated an object programming model. This language was chosen because is easy to use and allows fast and efficient communication with the data base.

- *PHP GD library* is used to create and manipulate image files in JPEG, GIF, PNG, SWF, TIFF and JPEG2000. It was chosen for implementing the graphic models and is included in the WampServer described below.

- *Glade 3.6.1* used for designing the user interface.

- *HTML (Hypertext Markup Language)* is a markup language for web pages. It allows to give a structural semantic to web pages content, including multimedia resources like images, forms, applets. It was chosen to create the interactive forms needed to collect the data for updating the data base.

- *CSS (Cascading Style Sheets)* is a style sheet language used to describe the look and formatting of a document written in HTML and XML. It was chosen because its association to HTML for formatting web pages.

- *JavaScript* is a programming language for scripts used mainly in interactive web pages. It was chosen because it offers several possibilities for creating interactive web pages not allowed by PHP.

C.2 Tools

- *MySQL 5.1.32* is one of the most used Relational Database Management Systems (RDBMS) either by the general public or professionals, competing with Oracle or Microsoft SQL Server. It was chosen because is included in the WampServer described below.
- *Apache Server 2.2.11* is the most popular open source HTTP web server software.

C.3 Programming and specification

- *Notepad++* is a text and source code editor for Windows, Linux and Mac OS X. It proposes syntax highlighters (positioning, spacing, color, etc.) for the source code of the different web languages used in the project.
- *Visual Paradigm* is an UML modeling tool for generating the class, use case and sequence diagrams for the prototype specification.
- *PhpMyAdmin* handles the administration of MySQL over the World Wide Web. It allows creating, modifying or deleting databases, tables, etc., executing SQL statements and managing users and permissions.
- *AnalyseSI* is a Java software of Merise analysis that helps to model a relational DB and generates the Conceptual (CDM) and Logical Data Models (LDM).

C.4 Development environment

- *WampServer* is a web development environment that enables Windows, Apache, MySQL, PHP and the SQL PhpMyAdmin.

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Glossary

Grid is a distributed calculus technique for sharing resources from a large number of computers, usually different, disseminated in far places and linked by internet or another specialized network.. 39, 41, 45

Human Computer Interaction (HCI) is the study of interaction between people and computers. It is often regarded as the intersection of computer. 62, 158, 164

Service Level Agreement (SLA) Is a service contract negotiated between the service provider and the customer written in plain language wich includes the terms of the service being sold.. 41

Web Service Is a standard application for integrating Web-base applications accessed via an Internet protocol. 41, 42

Acronyms

360° VOvision 360° vision for Virtual Organizations. 1, 3, 4, 72, 73, 78, 80, 83, 123–125, 131, 140, 149–152, 154–156, 164

4GL Fourth Generation Languages. 50

ABU Alimentos Balanceados Unión. 10, 13

AGL Asociacón Ganadera Local. 7, 13, 27

ARCON A Reference model for COllaborative Networks. 36–39

ARTScene Analyzing Requirements Trade-offs: Scenario Evaluations. 62

BEinGRID Business Experiments in GRID). 39, 45

BP Business Process. 75, 76, 131, 148

BPD Business Process Diagram. 125, 128, 129, 131, 144–146, 148

BPEL Business Process Execution Language. 131

BPM Business Process Management. 125

BPMI Business Process Management Initiative. 131

BPMN Business Process Modeling Notation. 125, 128, 129, 131, 133–135, 138, 140, 143, 147, 148

CASE Computer Aided Software Engineering. 50

CCG Cooperativa de Consumo “Ganadero” S.C.L.. 9–11, 13, 27

CFPP Comité para el Fomento y la Protección del Ganado. 9, 13

CNO Collaborative networked organization. 36–38

CNOG Confederación Nacional de Asociaciones Ganaderas. 11

CNRS Centre National de la Recherche Scientifique. 149

Competitor Organization CtO. 11, 76, 78, 85, 118

Complementor Organization ClO. 11, 76, 78, 85, 118, 119, 179

Contributor Organization CO. 77, 79, 85–87, 89, 94, 179

CREWS Cooperative Requirements Engineering With Scenarios. 62, 67

CRI Centre de Recherche en Informatique. 61

CSCW Computer Supported Cooperative Work. 100

e^{3}value e^{3}value methodology. 65–67

ECOLEAD European Collaborative networked Organizations LEADership initiative. 36, 38, 39, 80

EDS Electronic Data Systems. 23

Epistemics Epistemics Knowledge Models in PCPACK tool. 50

External Organization EO. 78, 79, 83, 85, 94, 108, 111, 118, 179

FSU Florida State University. 50

FutureSME Future Small and Medium Enterprise. 34, 35

FyETSA Frigorífico y Empacadora de Tabasco S.A. de C.V.. 8, 10, 13, 27–29

GBRAM Goal Based Requirements Analysis Method. 54

GORE Goal Oriented Requirements Engineering. 54, 66

GSS Group Support Systems. 50

HP Hewlett Packard. 23

i* i* methodology. 54–56, 66, 67

ICT Information and Communication Technology. 3, 12, 16, 17, 22, 24, 26, 33, 38, 39, 45, 64, 69, 75

INIFAP Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias. 11

IS Information System. 1, 2, 17, 25, 27, 29, 39, 45, 49, 50, 54, 55, 64, 65, 71–76, 78, 79, 81, 100, 131, 149, 150, 173

IST Information Society Technologies. 39

IUT2 Institut Universitaire de Technologie 2 de Grenoble. 82

JAD Joint Application Development. 50

KAOS Knowledge Acquisition in Automated Specification. 54, 56, 57, 59, 66, 67

LIG Grenoble Informatics Laboratory. 149

MARVELIG Mobile Ambient Reactive Versatile Experiments in LIG. 80, 149, 164

Member Organization MO. 77, 79, 81, 83, 85–87, 89, 92–94, 97–101, 106–108, 111, 116, 118, 121, 131, 143–145, 174–177, 179

NAFTA North American Free Trade Agreement. 10, 122

NAICS North American Industry Classification System. 84

NFR Non-Functional Requirements. 54

Objectiver Objectiver tool. 59, 80

OMG Object Management Group. 125, 131, 140

PDA Personal Digital Assistant. 62

RAD Rapid Application Development. 50

RE Requirement Engineering. 1, 2, 27, 45, 47–50, 52–54, 62, 66, 67, 69, 71, 72, 76, 151, 165

Regulator Organization RO. 27, 71, 76, 78, 85, 179

SAGARPA Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación de México. 11

SAP Systems, Applications, and Products. 42

SE Secretaría de Economía. 11

SEDAFOP Secretaría de Desarrollo Agropecuario, Forestal y Pesquero del Estado de Tabasco. 11

SHCP Secretaría de Hacienda y Crédito Público. 11

SME Small and Medium Enterprise. 34, 36, 39

SMEcoll Small and Medium Enterprise Collaborate. 33, 34, 39, 80

SOA Service-oriented architecture. 41

SoS Systems of Systems. 22, 27–29, 67

SVN Service Value Networks. 63, 64, 67, 79

SYNERGY Synergy research project. 43, 45

TAOM-Tool Tool for Agent Oriented Modeling. 56

TCUG Tienda de Carne Unión Gourmet. 10, 13

TCyDU Transportes Cárnicos y Derivados Unión. 10, 13, 27–29

TIF Tipo Inspección Federal. 8

Tropos Tropos project. 55, 80

TrustCoM Trust and Contract Management. 41, 42, 45, 92

UCGT Unión de Crédito Ganaderos de Tabasco. 8, 13, 27

UGRT Unión Ganadera Regional de Tabasco. 5–8, 10–13, 23, 24, 27–29, 56, 59, 61, 63, 65, 80, 111, 116, 118, 119, 124, 125, 140, 167

UKent University of Kent. 42

ULSSA Ultralacteos S.A.. 9–11, 13

UML Unified Modeling Language. 55, 56, 59, 63, 64, 79, 82, 98, 106, 107, 121, 125, 131–133, 143

UMSL University of Missouri-St.Louis. 50

UofS University of Strathclyde. 34

VBE Virtual Breeding Environment. 38, 39

VO Virtual Organization. 1–3, 15–17, 22, 27, 32, 33, 38, 39, 41–45, 52, 62, 66, 67, 69–79, 81, 83–86, 88, 89, 91–94, 97–99, 101, 106–108, 111, 116, 118, 122, 124, 125, 131, 135, 143, 144, 150–157, 165, 173–176, 178, 179

WSCDL Web Services Choreography Description Language. 42

XML Extensible Markup Language. 131, 133, 140, 148, 167

Intentional and Organizational Information Systems modeling for Virtual Organizations

Abstract: Nowadays, organizations which aim to be competitive in a more concurrent market, tend to group together into virtual organizations (VO). Designing the information system (IS) of such a VO on the basis of the IS of those participating arises methodological and technical problems. Particularly, the formal identification and representation of requirements which has been researched to a large extent for a single organization, is not adequate for a VO. Indeed, the IS of a VO plays an important role in the collaboration and the cooperation of the participants organizations to achieve a common goal. We propose at an intentional level, criteria allowing virtual organizations to be identified and classified, as well as simple graphical and textual models to design the virtual organization's IS. Our work includes a partial transformation proposal from the intentional models to basic business process models at the organizational level.

Résumé: Pour répondre à un marché de plus en plus concurrentiel, les organisations tendent aujourd'hui à se regrouper sous la forme d'organisations virtuelles (OV). Concevoir le système d'information (SI) d'une OV sur la base des SI des organisations participantes pose des problèmes méthodologiques et techniques. En particulier, l'identification et l'expression des besoins, déjà difficile lors du développement d'un SI « classique », représente un enjeu important. Le SI de l'OV jouant un rôle prépondérant pour la collaboration et la coopération des organisations participantes et l'atteinte de l'objectif commun. Nous proposons des critères permettant d'identifier et de classifier précisément et à un niveau intentionnel, les différentes informations nécessaires à la conception du SI de l'OV ainsi que des modèles graphiques et textuels simples. Notre travail comprend une transformation partielle à partir des modèles intentionnels jusqu'aux modèles de processus métier de base au niveau organisationnel.

Keywords: Virtual organization, requirements engineering, information system design.

Mots Clés: Organisation virtuelle, ingénierie des besoins, conception de systèmes d'information.

Curriculum Vitae

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