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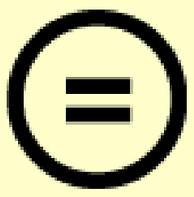

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LOUGHBOROUGH UNIVERSITY

Development of the theory and method to manage organization's Intellectual Capital.

by

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Dedications.

To God who helped me make a step ahead on the path of my life.

To my parents who gave me the much needed motivation, love and support to initiate a dream.

To my wife Margarita who was always next to me during the effort to make this dream reality.

To my daughter Isabel Eleni whose smile inspired me in the effort of complementing and improving actual methods for us to guide society towards a more democratic and human world for them to live.

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Abstract.

This thesis adopts a "managing-developing" rather than a "measuring" approach to the intellectual capital of organizations, demonstrating that the former is compatible to the knowledge creation process while the latter is not. In this basis, in the thesis the intellectual capital of an organization is defined as the combination of the intangible assets of an organization that add value to its effort to achieve its goal, referring to the skills, innovation, information, experience and employee attitudes an organization possesses. This thesis proposes a systemic, systematic and human-oriented approach to the management of intellectual capital which includes the participative development of systems to support the management of skills (learning systems), innovation (innovation systems) information (information systems), experience (organizational memory systems) and attitude (selection, reward, career development, retirement systems). The design of such systems needs to be based on organizational requirements and in this thesis a formal method of requirements definition is developed (ORDIC - Organizational Requirements Definition for Intellectual Capital management). The thesis presents a number of case studies of the application of this method in Mexican companies and international corporate groups that demonstrate how the methods can be applied and in particular show the role of users in the use of the component methods of ORDIC. The thesis provides evaluation evidence of the success of the methods in creating systems to manage intellectual capital.

Keywords.

Human Capital, Intellectual Capital, Participative Design, Intellectual Capital Management, ORDIC, Requirements Definition, Endogenous Economic Growth, Innovation, Organizational Memory, Selection Systems, Learning Systems, Information Systems, Reward Systems, Career Development Systems, Experience Systems.

List of Tables.

List of Figures.

List of Acronyms.

AC	Allied Community.
BPR	Business Process Reenginnering.
CeVIC	Virtual Center for Intellectual Capital management.
CRETI	Corrosivity-Reactivity-Explocivity-Toxicity-Inflamability analytical process.
FMP	Factory Master Plan.
FP&AC	First Provider and Allied Community.
HC	Human Capital
HP	Hewlett Packard.
HRL	Hazardous Residues Laboratory.
IC	Intellectual Capital
ITESM	Instituto Tecnológico y de Estudios Superiores de Monterrey (Monterrey Institute of Technology).
NSAL	National System of Analytical Laboratories.
OECD	Organization for Economic and Commercial Development.
ORDIC	Organizational Requirements Definition for Intellectual Capital management.
ORDIT	Organizational Requirements Definition for Information Technology.
R&D	Research and Development.
SIDEP	Integrated System for Personnel Development.
TQM	Total Quality Management.
UK	United Kingdom.
US	United States of America.
VC	Value Community.

Contents.

CHAPTER 1

INTRODUCTION

1.1. Antecedents

The Stockholm Stock Exchange values many Swedish companies at 3 to 8 times the value of their financial capital, and in the United States some companies are valued at twenty times their book value [Drake, 1996]. This often-significant difference between a company's market value and its financial capital is attributed to Intellectual Capital. In 1994, the concept of Intellectual Capital appeared in the annual report of Skandia, a Swedish insurance and financial services company, with 60% of its employees, 70% of its clients and 80% of its assets outside Sweden. Leif Edvinsson, Skandia's Intellectual Capital Director, stated that Skandia's Intellectual Capital was at least of equal importance to financial capital in providing truly sustainable earnings [Skandia, 1994] and in providing an accurate picture of an enterprise's true worth [Skandia, 1995].

Due to the increasing recognition of the value of the Intellectual Capital of a company, there is a need to define mechanisms for managing it. Since existing management techniques are not compatible with the nature of this type of capital, managers and researchers are searching for new forms of management. In this dissertation the theory and techniques developed to facilitate the management of the Intellectual Capital of organizations are presented.

1.2. Objectives and Contribution of the thesis.

The principal ***objectives*** of this thesis are defined follows:

- To demonstrate that in order to manage the Intellectual Capital (IC) of an organization a systemic approach has to be followed.
- To demonstrate that IC management should be based on participative design of systems to manage individual and organizational *skills, information, innovation experience* and *attitudes*. The corresponding systems, should be aligned to organizational mission and objectives. Therefore, the design of these systems should be based on organizational and individual requirements definition.
- To develop a set of systemic methods that enable organizations to manage their IC.
- To implement in the industry, test and improve systemic methods based on participative design of systems to manage individual and organizational s*kills*, i*nformation, innovation experience* and a*ttitudes.*
- To develop adequate tools that permit organizations to implement the above mentioned methods and manage effectively and efficiently their most valuable asset, their Intellectual Capital.

The primary contributions of this thesis are considered to be :

- The facilitation of the transition of organizations from the *resource management model*[1] to the *intellectual capital management model*[2], in the context of the knowledge economy.
- The development of tools that permit organizations management their Intellectual Capital and achieve continuous economic growth.

1.3. Structure of the thesis.

[1] **Resource Management model:** task oriented, no participative, structured, hierarchical, based on individual knowledge and social intelligence.
[2] **Intellectual Capital Management model:** human oriented, participative, flexible, democratic, based on collective knowledge.

Initially, Chapter 2, the evolution of social and organizational systems is presented in order to position the reader with respect to the Knowledge era, where Intellectual Capital is the main source of economic development. The theory of endogenous economic growth is presented, together with a model of a knowledge based innovation mediated mass production for achieving it. The different views of academics and practitioners on the concept of Intellectual Capital are introduced and analyzed. This analysis is based on the distinction between Tacit and Explicit Knowledge and the fact that knowledge creation occurs through the interaction of these two types of knowledge. As part of this analysis the three predominant views on knowledge creation are presented: the Western, the Japanese and the Emerging one that integrates the merits of the former views on knowledge creation.

Based on the Emerging view on knowledge creation, Chapter 3 presents the specific steps taken in terms of developing the theoretical basis and practical tools for managing the Intellectual Capital of an organization. The conceptual basis, definitions and nature of Intellectual Capital is analyzed and revised with the objective of determining the characteristics of mechanisms for managing it. Then, a process of Intellectual Capital management is developed and presented together with a systemic, participative and human oriented approach for its implementation.

To implement the process and approach in the organizational context a method is needed. In Chapter 4 the characteristics of this method are defined. Existing methods for facilitating change management as well as participative information systems design are evaluated to determine whether they satisfy the requirements for the IC management method.

A new methodology, ORDIC, for implementing the Process of Intellectual Capital Management is presented in Chapter 5.

Chapter 6 describes the development (Alpha test) of ORDIC and the design of its Beta test. In Chapter 7 and 8 the implementation of the Beta test is described

together with the results obtained and the experience of the application of ORDIC to companies through consulting services.

In Chapter 9 the outcomes are discussed, together with the general lessons learned during the research. Finally, further directions of research and applications are addressed.

1.4. Limitations in the development of the thesis.

The following limitations on the development of the thesis need to be considered:

The author has played different roles, that in relation to the IC management projects: (i) IC consultant, (ii) project leader, (iii) account leader (coordinating all projects with a particular client), (iv) trainer of IC consultants. In all case studies presented in this thesis, the role of the author in the corresponding projects was limited to trainer. This is a constraint defined on purpose to reduce the potential effects which the author, as originator of the method, might have and the way in which the ORDIC was applied on the research results. Nevertheless, it is considered as a strong limitation on the development of the thesis, in the sense that the author had no control on the execution of the corresponding IC management projects.

Another limitation is that the only information included in the case studies of this thesis is the one presented with permission of the corresponding client - companies. Only in two cases did the disclosure agreement permit the publication of specific examples of the application of the ORDIC tools. Nevertheless, the disclosure agreement negotiated for all the cases allowed the publication of the overall results linked to the research questions behind this thesis based on the application of (i) the Socio-technical systems questioner, and (ii) the ORDIC tools evaluation questionnaires.

CHAPTER 2.

INTRODUCTION TO THE INTELLECTUAL CAPITAL OF ORGANIZATIONS IN THE KNOWLEDGE ERA.

2.1. Antecedents - the new focus on "knowledge".

A keen interest in the subject of knowledge has been developing in recent years. In the West, an explosion of sorts has occurred in the business press, with prominent authors such as Peter Drucker [1993], Alvin Toffler [1990] and James Brian Quinn [1992] leading the field. In their own ways, they all herald the arrival of a new economy or society or era, refereed to as the "knowledge society" by Drucker, which distinguishes itself from the past in the key role knowledge plays within society. Drucker [1993] argues in his latest book that in the new economy, knowledge is not just another resource alongside the traditional factors of production - labor, capital, and land - but the only meaningful resource today. The fact that knowledge has become *the* resource, rather than *a* resource, is what makes the new society or era unique, he contends.

Toffler [1990] echoes Drucker's contention, proclaiming that knowledge is the source of the highest-quality power and the key to the *power-shift* that lies ahead. Toffler observes that knowledge has gone from being an adjunct of money power and muscle power to being their very essence, and that is why the battle for the control of knowledge and the means of communication is heating up all over the world. He believes that knowledge is the ultimate replacement of other resources.

Quinn [1992] shares with Drucker and Toffler the similar view that the economic and production power of a modern corporation lies more in its intellectual and service capabilities than on its hard assets, such as land, plant, and equipment. He goes a step further by pointing out that the value of most products and services depend primarily on how "knowledge-based intangibles", like technological know-how, product design, marketing presentation, understanding of the customer, personal

creativity, and innovation can be developed.

These authors agree that the future belongs to people endowed with knowledge. In a society based on knowledge, says Drucker, the "knowledge worker" is the single greatest asset. Included in his definition of a knowledge worker is a knowledge executive who knows how to allocate knowledge to productive use, just as the capitalist knew how to allocate capital to productive use. Reich [1991] contends that the only true competitive advantage will reside among those he calls "symbolic analysts," who are equipped with knowledge to identify, solve and broker new problems. Quinn notes that the capacity to manage what he calls "knowledge-based intellect" is fast becoming the critical executive skill of this era.

In the following section the characteristics of the knowledge era will be presented in relation to the evolution of previous eras.

2.2. Knowledge Era.

Reviewing history with the objective to determine the changes that have occurred in organizations one can make conclusions as far as organizational systems evolution is concerned [Altshuller, 1988], [Toffler, 1990], [Reich, 1991], [Quinn, 1992], [Drucker, 1993], [Altov, 1996], [Kaplan, 1994], [Stewart, 1997], [Edvinsson et al, 1997]. This evolution has been classified by the author of this thesis in the following stages or eras: Agricultural Era, Industrial Era, Post Industrial or Information Era, Knowledge Era. In this section, (see also Table 1) these eras are presented, together with there characteristics classified as: strategic factors of economic growth, organizational structure, consumption goods produced, corresponding technology, principle resource used and value interchange medium.

In the Agricultural era, land was the main factor of economic growth and was considered as the main object of value. Land ownership was the sign of power and control. To make the land produce one had to be physically at the same place were the land was. The organizational structure was strictly hierarchical, the land owner was the only decision maker, the workers were working for him and had no voice or vote on the decisions.

Technological developments such as the steam engine, facilitated the transition to the Industrial era. Industrial Production of goods was considered the main object of value. To produce, one needed to have access to physical sources of energy and human labor. Control over the market of industrial production became the reason for competition over physical sources of energy. As far as the decision making process concerned, in this era the owner of the means of industrial production, and also the leaders of the syndicates of workers were involved.

Technological developments related to information technology and telecommunications initiated the transition to the Information Era. Access to information was the main source of economic growth and input to the decision making process. The latter was then controlled by the white collar bureaucrats, who

had control over information and could communicate rapidly via local, national or international networks.

ERA	Agricultural Era	Industrial Era	Post Industrial or Information Era	Knowledge Era	
Strategic Factors of Economic Growth	Land	Capacity of Industrial Production	Information	Knowledge (= Information with meaning)	**Time**
Organizational Structure	Hierarchical	Blue collar bureaucracy	White collar bureaucracy	Collaboration	
Consumption Goods	Food	Agricultural goods, Housing, Clothing	Information Products and Services	Intellectual Product and Services	
Technology	Agricultural Technology	Manufacturing, Engineering Technology	Information Technology, Telecommunication Technology	Telecommunication Technology Learning Technology, Innovation Technology	
Resources	Human	Physical sources of energy	Information	Ideas	
Value Interchange medium (Madrid, 1996)	Interchange through primitive value representatives (i.e. cacao beans in the Aztec society)	Interchange through value representatives warranted by the state	Interchange through value representatives (plastic or electronic money), warranted by inter banking entities such as Commercial Banks (i.e. VISA, Mastercard and Central Bank of Central Banks.	Direct inter community interchange of intangible and/or tangible products and services of the present and the future (know how or capacity of producing them)	

Table 1. The evolution of social and organizational systems (adopted and expanded from [Masoulas, 1997c]).

The development of telecommunications not only facilitated remote access to information but also permitted the exchange of ideas between people located in distant places. This exchange of ideas which started in the information era and was accelerated through the developments in telecommunication industry marks, according to the author of this dissertation, the advent of the Knowledge era. This is due to the fact that new ideas are the resources of knowledge development through innovation. Since everyone can have ideas, organizational structures in the knowledge

era tend to be more flexible, and are based on collaboration. This is due to the fact that new, creative ideas can occur to us independently of the physical place in which we are located.

2.3. Human Capital and Endogenous Economic Growth In The Knowledge Era.

The term Human Capital has only been used in the past couple decades. Human Capital is, according to Gary S. Becker [1993], recipient of 1992 Nobel Price in Economics Science, "the place where all the ladders start: the wellspring of innovation, the home page of insight". According to Skandia's Intellectual Capital Manager Leif Edvinsson, "money talks, but it does not think; machines perform, often better than any human being can, but do not invent".

The term Human Capital originates with American economist Theodore Schultz [1981], who won the 1979 Nobel Price in Economics Science. Schultz began his career as an agricultural economist who was interested in the progress of the world's poorest people. As his experience and research widened, Schultz began to argue that the traditional concepts of economics were inadequate for treating the growth prospects of low-income countries:

> The decisive factors of production in improving the welfare of poor people are not space, energy, and cropland; the decisive factors are improvement in population quality and advances in knowledge [Schultz, 1981, p. 4].

According to Hudson [1993] this is an argument with more natural appeal than the usual mathematical theories of economics. Schultz continues:

> Child care, home and work experience, and acquisition of information and skills through schooling, and other investments in health and schooling can improve population quality [Schultz, 1981, p. 7].

The term Schultz used to capture this qualitative concept of economic growth is Human Capital. "A rigorous definition of Human Capital is not within our research", Schultz says, but makes the following distinctions:

"Consider all human abilities to be either innate or acquired. Every person is born with a particular set of genes which determines his innate ability... Attributes of acquired population quality, which are valuable and can be augmented by appropriate investment, will be treated as Human Capital." [Schultz, 1981, pp. 21].

The acquisition of additional Human Capital is not free, according to Schultz. Human Capital requires investment of physical resources and monetary capital. But in the twentieth century, especially in high-income countries, people have made human capital the top priority. In advanced countries:

> "(1) The rate of return on investment in human capital has tended to exceed the rate of return on investment in physical capital;
>
> (2) The rate at which human capital increases exceeds that of non-human capital; and
>
> (3) The central issue is the increase in the economic value of human time... This rise in the value of human time is, in large part, a consequence of the formation of new kinds of human capital in response to economic incentives." [Schultz, 1981, pp. 60, 74].

Schultz's concept of Human Capital has recently been elaborated further by Paul Romer [1986], an economist at Stanford University. In most economic theory, there are three main factors of production: land, labor, and capital. In Romer's view, we must add factors of Human Capital (measured by years of education) and ideas (measured by number of patents).

In his attempt to incorporate technology directly into models of economic growth, Romer explained how knowledge is created and spread through the economy. Romer argues that knowledge is the basic form of capital. He developed the *model of endogenous economic growth*, in which he treats knowledge in the shape of both technology and Human Capital. Romer uses the word "endogenous" to differentiate

between:

- growth that is generated (*genus*) by the utilization of resources that reside inside (*endo*) humans, such as ideas, and
- growth generated by the use of resources which reside outside humans, such as petroleum, and other physical sources of energy.

According to Romer the differences between knowledge (ideas) and physical capital is that ideas, unlike material inputs, are not in themselves scarce. New ideas for more efficient processes and new products can therefore make continuous growth possible [Romer, 1986].

Romer's [1990] model of endogenous development is participative. He says that getting workers involved in production increases Human Capital, and develops more innovation. Furthermore, it has 4 basic inputs:

- *Capital* - measured in units of consumption goods;
- *Labor* - skills available from a healthy human body;
- an *index of the level of the technology*; and
- *Human Capital* - activities such as formal education and on-the-job training.

The key in Romer's model is an adequate stock of Human Capital. He finds that "what is important for growth is integration not into an economy with a large number of people but rather into one with a large amount of Human Capital" [Romer, 1990].

Following on from Romer´s work, Florida and Kenney [1993] described a system of mass production which uses resources such as knowledge and innovation. Through their work they have identified 5 major dimensions in the production processes of the knowledge era:

a. A shift in the main source of value creation from physical skill or manual labor to intellectual capabilities or mental labor.
b. The increasing importance of social or collective intelligence as opposed to individual knowledge and skill.

c. An acceleration of the pace of technological innovation.
d. The increasing importance of continuous improvement at the point of production.
e. The blurring of the lines between the R&D laboratory and the factory.

Basically, what Florida and Kenney describe is the model of production in the Knowledge era. In order to stay competitive in an era of constant change, companies have to use all the resources available. The basic elements of Florida and Kenney's knowledge-based innovation-mediated production system are:

a. Decentralized decision making.
b. Daily learning.
c. Use of knowledge and intelligence of all employees.
d. Recognition of the value of organizational Knowledge.
e. Implementation of "Continuous Innovation".

Following the participating nature of Romer's model of endogenous growth, Florida and Kenney underline the fact that successful implementation of a production process of this nature is closely related to additional factors such as cooperation and trust. Supporting the above, during a seminar organized in Finland by the Organization for Economic Development (OECD) [Drake, 1996], Pertti Sorsa, Secretary-general of Finland's Ministry of Labor agreed with Skandia's Intellectual Capital Manager, Leiff Edvinsson, that it is of vital importance to develop *trust* between a company's general or core staff, its total staff, its business allies and its customers. This is because trust will form the basis for the very high level of cooperation, which is needed if knowledge is to be effectively exploited as an important competitive factor. In other words, trust energizes the knowledge network upon which it must increasingly depend.

Summarizing and integrating the above ideas, the author believes that in the knowledge era continuous growth can be achieved through the implementation of processes of knowledge based innovation mediated mass production and *adequate* management of the **value** of organizational knowledge, organization's Intellectual

Capital. Referring to adequate management, this is defined as being one that propitiates the exchange of ideas and the development of trust among organizational members through the involvement of all stakeholders, the latter being considered as the basis for knowledge creation (innovation).

From this point ahead, the key resources in the Knowledge era, knowledge and innovation will be treated as organization's Intellectual Capital. The question now is what exactly is an organization's Intellectual Capital? What is its value for the organization? How can it be defined in practical organizational terms, and how can it be managed?

2.4. Intellectual Capital.

Following Aristotle's method for defining the causes of things, to define something we must first say what it *is* and second what it *is not.* According to the experience of the author, apart from that, everything we attempt to define requires the development of appropriate and extensive *context.* Thus the objective of this section is to say what Intellectual Capital is by means of giving its derivation and presenting its relation to knowledge creation and analyzing the different approaches to it. In the next section will be presented the definition of Intellectual Capital used in this research. In the last section of this Chapter the main criteria for managing organization's Intellectual Capital will be presented as the criteria this research seeks to meet.

In 1994, the concept of Intellectual Capital appeared in the annual report of Skandia (a Swedish insurance and financial services company). Skandia, presented the importance of Intellectual Capital for companies in the following way:

Intellectual Capital = Market Value - Net Tangible Asset Value

where "Market Value" equals the company's share value multiplied by the number of company's shares, and "Net Tangible Asset Value" is the one presented in the financial statements (i.e. annual report or balance sheet) of the company. By intending to calculate the value of Intellectual Capital of a company such as Netscape or Microsoft, one can conclude that the management instruments and methods currently used, are focused on managing the less valuable capital of companies, represented in their Net Tangible Assets Value. Bradley [1996] supports this by saying :

Over the past twenty years there has been a significant widening of the gap between the values of enterprises stated in corporate balance sheets and investors assessment of those values. The median market-to-book value ratio for U.S. public corporations over a twenty-year period between 1973 and 1993 increased from 0.82 to 1.692.] The gap in 1992 indicates that roughly forty percent of market value of the median U.S. public corporation was missing from the balance sheet. For knowledge-intensive corporations *(like Microsoft)*, the percentage assets missing from the balance

sheet is over one hundred.

These distortions are also reflected in recent U.S. acquisitions. An examination of the relationship between the price paid for U.S. acquisitions over a thirteen-year period between 1981 and 1993 of some 391 transactions with a median value of $1.9 billion shows that the mean of the price of acquisition-to-book value is 4.4. This indicates that, on average, the real values of the acquired corporations were about four and a half times larger than the values reported in the balance sheets. Acquisitions of knowledge-intense companies had price-to-book values larger than ten... Do we have the tools to manage these hidden assets? The simple answer is "no, we don't."

Reflecting on Bradley's statement and the Intellectual Capital formula presented above, there is a need to develop mechanisms for managing organization's Intellectual Capital. To develop such mechanisms, initially an effort must be made to define Intellectual Capital in a more tangible, more "manageable" way.

2.4.1. Intellectual Capital Definitions.

A number of definitions, such as those of [Feiwel, 1975, p.17], [Stewart, 1991], [Hudson, 1993], [Skandia, 1995], and [Brooking, 1996] are discussed below.

An early reference to the term Intellectual Capital is found in a letter John Kenneth Galbraith sent to the economist and writer Michael Kalecki. In 1969, Galbraith wrote: "I wonder if you realize how much those of us the world around have owed to the intellectual capital you have provided over these past decades" [Feiwel, 1975, p.17].

In 1991 Thomas Stewart in his article published in *Fortune 500*, defined Intellectual Capital as "the sum of everything the people of the company know which gives a competitive advantage in the market" [Stewart, 1991]. Stewart comments that "companies depend more and more on the knowledge, patents, processes, management skills, technologies, information over clients and suppliers, and traditional experience". For Stewart, the sum of this knowledge is Intellectual Capital. Reflecting on Stewart's definition, we could say that rather than the sum, Intellectual

Capital of an organization is the combination of the above mentioned elements. That is because it seems rather difficult to add together completely different things such as patents with information over clients or suppliers, etc. Another argument over Stewart´s definition is in respect to what he defines as "traditional experience": which is the difference between "traditional" and "not traditional" experience? In general terms, this definition although that it does not help us in terms of finding ways to manage Intellectual Capital, it certainly achieves to make people question themselves and reflect on the concept of Intellectual Capital and its importance to organizations.

In 1993, William Hudson, in his book "Intellectual Capital" defines it as "the combination of four factors: your genetic inheritance, your education, your experience and your attitudes about life and business plus organizational systems, research and culture" [Hudson, 1993]. Hudson says that although an organization may have individuals with high Intellectual Capital, if it lacks appropriate research, culture and organizational systems, the overall Intellectual Capital will not be as great as it can be. Furthermore, he says the same happens in an organization with appropriate organizational culture, systems and research, but without the right employees.

According to the opinion of the author in the context of this research:

i. Skandia's Intellectual Capital definition makes people reflect on the fact that there is a very valuable organizational asset that actual administrative practices and techniques are incapable to manage. Nevertheless, as it will be shown in the following section, Skandia's IC definition can not serve as a starting point for improving actual management practices and developing required techniques, being this the objective of this research work.

ii. On the contrary, Hudson's Intellectual Capital definition is adding particular value to the objectives of this research because it presents how important it is for an organization to follow a systemic approach for managing Intellectual Capital and look for synergy that permit Intellectual Capital grow. As it will be seen in the following Chapter, the approach for managing Intellectual Capital proposed in this thesis is a systemic and participative one, focused on achieving synergetic development of social, intellectual and technical elements

of the organization.

2.4.2. Classification of Intellectual Capital Approaches.

Analyzing these Intellectual Capital definitions, the author has classified them in the following way:

a. Intellectual Capital definitions that emerged as a response the interest of investors in estimating the *actual value* of an organization's Intellectual Capital.
b. Intellectual Capital definitions following a managing-developing approach towards an organization's Intellectual Capital.

2.4.2.1. Intellectual Capital definitions that emerged as a response to investors' interest in estimating the actual value of organization's Intellectual Capital.

Definitions following this approach add value in the sense that they invite the public to reflect on the existence and nature of Intellectual Capital. Furthermore, they are more technology oriented and focus on developing indexing systems that help to calculate the actual value of a patent, a trademark, a process, a working team, etc. Skandia's intellectual capital definition is an example of this category.

2.4.2.2. Intellectual Capital definitions following a managing-developing approach towards organization's Intellectual Capital.

This approach considers organization's Intellectual Capital as the principal resource for continuos competitive advantage, knowledge creation and growth. Furthermore, it has a human orientation and is focused on developing organisation's Intellectual Capital with the objective of maintaining it in the company. Hundson's definition is an example of this category.

2.4.3. The Difference Between The Two Approaches To Intellectual Capital Management.

According to the author, the differences between the two approaches to Intellectual Capital management are based on the distinction between Tacit and Explicit Knowledge and the different views on how *knowledge is created.* In this section the basis of that will be elaborated.

Generally speaking knowledge creation occurs through the interaction of Tacit and Explicit knowledge [Nonaka and Takeuchi, 1995]. Nevertheless, there are three basic approaches to knowledge creation:

- The Western approach, according to which the interaction between tacit and explicit knowledge tends to take place mainly at an *individual level*, with a few individuals (usually top executives) playing a critical role. This approach overemphasizes the importance of *explicit* knowledge and follows a top-down direction to create knowledge (from explicit to tacit).

- The Japanese approach, according to which the interaction between tacit and explicit knowledge takes place at a *group level.* The tendency is in this case to overemphasize the use of figurative language and symbolism at the expense of a more analytical approach and documentation. Tacit knowledge of the front-end employees is key to this approach and a bottom-up direction is followed to create knowledge (from tacit to explicit).

- The approach presented by Nonaka and Takeuchi [1995], that integrates the merits of the previous two models of knowledge creation. Middle level managers are seen as playing the key role to knowledge creation which follows a middle-up-down direction to knowledge creation (from explicit to tacit and vice versa).

Returning to the different definitions of Intellectual Capital, according to the opinion of the author:

- Intellectual Capital definitions that emerged as a response to investors' interest in estimating the actual value of organization's Intellectual Capital follow the first two approaches to knowledge: the Western (in North of Europe, USA, Canada and Australia), and the Japanese (in Asia).
- Intellectual Capital definitions following a managing-developing approach towards organization's Intellectual Capital is basically compatible to Nonaka and Takeuchi's approach to knowledge creation.

In the following the implications of these approaches to knowledge will be further analyzed.

2.4.4. Implications of the different approaches to Intellectual Capital management.

The Western approach to Knowledge follows the realization that knowledge is the new competitive resource. This is something that has hit the West like lightening, provoking all the intellectual production of Drucker, Toffler, Quinn and Reich among others. Nevertheless, this talk about the importance of knowledge both for companies and countries, does little to help us understand how knowledge gets created. Despite all the attention by these leading observers of business and society, none of them has really examined the mechanisms and processes by which Knowledge is created [Nonaka and Takeuchi, 1995].

As a result, it is the author believe that Intellectual Capital researchers, authors and consultants who part from the Western approach to Knowledge, face serious difficulties in developing the theoretical background of Intellectual Capital management and in proposing concrete tools and methods to be used by managers. For example, one could comment that it is pointless estimating today's value of a patent, since tomorrow the same patent may have no value at all due to the fact that a competitor has managed to circumvent the barrier of this patent, developed a new one and now dominates the market. Furthermore, it is pointless estimating the actual value

of a Knowledge Worker or a Knowledge Team since tomorrow they may work for the competitors.

According to Nonaka [1987] there is a reason why Western observers tend not to address the issue of organizational knowledge creation. They take for granted the view of the organization as a machine for "information processing." This view is deeply ingrained in the traditions of Western management, from Frederick Taylor to Herbert Simon. And it is a view of Knowledge as necessarily "explicit"-something formal and systematic. Explicit knowledge can be expressed in words and numbers, and easily communicated and shared in the form of hard data.

On the other hand, the "Japanese" approach is based on the distinctive way in which Japanese society and companies understand knowledge: they recognize that the knowledge expressed in words and numbers represents only the tip of the iceberg. They view knowledge as being primarily "tacit", something not easily visible and expressible. Tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or to share with others. Subjective insights, intuitions, and hunches fall into this category of knowledge. Furthermore, tacit knowledge is deeply rooted in an individual's action and experience, as well as in its ideals, values, or emotions he or she embraces.

The distinction between explicit and tacit knowledge is the key to understanding the difference between the "Western" and "Japanese" approach to knowledge creation and the one proposed by Nonaka and Takeuchi, and consequently to understanding the difference between the first and second approaches to Intellectual Capital.

Tacit knowledge can be segmented into two dimensions. The first one is the technical dimension, which encompasses the kind of informal and hard-to-pin-down skills or crafts captured in the term "know-how." A master craftsman, for example, develops a wealth of experience "at his fingertips" after years of experience. But he is often unable to articulate the scientific or technical principles behind what he knows.

At the same time, tacit knowledge contains an important cognitive dimension. It consists of schemata, mental models, beliefs, and perceptions so ingrained that we take them for granted. The cognitive dimension of tacit knowledge reflects our image of reality (what is) and our vision for the future (what ought to be). Though they cannot be articulated very easily, these implicit models shape the way we perceive the world around us.

Explicit knowledge can easily be 'processed' by a computer, transmitted electronically, or stored in databases. But the subjective and intuitive nature of tacit knowledge makes it difficult to process or transmit the knowledge to be communicated and shared within the organization, it has to be converted into words or numbers that anyone can understand.

According to Nonaka and Takeuchi's approach to knowledge creation [1995], it is precisely during the time this conversion takes place, from tacit to explicit, and, again back into tacit, that organizational knowledge is created.

2.5. Definition of Intellectual Capital used in this research.

The author of this dissertation believes that it is precisely through the above described process of knowledge conversion from tacit to explicit, and, again back into tacit that organizations Intellectual Capital is augmented. The author believes that this is achieved by implementing continuous participative learning, innovation and experience integration and transfer. *Participative learning* in order to "acquire" explicit knowledge. *Participative innovation* in order to "develop" new tacit knowledge building on acquired knowledge and experience. *Participative integration and transfer of experience* in order to facilitate others learning and innovation.

Following these antecedents, and according to the approach of Nonaka and Takeuchi to organizational knowledge creation and the second approach to Intellectual Capital ("maintain and develop"), Intellectual Capital will be defined in this thesis as follows:

"*The combination of intangible assets that add value to the organizational effort in reaching its goal*".

Understanding as intangible assets the following: "*innovation, information, experience, employee skills and attitudes that allow them do their job adding value for themselves, the organization and* .society.

This definition makes evident the importance of five intangible assets of each company. Furthermore, recognizing the fact that each company is unique in terms of its goals and culture, this definition invites each company to try to find continuously the right way to combine its intangible assets in order to achieve human, organizational and market oriented value addition. To illustrate on the implications of this definition in the following a number of examples are presented:

- "If we automate a process, have we increased Intellectual Capital?"
- "If we move from crew structure to team structure, have we increased Intellectual

Capital?"

- "If we simplify a process, have we increased Intellectual Capital?"
- "If we hire researchers and invest on innovation, have we increased Intellectual Capital?"
- "If we document all existing organizational experience (best and worse practices) and we develop an Intranet that facilitates access to it by all employees, have we increased our Intellectual Capital?"
- "If we invest on scholarships and send members of staff to study in the most prestigious universities or if we hire the services of famous trainers in order to develop certain skills to our employees, have we increased our Intellectual Capital?"

According to the above-mentioned definition the answer to all these questions is: "Not always. It depends". If investment on *intangible assets* added value to the efforts of the organization in achieving its goal then we have increased Intellectual Capital. Otherwise, we have not. How can we then make sure that any action we take increases Intellectual Capital?

Due to the fact that methods for managing organization's *tangible assets* have already been invented, improved and dominated by managers, enterprises - either by themselves or with the assistance of experts - are generally in the position to manage their tangible assets effectively and to evaluate accurately whether investing in them would result in benefits or not.

Yet, there is hardly any experience in performing similar activities regarding intangible assets. Enterprises are keen to be able to evaluate whether an investment in skills development, information management, innovation, or their combination, will add more value to their effort in achieving organizational objectives. So in this thesis the objective is to develop and make available appropriate methods, tools and techniques for companies to manage their intangible assets and to develop there Intellectual Capital.

2.6. Managing Intellectual Capital.

2.6.1. The concept of management.

What is management and how should function? According to Gareth Morgan the way people think management should function is influenced by the different views people have in terms of what an organization is. In his book Images of Organization [1986] he uses the idea of a metaphor to show the influence that people views of an organization have on the way they perceive and define management. The basic premise of the book is that our theories and explanations of organizational life are based on metaphors that lead us to see and understand organizations in distinctive yet partial ways. The use of a metaphor implies a way of thinking and a way of seeing that pervade how we understand our world generally. We use metaphor whenever we attempt to understand an element of experience in terms of another. Thus, metaphor proceeds through implicit or explicit assertions that A is (or is like) B, which then has a strong influence on how we deal with B.

There is a plethora of metaphors we use. We see organizations like "*machines*", "*organisms*", or "*brains*". We use a "*political metaphor*" to focus on the different sets of interests, conflicts and power plays to shape organizational activities. We use more abstract metaphors such as the idea that organizations are "*psychic prisons*" where people become trapped by their own thoughts, ideas, and beliefs, or by preoccupation originating in the unconscious mind. Or we see organizations like "*instruments of domination*", where the focus is on the potentially exploitative aspects of organizations

According to Morgan [1986], one of the interesting aspects of a metaphor rests in the fact that it always produces this one-sided insight. In highlighting certain interpretations it tends to force others into a background role. As an example, we frequently talk about organizations as if they were machines designed to achieve predetermined goals and objectives, and which should operate smoothly and efficiently. And as a result of this thinking we attempt to manage them in a

mechanistic way, forcing their human qualities into a background role and developing what is known as a bureaucratic organization.

In terms of management, according to the author, there are two main patterns we follow:

One according to which management and problem solving approaches and mechanisms seem to be forcing us to interpret everything from a fixed standpoint. This happens when we apply and use only one metaphor. As a result, we frequently hit blocks that we can't get around; our actions and behaviors are often rigid and inflexible and a source of conflict. When problems and differences of opinions arise, we usually have no alternative but to hammer at issues in the same old way and to create consensus by convincing others to "buy into" our particular view of the situation. Management approaches following this pattern are usually hierarchical. Decisions are made and imposed by the few in power and are basically the result of the metaphor these people used to interpret situations and decide on actions. Nevertheless, the metaphor used may be incompatible with the metaphors of the people who implement these actions. This may lead to misunderstandings, disagreements, conflicts, resistance, etc. all of them having a negative influence on the implementation of decisions. It is the author's opinion that this is a less effective pattern of management and should be avoided.

The alternative pattern of management recognizes as a basic premise that new insights often arise as one reads a situation from "new angles", and that a wide and varied reading can create a wide and varied range of action possibilities. In this sense management approaches and mechanisms allow us to remain open and flexible, suspending immediate judgments whenever possible, until a more comprehensive view of the situation emerges. To do that we need to share our metaphor with other people and vice versa and decide collectively on the actions to be implemented. Following a participative or collective management process is congruent with this approach. Such a participative approach leads to a decision making process that although it may by more time consuming makes sure that most errors have been

detected, and that the decision will carry the commitment of those involved. According to the author's opinion this is the most effective management pattern.

2.6.2. Managing intangible assets.

How can Intellectual Capital be managed? Following the second pattern of management (collective decision making) and according Skandia [1994], in order to manage Intellectual Capital the need is:

a. to provide a basis for the systematic management process that is essential for the creation of future value;
b. to have a balanced overview of a function (e.g. employee training) or a business unit; and
c. to have an organizational structure that propitiates an environment of trust and involvement, and at the same time facilitates the process of individual and organizational requirements definition (e.g. for training).

The research carried out and reported in this thesis seeks to meet the above mentioned 'criteria' for Intellectual Capital management. The theoretical basis presented in Chapter 3 covers:

- the *Process for Managing an Organization's Intellectual Capital.*
- the *Systemic* and *Participative Approach* for implementing the IC management *Process.*
- a comparison and contrast between Intellectual Capital management and Human Resource management to distinguish the former from the latter.

Based on the theoretical framework a method has been developed and will be presented as a means to facilitate the implementation of the Intellectual Capital management process (Chapter 4). Furthermore, results of field-testing are presented to show the applicability of the method (Chapters 5 and 6).

CHAPTER 3.

MANAGING ORGANIZATION'S INTELLECTUAL CAPITAL

3.1. Process for Managing Organizations Intellectual Capital.

In order to manage IC there is a need to establish the actual state of affairs versus the desired one, and to design and develop systems that cover the gap between actual and desired state of affairs (see Figure 1). The gap between desired and required state of affairs represents the organizational requirements.

The design of such systems will facilitate the management of individual and organizational information, skills, innovation, experience and attitudes, necessary so that employees of all organizational levels can perform successfully activities that add value to the organizational effort for achieving its goal.

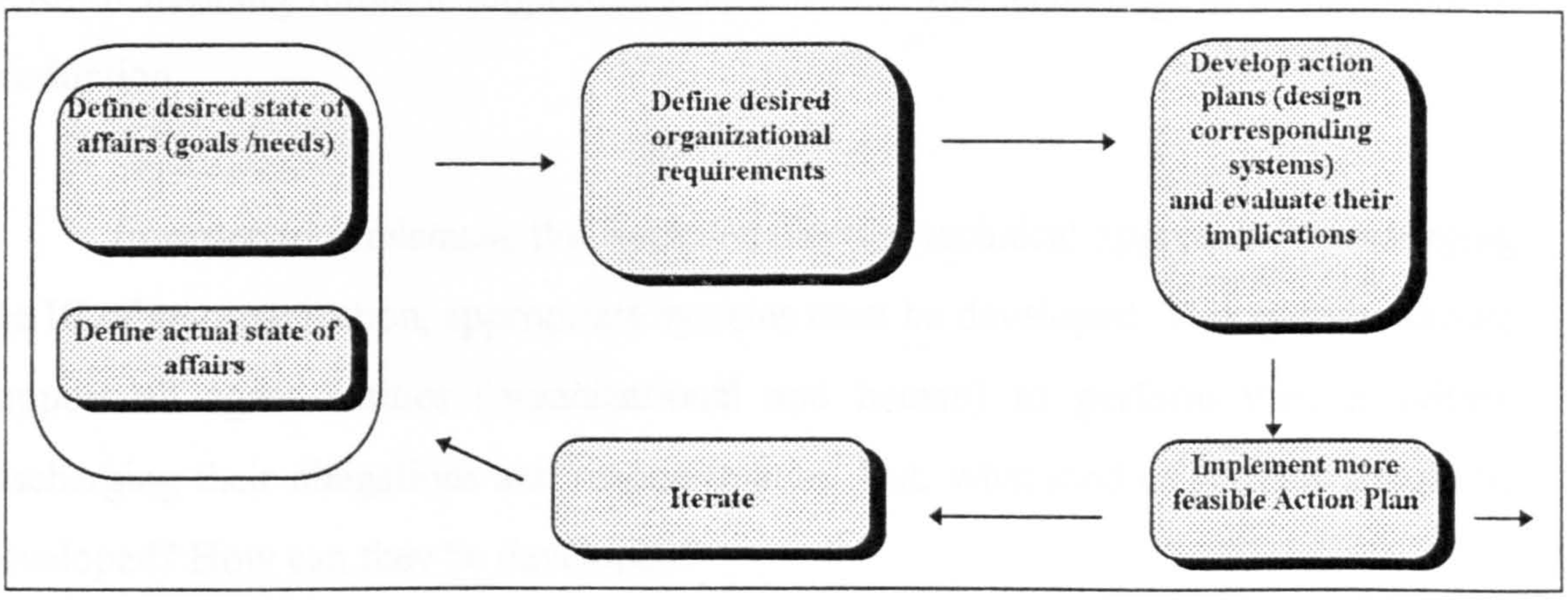

Figure 1. The Intellectual Capital Management Process.

The process of Intellectual Capital Management is an iterative process. That is because once a feasible plan has been selected (as a result of the development and evaluation sub-process), and implemented, the "actual state of affairs" has changed; and most probably the desired state affairs has also changed.

3.2. Systemic Approach to IC Management.

Systems theorists such as Checkland [1990], Jackson [1995] and Altshuller [1988], among others, together with Deming [1986], Senge [1990], Hammer [1993] and other quality and change management analysts lead us to think in terms of systems. The systems view is recognition that elements and actions in organizations are interdependent.

Following this, it is the author's belief that to manage IC (innovation, information, organizational and individual skills, experience and attitudes) a *systemic approach* has to be followed and particularly *socio-technical* and *human oriented* one. This is because a Socio-technical systems approach seeks to achieve joint optimization of the human resources and the technical systems [Emery, 1959]. The author decided to call the approach to IC management a *Socio-intellectual-technical.* The aim is *systems integration*, whereby the technical system is well integrated with organizational structures, processes and developments and the human system is given a sense of meaning through supportive relations with the technological components of production.

In order to implement the Socio-intellectual-technical approach for managing the IC of an organization, appropriate systems must be developed. This systems should support all agent entities (organizational and human) to perform their activities, discharging their obligations and responsibilities. But, what kind of systems should be developed? How can they be developed?

Viewing an organization as a Socio-intellectual-technical system (see Figure 2), in order for the social subsystem to function, a series of requirements must be met: organizational requirements on innovation management, human skills development, information access, experience reuse, employee motivation and access to appropriate technological tools. Based on these requirements, appropriate innovation, learning, information, experience and attitude management systems can be developed effectively and efficiently. Furthermore, the appropriate technology can be selected to support those systems.

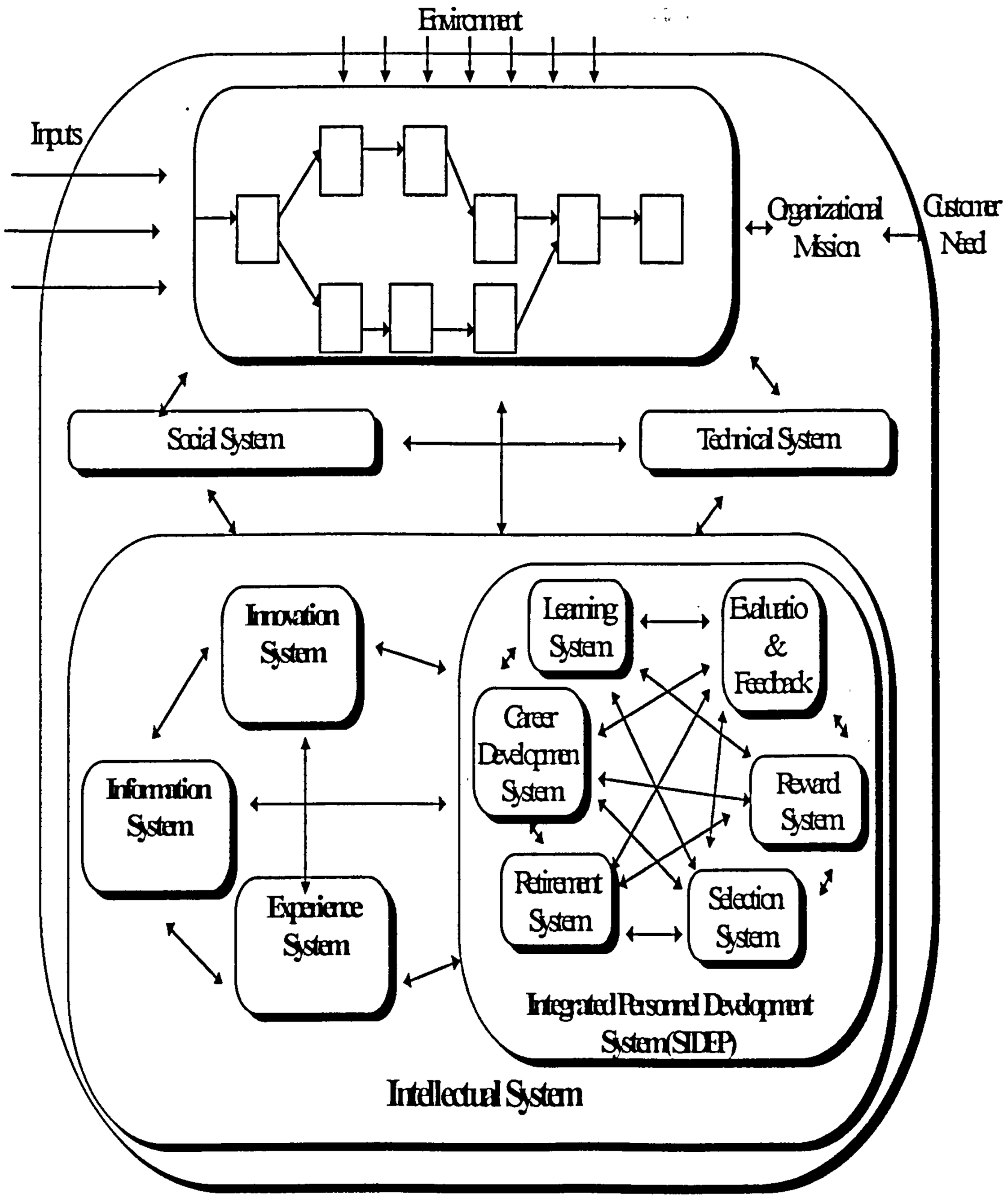

Figure 2. The systemic approach for managing IC: model of the subsystems and their interdependencies (⟷ means: designed based on the needs of the system it supports).

3.2.1. Intellectual Subsystems.

An innovation system facilitates the purposeful and organized search for change and the systematic analysis of the opportunities such changes might offer for economic or social innovation research [Drucker, 1985]. Furthermore, an innovation system incorporates appropriate mechanisms that rigorously select, describe, classify, and evaluate specific intellectual asset resources[1] - such as patents, trademarks, copyrights, trade secretes and know-how [McConnachie, 1997] - with demonstrated links to financial results.

An *information system* provides employees and the organization with the necessary information to take the appropriate decisions - decisions that bring the organization and its employees closer to their goal.

A *learning system* in an organizational context, can be defined as a system that develops individual and collective skills, so that employees can do their job effectively and efficiently - activities that add value at individual and organizational level.

An *experience system* registers formally or informally individual and collective experience on organizational methods and procedures, so that it can be used to improve learning and information processes as well as future decision-making.

Finally, appropriate *selection, evaluation and feedback, reward, career development* and *retirement systems* help employees be satisfied, motivated, have joy in working, be dedicated to successful operations and feel as part of the organization, something that will decrease personnel turn-over (organization's intellectual capital leak).

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[1] McConnachie [1997] distinguishes between *Intellectual Property (IP)* and *Intellectual Asset (IA)* in the following way:

- IP is knowledge that has been articulated with defined property, i.e. by patent protection. IP has a quantifiable value potential which depends on its potential use. This value potential is not, however, realised until the IP is put to some use.
- IA is knowledge that has a defined value (IP) and used in a targeted manner, i.e. patents licensed for a particular purpose, having a defined dollar book value for the owner.

3.2.2. Problems related to IC systems design.

Generally speaking, *innovation systems* instead of supporting the strategic organizational processes, performed systematically by all personnel, are delimited to pure R&D activities, constrained to laboratories that have little or no contact with real world's technological and/or organizational problem solving. In other words, innovation processes, when they exist in the organization, usually are not integrated to other organizational processes, especially those related to problem solving. On the other hand, in the cases that innovation mechanisms are integrated to the problem solving processes, those are limited to traditional forecasting, with the limitations that this has caused mainly from the intuitive approach to innovation prediction.

Coming to *information systems,* often these are designed which instead of facilitating users work, impede it by placing arbitrary restrictions on the tasks in certain ways.

On the other hand, training research [Tannenbaum and Yukl, 1992; Baldwin and Ford, 1988; Broad and Newstrom, 1992] supports that much of the training currently going on does not 'stick'. *Training programs* are oriented in transmitting general-purpose theoretical information but leave the tough 'bring to practice' part to learners. The typical corporate training program produces only about a 10 to 20 percent return when return is based upon an estimate of the trainees who will actually end up using training in their jobs [Brinkerhoff and Gill, 1994]. Furthermore, training programs are often designed as social events rather than working skills (*competencies*) development processes.

For skill development to take hold employees need opportunities to practice and to make errors. They need consistent rewards not only for correct responses but also for detecting errors so that they can be corrected. Successful training programs require an *incentive system* that favors risk-taking [Garvin, 1993]. Nevertheless, rewards for error detection and invention of innovative solutions are often lacking [Schein, 1993]. *Rewarding mechanisms* in many cases (a) are not oriented to positive motivation, (b) do not embrace or tolerate errors as a valuable part of the innovating process, and (c) do not support employees in their effort to overcome their feeling

associated with an inability or unwillingness to learn or do something new because it appears too difficult or disruptive[2] or because it does not accord to organizational culture[3]. On the contrary in many cases rewarding mechanisms promote negative motivation by consistently punishing any rule-braking behavior, provoking strong resistance to change [Schein, 1993].

In terms of managing organizational experience, there is evidence that suggests that companies need to review continuously their successes and failures, assess them systematically, and record them in a form that employees find open and accessible. This process is also known as the 'Santayana Review', citing the famous philosopher George Santayana, who coined the phrase "Those who cannot remember the past are condemned to repeat it." Garvin [1993] concluded that too many managers today are indifferent, even hostile, to the past, and by failing to reflect on it, they let valuable knowledge escape. On the other hand, when they use *experience management mechanisms*, those are restricted to additional, post event activities of unstructured documentation, such as those included in Total Quality Management projects. These activities are usually interpreted by employees as a secondary purpose job, to be done because there is an external obligation (i.e. ISO certification), rather than a strategic decision for managing organizational experience and add value to the organization [Ruiz, 1996].

As far as *selection* is concerned, usually this is limited to psychological assessment instead of being linked to organizational strategies, contemplating appropriate processes and tools (from one-of-a-kind assessments of key employees to the design of integrated selection processes for entry-level job), for all organizational levels. Selection strategy, processes and tools should flow from organizational strategy and from business plans. They should complement and support the overall human resource strategy (how you train, develop, pay, and promote people has implications for how you select them and vice versa). The selection process and tools should be

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[2] Schein [1993] defines as Anxiety 1 the feeling associated with an inability or unwillingness to learn something new because it appears difficult or disruptive. He defines as Anxiety 2 the fear, shame or guilt associated with not learning anything new.

cost effective, efficient and easy to use. They should include full psychological assessment of skills, intellectual style, work style, and interpersonal style together with full psychological assessment of key candidates including complete evaluation by specialists, immediate boss, subordinates and colleagues.

Finally, *career development* programs scarcely reflect an understanding of emerging business needs. Furthermore, they usually lack an ergonomic design that helps employees to grow inside the organization (see Figure 3, a and b), forcing them

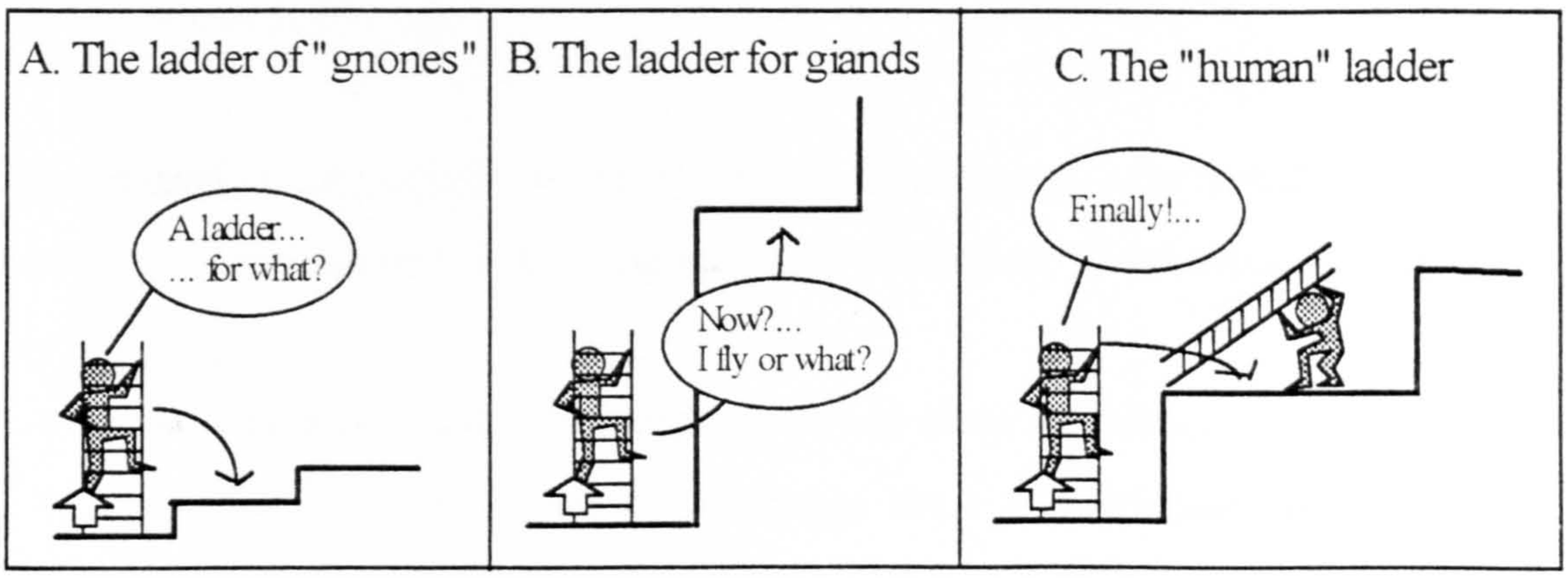

Figure 3. The ergonomic organization, after Carlos Torres.

to move from one organization to another (IC leak). Assessment, feedback, coaching and development of people at all organizational levels should be linked to overall business strategy and should guide individuals to take initiatives develop themselves in ways that will prepare them for changes in their work, increase their job effectiveness and improve their overall value to the organization and to themselves (see Figure 3, c).

3.2.3. Integrated IC systems development.

To manage IC assets, a systems approach must be followed. The design of the corresponding Intellectual Capital subsystems for Innovation management, Information management, Experience management, and SIDEP (Integrated Personnel Development

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[3] Shein [1993] defines culture as the accumulation of past knowledge; to him culture reflects past successes.

System) should be compatible with the vision, mission, objectives, values and needs of the organization, and should be based on organizational requirements [Brinkerhoff and Gill, 1994; Eason, 1989; Scein, 1993].

3.3. Participative Approach for Managing Intellectual Capital.

As it is already mentioned in order to manage organizations IC and following:

- the recommendations of Edvinsson and Pertti in respect of the need to create trust [Drake, 1996];
- the participative nature of Romer's model of endogenous growth;
- the decentralized nature of decision-making of Florida and Keney's mass production process;

extra emphasis must be made on the importance of involving all the Stakeholders in the process of IC management and the design of the IC systems. Furthermore, in order to:

- achieve successful design and implementation of the IC systems;
- ensure that relevant employee knowledge about organizational structures and processes is captured and embodied in the design of the individual and organizational IC systems;
- ensure that employees understand and are committed to the systems which might then be implemented to support IC management; and
- make sure that these systems add value to organizational products and services as well as to individuals

effective management of change and a high degree of employee involvement in the systems development process should be implemented.

To achieve the above, it is necessary to implement a democratic organizational structure together with a clear orientation towards the individual in order to eliminate resistance to change and facilitate the involvement of the personnel in the process of requirements definition, systems design, technology selection and implementation.

Participative design is a process that permits to move from an autocratic organizational structure to a democratic one [Emery, 1995]. In participative design (see Figure 4) individuals from different disciplines are involved in the decision-making

process. There is a need for them to communicate their ideas to one another (interdisciplinary communication), define there needs and generate and evaluate future options of design solutions. Furthermore, decision-making is done by different individuals or groups at the organizational level were the job is done (democratic management model) rather than above working level, from the manager, as in Taylor's management model [Emery, 1995].

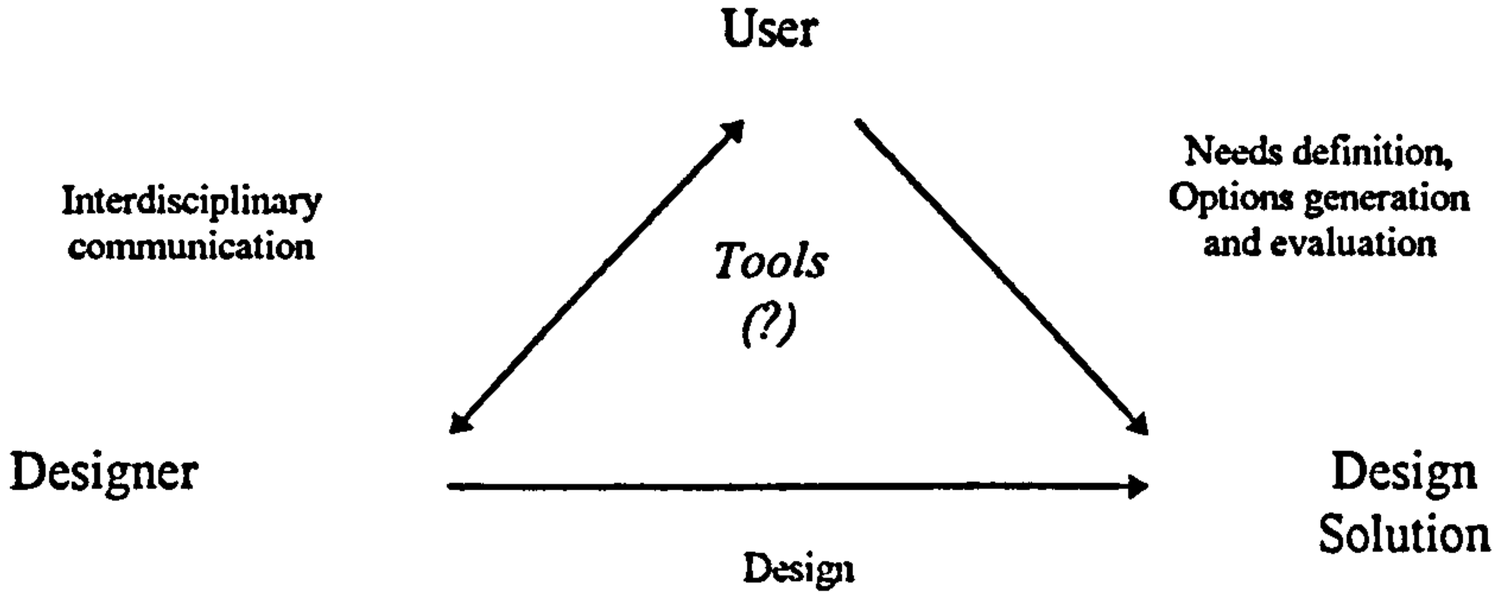

Figure 4. The Process of Participative Design [Eason, 1989].

In the latter, there is little need for registering and transferring organizational experience since this is accumulated on the manager - individual who has always taken decisions. Nevertheless, this is not the case in participative design: each decision making group needs to learn certain things from all other groups experience in order to (a) avoid committing similar mistakes during the decision making process and (b) advancing on a faster pace.

To implement effective participative design in the development of systems to manage organizations IC, the above mentioned requirements should be satisfied. Additionally, it is necessary that the organization and its employees have access to tools that facilitate participative design. In other words, to manage IC there is a need for modeling tools that represent and register organizational knowledge and experience, support interdisciplinary communication, analysis, design, solution generation and evaluation.

3.4. Comparing Intellectual Capital management and Human Resource (HR) management.

The author has witnessed various cases in which IC management is confused with HR management. These cases include among other:

- Having HR people attending courses and reading books on the subject in order to define and propose ways to "utilize better everything that is inside employees head".
- Having HR and IT people working together in order to capture and document on an intranet employees experience ("best and worse practices").

In all the cases that the author has witnessed, the objective behind such efforts is to

- reduce the negative influence employee rotation may have on the execution of organizational processes and/or
- automate as much as possible employee knowledge-based functions making the organization independent of humans.

I believe that the reason why IC management is confused with HR management is due to the word "intellectual" and its "human" connotations. The traditional division of organizational functions makes no one else but HR people responsible of everything related with humans.

As it has already been said, organizations IC is the combination of five intangible assets (innovation, information, experience, skills and attitudes) that best supports organizational efforts. The perfect combination of these intangible assets (i) continuously changes and (ii) can not be defined by one or two organizational areas.

IC management requires integrated and continuous cooperative work involving *all* organizational areas on:

- Agreeing organizational goals.
- Designing and/or improving organizational processes to achieve organizational

goals.

- Defining organizational and individual requirements on both tangible and intangible assets.
- Deciding on priorities and investment on the development of the right combination of intangible assets.
- Designing and implementing corresponding IC systems.

This integrated effort involving all organizational areas together with the specific activities to be performed marks the difference between HR management and IC management as presented in this thesis.

3.5. Conclusion - Theory for managing the intellectual capital of organizations.

Summarizing what has been mentioned so far, the IC of an organization can be defined as the combination of intangible assets of an organization that adds value to organizational effort in reaching its goal, understanding as intangible assets innovation and knowledge (the employees skills, experience, attitudes and information that permit them do their job, adding value for themselves and for the organization).

According to Skandia [1994] and following Paul Romer's model of endogenous growth, to manage organizations IC it is observed the need (a) to provide a basis for the systematic management process that is essential for the creation of future value; (b) to have a balanced overview of a function or a business unit; and (c) to have an organizational structure that propitiates an environment of trust and involvement, and at the same time facilitates the process of individual and organizational requirements definition. To meet the above mentioned 'criteria' for IC management, developed and presented in this Chapter is the *Process of Managing Organizations IC*, together with the *Systemic, Socio-Intellectual-Technical* and *Participative Approach* for implementing it.

According to that, in order to be able to manage and get advantage of organizations IC the decision-making process has to change, becoming more participative, involving those who should be innovating systematically, those who possess the knowledge, have a direct interest and can contribute to decision-making. Furthermore, the process of managing IC should be an *iterative* and *participative process of requirements definition, generation of possible solutions and evaluation of their implications* (see Figure 5).

This process leads from organizational goals and objectives to the definition of social systems requirements, IC systems requirements, to technology requirements. To implement this process, certain aspects of participative design have to be facilitated, such as interdisciplinary communication, requirements definition, scenario generation and evaluation, systems design and collective experience registration and management.

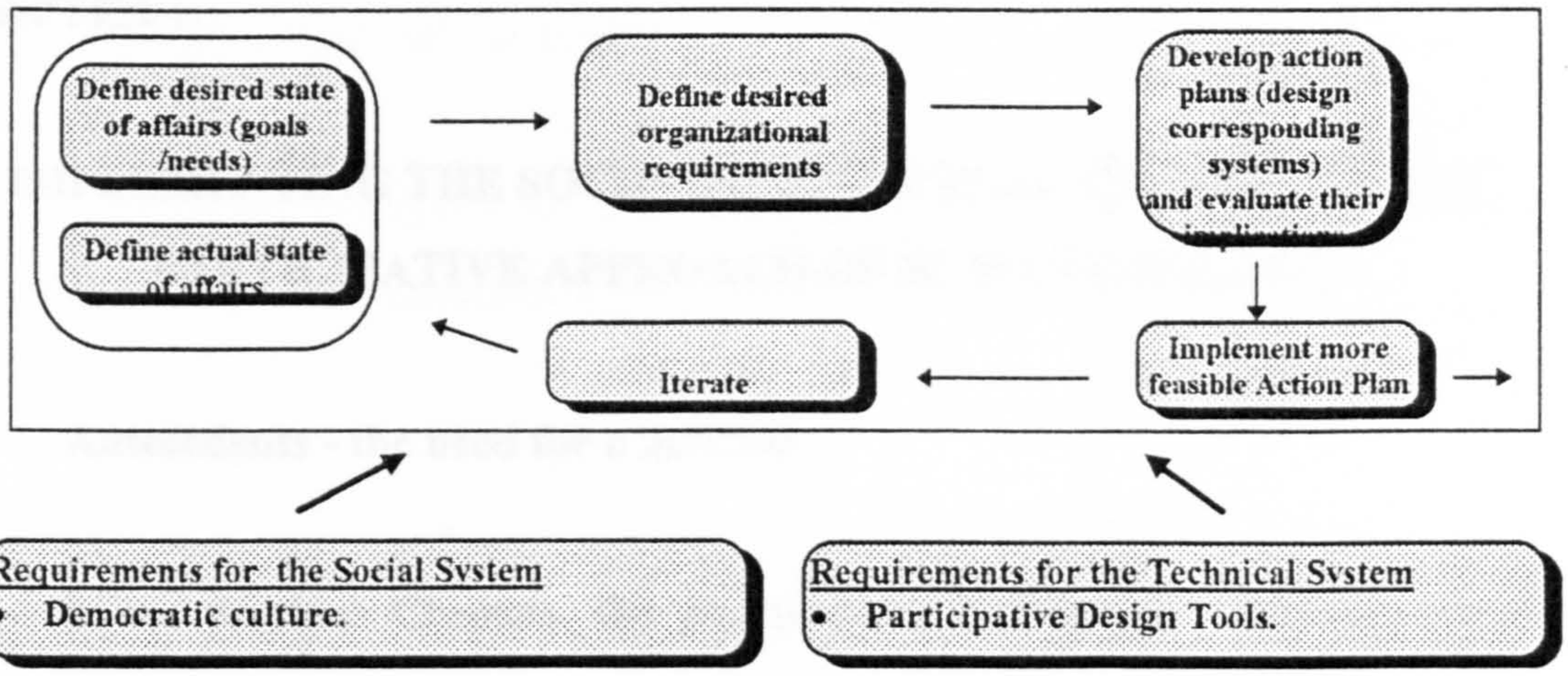

Figure 5. The systemic and participative process of Intellectual Capital management.

In order to facilitate the effective implementation of the above mentioned theory of IC management at an organizational context is needed:

- A democratic organizational culture that generates a will to participate.
- A method that contemplates tools for participative design.

In the following Chapter, the effort of finding a method for implementing the Socio-Intellectual-Technical and Participative approach to IC management will be presented.

CHAPTER 4.

IMPLEMENTING THE SOCIO-INTELLECTUAL-TECHNICAL AND PARTICIPATIVE APPROACH OF IC MANAGEMENT.

4.1. Antecedents - the need for a method.

In the previous Chapters, the practical and real problem of managing the Intellectual Capital of organizations has been defined. An approach has been developed and presented for solving the problem at theoretical level. A question that now arises is "What do we do with this theory?"

From the point of view of the problem owners - organizations, a theoretical solution to the problem of managing IC is of no value unless it can be put into practice and provide satisfying results. On the other hand, the concept of management implies that people take actions in relation to IC.

In order to put theory into practice a method is needed. The method should allow systematic repetition of actions through which managers can implement the Socio-Intellectual-Technical and Participative approach of IC management.

The question that now arises is: "Do we need a new method? Could we use methods for participative design that already exist or is it necessary to develop a new method?"

To answer this question, in this Chapter, initially, the requirements that the method must satisfy will be defined. Then these requirements will be used as the criteria for evaluating existing methods.

4.2. Requirements for an Intellectual Capital management method.

There are specific requirements that a method should meet for implementing the Socio-intellectual-technical approach to IC management. These requirements are related to:

- The nature of the design process the method should support.
- The nature of the systems whose design the method should support.

In this sense, the two fundamental requirements for the method are:

a. It has to be participative, Socio-technical and should support change management.
b. The method should offer the appropriate tools for facilitating participative design, managing experience and developing organizational memory.

Additionally, the following requirements have been defined by the author:

c. Learning and using the method should be easy.
d. Implementation of IC management activities should not depend on the continuous advise by an expert on the method and
e. The method should be compatible with other practices the organization has already used, taking advantage of organizational projects and developments prior to IC management project.

Based on these requirements, in the following section existing methods will be evaluated.

4.3. Evaluating existing methods.

Due to the first requirement presented in the previous section, only Participative and Sociotechnical methods that facilitate change management qualify. Therefore, the method for implementing the Socio-Intellectual-Technical and participative approach to IC management, if it exists, should be looked for in the group of Participative and Sociotechnical methods.

In this section initially change management methods such as Continuos Improvement, Business Process Reengineering and Sociotechnical systems design are analyzed and evaluated. The evaluation is based on the above mentioned criteria for the IC method. In the next section specific participative methods developed to facilitate Information systems design are analyzed in terms of their compatibility with the above mentioned criteria for the IC management method.

4.3.1. Evaluation of change management methods.

Emery [1995] and Jackson [1995] among others have recently presented research results as far as the use of change methods in Europe, USA, Canada and Australia is concerned. Surveys were curried out with directors and managers of different organizations which had gone through a process of organizational change by means of Business Process Reengineering (BPR), Continuous Improvement (TQM) or Sociotechnical systems theory. The general objective of these surveys was to register the experience of companies that had used these methods in their process of change: according to Emery [1995] and Jackson [1995] these methods are not appropriate for managing change.

During the period between October 1995 to May 1996, a similar survey was curried out with directors and managers of different Mexican organizations which had gone through a process of organizational change by means of the above mentioned methods [Ruiz, 1996]. The survey was applied to 68 organizations in different business sectors. 39 of these organizations were manufacturing some sort of goods or

products whereas 29 were providing services. The results of this survey in Mexican companies are compatible with those presented by Emery and Jackson. The reasons are also similar ([Emery, 1995], [Jackson, 1995], [Ruiz, 1996]):

- *Continuous Improvement* it is considered by most of the authors [Harrington, 1987], [Berry, 1992], [Ishikawa, 1990], [Imai, 1992] as a highly participative approach to change. Nevertheless, in most of the, worker participation was very limited [Emery, 1995], [Jackson, 1995], [Ruiz, 1996]. Only project leaders and specific teams participated in the change project. Important decisions were made at the higher hierarchical levels. Evidence reported that even in quality circles participants could not identify themselves with improvements proposed. That was due to the fact that the focus of the change process was on modeling the activities and measuring results rather than considering and satisfying the needs of the people who would execute the improved activities. In other words, Total Quality Management tools do not face the Agent problem: there is no way to include in the models the executor(s) of organizational activities. As a result, employees' requirements on learning, information, reward and career development are not explicitly considered. Furthermore, since organizational roles are not represented in the models, employees do not see themselves as part of the organizational processes, something that results to lack of compromise with their job.
- As far as *BPR* is concerned, most of the authors such as Hammer [1994], Davenport [1993] and Manganelli [1994] focus on the redesign of organizational processes and the role of the technology as a facilitator. Of these, only Manganelli considers the social aspect. The results of the surveys ([Jackson, 1995], [Ruiz, 1996]), confirmed that in the implementation of BPR, generally a selected group of persons participate in the redesign, without considering the opinion of the rest of the workers. Superiors make decisions regarding the new design, that is, the control and coordination is done on a superior level from where the work is done. As a result, workers do not assume responsibility and moral engagement in the change process because they do not count on a shared concept of participation. BPR tools also do not address the Agent problem: there is no way to include the agent of organizational activities in the process models. As a result employees'

requirements on learning, information, reward and career development are not explicitly considered. Furthermore, in this case also due to the fact that organizational roles do not appear in process models, employees do not identify themselves with organizational activities, something that results to lack of compromise with their job.

- As far as *sociotechnical systems theory* is concerned, its conceptual base says that semi autonomous work groups are in charge of making the decisions related to their work area [Trist, 1993], [Pasmore. 1995], [Christensen, 1993]. This would classify this approach to change as a participative one. However, the results obtained from field research in Europe, Australia, USA, Canada [Emery, 1995] and Mexico [Ruiz, 1996], show that superiors continue making decisions on aspects that correspond to the semi-autonomous groups. In many cases, decisions already taken by the group members were changed by superiors outside the group. This reflects the fact that the implementation of Sociotechnical systems theory in practice is not participative.

Evaluating the above mentioned change management methods in terms of the criteria corresponding to the requirements for the IC method it is concluded the following:

- None of the methods so far considered matches the requirement on change management.
- The tools of these methods are not considered appropriate for participative systems design.

Therefore, these methods are not considered appropriate for supporting IC management. In the following, participative methods for the design of information technology systems will be presented and evaluated in terms of the criteria for the IC management method.

4.3.2. Evaluation of participative methods for systems design.

There are many efforts to support effective participative design for particular purposes. Several projects following the "Scandinavian approach to participative design", such as the *Carpentry Shop* project [Ehn & Sjogren, 1986], *Utopia* project [Bjerknes, Ehn, & Kyng, 1987], *DEMOS* project [Ehn, 1989], *Our Shop* project [Ehn & Sjogren, 1991]), together with a number of projects for developing participative methods such as *ETHICS* [Mumford, 1986], *User-Centered* [Eason, 1988], *Soft Systems Methodology* [Checkland, 1990], and *ORDIT* [Olphert and Harker, 1994]. The majority of these represent examples of efforts to support effective participative design of *Information Technology (IT) systems* and/or *Social systems*. Due to the fact that an information system is one of the systems to be designed under the socio-intellectual-technical approach to Intellectual Capital management the author decided to include them in the evaluation process against the criteria for the IC management method. Follows a brief description of the above mentioned efforts and their evaluation.

4.3.2.1. The Scandinavian approach to participative design.

Scandinavian countries have a long tradition in the area of democratization of the work place. The latter was the goal of a number of research projects. An overview of the projects and related activities is reported by Ehn and Kyng [1987]. According to research results, active user participation and improving the quality of work and products were seen to be main factors in supporting democratization of the work place. Though the application domains and level of technology were very different in these projects, they had many features in common.

Some central features were the participatory design approach and the understanding of the design process as a process of mutual learning between professional designers and skilled users within the application domain, and as a process where future or alternative technology and work organization were envisioned and experienced rather than described. Aspects shared by the design approaches included a focus on concreteness and ease of use. The design approaches included

mock-up simulations, prototyping, and organizational games supporting research work in study circles and in design groups. The use of mock-ups [Ehn & Kyng, 1991] and prototypes [Bodker and Gronbaek, 1991] opened up possibilities for "design-by-doing" - for getting hands-on experience with future technological alternatives.

As an example of the Scandinavian approach to participative design, the Utopia project is presented: the Utopia project is one of several Scandinavian projects where shop stewards and other workers cooperated with researchers and designers on evaluation and design of computer systems. The project was formed cooperatively by the Nordic Graphic Workers Union and research institutions in Denmark and Sweden. The aim was to design computer-based tools for text and image processing. To this end the design group, consisting of skilled typographers and designers with a background in computer science, was set up. In the first activities of the project, both end users and designers played active roles in the mutual learning process: teaching, discussing, and learning about their own work and that of the others in the group. However when the work moved to design activities in terms of writing "traditional" system specifications, the designers took the initiative. For a detailed description of the Utopia project see [Bodker et al, 1987].

4.3.2.2. ETHICS.

ETHICS stands for Effective Technical and Human Implementation of Computer-based Systems. It was developed by Professor Enid Mumford [1986] and it is used to ensure that the new system is valuable to the organization. All levels of the organization are involved in system design and this creates a feeling of the system being 'their baby to bring up and look after'. The process starts with setting up two working groups: (i) the Steering Committee which consists of senior management from the user, systems development, finance and all major areas, including senior union officials; it sets the guidelines for the Design Group; (ii) the Design Group consists of representatives of all those interested in the design area as well as professional information system analysts. At the design and development level, ETHICS: (a) facilitates design based on accurate and careful diagnosis of business problems and human relation needs; (b) gives equal weight to problems and needs; (c)

ensures that design covers organization as well as technical design; and (d) creates effective, efficient, acceptable and stimulating systems. ETHICS involves members of staff, management, and designers.

4.3.2.3. User-Centered method.

This method is the result of the study of system analysis and design methodologies. Eason [1989] concluded that current methods tend to only emphasize part of the functional aspects of a system and although some methods do address non-technical issues, they do not provide the technique or the expertise to cope with them. The User-Centered method should be used as a set of techniques within a set of design methodologies.

Involving all potential users in the design of a system is a good way of producing a usable end system, but there are problems with using this method [Eason, 1989]. One problem is due to the fact that it is impossible to involve every single end user in every aspect of the design. This problem can be solved by adopting the minimum critical specification strategy. A second problem is related to the knowledge the users require to take part in the design process. The third problem concerns the management of the project in which the user-centered method is used, due to the potentially large number of people involved. According to Eason [1989] to tackle these problems the project management must make clear that participation does not mean that everything is possible but there are many choices within limits.

4.3.2.4. Soft systems Methodology.

This methodology was developed after extensive research carried out particularly by Peter Checkland [1990]. Its aim is to provide an alternative to 'Hard System Methodology', which tackles real-world problems in which an objective can be taken as given.

Soft systems methodology tackles problems in which an objective cannot be taken for granted and it provides methods that help the designers to see the problem with an open mind. According to Checkland it has four basic characteristics:

(a) It is capable of being used in actual problem situations.

(b) It is not vague in the sense of providing greater support to action than a general method.

(c) It is not precise, in order to allow insights that precision might obscure.

(d) Any development in system science can be included in the methodology and can be used if appropriate in a particular situation.

It consists of two kinds of activities : real world activities, involving people in the problem situation; 'system thinking' activities, which may not involve those in the problem situation.

4.3.2.5. ORDIT.

ORDIT stands for Organizational Requirements Definition for Information Technology. Was the product of an ESPRIT II European R&D project. It is a methodology for *information* requirements definition, with a process that support participation and a set of tools which enable the modeling and evaluation of alternative sociotechnical solutions for organizational and information system. In the next Chapter will be presented in more details different aspect of ORDIT method.

4.3.2.6. Match with requirements.

Table 2 presents the evaluation of the above mentioned methods. As it has been seen in the presentation of each method, all of them represent efforts to support participative and socio-technical systems design. The learning process for ORDIT method and the Scandinavian approach is considered easy. Three out of the five methods revised do not require the present of an expert in order to be implemented. Only User Centered Method and ORDIT were designed to be compatible to other methods that the organization may be using. All of the methods are designed mainly to support information systems design. This system is one of the systems to be designed under the socio-intellectual-technical approach to Intellectual Capital management. The methods presented above are not oriented to the design of Innovation, Experience, Skill and Attitude management systems. In conclusion, the

Criteria / Method	Supports Participative and S-T Design	Oriented to Intellectual Capital systems design	Easy to learn	Non dependent to expert's presence	Compatible to methods in use
Scandinavian approach	YES	NO	YES	NO	NO
ETHICS	YES	NO	NO	NO	NO
Soft Systems Methodology	YES	NO	NO	YES	NO
User Centered Method	YES	NO	NO	YES	YES
ORDIT	YES	NO	YES	YES	YES

Table 2. Evaluation of existing participative methods for implementing the Socio-Intellectual-Technical and participative approach to Intellectual Capital management.

methods presented above are all based on a sociotechnical participative approach. Nevertheless, it can be seen that as with general sociotechnical approaches, they do not meet all the criteria set out at the beginning of this Chapter as far as the Intellectual Capital management method is concerned.

4.4. Need for a new method for managing organizations Intellectual Capital.

The above mentioned results and the failure to identify a method that matches all the criteria led the author to think in terms of a new method. In other words, a method must be developed for facilitating the management of organization's IC. Furthermore, this method should integrate modeling tools, with which companies and there employees can design and develop systems for managing their IC. These modeling tools apart from facilitating participative requirements definition, future scenario generation for IC development and evaluation, should provide the mechanisms necessary for developing a company's *organizational memory* by registering individual and collective experience at the moment that this is generated.

Responding to the above described need for a method that facilitates the implementation of participative design of systems in order to manage IC, the ORDIC methodology has been developed. ORDIC stands for Organizational Requirements Definition for Intellectual Capital management.

Since ORDIT proved to be closer to the defined requirements than the rest of the methods evaluated, it was used, together with the general principals of the Scandinavian approach to participative development of systems, as a starting point for the development of ORDIC. Research evidence [Pugliese, 1995], [Ruiz, 1996] showed that ORDIT needed to evolve in order to satisfy the particular requirements. For example, ORDIT tools are not appropriate for modeling Experience management, Career Development, Reward, Innovation and/or Learning systems. Feedback from the case studies to be reported later endorses this decision. The common characteristics and main differences between the ORDIT and the ORDIC methods will be discussed in Chapter 5 after the ORDIC method has been presented.

4.5. Process for developing the New Method for IC management.

The process for developing ORDIC was an iterative and participative process of requirements definition for the method and tools, generation of possible solutions - improvement of the tools, application of these solutions to real projects and evaluation of their implications. It can be appreciated that the process for developing the ORDIC method is compatible with the process of IC management (see Figure 5 in Chapter 3) and follows the principles of IC management.

The general steps for the development of the method could be classified in the following way:

- Development of the ORDIC method.
- Alpha test and modifications of the ORDIC method, with the author playing both the role of the developer of the method and the role of member and coordinator of the user groups who were testing the method.
- Beta test of the method, with people other than the author implementing and evaluating operational ORDIC.

The ORDIC development project has many similarities with the Scandinavian projects mentioned earlier in this Chapter. Some common features were those related to the participatory design approach and the understanding of the design process of IC systems as a process of mutual learning between professional designers and skilled users within the application domain, and as a process where future or alternative IC resources and work organization were envisioned and experienced rather than described. Aspects shared by the Scandinavian and ORDIC design approaches included a focus on concretness and ease of use. The ORDIC design approach in both Alpha and Beta tests included collaborative projects with companies who received consulting services on IC management. These projects supported research work in study circles and in design groups.

The people involved to the study circles and design groups were classified in the following categories:

- *Users of the ORDIC method*: these people were either students of different postgraduate courses of the ITESM University or systems analysts of the Information Services Division of the ITESM university.
- *Organizational participants*: employees of the client organizations who participated in the IC projects.
- *Developer of ORDIC*: the author, either from his position as a Manager of the Information Services Division of the ITESM or as a professor of postgraduate courses of the ITESM University.

Figures 6a and 6b show the structural relationships between people involved in the study circles and design groups during the Alpha and Beta test of ORDIC.

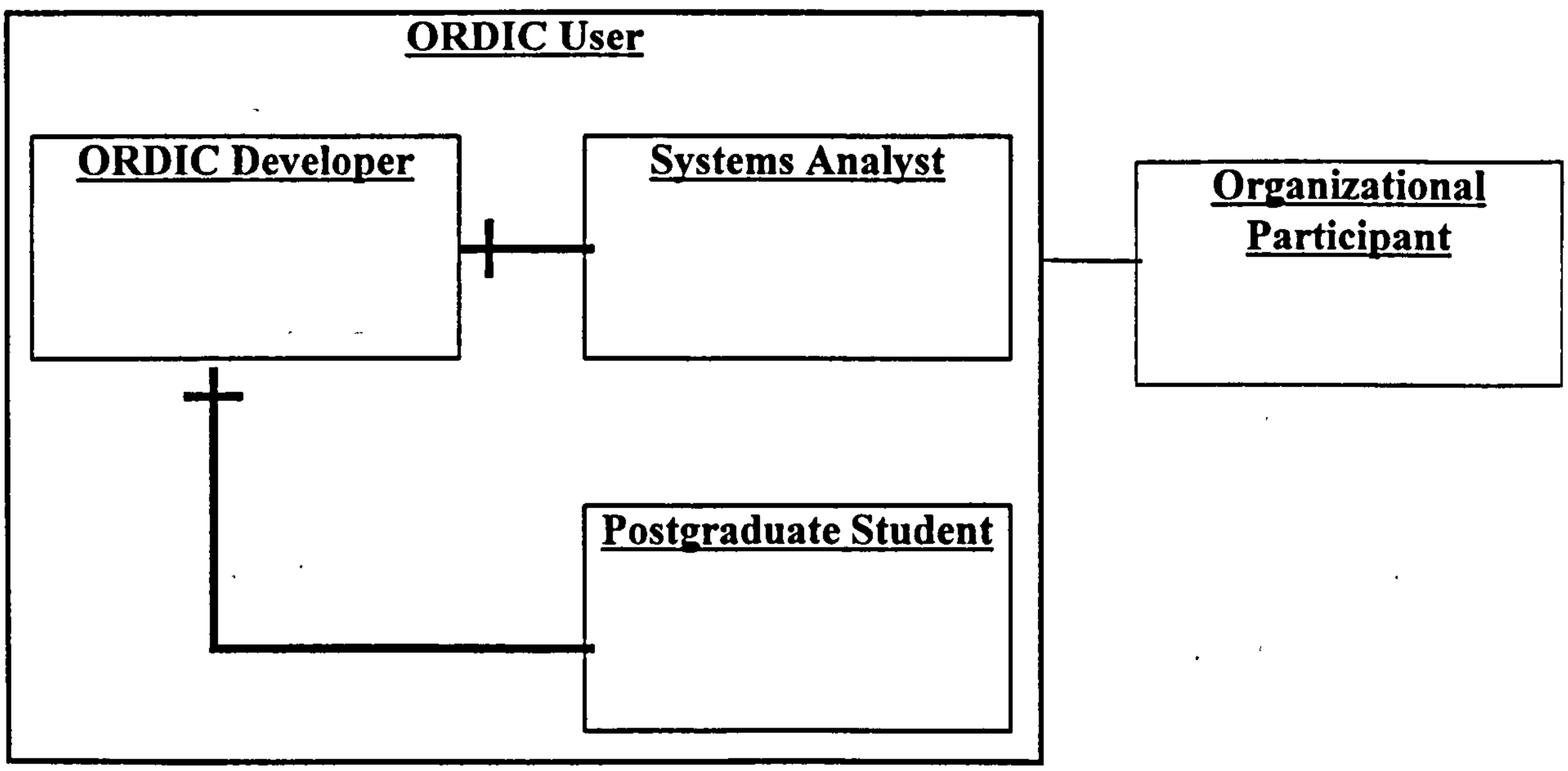

Figure 6a. Structural relationships during the Alpha-test of ORDIC.

Two types of relationship are presented:

- *Superior - Inferior* represented by the continuous line, with the position of the superior being indicated by the end where the vertical line is located.
- *Peer* represented by dotted line.

As can be appreciated from Figure 6a, during the Alpha test both postgraduate students and subordinates at the Information Services Division were receiving

training, and guidance from the ORDIC developer and were making suggestions for the design of the method. The author had direct control over the whole process.

During the Beta test of the method (see Figure 6b), the role of the ORDIC developer was limited to that of a trainer, ORDIC Users were empowered and could make decisions as far as the implementation of the method and the project they were doing in collaboration with Organizational Participants.

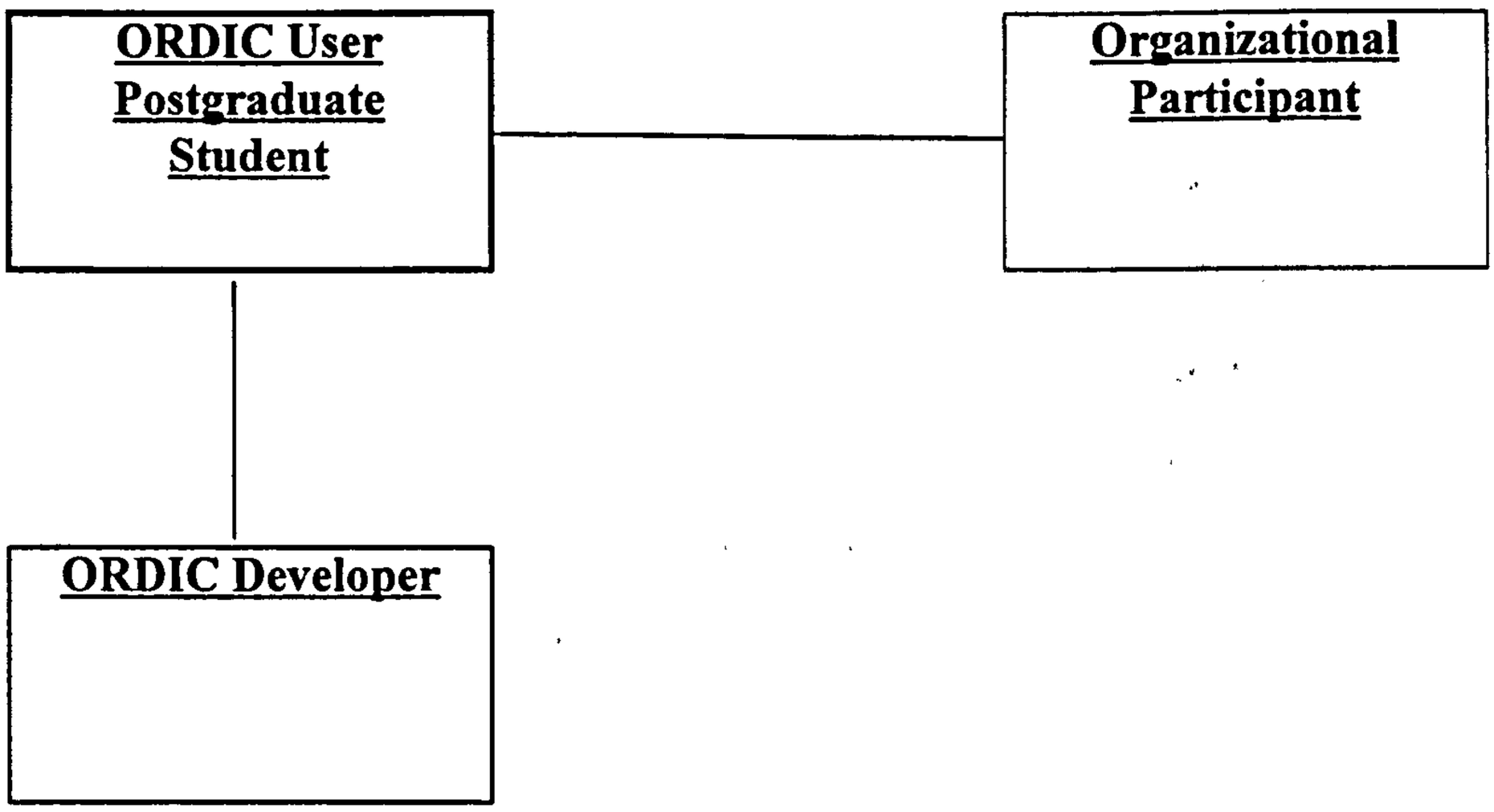

Figure 6b. Structural relationships during the Beta-test of ORDIC.

The development of ORDIC method together with the Alpha test and modifications will be presented in Chapter 5. The design of the Beta test of the method will be presented in Chapter 6. The implementation and evaluation of results of the Beta test will be presented in Chapter 7 and 8 and discussed in Chapter 9.

CHAPTER 5.

DEVELOPMENT OF ORDIC METHOD FOR MANAGING ORGANIZATIONS' INTELLECTUAL CAPITAL

5.1. Antecedents.

In order to facilitate the implementation of participative design of systems to manage IC the author developed ORDIC method (Organizational Requirements Definition for Intellectual Capital management).

ORDIC supports IC management practitioners achieve the integration of organizational production systems, IC systems and technological systems. This is done by identifying the requirements of the Social system (employees) as far as skill development, innovation, information, experience and selection, rewarding and career development is concerned, and exploring the implications of possible IC systems to satisfy them, deciding on the system(s) to focus first.

5.2. Development of ORDIC Method.

To develop ORDIC there were specific requirements that had to be met. As it has already been mentioned in the previous Chapter, these requirements were:

- the method should support participative and sociotecnical systems design;
- the method should support IC systems design, their integration with the organizational production systems, and should offer the appropriate tools for facilitating participative design, managing experience and developing organizational memory;
- learning and using the method should be easy;
- implementation of IC management activities should not be depended on the continuous advise of an expert on the method and
- the method should be compatible with other practices the organization has already used, taking advantage of organizational projects and developments prior to IC management project.

To meet these requirements, the author had certain building blocks that he knew were functioning for participative design of Information Technology systems and for getting people to participate in the design of these systems.

The author could also anticipate user-organization reactions on the "new" idea of participative decision making - that was related to participative design - as opposed to structural and hierarchical decision making, the most common practices in organizations.

The author started applying these building blocks and participative concepts in the design of Intellectual Capital systems. From the feedback he was receiving, he was improving them and applying them again. After four years of implementing this iterative development process (Alpha test), and having involved:

- more than 4,200 Organizational Participants to IC projects, employees of 35 small, medium and large companies in Mexico, Honduras and Venezuela; and

- 143 ORDIC Users

ORDIC method took its operational form.

In the subsections of this section the development of ORDIC will be described (ORDIC alpha test), covering the development of *the ORDIC philosophy*, *the Premises of ORDIC, the ORDIC process* and *the ORDIC tools*. In the following section the result of the ORDIC development - *Operational ORDIC* will be presented.

5.2.1. Developing the ORDIC Process.

As a starting point for developing the ORDIC process, the author had the process provided by ORDIT (see Figure 7), which was functional for participative design of IT systems.

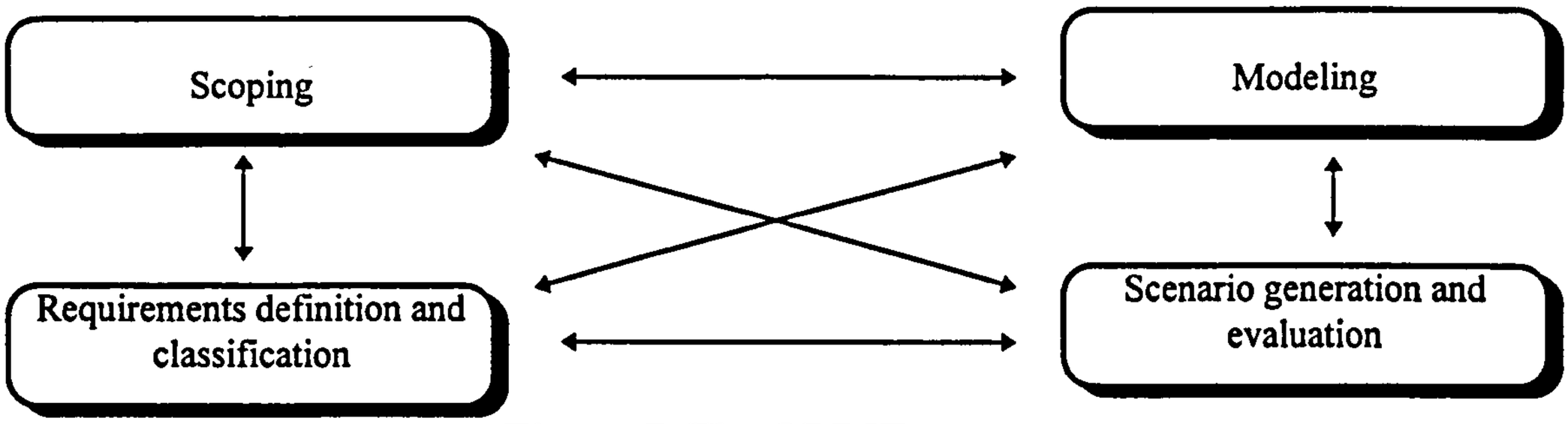

Figure 7. The ORDIT process.

Nevertheless, the author had to try it in designing participatively other kind of systems (*non IT systems*). He anticipated that something more might be required.

To validate the process, and as part of the *Alpha Test of ORDIC,* the author applied it, generated case studies, modified and/or adapted it on the basis of the feedback received. As it will be presented further on (see Figure 8), an extension of the Modeling subproceses was necessary, adding the *Inventive Problem Solving* Subproceses.

5.2.2. Developing the ORDIC Tools.

Similarly to the development of the ORDIC process, as a starting point for developing the ORDIC tools, the author had the tools provided by ORDIT, which were functional for participative design of IT systems.

Nevertheless, the tools had to be tried out in designing participatively other kind of systems (*non IT systems*). The author anticipated that something more might be required.

To validate the tools, and as part of the *Alpha Test of ORDIC* the author applied them, generated case studies, modified and/or adapted concepts and tools on the basis of the feedback received.

In order to measure the functionality of each one of the ORDIC tools and receive formal and structured feedback from the Users and Organizational Participants in order to improve the tools, the author developed five questioners, one for every ORDIC tool (see Appendices II to VI). The questioners were applied after the end of each one of the 35 Intellectual Capital Project, during the four years of the development phase. The closer responses were to the highest score (1 to 5 scale), the more functional was considered to be the ORDIC tool.

5.2.3. The ORDIC Alpha test.

The ORDIC process and tools presented in the following sections are the result of structural changes and additions the author had introduced to the original ORDIT process and tools, and the suggestions recollected during the ORDIC Alpha test.

The Alpha test was a continuous improvement ORDIC development program. It lasted for four (4) years. During this period:

- 35 intellectual capital projects were implemented; the type of companies

varied in:

⇒ size (small, medium, large companies);

⇒ industry (private, public, education, manufacturing, high tec, food and beverages, health, ecology, telecommunications, finance and construction among others) and

⇒ nationality; in Mexico, Honduras and Venezuela;

- more than 4,200 people, employees of the above mentioned companies have used the method and provided feedback; and
- 143 ORDIC Users working individually or in teams have facilitated IC projects, and provided feedback on the method.

5.3. The Operational ORDIC Method.

After four years of development ORDIC passed its Alpha test and took its operational form. The outcome of the development process includes:

- the ORDIC philosophy
- ORDIC process
- ORDIC tools
- ORDIC training tools and
- Guidelines for its implementation.

In Appendix XX is presented the outcome of the development process In the next sections of this Chapter will be presented the differences between ORDIC method and its antecesor.

5.4. Differences between ORDIC and its antecesor.

As it has already been mentioned, in order to facilitate the implementation of participative design for developing IC management systems the author developed ORDIC method as an evolution of ORDIT [Olphert and Harker, 1994].

One question that may arise could be "Since there are other participative methods for developing IT systems why only ORDIT method was used as a starting point of the development of ORDIC?" There are three main reasons for that:

As it has been mentioned in Chapter 4, ORDIT method is the result of a European R&D project. In this project different private and public entities of different European countries, representing academia and industry collaborated for five years in order to develop a method that lacks the limitations of all the other participative methods for developing IT systems. As a result, at the time that this research started ORDIT was -and to the author's knowledge it still is the state of the art in participative design of IT systems.

On the other hand, due to the success of the ORDIT project, although it was dealing primarily with computer systems development, the careful attention and concern for participation and cooperation issues in design provided a very solid basis for facilitating participative development of IC systems. Furthermore, the theoretical *analyses made during the ORDIT project were grounded in* the actual practices of *system design, and the practices were analyzed and designed in the light of a* theoretical understanding of human behavior, both individual and social.

Finally, the author, his supervisor and the director of research participated in the ORDIT project and had access to valuable experience on this kind of projects. The author has participated as a practitioner in the development of ORDIT; his supervisor, Mrs. Susan Harker was the project leader of the ORDIT project and his Director of Research, Professor Ken Eason was at the steering committee of the project.

Due to the above mentioned reasons, once the need for a participative method for implementing the Intellectual Capital management theory was clear, using ORDIT as a starting point was considered a major advantage for the development of the method. In other words, starting with ORDIT, the author had certain building blocks that he knew were functioning for participative design of IT systems and for getting people to participate in the design of this kind of systems.

As it has been presented in Chapter 4, the mutation of ORDIT to ORDIC was necessary in order to extend its focus and achieve the integration of organizational production systems, IC systems and technical systems. Comparing ORDIC with ORDIT, there is a number of differences between the two methods. These differences are classified in the following way:

- Differences in the Philosophy.
- Differences at the Premises.
- Differences in the Process.
- Differences in the Tools.

In this section the differences between the two methods will be elaborated in details.

5.4.1. Differences in the Philosophy.

ORDIC, as its antecesor ORDIT, is a set of methods for the articulation of organizational requirements by modeling future systems and exploring the implications of the different possibilities. At the heart of both ORDIC and ORDIT is a modeling language which uses *responsibility analysis* to explore the way in which different types of systems combine to achieve *cooperative tasks*. For both ORDIT and ORDIC, the underlying concept of responsibility analysis is that large tasks are achieved by assigning responsibility for different sub-tasks to members of the organization. One difference at this point is based on the focus of responsibility analysis of each method:

⇒ In ORDIT responsibility analysis focuses on the combination of Social and Technical systems and particularly Information system.

⇒ In ORDIC responsibility analysis focuses on the combination of Social, Intellectual and Technological systems.

Another difference at this point is that, although both methods recognize the fact that organizational members, in order to be able to execute their responsibilities, need to "*have access to*" resources, each method focuses on different type of resources:

⇒ ORDIT suggests that employees should have access to information appropriate to their role.

⇒ ORDIC suggests that apart from information employees should have access to skills, tools, experience, reward, appropriate to their role. Furthermore, according to ORDIC employees selection process as well as their career development should be such that will assure they will correspond not only to their job responsibilities, but also to those related to their coworkers and the organization.

5.4.2. Differences in the Premises.

ORDIC shares with ORDIT one fundamental premise:

⇒ Successful systems design is user-centered.

Nevertheless, in terms of IC management, in addition to this fundamental premise, ORDIC is based on premises related to:

⇒ *Employees learning facilitation.*

⇒ *Reward and Innovation systems.*

⇒ *Experience management mechanisms.*

5.4.3. Differences in the Process.

As a starting point for developing the ORDIC process, the author had the

process provided by ORDIT (see Figure 7), which was functional for participative design of IT systems.

As it can be appreciated in figure 8, an extension of the Modeling Subprocess was necessary, adding the *Inventive Problem Solving* Subprocess. Furthermore, the objective of Modeling has changed:

ORDIT models:

⇒ Structural and functional relationships.

⇒ Information systems.

ORDIC models:

⇒ The processes of organizational production systems.

⇒ Organizational requirements for IC management.

⇒ The processes of Intellectual Capital systems (including IT systems).

5.4.4. Differences in the Tools.

As it was already mentioned, a starting point for developing the ORDIC tools, the author had the tools provided by ORDIT, which were functional for participative design of Information systems but not for Intellectual Capital management systems. The author started applying the ORDIT tools in IC management projects during the Alpha test. As a result of this test some ORDIT tools where evolved to ORDIC tools, others were adopted but not adapted and some ORDIT tools were not used in ORDIC.

5.4.4.1. ORDIT tools that evolved to ORDIC tools.

Three ORDIT tools have evolved to ORDIC tools. The result of this evolution is the Stakeholder Analysis Table, the Functional Modeling Tool and the Socio-Intellectual-Technical (SIT) Task Representation Tool.

- ***Differences in the Stakeholder Analysis Table:*** In Figure 19a and 19b is presented an example of the improvements on the original modeling tools belonging to ORDIT methodology.

Position in the Organization	Main objectives and tasks	Principle Problems

Figure 19a. ORDIT's Stakeholders Activity Table.

Position in the Organization	Main objectives and tasks	Principle Problems	Requirements / Solution Proposals

Figure 19b. ORDIC's Stakeholders Activity Table.

In this particular example, based on the feedback provided by ORDIC users and Organizational Participants, another column was added to the original Stakeholder activity table, making the tool more participative, in the sense that users could state their suggestions as far as possible solutions to particular problems are concerned.

- ***Differences in the Functional Modeling Tool:*** In both methods the Functional Modeling Language includes three basic elements: *agent, activity* and *resources.* In ORDIT *Resources* are *Information resources,* whereas in ORDIC *Resources* are all the means an agent needs to use in order to perform an activity. These are classified in *equipment, tools, materials, financial support, information, skills* and *experience.*
- ***Differences in the Socio-Intellectual-Technical (SIT) Task Representation Tool:***

  The ORDIT Socio-Technical Representation Tool, used to model the interaction between the Social system and information system, (see Figure 13) has evolved to a flexible modeling tool that can be used to model how the social

system interacts with each one of the technological, innovation, information, experience, learning, reward, career development, evaluation, selection, or retirement system (see Figures 14 a 18). Furthermore, this ORDIC tool can model the interaction between these systems.

5.4.4.2. ORDIT tools that were adopted by ORDIC but not adapted.

The following ORDIT tools were adopted by ORDIC method.

- Sociotechnical Organization's View Tool.
- Task Analysis Tool.

Although there are no obvious structural changes in the tools, it should be kept in mind that in ORDIT these tools were used in the design of information systems whereas in ORDIC they are used to develop IC systems.

5.4.4.2. ORDIT tools that were not used by ORDIC.

The following ORDIT tools were not adopted by ORDIC method:

- Structural Analysis tool.
- Enterprise modeling tool.

These tools were considered too difficult to be used by the users at the initial stages of the ORDIC Alpha test and development. As a result it was decided to eliminate them from the initial list of ORDIC tools. Nevertheless, in the future they could be tested and possibly adapted and/or adopted by ORDIC.

5.5. Putting ORDIC into Practice.

Up to this point a problem has been defined, (*how can organizations manage their Intellectual Capital*), a theoretical solution has been proposed (*a participative and systemic approach towards the development of IC systems*) and methodology *(ORDIC)* has been developed in order to facilitate the practical implementation of the solution. The solution has passed successfully the Alpha test (was implemented successfully by its developer in a number of projects described in the corresponding case studies).

Their is though a possibility that the solution works because of the fact that its developer has been directly involved on its implementation. To increase the credibility of the solution, a *Beta test* is needed, where the solution will be tested by people other than the developer.

As a basic requirements for the design of the Beta test are considered the following:

- the solution should be implemented by others;
- the author-developer of the solution must not be involved neither directly as practitioner nor indirectly as coordinator of the practitioners in the projects;
- the author-developer of the solution can train the practitioners on the conceptual background of IC management and ORDIC method;
- the analysis and evaluation of the results achieved on the corresponding projects should include both inter and intra case study analysis, and reflect the views of both client-companies and practitioners.

In the following Chapters is going to be presented the design (Chapter 5), implementation (Chapter 6) and results (Chapter 7 and 8) of the Beta test.

CHAPTER 6.

THE ORDIC BETA TEST:
A CASE BASED APPROACH

6.1. Introduction - Antecedents for the design of the Beta-test.

In the framework of the requirements mentioned in the previous Chapter, the main objectives for the design of the Beta-test were defined as follows:

- Have others use and justify the IC management approach and ORDIC method.
- Provide the opportunity to apply ORDIC and develop case studies.
- Provide the people who put ORDIC into practice.
- Provide a training environment for Users to develop skills related to IC management and the use of ORDIC method.

In order to design the Beta test, the author used the tools of the ORDIC method. The Socio-Technical systems view of the Beta-test was modeled (see Figure 20). To achieve the goal of the Beta-test ("prove the credibility on the systemic and participative approach to IC management and of ORDIC method", the corresponding requirements had to be satisfied and a number of structural problems had to be overcome. To achieve that, the following synergies were considered:

a. The author of the thesis had access to advanced *learning* and *working know-how*, *personnel* and *technology*, related to the internet, infrastructure for satellite and cable television production, etc., available to professors of ITESM university, and members of the Center for Knowledge Systems. All these could be used to create a "virtual learning and working environment" for students (ORDIC Users).
b. The nature of the postgraduate courses the author was imparting was such that he could ask students to be involved in IC management activities.

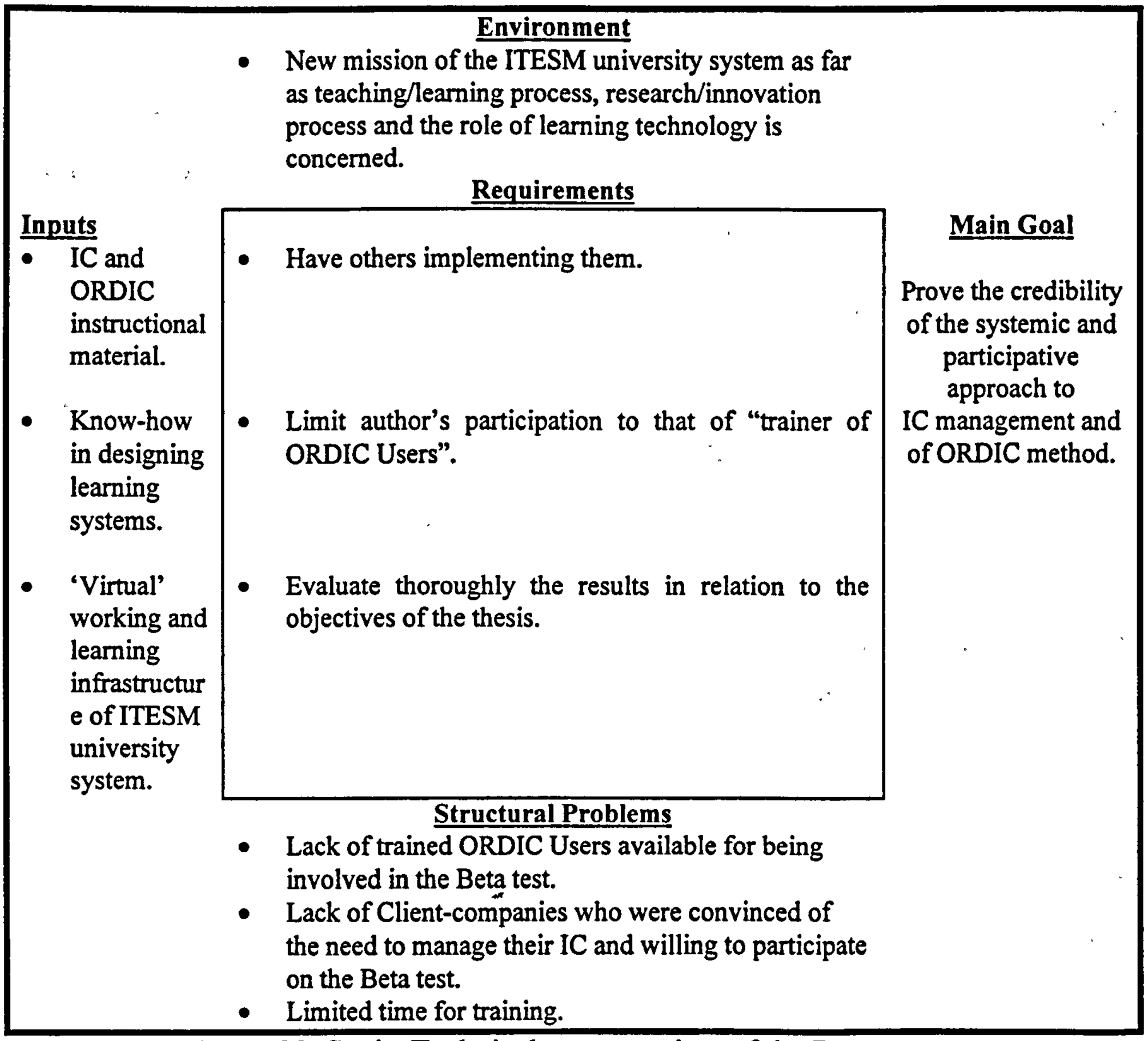

Figure 20. Socio-Technical systems view of the Beta test.

c. The new mission of the ITESM university as far as the teaching/learning process, research/innovation process and the role of learning technology is concerned, was facilitating things: redesigning completely a course, introducing innovative virtual leaning processes and supporting technology was part of a professor's job. As in all change projects, pioneers were strongly motivated.

ITESM university system is a private educational institute with 26 campuses across the Mexican territory. The recently defined mission is the outcome of a participative process that involved members of the internal and external ITESM

community. This process concluded that the ITESM university system should collaborate in the development of Mexico in four aspects: (a) job creation, (b) international competitiveness, (c) democratization and (d) the improvement of education.

To achieve these aims ITESM wishes to form persons that are (i) committed to the social, economic and political development of their community, and (ii) competitive internationally in their knowledge area. In the mission is contemplated the execution of research and technology transfer activities relevant to the development of Mexico.

To achieve its mission ITESM has defined the following strategies: (i) reengineer the teaching - learning process; (ii) re-focus the research and technology transfer activities; (iii) develop a Virtual University; (iv) internationalize itself and (v) continue implementing the "continuos improvement" process.

To achieve the objectives of the ORDIC Beta-test and taking advantage of the above mentioned synergies, the author, using ORDIC methodology, redesigned and implemented two postgraduate courses of the university:

- "Participative Working Systems" of the master in Quality Management and
- "Information Systems that Support Organizational Change" of the master in Information Technology Management.

6.2. Design of the Beta-test: development of Changeland.

Before the redesign, the learning process implemented in the above mentioned courses was very similar to that of the typical traditional "pedagogic"[1] postgraduate course, which considers the learner as an immature individual to be formed[2].

The general objective of the redesign process was to provide an environment compatible to (a) the Beta-test of ORDIC, (b) the new "andragogic"[3] learning philosophy of the ITESM which treats the learner as a mature adult who can take responsibility for his own learning, and (c) the knowledge based economy.

As a result of the redesign process was developed "Changeland": a participative environment for research development, technology transfer and andragogic learning. In this environment students (ORDIC Users), who formally attend the above mentioned postgraduate courses, developed skills of IC management, participation, collaboration and working in teams, through the implementation of knowledge based innovation mediated processes of production of intellectual services in the specific knowledge areas of each course. The above was achieved through the implementation of participative systems,

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[1] The word Pedagogic is a Greek composite word which means "guide children" (*paidi* means *child; agogo* means *guide*). Generally speaking, in the "pedagogic" type of education, the role of the professor is proactive (he is the one who can take initiatives and influence students learning), and of primary importance (i.e. if the professor is not present in the class, no learning takes place there). On the other hand, the role of the student is reactive (he does as he is told), and of secondary importance (he is not considered capable of contributing to other students learning). Furthermore, students, in order to learn, they have to be at the same physical place with the professor and/or their team members. Not to mention that students usually dislike team projects due to the fact that there is no formal mechanism for evaluating individual contributions on team projects, provoking the incorrect assignment of the same reward (grade) to team members whose level of contribution in team's results was radically different.

[2] In this course the professor was the one defining what was to be learned by the students, transmitting his knowledge, asking students to memorise it, and evaluating the result of this process through an exam. In general terms, exams were meant (i) to make sure that students have learned (memorised) at theoretical level what the professor shared with them during the semester and/or (ii) to be used as an instrument for punishing students because they did not do as they were supposed to.

were students had to have (a) the initiative for learning by doing, (b) the initiative for contributing in the learning and development of others and (c) the initiative for co-evolving. In this section the socioeconomic structure and the participative working systems of Changeland will be described.

6.2.1. Socioeconomic structure of Changeland.

The fundamental elements for the design and development of Changeland were considered the following: (a) the extinction of the social structure of Hierarchical Corporation and (b) the birth of the social structure of Value Community. In terms of the ***Socioeconomic Structure of Changeland*** the different organizational entities in Changeland were the following (see Figure 21):

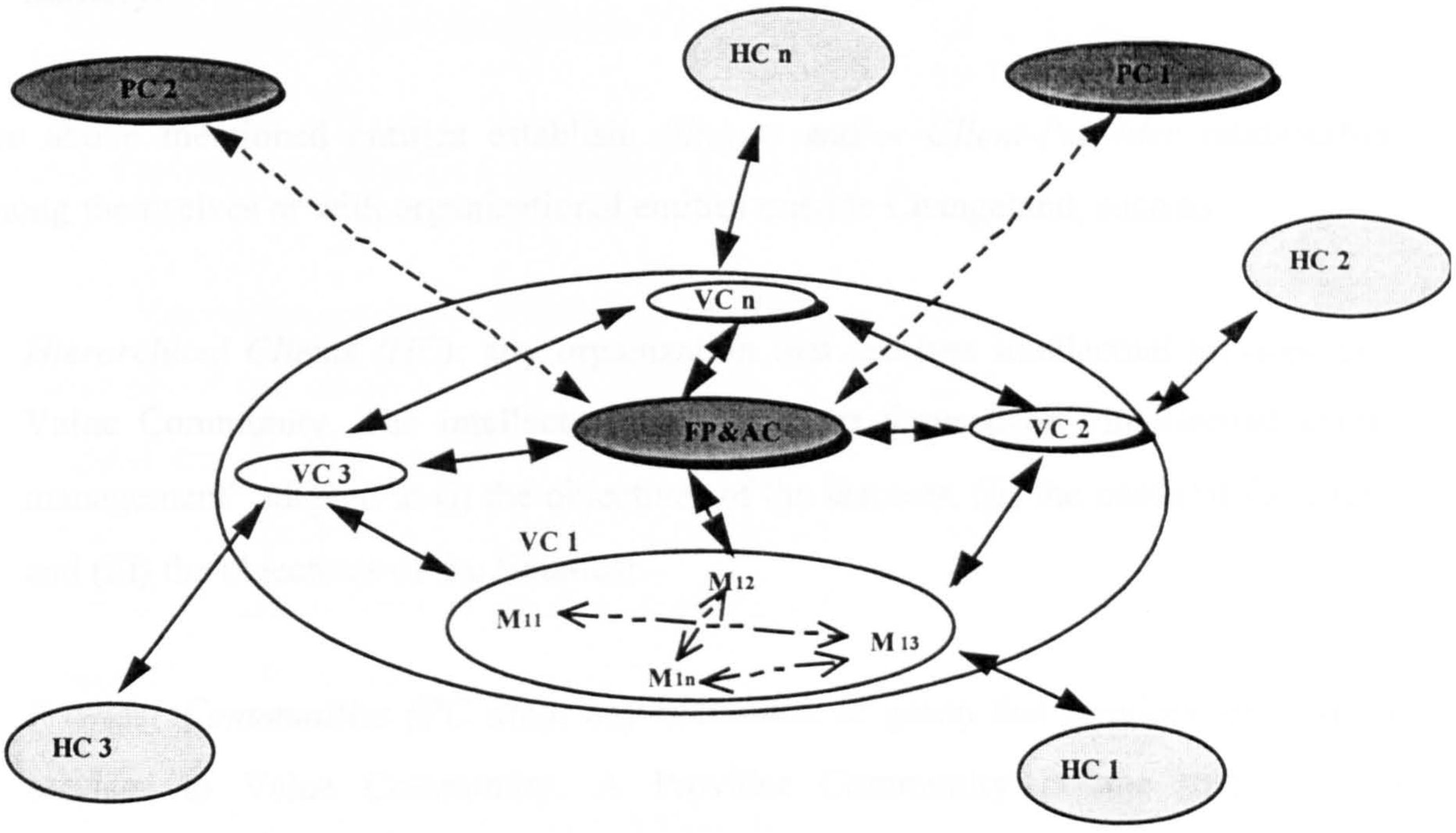

Figure 21. The socioeconomic structure of Changeland.

(dashed lines represent **Intra** relations between members of a VC; small circles correspond to the different communities; lines represent **Inter** relations between entities of Changeland; dotted lines represent **Exo** relations between communities of Changeland and external communities).

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[3] Andragogic in Greek means "guide mature people" (*andras* means *mature man; agogo* means *guide*).

- *Value Community (VC Inc.)*: is a group of students (ORDIC Users) who voluntarily decide to form a virtual team (there are no two members of each Value Community physically located at the same place); operates as an independent company, is self-governed, selects voluntarily its provider and allied communities as well as its client(s); is rewarded according to the contributions and services it provides to its clients at intra, inter and exo level.
- *Individual Member* of a Value Community: postgraduate student of the ITESM university system (ORDIC User) located in different cities, in Mexican and/or foreign territory.

The above mentioned entities establish *Alliance* and/or *Client-Provider* relationships among themselves or with organizational entities outside Changeland, such as:

- *Hierarchical Clients (HC)*: any organization that receives intellectual services by a Value Community. The intellectual services were focused on "intellectual capital management" adapted to (i) the objectives of the learners, (ii) the needs of the clients and (iii) the objectives of the Beta-test.

- *Provider Communities (PC Inc.)*: any individual or group that provides any kind of services to Value Community. A Provider Community is one that provides satisfactors to the Value Communities. These satisfactors are knowledge and experience which is shared through seminars or consulting sessions, which can be live or videotaped, on subjects related to the services that a Value Community offers to its clients. Provider Communities are evaluated and rewarded by their clients (Value Communities) according to the service they provide to them (value they add on the effort of Value Communities to achieve their goals). A specialized module of the Changeland's evaluation system is designed for this purpose.

The establishment of these relationships is based on the activities performed by Value Community and their members. These activities include the implementation of:

a. a ***participative Technology Transfer system,*** focused in providing to clients consulting services related to IC management;
b. a ***participative Research and Development system*** (R&D) focused on the customization of the IC management technology to be transferred to clients;
c. a ***participative Learning system*** focused on developing the necessary skills to the Value Communities and their members (ORDIC Users) for implementing the above mentioned systems;
d. a ***participative Evaluation and Reward system*** tailor-made to the Research and Development, Technology Transfer and Learning activities performed by Value Communities and their members in Changeland.

6.2.2. Participative Working Systems in Changeland.

The implementation of Participative Working Systems in Changeland implies the execution of the above mentioned activities, as well as the evaluation of the results obtained and the way that they were obtained. In Figure 22 is presented the Socio-Intellectual-Technical view of the participative working systems of Changeland. In order to provide a clearer view of the design of the ORDIC Beta-test, in the following, each system will be described.

6.2.2.1. Participative Technology Transfer system.

Each Value Community should contact a number of companies (Hierarchical Client candidates), offering them consulting services in IC management. Once an agreement was established between the Value Community and a client, the activities defined in *the IC management Process* were performed. Furthermore, there were designed the strategies that would *make the client self-sufficient in implementing these activities.*

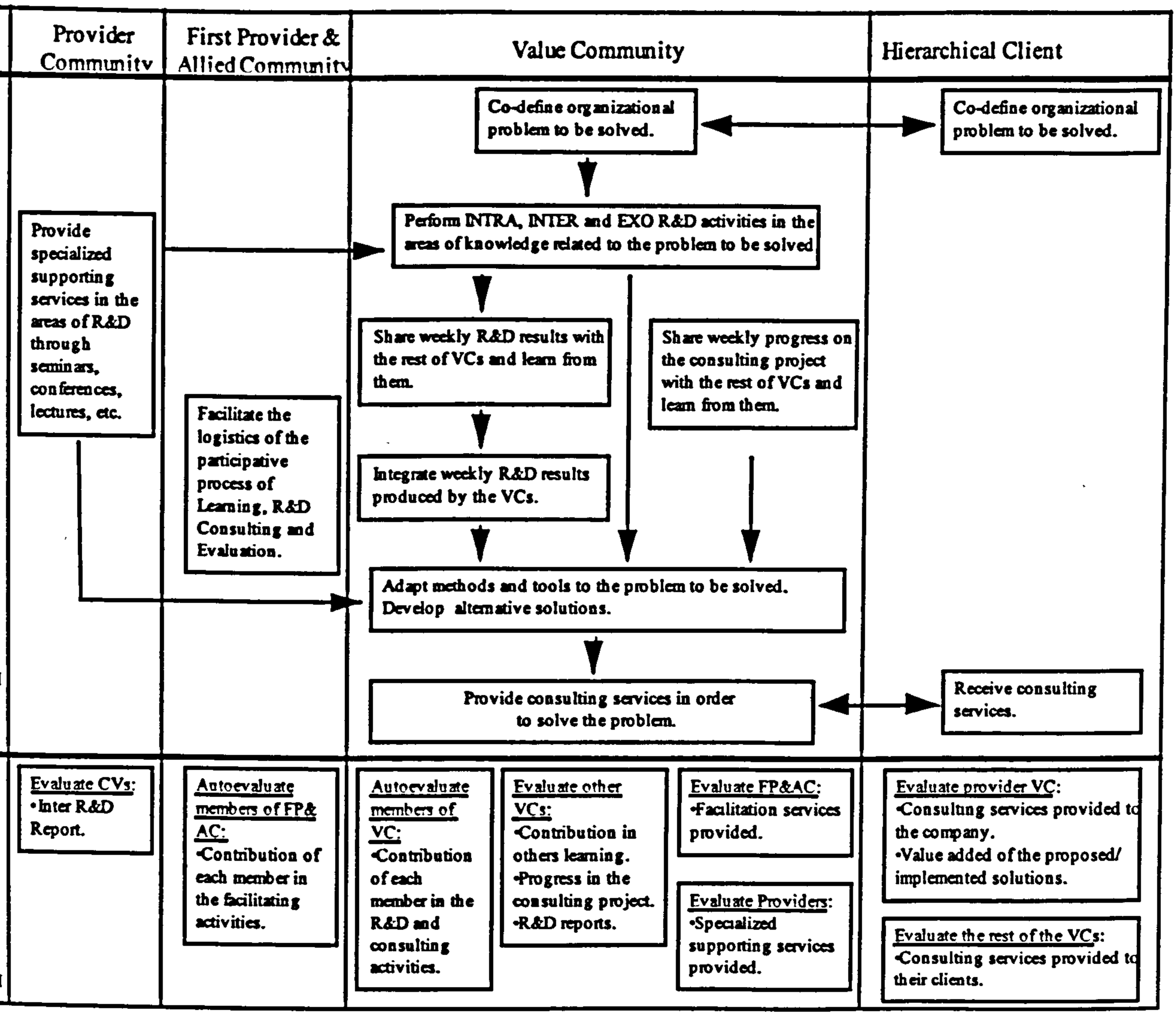

Figure 22. The Socio-Intellectual-Technical view of the participative working systems of Changeland.

All the above was performed collaboratively, between Value Community and the Client, with selective support from Allied Communities (ACs Inc.) and/or Provider Communities. In other words, members of Value Community would collaborate with members of the Client in order to bring about the project and provide the corresponding service.

Every two weeks each Value Community should make a formal presentation to

the Allied Communities (other Value Communities) on the progress of the IC project. In this way each Value Community could receive feedback and be evaluated by Allied Communities. On the other hand, each Value Community would contribute to the learning process of the rest of the communities by sharing with them its knowledge and experience on *IC management* and *the use of ORDIC method*, developed through the execution of the project *(Participative Learning system)*. At the end of the project each of the Value Communities would also be evaluated by its Client company, based on the services provided.

6.2.2.2. Participative Research and Development system.

Each Value Community, in order to satisfy the needs of its client, should develop the appropriate skills as well as customize the IC management technology that were going to be transferred. To achieve that, each Value Community had to perform individually and in collaboration with all other Value Communities in Changeland, Research and Development in the corresponding field of knowledge. The general research and development activities are presented in Figure 23. The distribution of the specific Research and Development activities between the social and technical system, as well as among the Stakeholders of the social system, is presented in the Socio-Intellectual-Technical view of the R&D system (see Figure 24).

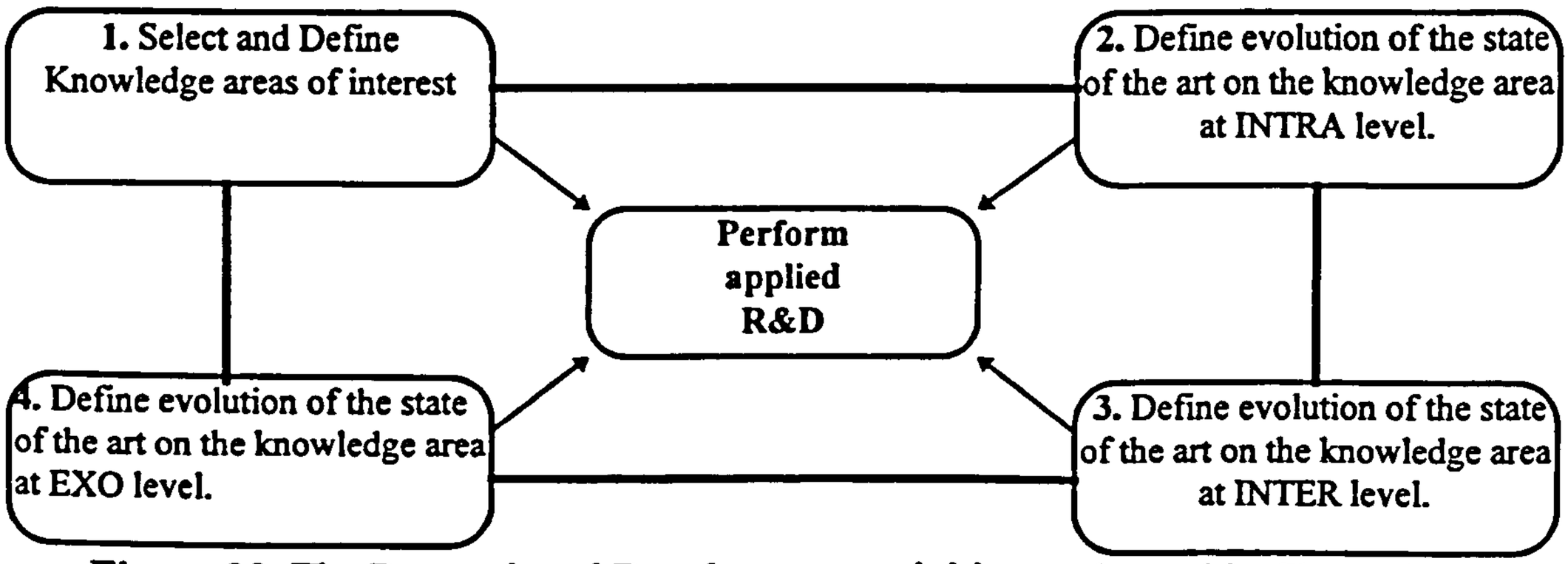

Figure 23. The Research and Development activities performed in Changeland.

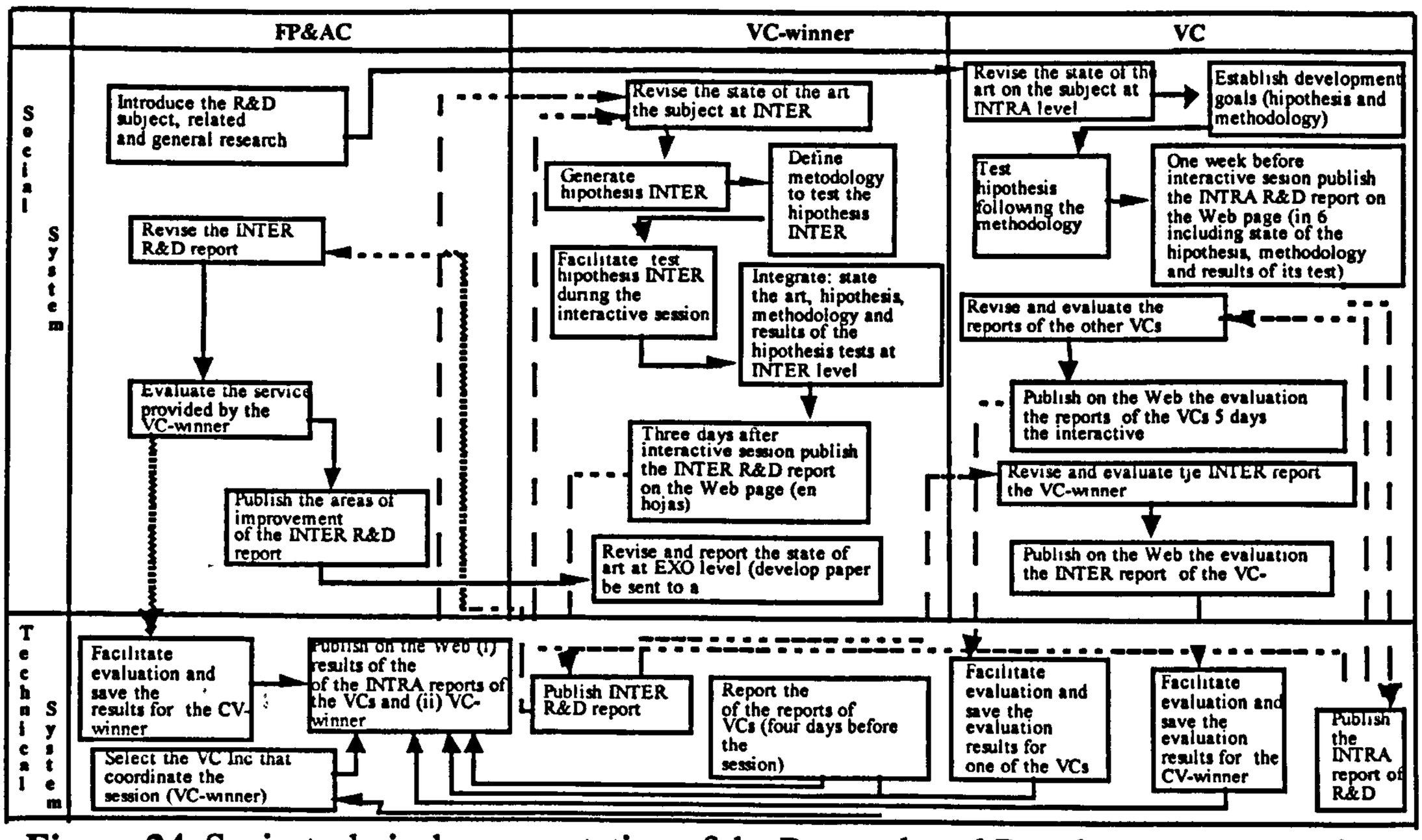

Figure 24. Socio-technical representation of the Research and Development process in Changeland.

The specific topics of research were defined and published on the Web page of the post-graduate course by the First Provider and Allied Community (FP&AC Inc.)[4]. The specific activities in the Research and Development system were performed in a participative way:

- Initially, *within* the members of each Value Community (INTRA level).

[4] The mission of the First Provider and Allied Community, is to collaborate with the Value Communities and facilitate the implementation of the Research and Development, Technology Transfer, Learning and Evaluation participative systems in Changeland. The First Provider and Allied Community has seven members: *President and Chief Executive Officer* (the professor of the course), *Assistant of the President, Instructional Designer, TV Producer, Webmaster, Graphics Designer* and *Institutional Communicator*. The First Provider and Allied Community provides its services to all Value Communities, represents them in the establishment of contractual relationships with hierarchical providers, co-designs, develops and establishes general policies of Changeland, and facilitates their implementation. Furthermore, develops and manages the supporting technology for all the activities performed in Changeland, co-ordinates television production, video-conferencing, information technology, telecommunications and Wold Wide Web support, institutional communication and specialised consulting. For each one of these services the members of the First Provider and Allied Community, individually and as a team are evaluated by their clients (Value Communities) through a specially designed module of Changeland's participative evaluation system (see Figure 23).

- Later, *between* all Value Communities (INTER level), coordinated by the Value Community who had the best results at INTRA level (VC- winner), and finally *between* the winning Value Community and the FP&AC (EXO level).

6.2.2.3. Participative Evaluation and Reward System.

The key system that made the IC Beta-test possible and the above mentioned systems work, was the participative evaluation system (see Figure 25). The design of this system was based on the analysis of the activities that Value Communities and individual members (ORDIC Users) perform at INTRA, INTER and EXO level, and the definition of the corresponding evaluation criteria and evaluators. This system, being compatible and aligned to the virtual nature of the Beta-test, was implemented on the Web.

6.2.3. Technology used on the ORDIC Beta-test.

The supporting technology used to perform the Beta-test - that facilitated Intra, Inter and Exo communication, implementation of the corresponding participative working systems, development of the technology and providing the services - included the following: (i) SIR - Remote Interaction System (in-house communication system developed by ITESM's Virtual University), (ii) internet (electronic mail, web pages, chat, discussion groups), (iii) synchronous and asynchronous satellite telecommunication, (iv) telephone and fax, (v) video-conference, and (vi) the One Touch interaction system.

6.2.4. Setting up the ORDIC Beta-test.

During the first semester of 1997 Changeland had 58 members (students of the ITESM attending the Participative Working Systems postgraduate course). They were located in 19 different cities in the Mexican territory, forming 10 Value Communities (VC Inc.). These communities, working as independent companies, provided Intellectual Capital Management services to 10 client companies of different sizes and industrial sectors, all of them located in different Mexican states.

To provide these services each Value Community established learning relationships with different entities. These relationships were basically of two types: (i) **alliances** with other Value Communities and the First Provider and Allied Community and (ii) **client-provider** relationships in order to receive specialized services by Provider Communities (PC Inc.)[5].

[5] Based on the client-provider relationships, eleven experts (Provider Communities) in different knowledge areas were either interviewed or invited to give a seminar in Changeland. Seminars and interviews were videotaped and transmitted via satellite to the members of Value Communities. In turn the quality of service provided by Provider Communities was evaluated by Value Communities rewarding them accordingly.

6.3. Case Research - Data gathering.

This section describes the sources of data that were initially considered, and the tools through which these data was collected (questionnaires). These were generated from the different case study sites.

6.3.1. Data sources.

Before the execution of the Beta-test, two types of results were considered related to the IC projects on the case studies: *Company results* and *Users results*. In order to define the *evaluators* of the implementation of IC management approach and ORDIC (evaluators were considered to be the *sources of data* for the research), the following actions were taken:

First, the author identified the main Stakeholders of the projects. These were:

- Companies - Hierarchical Clients of the Value Communities;
- Company Employees and
- ITESM's Students - ORDIC Users members of the Value Communities.

The general focus of the evaluations were:

i. the administrative theory of Intellectual Capital management

ii. the technology for managing Intellectual Capital.

Each stakeholder was linked to specific project elements that he could evaluate based on his participation in the IC project and the type of project results:

- Companies were linked to any change that occurred to the organization or organizational unit as a result of the IC management project (evaluation of (i)).
- Employees were linked to and could evaluate the functionality of ORDIC method,

from the point of view of the user of the tools (evaluation of (ii)).

- ITESM's Students were linked to and could evaluate the functionality of ORDIC method, but from the point of view of the User of the tools (evaluation of (ii)).

6.3.2. Questionnaires.

To gather the data from the sources, two questionnaires were used:

- the Socio-Technical systems questionnaire (see Appendix I), in order to measure validity and effectiveness of the administrative theory of Intellectual Capital management and
- the ORDIC tools questionnaires (see Appendices II), in order to measure the effectiveness of the technology for managing Intellectual Capital.

As it can will be appreciated, these questionnaires do not provide "direct" and "objective" measures of the improvement in Intellectual Capital management on the companies involved in the Beta-test. Such measures could be, for example, any measurable change on medium o long-term business results. Two reasons obligated the author not to use such measures:

i. All Beta-test's IC projects were performed by post graduate students (not by the author), something that limited the author's control and access both to the client-companies and the final results of the projects.

ii. The time available for performing the projects of the Beta-test and performing the evaluation was very limited (six months) in order to make evident changes on business results.

6.3.2.1. The Socio-Technical systems questionnaire (generates Ad Hoc and Post Hoc data).

The Socio-Technical systems questionnaire was designed by Pasmore [1988]. The original objective of this questionnaire, as defined by Pasmore, is to measure the grade

according to which the design of the organization is consistent with the principles of the sociotechnical systems theory. As far as the framework of this thesis is concerned, the questionnaire, because of its design, was considered by the author to be appropriate for *measuring the general impact to organizations of the Systemic and Participative approach to IC management*. It was translated in Spanish by the author in order to be applied to the Spanish-speaking employees of organizations located in Latin America. To assure consistency between English and Spanish versions, a third party translated the questionnaire back to English.

The questionnaire measures six dimensions of the design of Sociotechnical systems:

- ***Innovation***: The extent to which organizational leaders and members maintain a futuristic versus historical orientation; their propensity for risk taking; rewards for innovation.
- ***Human Resources Development***: The extent to which the talents, knowledge and skills of organizational members are developed and tapped; work design; supervisory roles; organizational structure; workflow structure.
- ***Environmental Agility***: The extend to which organization maintains awareness of the environment and responds appropriately to it; customer importance; pro-activity vs. reactivity; structural flexibility; technical flexibility; product-service flexibility.
- ***Co-operation***: The extend to which individuals and sub units work together to accomplish goals; teamwork; mutual support; share values; common rewards.
- ***Compromise/Energy***: The extend to which organizational members are dedicated to accomplishing organizational goals and are prepared to expend energy in doing so; reward systems; information availability.
- ***Joint optimization***: The extent to which organization is designed to use both its social and technical resources effectively; variance control; the appropriateness of technology; the extent to which technology is designed to support teamwork, flexibility and changes in organizational structure.

Every dimension is measured through different questions. Due to the fact that organizations are unique in terms of their history, objectives, social systems, technical systems and environment, not all the questions have to be applied to all organizations; neither being the highest in the scale is the ideal for every case. Generally speaking, the closer an organization gets to the higher score of each question (5 on a five point scale), the more compatible it is with the principles of Sociotechnical systems design.

This questionnaire was applied before and after the IC management intervention to produce Ad and Post Hoc data.

6.3.2.2. The ORDIC tools questionnaires (generates Post Hoc data).

The author designed the ORDIC tools questionnaires. They were translated in Spanish in order to be applied to the Spanish-speaking employees of organizations located in Latin America. To assure consistency between the two versions of the questionnaires, a third party translated it back to English.

The objective of these questionnaires is:

a. To measure the extent to which each one of the ORDIC tools facilitates the participative design of the IC systems. To achieve this the questionnaires measure seven dimensions:
   - ***Background of the user*:** general knowledge and experience; familiarity with design methods.
   - ***Purpose for using the tools.***
   - ***Familiarity with the tools:*** how long ago was the last time the user used each specific tool; for how long did the user use the tool; how well he remembers the particular elements of the tools.
   - ***Learning to use the tools*:** grade of difficulty for learning how to use the tools; length of training required.
   - ***Design of IC systems:*** the extent to which each tool supports representation and understanding of the work flow of activities and problems identification related to

actual work flow of activities.

- ***Participation***: the extent to which each tool supports in presenting and proposing solutions to problems related to work activities and flow; facilitates interdisciplinary communication (i.e. between the Organizational Participants and ORDIC User).
- ***User acceptance and commitment to the tools***: whether the user would recommend the tools to someone else and/or would use it again.

Every dimension is measured through different questions. Generally, the closer a tool gets to the higher score of each question (5 on a five point scale), the more appropriate it is for the participative development of IC management systems.

b. To provide feedback from the users in order to improve the tools. The tools presented in Chapter 4 are the result of the implementation of the suggestions collected during four years, before the Beta-test, by:
   - more than 4,200 Organizational Participants, employees of 35 small, medium and large companies in Mexico, Honduras and Venezuela; and
   - 143 ORDIC Users.

In the following section it will be presented the way in which the data collected through the Sociotechnical systems questionnaire and the ORDIC questionnaires was planned to be analyzed. Nevertheless, as it will be seen, through this analysis additional data appeared and was incorporated to the research.

6.4. Data Analysis.

Once the data sources and the data collection instruments were defined, the type of data analysis was determined. Initially, only two types of analysis were considered:

- ***Inter case study analysis*:** evaluation of the systemic and participative approach to IC management and ORDIC, based on the data at macro level (10 case studies of the Beta-test);
- ***Intra case study analysis*:** detailed analysis of selected case studies.

As it has been already mentioned, once completed the Beta-test, the results of the IC management projects provided additional data. Based on this data an ***analysis and evaluation of the results of the case studies*** was incorporated to the research method. Following the three types of analysis will be elaborated.

6.4.1. Inter Case Study Analysis.

This analysis was based on the overall data provided by the application of the questionnaires to all 10 case studies of the Beta-test.

6.4.1.1. Sociotechnical systems questionnaire.

This questionnaire was applied *before* and *after* the IC project, generating Ad Hoc and Post Hoc data. The members of the organization or organizational unit that participated in the project answered the 100 questions of the questionnaire.

The analysis of any differences between the Post hoc and Ad hoc responses of the total of the people who have participated in IC management projects of the Beta-test, is considered to represent objective conclusions on the effectiveness of the systemic and participative approach to IC management.

6.4.1.2. ORDIC tools questionnaires.

These questionnaires were applied *after* the IC project, generating Post Hoc data. The members of the organization or organizational unit that participated in the project and used the ORDIC tools answered the questionnaires.

The selection and use of particular ORDIC tools in the case studies was based on the decision of the people involved in the project and their particular needs. As a result, not all ORDIC tools were used in all IC management projects.

The analysis of the responses of the total of the people who have participated in IC management projects of the Beta-test, is considered to represent objective conclusions on the effectiveness of the ORDIC method.

6.4.2. Evaluation of the application of the Socio-Intellectual-Technological approach and ORDIC according to the outcomes of the case studies.

After the end of the Changeland experiment a number of additional results were generated. This provided an additional source of material for an evaluation, which was incorporated to the research method. Two mechanisms were used to gather the data for this analysis:

- On site observation reports.
- Feedback received from organizational participants and ORDIC users.

Criteria relating to these *outcomes of Changeland were **classified*** in the following way:

a. Results at Company level:
   - *Project Expansion*: Evidence for this would be any positive results of the project initiated in Changeland which gave confidence to client companies to continue with the project after the end of the corresponding postgraduate course. Project

expansion could take different shapes: either *intra-company* (inside the same company) or *inter-company* (inside the same consortium of companies) or *exo-company* (to other companies after been recommended from Changeland clients).

- *ORDIC penetration to organizational culture*: Evidence for this would be any observation that organizational participants continued using ORDIC tools, in their everyday working activities, even after the end of the Changeland projects. ORDIC penetration to organizational culture could take different shapes: (i) having colleagues of Changeland participants learning from them to use the tools and apply them in their everyday activities also; (ii) having companies which have formally complemented their strategic planning and communication mechanisms with ORDIC tools; (iii) having companies asking there Information Services departments to start evaluating ways for developing computer based ORDIC tools.
- *Acceptance of the concepts of IC management*: Evidence for this would be any observation having participants of the IC projects demonstrating their interest in working part time as ORDIC Users and/or joining the Virtual Center of Intellectual Capital management (CVACI).

a. Results at ORDIC Users level:

- *Acceptance of the concepts of IC management*: What did ORDIC Users (students) do after the end of Changeland? Evidence for this would be any observation of (i) having ORDIC Users start using ORDIC tools in their day to day working activities; (ii) having ORDIC Users initiating IC projects in the companies were they are working; (ii) having ORDIC Users becoming members of the CVACI and participate in collaborative consulting projects and/or perform further research and development on IC management.

The subjective analysis and evaluation of the IC management projects of the Beta-test is going to provide additional conclusions on the effectiveness of the ORDIC method and the participative and systemic approach to IC management.

6.4.3. Intra Case Study Analysis.

The main reasons for performing this type of analysis are the following:

- To present in a more detailed and understandable way how the Socio-Intellectual-Technical, systemic and participative IC management approach can be implemented.
- To understand the way ORDIC is used in detail.
- Since analysis at macro level is not sufficiently sensitive, to provide additional evidence of participative development of systems to manage IC.

To perform the Intra case study analysis the following actions were taken: having access to student, ORDIC-Users products (project reports and material) and with the permission from ORDIC-Users and client companies, the author of this thesis developed the corresponding case studies. In each case study is described how the collaboration between client company and ORDIC Users was organized; what tools were used; what IC systems were developed; what artifacts were used; the order in which things were done as well as the conclusions of the project.

In the next Chapter some of the case studies will be presented in detail. The reasons for picking up these case studies are:

- The selected case studies focus in different aspects of IC systems development (present the development of different systems).
- They show different roots on the way ORDIC can be used.
- Not all case studies have reached the same level of IC development; in some of them specific IC systems were developed and implemented while in the Changeland environment; in other projects, although IC needs were identified, development and implementation were part of the expansion of the project, after the end of the Beta-test.
- all case studies start from different levels on the Macro Questionnaire analysis results (S-T and ORDIC);

Seven out of the ten case studies meet all the above mentioned requirements and could be presented. Nevertheless, disclosure agreements permit the detailed publication of two case studies. These case studies will be presented as specific examples of the application of the ORDIC tools.

In the following two Chapters (Chapter 7 and 8) the results of the Data Analysis of the Beta-test will be presented. The discussion of the results will be presented in the last Chapter (Chapter 9).

CHAPTER 7.

ORDIC APPLICATION IN INTELLECTUAL CAPITAL MANAGEMENT PROJECTS.

7.1. Antecedents.

One of the key aims of ORDIC in addition to supporting IC systems design is for it to be applicable in a range of different design contexts and organizational cultures. The results of the Beta test of the method and IC management approach presented in this and the next Chapter illustrate the diversity of problems that ORDIC can be applied to.

This Chapter outlines 10 case studies to illustrate the use of ORDIC in different organizational contexts for designing IC systems and managing change. All these case studies are examples from consulting work carried out by postgraduate students as part of the learning activities included to the virtual course "Participative Working Systems". The course was designed and implemented by the author of this thesis during the first semester of 1997. In this Chapter are also presented the overall results of the Beta test. In the next Chapter is presented a detailed description of two case studies in order to show different potential "routes" through the Socio-intellectual-technological process to IC management and the ORDIC process.

7.2. Analysis of 10 Changeland Case studies.

For companies to be considered candidates for participating in the Beta test there were specific requirements they should meet. These were:

(i) The project should be concluded within a 6-month timeframe. In this period not only should take place the *analysis of IC needs* and *the design of corresponding systems* to meet them but also the *implementation* of these systems. Meeting this requirement was the objective of the initial scoping activities of the project.

(ii) The commitment of the company to the success of the IC management project. At the beginning of the project a letter of commitment from a powerful representative of the company was required. This was sent to the organizer of the post-graduate course.

(iii) The organizational need should be compatible with the objectives of the postgraduate course *and* aligned to the objectives of the Beta test.

During the first two weeks of the semester, ORDIC Users looked for "Hierarchical Clients" either in the companies in which they were working or in those in which they had contacts. The companies that met the above mentioned requirements and participated in the Beta test were: **Hewlett Packard** (computers), **CEMEX** (cement), **SUPERMATIC** (electro-domestic appliances), **Telmex** (Tele-communications), **CERVECERÍA SUPERIOR** (beer and refreshments), **SIGMA** (frozen food), **Bancomer** (financial and banking services), **Hazardous Residues Laboratory** (analytical services), **DRAW TITE** (automotive electrical appliances) and **KREARTON** (paper packaging), all of them located in different Mexican states.

In this section is presented an overview of:

- the configuration and form of operation of the teams of ORDIC Users (Value Communities) and Organizational Participants involved in the IC management project;
- an overview of the technology used to facilitate collaboration among ORDIC Users

and /or Organizational Participants; and

- an overview of the 10 intellectual capital management project.

7.2.1. Configuration and form of operation of the teams.

As has already been mentioned, postgraduate students of the ITESM University system formed the teams of ORDIC Users. Each team was designed as an independent company (Value Community Inc.) with a virtual structure and members located in 19 different cities in the Mexican territory. The members of each Value Community Inc. (VC Inc.) contacted a number of companies (Hierarchical Client candidates) located in their home cities, offering them consulting services in IC management. Once an agreement was established between the VC Inc. and a client, the activities defined in *the IC management Process* were performed. Furthermore, the strategies were designed that would *make the client self-sufficient in implementing these activities*. Both, ORDIC Users and Organizational Participants had access to IC management theory and ORDIC training material through the corresponding Web pages. Collaboration was implemented in real and virtual sessions between:

- the local representative of the VC Inc. and the Organizational Participants of the corresponding Hierarchical Client;
- the members of the VC Inc. and Organizational Participants in virtual sessions, using internet technology;
- the members of the VC Inc. and Organizational Participants with the support of Allied Communities (AC) and/or Provider Communities in virtual sessions, using internet technology;
- the members of the VC Inc. in virtual sessions; when necessary Allied Communities (AC) and/or Provider Communities were also invited.

7.2.2. Overview of the technology used in the projects.

The technology used in the IC projects during the Beta test is classified in the following way:

- Technology to support collaboration between ORDIC Users.
- Technology used to support collaboration between ORDIC Users & Organizational Participants.

7.2.2.1. Technology to support collaboration between ORDIC Users.

To facilitate virtual collaboration between ORDIC Users, members of VCs had access to various different types of technology. This included:

- Internet (electronic mail, web pages, chat, discussion groups). Due to the virtual nature of Value Communities the Internet was used as the main intra and inter VC Inc. communication medium. ORDIC Users used different internet tools to discuss alternative approaches to the solution of the client's problem, agree on the strategy to follow on the projects, exchange documentation that supported there ideas, distribute activities and share there experience through publications of their results on the web.
- Synchronous, asynchronous satellite telecommunication and Video conference. This type of technology was used once every two weeks. Each VC Inc. was presenting the progress on its project to the rest of the communities with the objective to share its experience and receive feedback from them.
- SIR - Remote Interaction System. This in-house communication system developed by ITESM´s Virtual University was used to support asynchronous communication during the satellite sessions.
- Telephone and fax. These communication mediums were used when links to the Internet were not functioning for some reason.
- The One Touch interaction system. This tool was mainly used to support inter community evaluation and feedback in relation to the progress of the projects and the research essays that its VC Inc. was developing and sharing weekly with the rest of the communities.

7.2.2.2 Technology used to support collaboration between ORDIC Users & Organizational Participants.

The type of technology used to support collaboration between VCs and Organizational Participants was mainly determined by the Client Company, depending on availability of infrastructure and corresponding skills. For example in some of the projects Organizational Participants were accustomed to use the Internet (i.e. with Hewlett Packard). In these projects ORDIC Users and Organizational Participants were exchanging documents and making appointments through electronic mail messages, and/or had virtual meetings through tools such as discussion groups. On the other hand, in projects were Organizational Participants did not have access to Internet tools, documents interchange and appointment agreements were done through fax and telephone accordingly. In these cases meetings were "real" rather than virtual with ORDIC Users participating through their local representative.

7.2.3. Overview of the 10 IC management project.

As it has been already mentioned, one of the key aims of ORDIC is for it to be applicable to a range of different organizational problems and different design contexts, organizational structures and cultures. To illustrate different organizational problems and design contexts this section outlines the 10 case studies performed during the Beta test of the Socio-intellectual-technological approach to IC management and ORDIC method. In Chapter 8 two case studies will be presented in more detail, in order to show different potential "routes" through the process of IC management and the use of ORDIC tools.

7.2.3.1. Quality Assurance Division of Hewlett Packard.

The plant of Hewlett Packard (HP) in Mexico is located in the city of Guadalajara, state of Jalisco. The problem this organizational unit was facing was related to the overload of information generated by client feedback. On the problems they were facing the VC Inc. was invited by HP's representative Mr. Castañeda to collaborate with the Client Satisfaction Department of this Division and develop mechanisms for managing

information effectively. The aim was to translate information into a true source for improving HP's products and services. Initially ORDIC Users together with Organizational Participants designed the *Information Flow Model* - a model that expresses the relation that exists between the *information concepts* of HP's clients and the *quality* of products and services provided by the company. Based on this model, the team designed and implemented a system that classifies and evaluates information. This system is considered as part of the *experience management system*, helping HP respond efficiently and effectively to problem reports, as well as to anticipate client needs for future development.

7.2.3.2. CEMEX.

CEMEX is one of the largest cement producers in the world, with factories in Latin America, Europe and Asia. To facilitate inter - factory knowledge transfer and provide the platform for innovation and increased competitiveness, CEMEX has created virtual teams denominated "Technology Groups". These Groups are integrated by members located in different factories, having as their main objective to document and share best practices and/or problem solutions developed in each factory. The ORDIC Users were invited to support the implementation of "Technology Groups" in the Mexican factories, and provide alternatives for resolving the resistance of Group members to share their knowledge and experience. This was achieved (i) providing experience management tools and (ii) facilitating the design of appropriate learning and incentive systems to motivate Technology Group members to participate actively in activities of experience transfer.

7.3.2.3. SUPERMATIC.

SUPERMATIC is one of the companies of the Vitro international consortium and an ally of The Whirlpool Corporation. The company is located outside of the city of Monterrey, state of Nuevo Leon, and develops electric appliances for households (i.e. refrigerators). During the first semester of 1997 a high investment project called *Factory Master Plan (FMP)* was in progress, contemplating the implementation of *Just-In-Time*

and *Total-Preventive-Maintenance* concepts. The ORDIC team was asked to collaborate with the Department of Organizational Effectiveness and propose alternative solutions on the main concerns of the company: (i) specialized and short duration training for the employees involved in the FMP project; and (ii) intellectual capital leakage -the shift of employees that participate in the project to other companies due to job dissatisfaction. The solutions proposed included customized training programs and an experience management system. Furthermore, the conceptual basis of the evaluation and reward mechanisms were analyzed providing insights to their improvement, in order to motivate employees not to leave the company.

7.3.2.4. Telmex-LADA.

Telmex-LADA is the Division of long distance services of the Mexican Telecommunications Company. At the time of the Beta-test, due to the recent application in Mexico of a new anti-monopoly law concerning telecommunication services, this Division was facing strong competition from various international companies, including AT&T and MCI, among others. This competition was based on the quality of service rather than on price or technological infrastructure. The ORDIC Users were invited to provide tools and techniques that facilitate participative decision making, strategic planning and utilization of the intellectual resources of the company. The main objective was (i) to reduce the training period employees needed to catch up with the latest technological developments in the field, (ii) to help employees transfer the new skills to their job quickly and (iii) provide a high standard of service to their clients, in order to remain in the Mexican market. The members of the VC Inc. collaborated with the managers of Telmex-LADA in the development of the strategic plans to achieve the above mentioned objectives.

7.3.2.5. CERVECERÍA SUPERIOR Brewery.

This company, which is located in the city of Guadalajara, state of Jalisco, has recently gone through a Total Quality management and ISO certification project. Nevertheless, there was still evidence of conflicts, lack of employee motivation, lack of

inter-personal communication as well as problems in planning, organizing and team integration. The objectives of the IC project included: (i) achieve a change of culture in the Quality Assurance Department of the company, towards a more participative one; (ii) improve teamwork and communication; (iii) improve departmental processes. 5 sub-directors and 23 representatives of the total of employees participated in the project. Organizational Participants were distributed in five teams working in parallel on different processes. A pilot team was defined in order to advance at a faster pace, and develop experience on the use of ORDIC tools and techniques of IC management, which could then transfer to other teams. Due to the success of the pilot project the company decided to develop a video documentary which was used to induce the rest of the organization units to IC management.

7.3.2.6. SIGMA Aliments.

SIGMA is one of the world leaders in the international food industry. In response to the increased demand on three new products SIGMA decided to construct a new factory in the city of Linares, state of Nuevo Leon. The plant would function with 127 employees distributed in three organizational levels, and five departments. Initially the members of the VC Inc. trained eight employees of the Department of Logistics on IC management concepts and the use of ORDIC tools. During the first semester of 1997, ORDIC Users and the eight Organizational Participants collaborated together with the different departments of the factory, in order to achieve the objectives of the project and facilitate: (i) the design and standardization of production processes in order to achieve ISO certification; (ii) the definition of organizational requirements on specialized skill development; (iii) the design of systems that decrease training life cycle; (iv) the design of appropriate experience management mechanisms that would register know-how on developing a new plant and support knowledge transfer to other members of the SIGMA consortium when they decide to develop a new factory. At the end of the project (May 1997), the plant initiated formal operations.

7.3.2.7. Bancomer's South Regional Center.

Bancomer is the second largest bank in Mexico. The project was focused on the department of Mortgage Services, located in the city of Pachuca, state of Idalgo. This department was providing services to the South Region of Mexico. The department was confronting a high and increasing rate of bad debt caused by (a) the difficult economic situation of the Mexican economy at the time and (b) the low rate of credit recovery. This situation was influencing the relations with customers negatively, which was intensifying the problem. The IC project focused on: (i) improving organizational processes orienting them towards customer satisfaction; (ii) increasing personnel participation and (iii) identifying and satisfying specific skill development needs. Participants in the IC project were distributed in nine teams working in parallel on different processes of the department. Out of the nine teams one was defined as a pilot team, working closely with ORDIC Users, adopting a faster pace, learning from the experience and supporting the rest of the teams.

7.3.2.8. Hazardous Residues Laboratory.

The lab forms part of the Environmental Quality Research Center of the ITESM university system in Mexico. The lab was seeking ISO certification for the analytical process of Corrosivity, Reactivity, Explosivity, Toxicity and Inflamability it performs. ISO certification was necessary in order for the lab to increase its client's portfolio and avoid existing financial problems. The IC project focused on (i) improving the lab's productivity, (ii) obtaining the certification and (iii) identifying and satisfying IC needs related to skill development and information management. The lab had 8 full-time employees distributed in three organizational levels: one Director of the lab, five certified Analysts with graduate and postgraduate degrees and two technical assistants.

7.3.2.9. Draw Tite/AmMex.

Draw Tite is one of the factories of Draw Tite International whose corporate office is in Canton, Michigan, USA. Draw Tite/AmMex is located in the city of Reynosa, state of Tamaolipas, in the borders between Mexico and USA. It is a small factory of 60 employees that develops electric appliances for the automotive industry. The average age

of the employees was 22 years and the educational level was primary and secondary school. The organizational structure was highly hierarchical and there was no quality management system implemented. The general director of the factory, as a first step towards ISO certification, invited the ORDIC Users to facilitate (i) the change towards a participative culture, (ii) the standardization of processes, and (iii) design of customized training systems for the employees.

7.3.2.10. KREARTON.

At the time the IC project took place KREARTON was a two years old Mexican company producing and commercializing material for wrapping, packing, bottling and/or baling. Its principal lines of production cover (a) cardboard-made products and (b) the design of integrated packaging systems for industrial products. The company had 15 employees and 40 workers working in one factory and two regional distribution centers located in Mexico City and in Aguascalientes. The owners of the company invited the ORDIC Users to facilitate the process of franchising of KREARTON's brand and concept of *model shop*. This shop was integrating the commercialization function together with the function of autonomous and self-financing production. The objective of the owners was franchising the concept of KREARTON's *model shop,* open new model shops in different strategic cities in Mexico and in this way achieve a 500% of growth during the third year of operation of the company.

7.3. Overall results of the Beta test.

In this section the overall results of the Beta test are presented. These results are compatible with the results obtained by the case studies generated during the Alpha test, especially those done close to the end of the Alpha test, when both the IC management approach and ORDIC method had reached their operational form.

In general terms, 223 Organizational Participants and 58 ORDIC Users participated in the Beta test. In Figures 25 and 26 are presented their corresponding academic level.

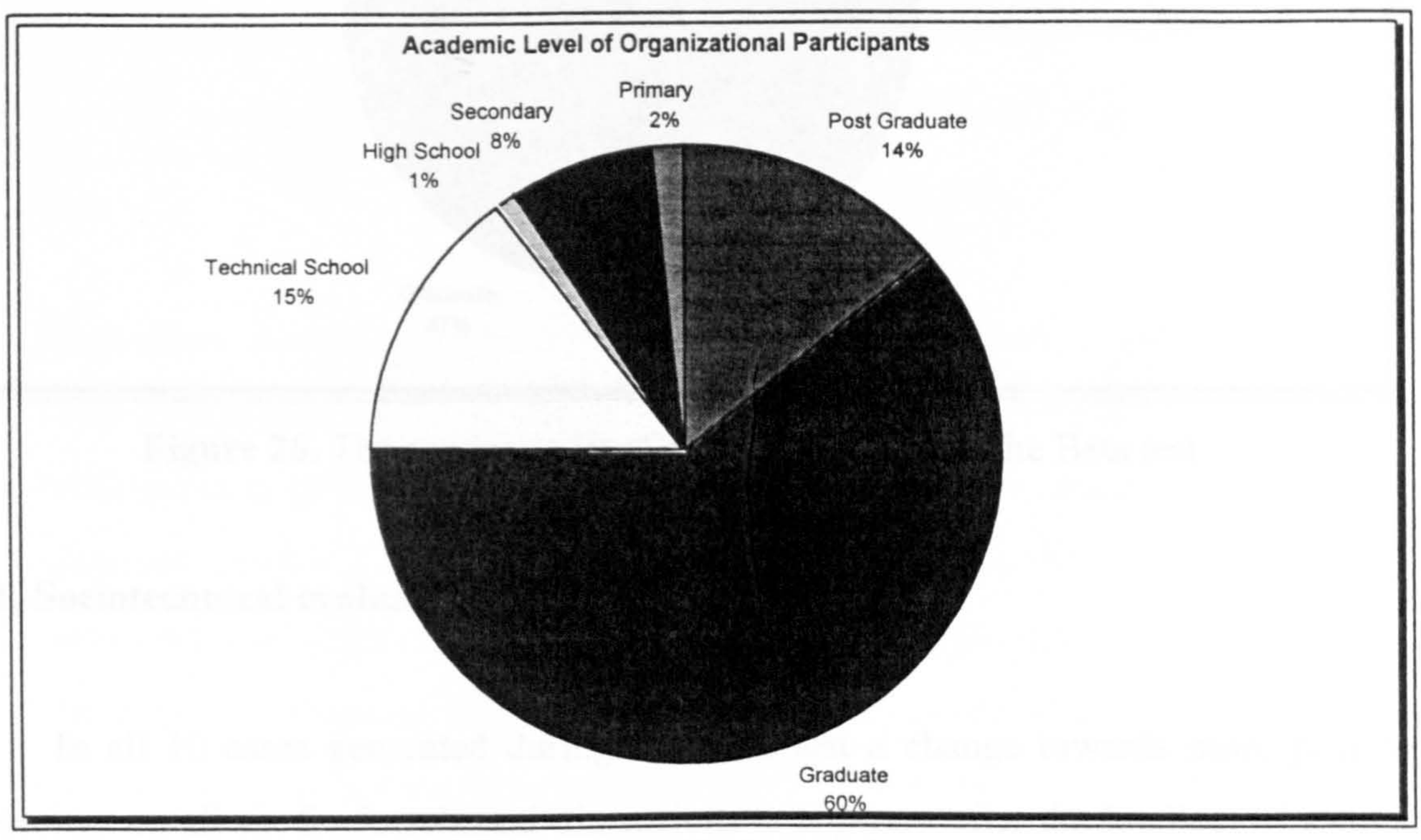

Figure 25. The academic level of Organizational Participants of the Beta test.

Only Organizational Participants responded to the Sociotechnical systems questionnaire. The results of the their responses before and after the Beta test will be presented in section 7.3.1.

Both Organizational Participants and ORDIC Users responded to the ORDIC Tools questionnaires. The results of the their responses after the end Beta test will be

presented in sections 7.3.2.1. and 7.3.2.2. accordingly.

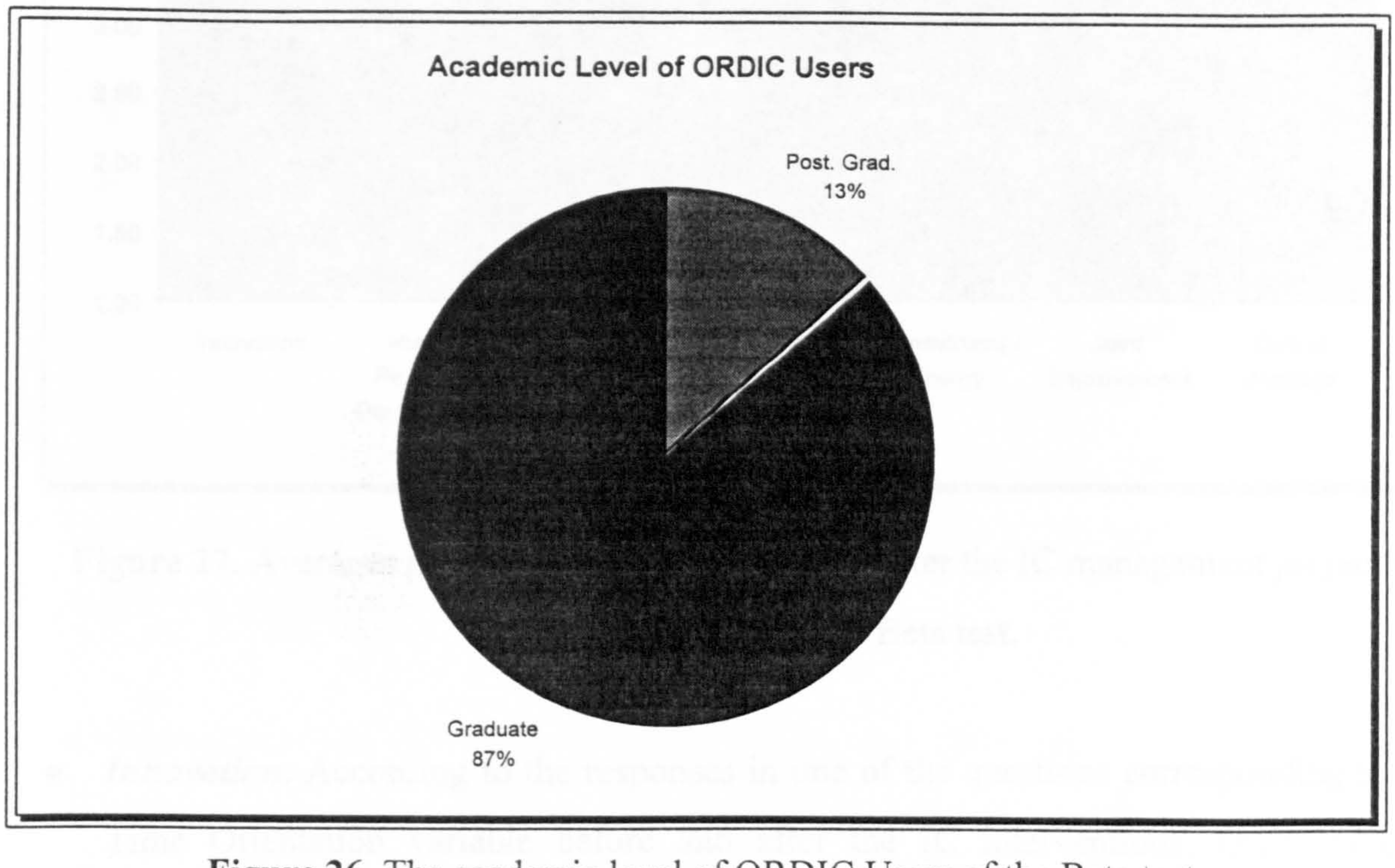

Figure 26. The academic level of ORDIC Users of the Beta test.

7.3.1. Sociotechnical evaluation.

In all 10 cases generated during the Beta test a change towards more positive assessment on all six Sociotechnical dimensions is apparent after the Intellectual Capital management project (see Figure 27). Nevertheless, the relative change in the dimensions differed among the cases. For example, in cases were the main goal of the project was innovation or environmental agility rather than standardization for achieving ISO certification, relative changes to corresponding dimensions were reflecting that dimensions lacking organizational interest had less relative change than those related to the primary goal of the project. In the following will be presented the general results for each one of the Sociotechnical dimensions.

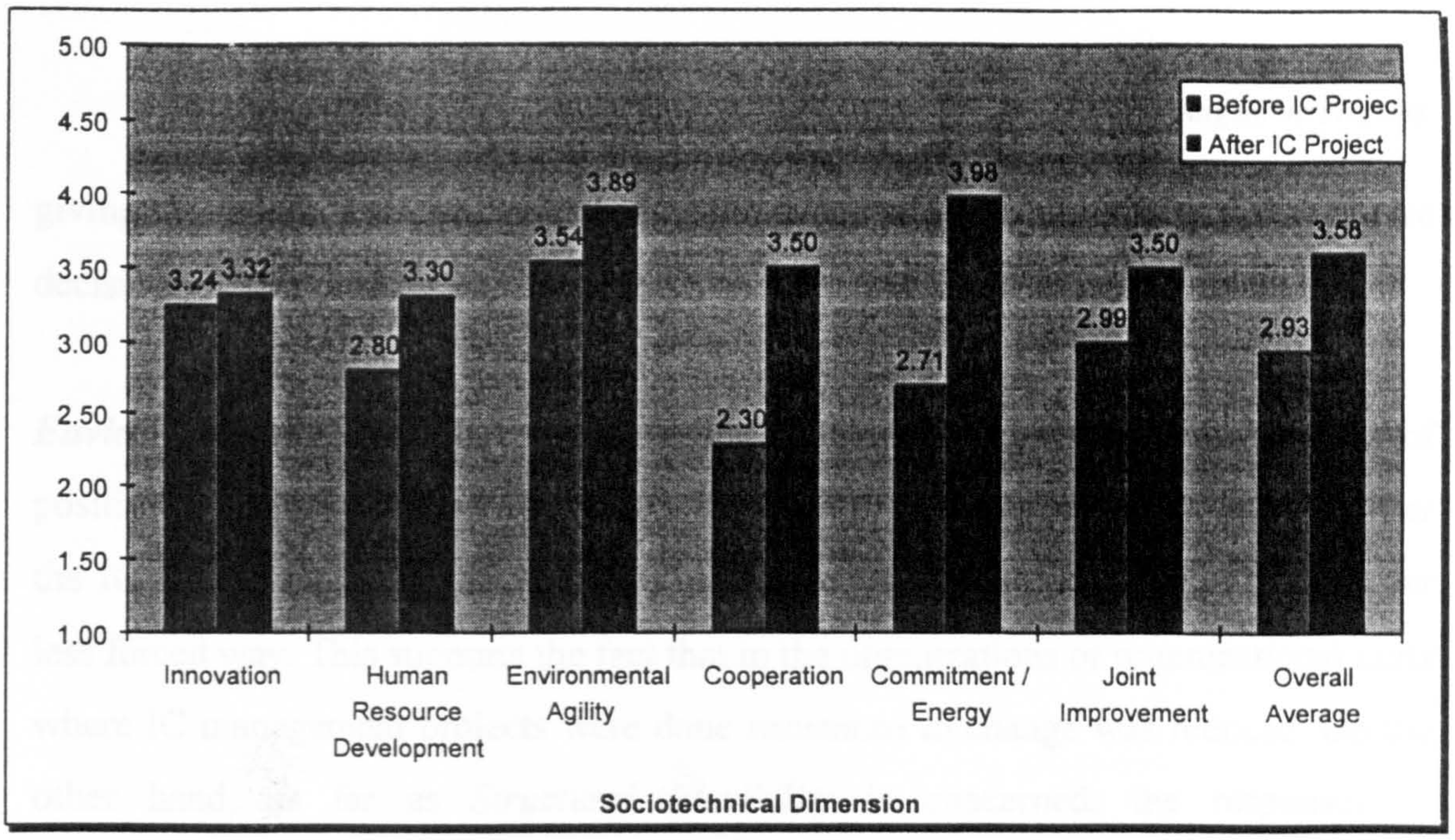

Figure 27. Averages per S-T dimension before and after the IC management project in the 10 case studies of the Beta test.

- ***Innovation***: According to the responses in one of the questions corresponding to the Time Orientation variable before and after the IC interventions, Organizational Participants in general consider that after the IC project they are more open to change (question number 2 of annex I). They also consider that after the intervention new ideas are taken under consideration more than before (question number 3 of annex I). These types of response reflect the generation of a positive attitude and a participative spirit as far as change is concerned after the IC intervention.

- ***Human Resources Development***: In questions 18 and 34 corresponding to the Work Design variable, Organizational Participants in the 10 case studies consider that after the IC intervention they participate actively in important decision making in respect to the way work is done; their supervisors still say to them what to do but also accept proposals. Generally speaking, responses to question 35 indicate that in the majority of the case studies, after the IC project, supervisors see their role as that of a facilitator and coach; they perceive their job as helping their colleagues be successful rather than

giving orders to subordinates. The above reflect a change towards a more participative decision making process.

- ***Environmental Agility***: In the results it was observed that the larger number of positive responses corresponding to *Environmental Consciousness* indicates that after the IC interventions organizations respond to environmental changes in a smoother less forced way. This supports the fact that in the organizations or organizational units where IC management projects were done resistance to change was reduced. On the other hand, as far as *Structural Flexibility* is concerned, the responses of Organizational Participants show that they can adapt better to changes due to the fact that newly defined policies and structures are flexible.

- ***Co-operation*:** The difference observed *before* and *after* the IC project in this dimension was one of the two most remarkable - the other one was that in the Compromise / Energy dimension (see Figure 27). In general, after the end of the projects, Organizational Participants consider, among other things, that the different sections or members of their organization that participated in the IC projects work together in a more cooperative way, they support one an other and work as a team, compared to the case before the IC project.

- ***Commitment / Energy***: In this dimension also the difference observed *before* and *after* the IC project was quite notable (see Figure 26). For example, according to the responses in the questions corresponding to the *Dedication* variable, Organizational Participants consider that almost all of them feel responsible for the positive or negative results of their organization (question number 78) and only a few of them present signs of laziness during the absence of supervisors (question number 79). In general terms it is observed a notable increase on the commitment from part of the Organizational Participants to the organizational goals as well as in the energy they invest in achieving them.

- ***Joint optimization***: According to the responses in the questions corresponding to the *Sociotechnical Balance* variable, after the IC project, Organizational Participants consider that people and technology are almost of the same importance to the organization (question number 89). Before the IC project, responses were indicating that people were not as important as technology. On the other hand, when new technology is evaluated in order to be acquired, those who will operate it are involved in the decision-making related to its design, development and/or acquisition. To questions related to the variable that received the most positive responses, *Technology to Support Teamwork*, Organizational Participants responded that both technology (question number 98), and the layout of the production processes (question number 99) are now designed to facilitate teamwork.

7.3.2. ORDIC tools evaluation.

Five ORDIC tools were used in the projects:

- Stakeholder Analysis Table;
- Functional Modeling Tool;
- Socio-Intellectual-Technical (SIT) Task Representation Tool;
- Task Analysis Tool and
- Sociotechnical Organization's View Tool.

In order to measure the functionality of each one of the ORDIC tools and receive feedback from the Organizational Participants and ORDIC Users of the 10 cases of the Beta test, the ORDIC questionnaires were applied (see Appendix II). All Organizational Participants and ORDIC Users responded the ORDIC questionnaires.

7.3.2.1. ORDIC tools evaluation by the Organizational Participants.

The acceptance the tools had among Organizational Participants was high (see Figure 28). All of them were rated above 4, with a overall mode of 4 in a 5-point scale,

were 5 is the best and 1 is the worst. The contribution of each one of the tools is rated as valuable in terms of facilitating IC management activities (see process of IC management: interdisciplinary communication, participative requirement definition, scenario generation and evaluation).

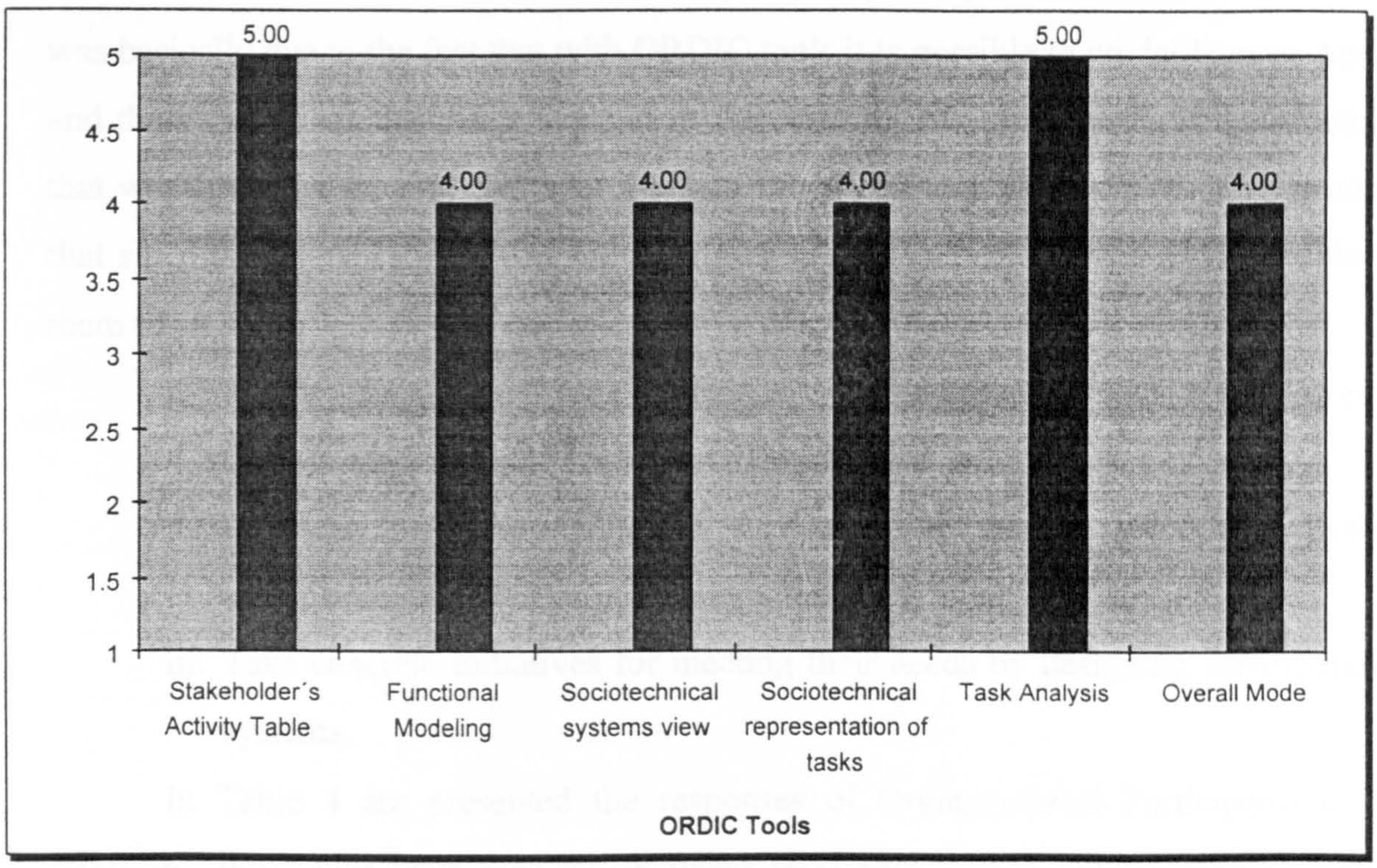

Figure 28. Modes of ORDIC Tools evaluation by Organizational Participants in the 10 case studies of the Beta test.

As far as training is concerned, the general appreciation is that *no training is required to use the tools*. Nevertheless, a sort explication of the way to apply each tool is considered necessary before using it. The majority of Organizational Participants were not familiar with similar tools. Those who were familiar with similar tools were classified in two categories:

a. Organizational Participants that had participated in the past in a Business Process Reengineering (BPR) or Total Quality Management (TQM) project; during the project they had used different modeling tools to design organizational processes and

work flow;

b. Organizational Participants that had a theoretical background of BPR, TQM and/or Information Technology design methods and tools; they had developed this background as part of there graduate or postgraduate education.

Responding to the open question that asked them to compare the tools they knew with ORDIC tools, they said that they preferred the ORDIC tools and they would be glad to recommend the tools to others. According to the open replies received, this preference was basically due to the fact that with ORDIC tools it is possible to model Human Agents and their shared responsibilities as part of the organizational process models, something that was not possible with BPR and TQM methods and tools they had used. They added that since the Human Agent was present in the ORDIC models, it was then possible for them to:

i. Identify themselves in the models and see themselves as part of the design of the processes and activities they were involved in.
ii. Consider the needs of Human Agents - *their needs*, in order to perform organizational activities in an integrated way.
iii. Take concrete initiatives for meeting their needs by designing corresponding systems.

In Table 4 are presented the responses of Organizational Participants to the question "*What was your purpose in using this tools?*". The author translated these responses from Spanish to English. To assure the consistency between the Spanish and English version, a third party translated the responses back to Spanish.

ORDIC Tool	Purpose for using the Tool
Stakeholder Analysis Table	• "To find out the needs as well as the areas of opportunity of the organizational unit." • "To think on possible solutions to the problems of the organization." • "To visualize the total of the activities of the organization." • "To understand what kind of activities the other members of the organizational unit were involved in."
Functional Modeling Tool	• "To identify the requirements of the specific activities of the organization's process in terms of equipment, materials, time and information, for performing them." • "To identify the know-how and characteristics required by the person who would perform them with excellence." • "To identify and visualize the complete flow of the processes." • "To support the description and documentation of the processes of the organization."
Socio-Intellectual-Technical (SIT) Task Representation Tool	• "To identify existent work overloads in the processes of the organization." • "To define any bottle necks on the organization's processes and define the requirements for making them disappear." • "To define the flow of the activities in the organization, including those executed by the employees as well as those executed by the machines." • "To model different options of the flow of the activities with different distributions between the employees and the machines and evaluate the most appropriate to their needs." • "To support the description and documentation of the processes of the organization." • To model different options for motivating employees and evaluate different distributions between the subsystems of SIDEP (Learning Evaluation, Selection, Reward and Career Development subsystems)." • "To model different scenarios for learning and innovating "by doing."
Task Analysis Tool	• "To model and visualize all the processes and identify any bottle necks." • "To support the description and documentation of the processes." • "To describe the activities corresponding to the different sections of the organization."
Sociotechnical Organization's View Tool	• "To understand where the organization was heading to - which was its main objectives." • "To co-ordinate and align themselves to the objectives of the organization." • "To create the overall view of requirements necessary, as well as the problems that the organization faces for achieving its objectives." • "To make mutual compromises and agreements among themselves in order to work together towards one common goal." • "To revise and improve organizational vision, mission and objectives."

Table 4. The reasons Organizational Participants used ORDIC tools.

7.3.2.2. ORDIC tools evaluation by the ORDIC Users.

The acceptance the tools had among ORDIC users was higher than that of Organizational Participants (see Figure 29). All of them were rated above 4.51, with a overall average of 4.69 in a 5-point scale, were 5 is the best and 1 is the worst. The contribution of each one of the tools is rated as valuable in terms of facilitating IC management activities.

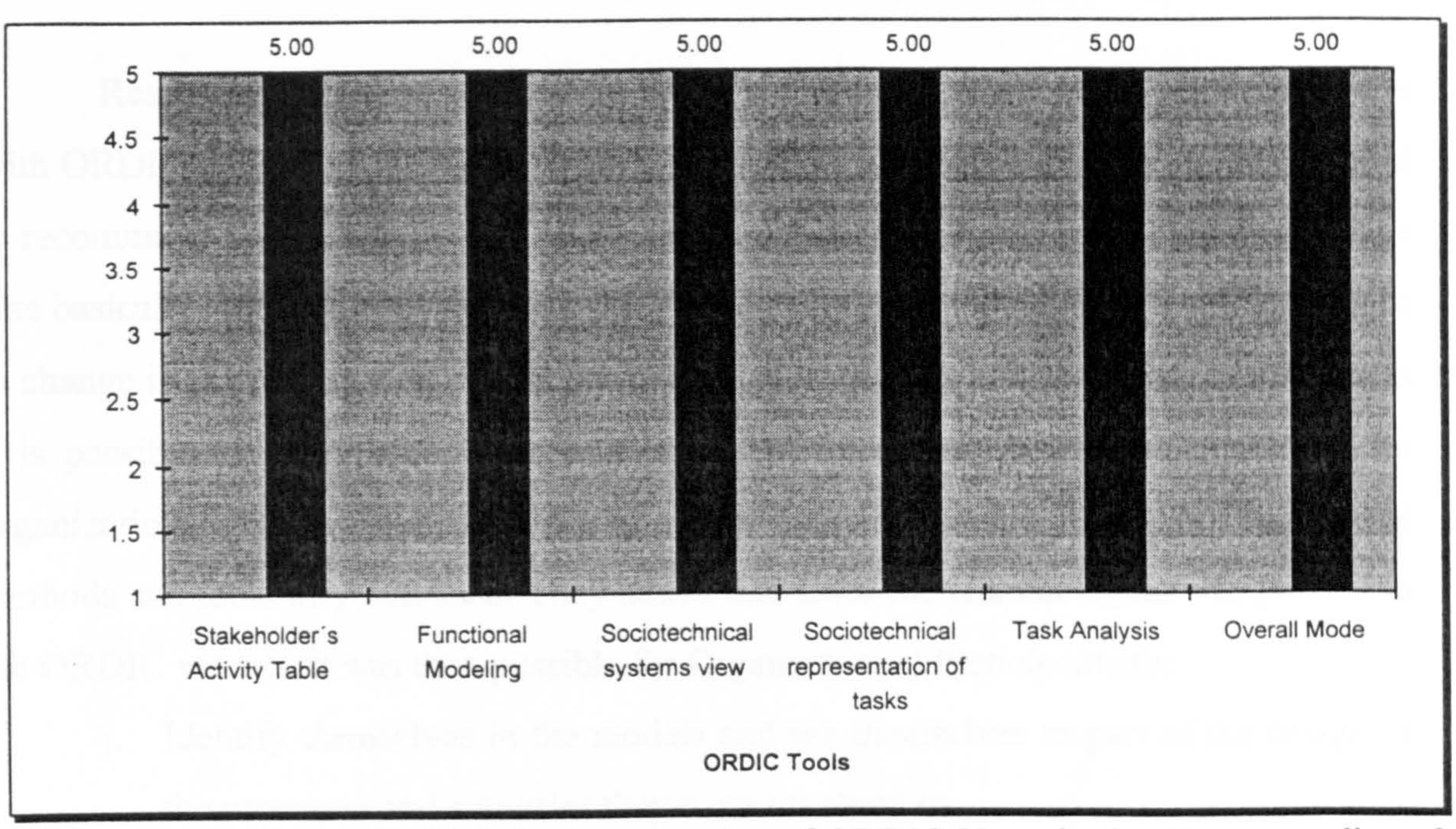

Figure 29. Modes of ORDIC Tools evaluation of ORDIC Users in the 10 case studies of the Beta test.

The majority of ORDIC Users were not familiar with similar tools. The general appreciation was that *training in the use of the tools* should be limited to a sort explication of the way to apply each tool.

Similarly with the case of Organizational Participants, Organizational Users who were familiar with similar tools were classified in two categories:

a. ORDIC Users that had participated in the past in a Business Process Reengineering (BPR) or Total Quality Management (TQM) project; during the project they had used

different modeling tools to design organizational processes and workflow.

b. ORDIC Users that had a theoretical background of BPR, TQM and/or Information Technology design methods and tools; they had developed this background as part of there graduate or postgraduate education.

Responding to the open question that asked them to compare the tools they knew with ORDIC tools, they said that they preferred the ORDIC tools and they would be glad to recommend the tools to others. According to the open replies received, this preference was basically due to the fact that with ORDIC tools Organizational Participants resistance to change is reduced. ORDIC Users attributed this to the fact that by using ORDIC Tools it is possible to model Human Agents and their shared responsibilities as part of the organizational process models, something that was not possible with BPR and TQM methods and tools they had used. They added that since the Human Agent was present in the ORDIC models, it was then possible for Organizational Participants to:

i. Identify themselves in the models and see themselves as part of the design of the processes and activities they were involved in.
ii. Consider their needs as Human Agents - *Organizational Participants needs*, in order to perform organizational activities in an integrated way.
iii. Take concrete initiatives for designing corresponding systems that meet Organizational Participants needs.

7.3.3. Analysis and Evaluation of the Outcomes of the Projects of the Beta test.

Based on the outcomes of the projects follows the presentation of the additional results of the Beta Test.

At *company level* in terms of value addition, client companies, through Changeland´s evaluation system, expressed their satisfaction as well as their wish to continue receiving intellectual services by the virtual teams (VCs), even after the end of the postgraduate course:

a. *Project expansion:* Before the end of the Beta Test, 3 cases of project expansion were registered. These were of two kinds: *intra-company* (inside the same company) and *inter-company* (inside the same consortium of companies). For example, in the case of the Bancomer bank, immediately after the end of the postgraduate course, the project initiated in Changeland escalated to a contract between the company and the ITESM university, contemplating the development of learning systems for all employees of the bank in the southern region of Mexico. In Cerveceria Superior Brewery case, two months after the end of the Beta test, the results of the project in one of the factories of the brewery consortium, were presented to the board of directors of the other 10 factories of the group; the feedback received was very positive; the consortium was considering to get involved to IC management projects.

b. *ORDIC penetration to organizational culture*: on site observation that took place in a three month time frame after the end of the Beta test in the different companies where projects were performed together with letters sent to ORDIC Users, report the following:

- In 7 out of 10 cases Organizational Participants were still using the ORDIC tools in their everyday activities. Among the activities mentioned were improving work processes, documenting, designing their personal learning systems and agreeing on responsibility, obligations and resource allocation with peers, subordinates and superiors.
- In 5 out of the 7 cases colleagues of Organizational Participants learned from them to use the tools and apply them in their everyday activities also.
- Two companies decided formally to complement their strategic planning and communication mechanisms with ORDIC tools.
- One company asked its Information Services department to start evaluating ways for developing computer based ORDIC tools.

a. *Acceptance of the concepts of IC management*: in 6 cases organizational participants demonstrated their interest in becoming members of the CVACI (Virtual Center for Intellectual Capital management), start working as IC facilitators and managers, contact possible clients, and perform IC projects. Some of them have already started contacting possible clients, inviting the author to give lectures and co-ordinate workshops on IC management in different countries (i.e. Mexico, Venezuela, Brazil), etc.

At *ORDIC Users level*, although the formal postgraduate course ended on May 1997, the new ORDIC Users of the Beta Test kept in contact, and started collaborating in different ways.

Acceptance of the concepts of IC management:

- out of the 58 ORDIC Users in Changeland, 43 have started using ORDIC tools in their day to day working activities. 5 out of the 43 have used ORDIC tools and concepts of Changeland to redesign the undergraduate courses they were coordinating in different universities. 12 have initiated IC projects in the companies were they were working.
- 50 out of the 58 decided to become members of the CVACI and participate in collaborative projects and/or perform further research and development on IC management.
- As a general awareness strategy on the aspects of IC management, which will then lead to IC projects coordinated by the new ORDIC Users, the author has already been invited to give lectures, present papers and co-ordinate workshops and seminars on IC management in different countries such as Sweden, Turkey, Russia, Greece, Italy, USA, Mexico, Venezuela and Brazil.

7.4. Conclusions.

In this Chapter the 10 IC case studies developed as a result of consulting work carried out during the ORDIC Beta Test, by postgraduate students that participated to the virtual course "Participative Working Systems" during the first semester of 1997 was presented, together with the results of the macro analysis of the responses of 210 Organizational Participants and 58 ORDIC Users who were involved in the Beta test and responded the Sociotechnical and ORDIC questionnaires. The above illustrated:

- Different organizational contexts for designing IC systems and managing change.
- The diversity of problems that ORDIC can be applied to.

In Chapter 8 two out of the ten case studies will be described in depth to illustrated different potential "routes" through the Socio-intellectual-technological process to IC management and the ORDIC process. In each case study are included the responses of Organizational Participants and ORDIC Users to the Sociotechnical and ORDIC tools questionnaire.

CHAPTER 8.

INDIVIDUAL CASE STUDIES OF INTELLECTUAL CAPITAL MANAGEMENT

8.1 Individual Representative Case Studies.

As has been already mentioned, ORDIC is applicable in a range of different organizational problems, design contexts, organizational structures and cultures. In previous sections outlines of the 10 case studies performed during the Beta test were presented, illustrating different organizational problems and design contexts. In this Chapter two case studies will be presented in more details in order to show different potential "routes" through the process of IC management and the use of ORDIC tools. These case studies are: the Hazardous Residues Laboratory (HRL) case study and the Bancomer case study.

The Hazardous Residues Laboratory case study is considered to be a representative one for the following reasons:

a. It describes the implications of managing IC on a semi-autonomous, business oriented and small organization unit, which is part of a large, private, academic institution.
b. It is focused on managing IC through the development of:
    - production systems
    - learning systems and
    - experience management systems,

with the objective to achieve ISO certification and financial problem resolution.

a. Some of the Organizational Participants had experience of using Total Quality Management modeling tools and were capable of comparing them with ORDIC.
b. The route of the way ORDIC was used is typical of product rather than service

oriented companies.

c. This case study started from an average level on the Macro Questionnaire analysis results project before the IC project (2.98 out of 5.00 on the S-T questionnaire) and had a substantial improvement (3.47 out of 5.00 on the S-T questionnaire).
d. A disclosure agreement permitted the publication of details of the case study.

On the other hand the Bancomer case study:

a. Describes the issues and implications related to managing IC on a large organization unit, which is part of a very large, private, financial institution.
b. Is focused on managing IC through the development of:
    - production systems
    - learning systems
    - participative working systems and
    - experience management systems.
c. Some of the Organizational Participants had experience of using Business Process Reengineering and/or information systems design modeling tools and were capable of comparing them with ORDIC.
d. Previous initiatives of BPR and TQM projects had failed and the organization was looking for a human oriented way of promoting and facilitating change.
e. The routes of the way ORDIC was used is typical of service rather than product oriented companies.
f. This case study starts from a law level on the Macro Questionnaire analysis results before the IC project (2.84 out of 5.00 on the S-T questionnaire) and has a substantial improvement (3.88 out of 5.00 on the S-T questionnaire).
g. A disclosure agreement permitted the publication of details of the case study.

8.2. Hazardous Residues Laboratory (HRL) Case Study.

8.2.1. Overview of the process of the project in the HRL.

In this section the overview of the process of the IC project in the HRL (see first column of Table 5) is presented, together with the corresponding sub processes of the IC Management Process, the sub processes of the ORDIC Process and the ORDIC tools used at each stage of the IC project. Furthermore, the in Figure 30 is presented the particular situation of the HRL as far as the specific systems needed to be developed.

January 1997

IC Project Process	IC Management Process	ORDIC Process	ORDIC Tool(s)
Definition of the Primary Objectives	Definition of Actual & Desired state of affairs of production systems	• Scoping • Requirements Definition	• Socio-technical systems View • Stakeholders analysis table
Redesign of the CRETI process	Development of action plans (new CRETI process) & Evaluation of the implications (investment on equipment)	• Scenario generation and evaluation	• Task Analysis Tool • S-I-T task representation
Definition of Learning and Information needs of the employees to implement the new CRETI process	Definition of Actual and Desired state of affairs (in respect to access to Knowledge and Information resources)	• Requirements Definition	• Functional Analysis • Process-Skills-Stakeholder Table

May 1997

Table 5. The Overview of the process of the Hazardous Residues Laboratory Intellectual Capital project.

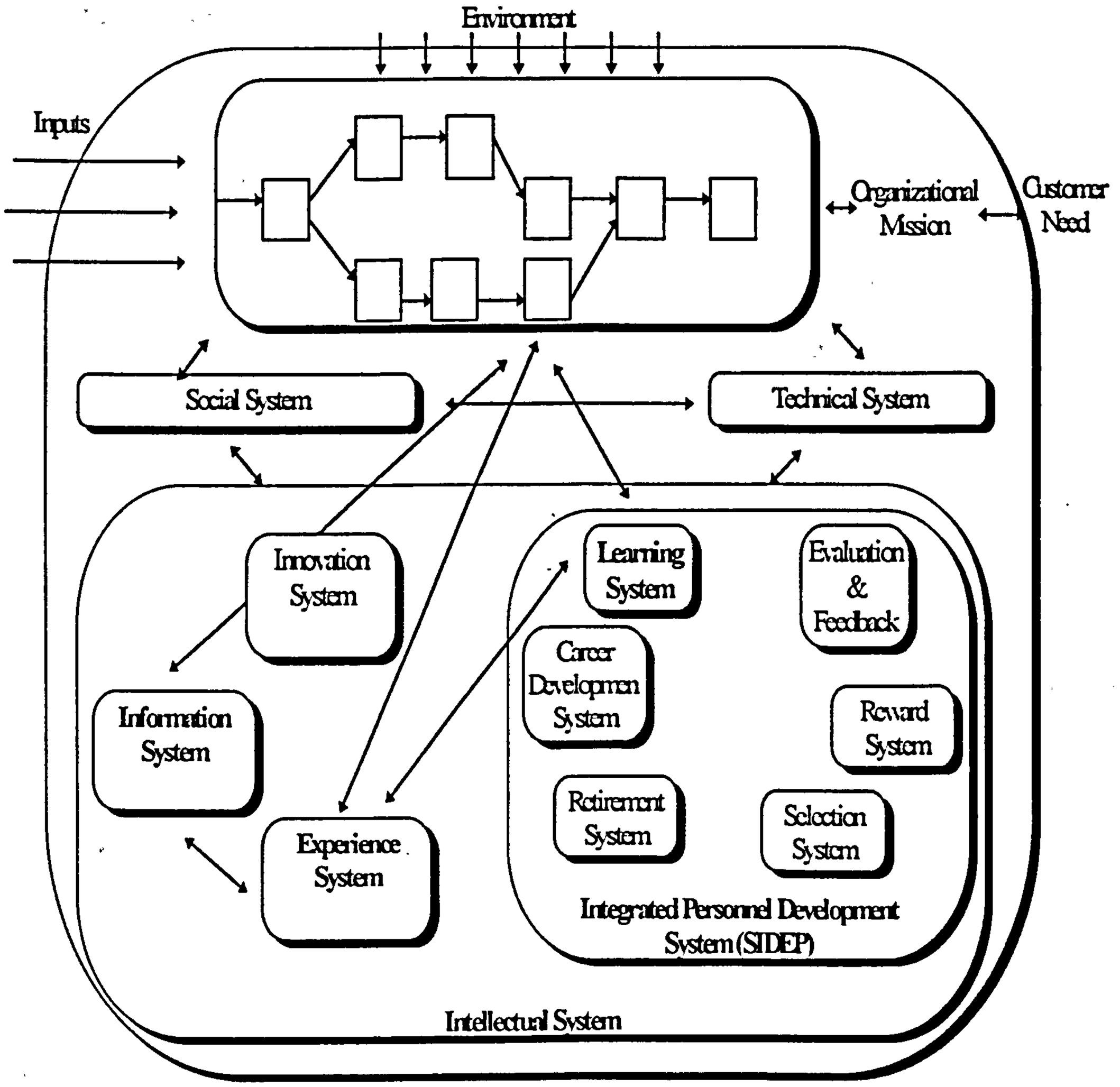

Figure 30. The systems analyzed and developed in the HRL IC management project.

Comparing this diagram with the one in Figure 2 (Chapter 3), the existing arrows indicate the "area of opportunity" in terms of IC systems development. The systems with letters in bold indicate where the project was focused living t of the systems (with letters in italics) to be designed in the future.

8.2.2. Intellectual Capital Project.

HRL performs analytical studies of industrial wastes, especially analysis of Corrosivity, Reactivity, Explosivity, Toxicity and Inflamability (CRETI). Through these analyses, industrial wastes are characterized as hazardous for the environment or not. The lab provides its services to private and public companies as well as to the ITESM University. Its research and development investment is high. Return on the investment is based on response time and volume of analytical results produced.

The lab, similarly to its competitors, constantly seeks to reduce response time and increase the volume of analysis performed per time unit. The competition is fierce in this industry; those labs that are certified by the National System of Analytical Laboratories (*NSAL*) and respond better to client company demands usually dominate the market and are the beneficiaries of tremendous profits. At the period the IC project was done, the lab had 8 full-time employees distributed in three organizational levels:

- One Director of the lab.
- Five certified Analysts with graduate and postgraduate degrees.
- Two technical assistants.

The lab also employed 3 part-time staff. Following the decision of the Director of the lab, part-time employees did not participate in the project nor in the evaluation process. This decision was based mainly to the fact that the high rotation rate of part-time personnel did not permit them develop sufficient experience on the job to make valuable contributions to its improvement. Furthermore, the activities performed by part - time staffs were not considered of any significance to the project.

At the time the lab's coordinator was contacted by the three members of the Value Community 4 (VC4 Inc.), the lab was not certified by NSAL and its client portfolio was decreasing, causing serious financial problems. The coordinator was convinced that an improvement effort should be conducted to achieve primarily four objectives: (a) improve

the lab's productivity in terms of the number of analyses performed by moving from one eight-hour shift per working day to three seven-hour shifts; (b) obtain the NASAL certification by revising and registering the analysis processes in terms of quality and efficiency; (c) identify the core individual skills needed to achieve the first two objectives and design customized training programs for the development of the personnel; (d) revise and improve the functionality of the information system of the lab.

The coordinator was aware that the most important asset of the lab was its employees, since "they were the 'owner' of the know-how of the lab". He recognized that the achievement of the lab's objectives depended greatly on employee involvement. Nevertheless, neither he nor the analysts and technical staff was accustomed to participative decision-making.

Initially, and as part of project scoping activities, participative design sessions were held to revise the mission and objectives of the lab and identify the requirements that would permit the lab to achieve its goals. During the participative design sessions and the process of Stakeholder analysis, using the corresponding ORDIC tool a number of opportunity areas were identified:

- communication mechanisms between analysts and with the customers were ineffective due to the fact that work was divided by functions;
- previous efforts of developing an information system were limited to satisfying needs of reporting results to clients;
- experience registration mechanisms were limited and not standardized - each analyst was registering his work informally;
- the increasing demands from customers to receive more sophisticated and complex assistance in addition to the analysis could not be met with the existing personnel, operational structure and informal training procedures.

The scope of the project was limited to the Corrosivity, Reactivity, Explosivity, Toxicity and Inflamability (CRETI) analytical processes, and their effective co-ordination. That was due to the fact that the CRETI analytical processes were the core processes of

the lab. The members of the lab with support of ORDIC's modeling tools redesigned the CRETI processes. In Figure 31,' the task analysis of the Lixiviation and Extraction sub process of the CRETI process is presented.

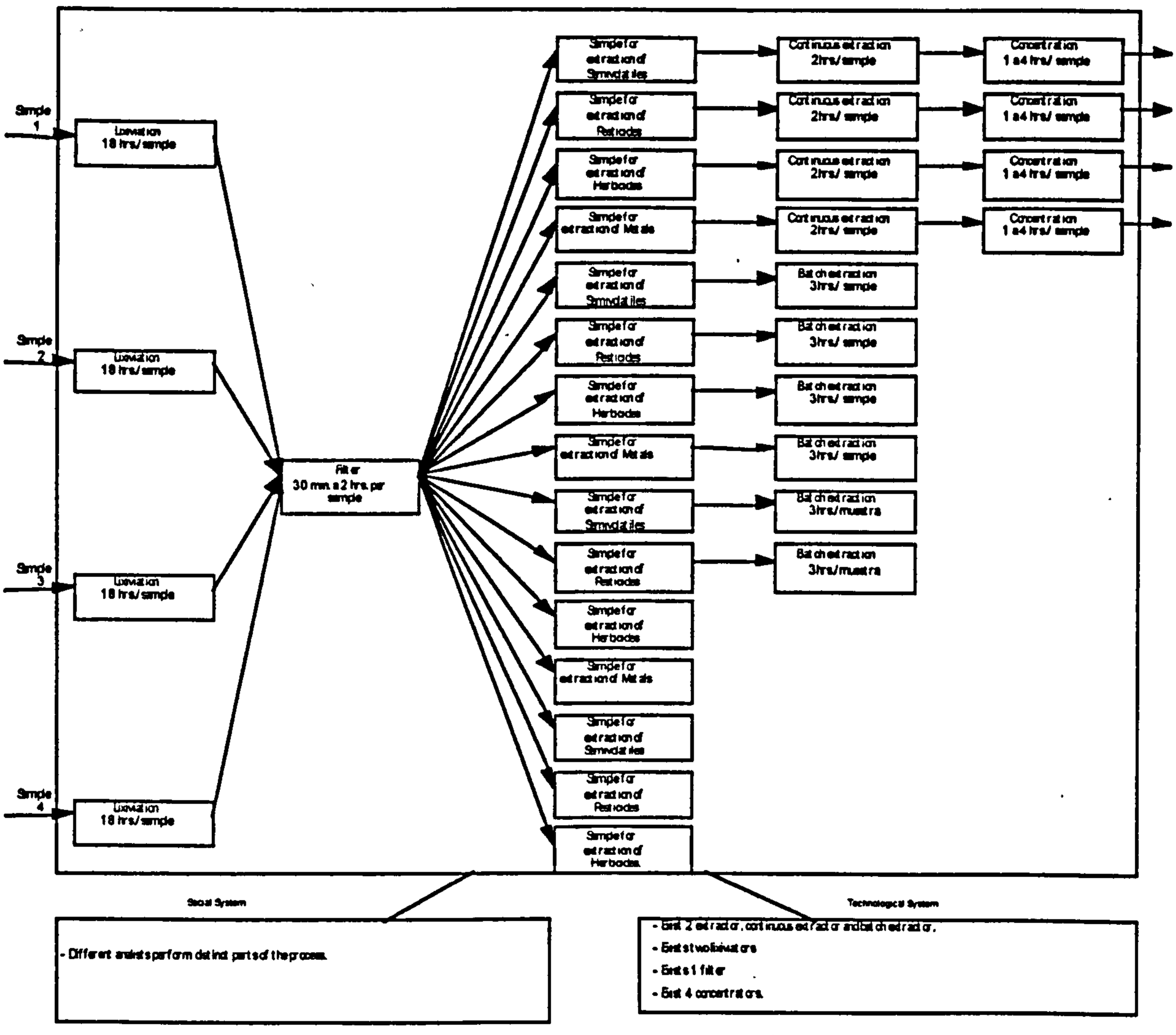

Figure 31. Task Analysis of part of the CRETI process[1].

This type of modeling permitted the Stakeholders to visualize clearly the whole macro-process, the generic needs on technical equipment and their contribution to the process. Furthermore, depending on the different scenarios of investment, it helped them:

[1] Presented with permission from the Hazardous Residues Laboratory of the ITESM.

(a) decide on possible bottle necks due to existing equipment capacity;

(b) define characteristics of equipment needed;

(c) decide on amount of financial investment necessary, and

(d) determine different types of information and knowledge work roles needed to access, in order to perform their job.

ORDIC's modeling tools was used to facilitate requirement definition. In Figure 32a, ORDIC's functional relationships modeling tool is presented.

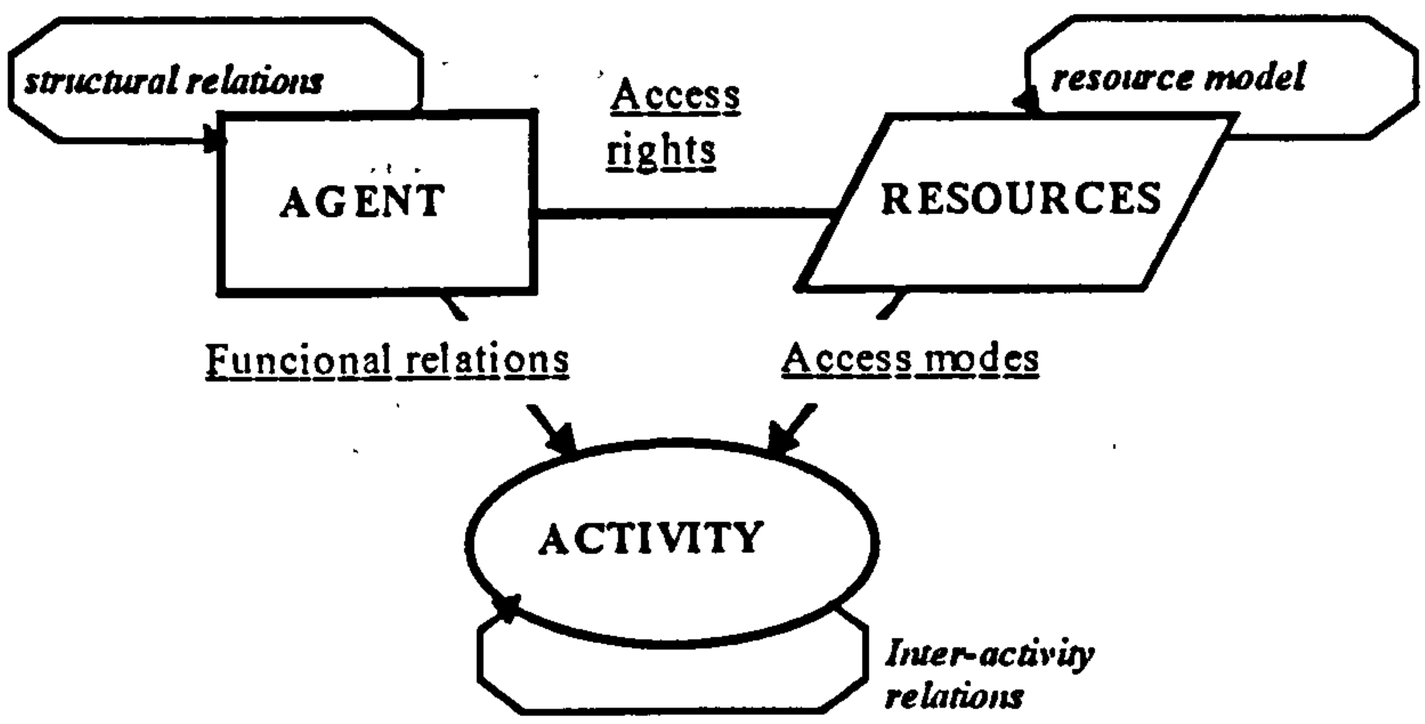

Figure. 32a. ORDIC's functional relations modeling.

An Agent needs to have access to Resources permitting him to perform the Activity for which he is responsible. For the purpose of this particular project, resources were classified as (i) *Knowledge* (registered in *italics*); (ii) Materials (registered in normal) and (iii) **Equipment** (registered in **bold**). In Figure 32b an example of ORDIC's functional relationship modeling is presented based on an activity that an HRL Agent has to perform.

Considering the representations of the functional relationships for each of the owners of the process at different levels of detail, a matrix was created for the personnel of the lab (for an example of the matrix see Table 6), indicating the different levels of required skills development for each specific task in the lab versus the work role

responsible for this task. Based on this 'map' of required skills, a 'map' of the existing skills was created. The gap between required and existing skills determined the design of customized training systems for each member of the lab, depending on the roles he/she was performing on the CRETI process.

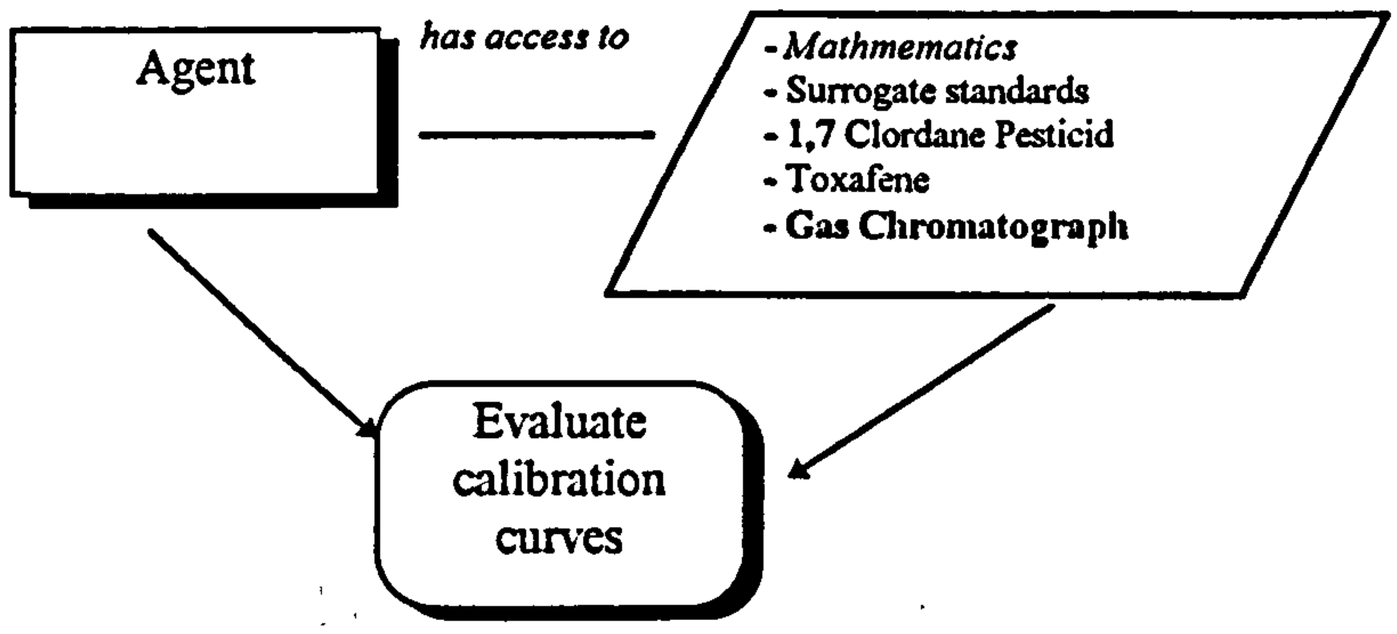

Figure. 32b. Example of functional relations modeling in the HRL case.

A similar process of determining required information needs and existing								
		Lab's Employees (Initials)						
PROCESS	**REQUIRED SKILLS**	**GMC**	**MFA**	**CMG**	**RMP**	**EAA**	**YVC**	**MAE**
Volatile Lixiviation	Technical Chemical Experience	x				x		x
	Implementation of EPA method	x				x		x
	Use of Lixiviation equipment	Ä				x		Ä
	Use of logbook	x	x		x	x		x
Volatile Analysis	Have a degree in Chemistry	x	x	x	x	x	x	
	Implementation of EPA method		Ä	x	x			
	Experts experience in the use of GC/MS equipment		x	x	Ä			
	Use of the logbook		x					

Ä = *Lack of required skill* x = *Existence of skill at required level of expertise* blank = *Non required skill*

Table 6. Example of personnel required skill-development for the CRETI process [2].

Lab's members used ORDIC's modeling tools to support interdisciplinary communication, requirements-definition, future scenario generation and evaluation for the

design of the CRETI analysis process and the corresponding learning and information systems. In terms of experience management, while performing the above-mentioned activities, they were registering their individual and group experience at the time that this was generated: during the participative decision-making sessions. This permitted them go back to it several times, as new requirements were appearing, re-evaluate their previous decisions and when necessary redesign.

8.2.3. Evaluation of the results obtained through the IC intervention in the HRL.

8.2.3.1. Sociotechnical systems evaluation.

The 8 full time employees of the lab responded the Sociotechnical Systems questionnaire (see Appendix I), before and after the Intellectual Capital management activities were carried out. As with all 10 cases, in the lab there was a change towards more positive assessment on all six Sociotechnical dimensions after the IC management project (see Figure 33).

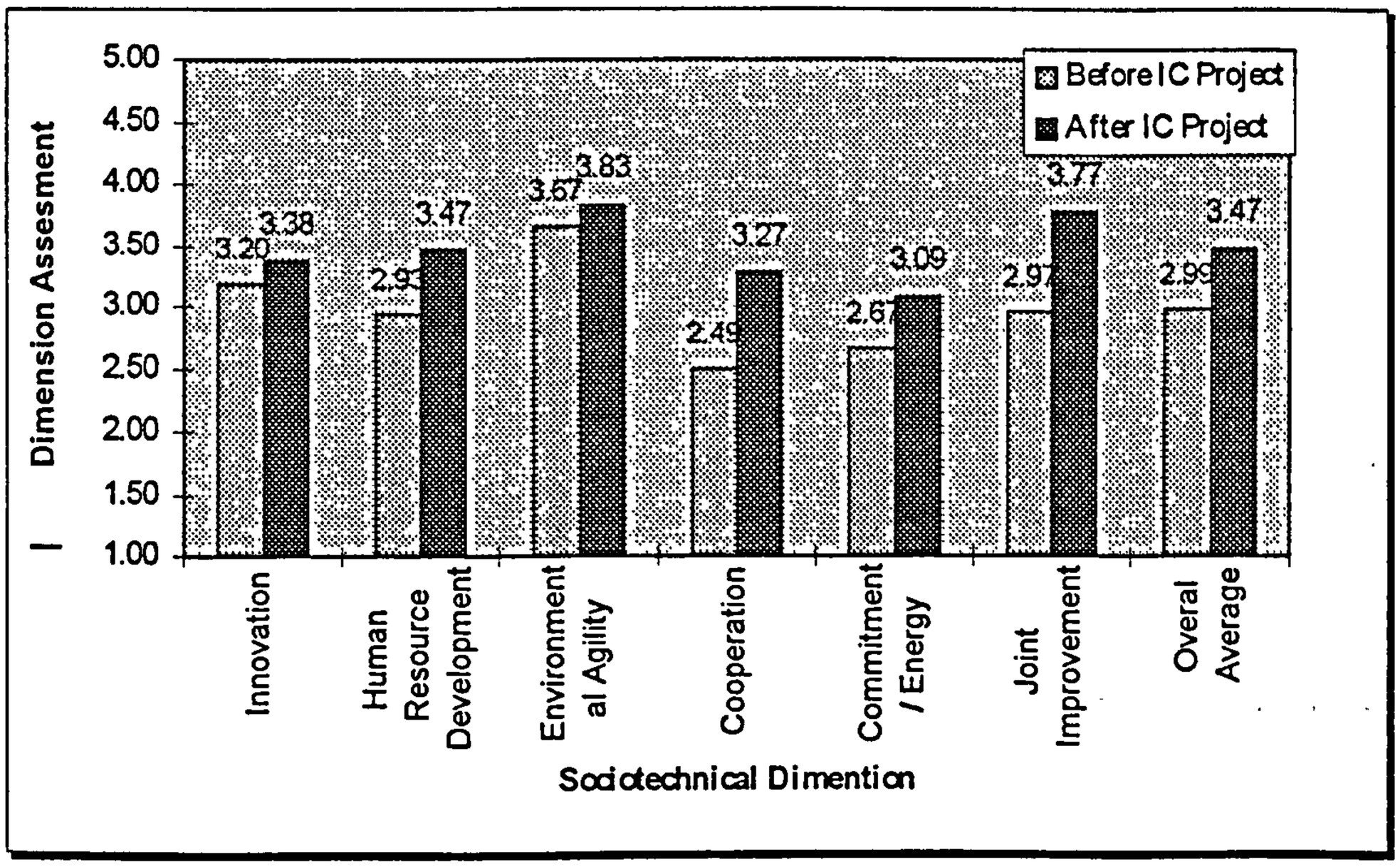

Figure 33. Averages per S-T dimension before and after the IC management project in the

[2] Presented with permission from the Hazardous Residues Laboratory of the ITESM.

Hazardous Residues Laboratory.

As it can be observed in the chart, although a change towards a more positive assessment in all six dimensions was registered in the lab, the *Human Resource Development*, *Cooperation* and *Joint Optimization* dimensions had relatively more change than the rest of the dimensions. This is explained by the fact that these dimensions were directly related to the primary goal of the project: standardization of processes for achieving certification and increase of cooperation among the members of the staff. The detailed results for each dimension are presented in Appendix III.

The use of averages was not considered acceptable because the data were neither ratios nor interval. So a Sign test was performed on the data in Table 7, treating the averages as ordinal measures. The Null hypothesis of no change from Before to After was rejected at a = 0.05.

	Rating on	Influence		
Couple	**Before**	**After**	**Direction of difference**	**Sign**
Innovation	3.20	3.36	$X_B > X_A$	+
HR Management	2.84	3.49	$X_B > X_A$	+
Environmental Agility	3.67	3.83	$X_B > X_A$	+
Cooperation	2.49	3.27	$X_B > X_A$	+
Commitment / Energy	2.67	3.09	$X_B > X_A$	+
Joint Improvement	2.98	3.77	$X_B > X_A$	+
Overall Average	2.98	3.47	$X_B > X_A$	+

Table 7. Judged influence to decide on the Averages per S-T dimension before and after the IC management project in the Hazardous Residues Laboratory.

8.2.3.2. Evaluation of the ORDIC tools from the Organizational Participants of the HRL.

In order to measure the functionality of each one of the ORDIC tools and receive feedback from the 8 users-employees of the Lab, the ORDIC questionnaires were applied (see Appendix II). All full time employees of the lab participated in the projects and

responded to the ORDIC questionnaires. The detailed results for each dimension are presented in Appendix III.

In general, from the responses one can see the acceptance the tools had among the members of the lab. In Figure 34 is presented the mode of the evaluation of each tool used in the HRL project, as well as the overall mode of the five tools. HRL Organizational Participants consider the contribution of each one of the tools as valuable as far as participative requirement definition, scenario generation and evaluation is concerned. Furthermore, after the end of the project employees continued using the ORDIC tools as everyday working tools for learning, improving their organizational processes, registering and transferring their individual and collective experience in a participative way.

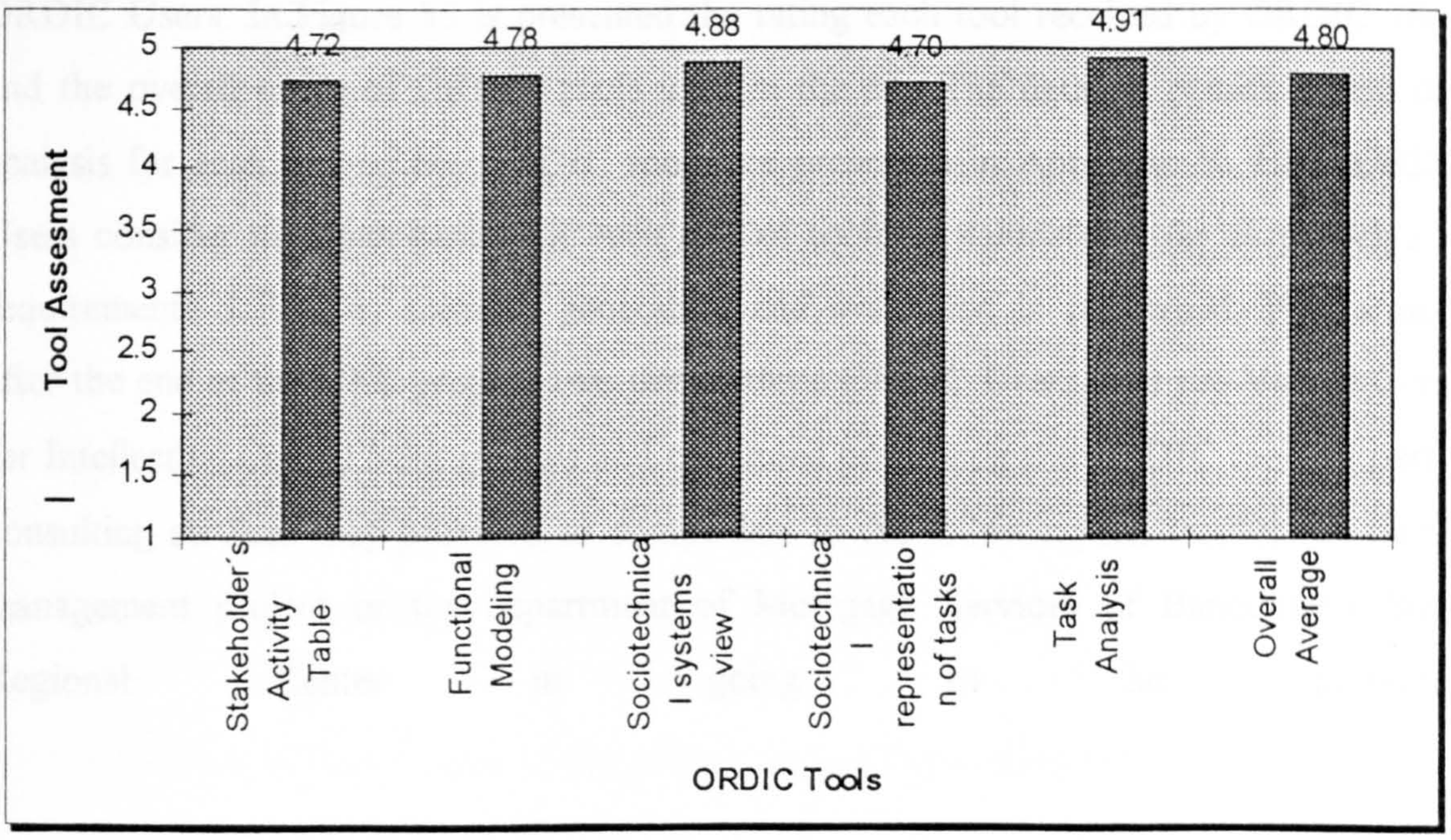

Figure 34. ORDIC Tools evaluation by Organizational Participants in the Hazardous Residues Laboratory.

The detailed results of the data analysis for each one of the ORDIC tools are presented in Appendix IV. In the lab, some of the employees were familiar with Total

Quality Management (TQM) tools for designing organizational processes and workflow. They compared these tools with ORDIC's Task Analysis tool, which they preferred. According to the explanations they gave, that was because, apart from modeling the process, the ORDIC tool invites designers to explicitly consider requirements on technology and people.

8.2.3.2. Evaluation of the ORDIC tools from the ORDIC Users of the HRL.

In order to measure the functionality of each one of the ORDIC tools and receive feedback from the 3 ORDIC Users who participated in the Lab project, the ORDIC questionnaires were applied (see Appendix II).

In general, from the responses one can see the acceptance the tools had among the ORDIC Users. In Figure 35 is presented the rating each tool received by ORDIC Users and the overall mode of ORDIC tools used in the lab. The detailed results of the data analysis for each one of the ORDIC tools are presented in Appendix V. HRL ORDIC Users consider the contribution of each one of tools as valuable as far as participative requirements definition, scenario generation and evaluation is concerned. Furthermore, after the end of the HRL project, two out of three ORDIC Users joint the Virtual Center for Intellectual Capital Management and continued promoting the ORDIC tools as part of consulting services they provided to companies. In the following the Intellectual Capital management project of the department of Mortgage Services of Bancomer's South Regional Center in going to be presented.

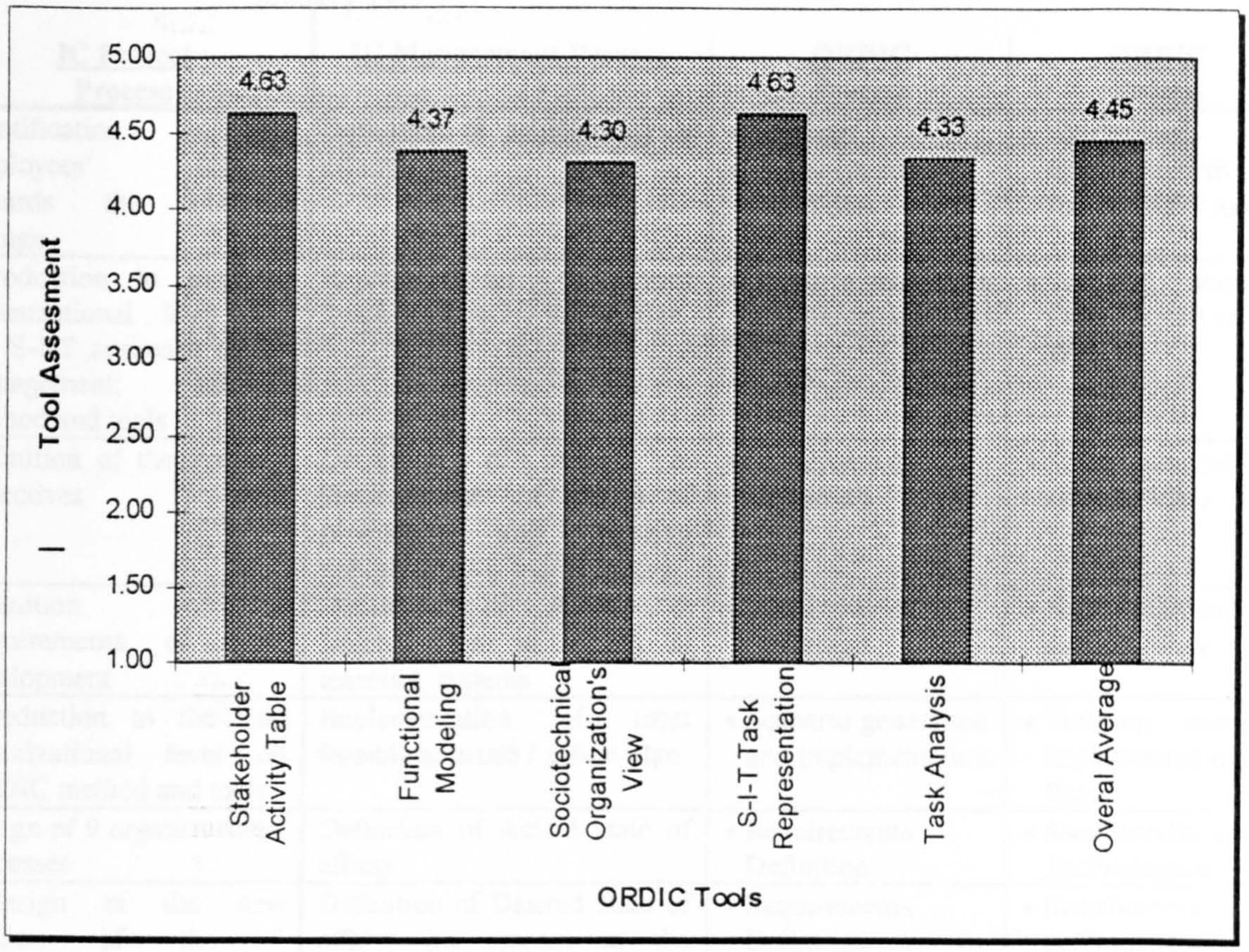

Figure 35. ORDIC Tools evaluation by ORDIC Users in the Hazardous Residues Laboratory.

8.3. The Bancomer bank case study.

8.3.1. Overview of the process of the project in the Department of Mortgage Services of Bancomer Bank.

In this section is presented the overview of the process of the IC project in the Department of Mortgage Services of Bancomer Bank (see first column of Table 8), together with the corresponding sub processes of the IC management Process, the sub processes of the ORDIC process and the ORDIC tools used at each stage of the IC project.

January 1997

IC Project Process	IC Management Process	ORDIC Process	ORDIC Tool(s)
Identification of employees' attitude towards the planned change	Definition of actual state of affairs	• Scoping • Requirements Definition	• Customized Questionnaires (non ORDIC tool)
Introduction to the 1st organizational level on: the S-I-T approach to IC management; ORDIC method and tools	Implementation of most feasible scenario / action plan	• Scenario generation and implementation	• Training material implemented on the Web
Definition of the Primary Objectives	Definition of Actual & Desired state of affairs of production and learning systems	• Requirements Definition	• Socio-technical systems View
Definition of Requirements of Skill development	Definition of Actual & Desired state of affairs of learning systems	• Requirements Definition	• Socio-technical systems View
Introduction to the 2nd organizational level on ORDIC method and tools	Implementation of most feasible scenario / action plan	• Scenario generation and implementation	• Training material implemented on the Web
Design of 9 organizational processes	Definition of Actual state of affairs	• Requirements Definition	• Socio-Intellectual-Technological
Redesign of the new version of the 9 organizational processes	Definition of Desired state of affairs (in respect to the production system)	• Requirements Definition • Scenario Generation and Evaluation	• Stakeholders analysis table • Socio-Intellectual-Technological
Definition of Learning and Information needs of the employees to implement the new CRETI process	Definition of Actual and Desired state of affairs (in respect to access to Knowledge and Information resources)	• Requirements Definition	• Functional Analysis • Process-Skills-Stakeholder Table

May 1997

Table 8. Overview of the process in the Bancomer IC project.

In Figure 36 is presented the particular situation of Bancomer as far as the specific systems needed to be developed. Comparing this diagram with the one in Figure 2 (Chapter 3), the existing arrows indicate the "area of opportunity" in terms of IC systems development. The systems with letters in bold indicate where the project was focused living the rest of the systems to be designed in the future (letters in italics).

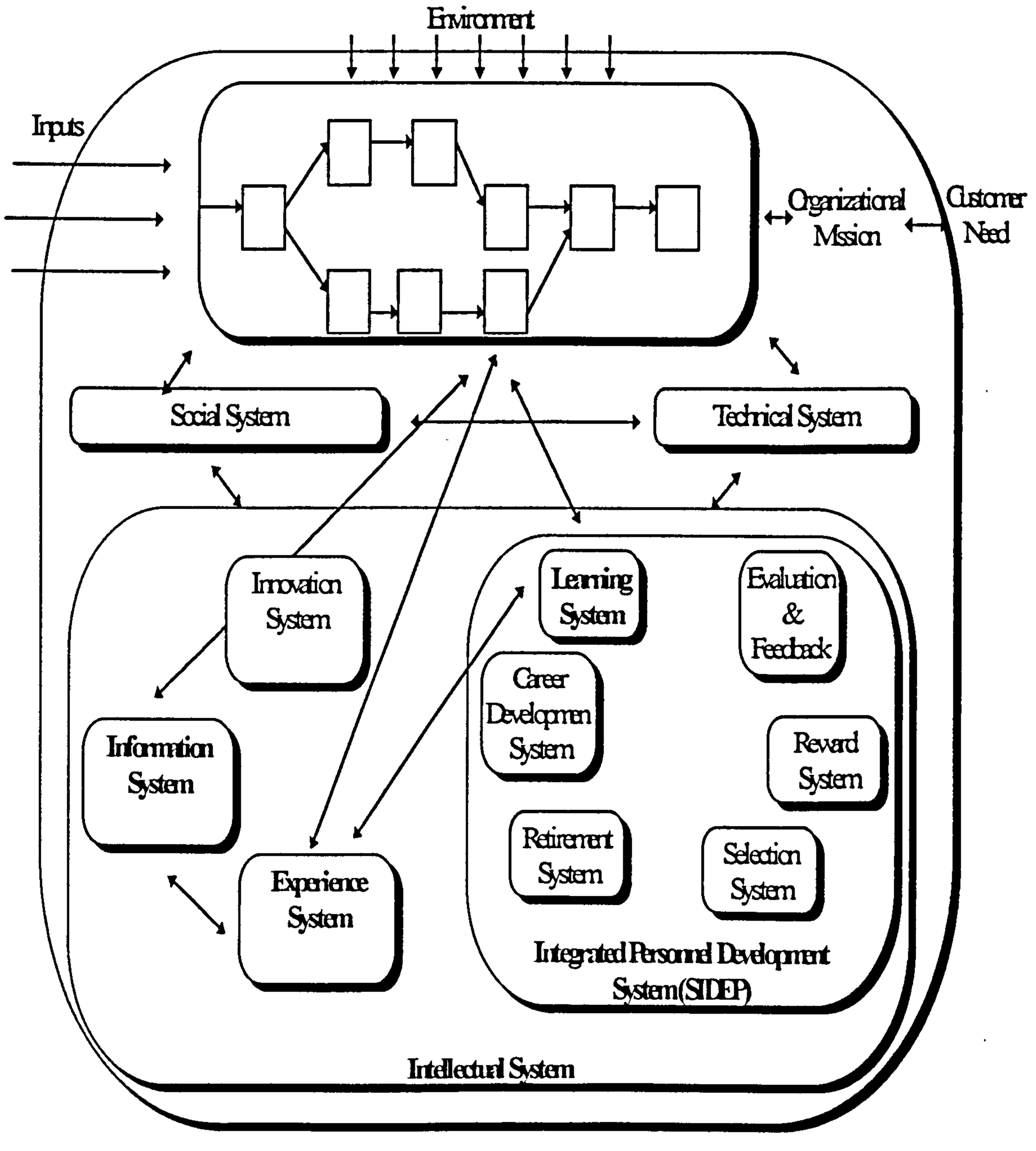

Figure 36. The systems analyzed and developed in the Bancomer IC management project.

8.3.2. Intellectual Capital Project.

The department of Mortgage Services was providing services to the South Region of Mexico. Due to the high and increasing rate of bad debt and the negative relations between the department and its clients, the direction of the department was considering necessary an extensive revision of organizational processes and a radical change of paradigms. At preliminary high level meetings was decided that this change should be directed towards a client-oriented operation and should be supported by appropriate technology. Furthermore, the attitude of the employees and the way they were performing their job had to become more service oriented.

Although the type of change needed was defined as "radical" and "profound" by the leading team of the Department, the director had disapproved the implementation of Business Process Reengineering (BPR). This was due to negative experience of BPR's application in other organizational units of the bank. On the other hand, Total Quality Management was considered as a relatively slow method for managing change that did not facilitate considerations of potential opportunities provided by information technology.

At the time that the 6 members of the Value Community (VC Inc.) contacted the direction of the Department, the announcement of the newly defined values and mission had already made clear to employees the intention of the Direction to promote certain kind of changes. The Department had 73 full-time employees distributed in three organizational levels:

- One director and five sub directors of the Department of Mortgage Services of Bancomer Bank.
- Sixteen section supervisors.
- Fifty-one employees.

The Department also employed twenty-seven part-time staff. Those according to the decision of the Director of the Department did participate neither in the project nor in the evaluation process. This decision was based mainly to the fact that the activities performed

by part - time staff were not considered to have any potential influence on the objectives of the project.

During the initial scoping activities, ORDIC Users and Organizational Participants (*Executive Team*) applied a number of questionnaires to the employees, to identify their opinion over the need to proceed to the changes announced. The result of this process showed the following:

- 65% of the employees replied that it was not clear to them how the new mission could be achieved and how the new values could be applied to everyday activities;
- 40% of the employees were not identifying themselves with the new values;
- 78% of them needed to be involved in a learning process that would facilitate their integration into the process of change.

These outcomes illustrated a sense of insecurity and confusion on the part of the employees, as well as an interest to be part of the change and collaborate for achieving it.

Based on these outcomes the following steps were implemented:

- The members of the VC Inc. introduced the Socio-intellectual-technical approach to IC management and how this could be implemented through ORDIC method and tools to the director and 5 sub directors of the department (1st organizational level).
- The Socio-Technical systems View of the department was created; this was done in participative sessions of the members of the 1st organizational level, involving members of the 2nd and 3rd level, when appropriate.
- The organizational processes to be revised during the project were defined. These processes were distributed to five teams. The members of the 3rd organizational level that were involved in the processes to be revised composed each team. A sub director coordinated each team.
- The local representative of the VC Inc. together with the corresponding sub director introduced ORDIC method and tools to the members of each team.

- Organizational processes were redesigned and documented in participative sessions, using different ORDIC tools.
- The inventory of corresponding skill development was defined.

Initially, the Executive team, formed by the members of the 1st organizational level and the ORDIC Users, defined the Socio-Technical systems View of the department. Participative sessions and individual interviews were used to involve all the employees in the implementation of the new mission of the Department. The requirements for implementing this mission, necessary inputs and existing structural problems were defined participatively. ORDIC's Socio-Technical systems view was used to integrate the opinion of the members of the department. The result of this process is presented in Figure 37. From the diagram it was concluded that the central driver of change were the employees. They should be actively involved in the detailed revision and redefinition of organizational processes. Furthermore, extra emphasis should be put in defining organizational and individual requirements on skill development in order to evaluate alternatives of appropriate learning services offered by educational institutions.

A second application of ORDIC's tool Socio-Technical systems view was considered necessary at that point. This, in order to visualize the elements related to personnel's skill development (see Figure 38). Based on the requirements for designing a customized learning system, first the organizational processes of the department would be revised and when necessary redesigned in a participative form. Based on the new processes, departmental and individual skill development requirements would be defined. External training service providers would be invited to present designs of training programs that meet these requirements. The proposals would be evaluated and the most appropriate would be selected and implemented. A certification process would be designed to validate the development of required skills. According to the agreement between the VC Inc. and the Direction of the Department, ORDIC Users would support the redesign of the processes and the development of the inventory of required skills.

Environment

- Bancomer's organizational culture
- Economic situation in the region
- Increase of companies that offer similar services

Inputs

- Employees
- Market requirements

Requirements

- Focus on the customer by implementing more efficient process.
- Design and offer packages of financial services based on the market's needs.
- Redesign personnel activities.
- Support working systems with adequate technology.

Mission

Decreasing rate of delinquent portfolio. Become the best option of customers in the country in terms of mortgage services

Structural Problems

- The department has rigid processes with high operational costs.
- The information is dispersed in different and non-integrated systems.
- Employees lack of necessary skills.
- Few financial resources.

Figure 37. Sociotechnical systems view of the department of Mortgage Services.

Environment

- Bancomer's organizational culture
- Personnel's learning culture.
- Economic situation in the region

Inputs

- Employees
- Learning Consultants
- Organizational processes

Requirements

- Revise and redesign organizational process.
- Apply ORDIC in the definition of individual learning requirements.
- Develop departmental inventory of required skills.
- Invite educational institutions to present proposals of customized learning systems to develop required skills.
- Evaluate proposals and select provider(s).
- Implement learning systems.
- Certify developed skills

Mission

Design systems that support the development of learning skills to the employees of the department.

Structural Problems

- There is no structured program for skill development.
- There is not a clear link between actual offer of educational institutions and general learning needs of the Department.
- There is not an inventory of job related skills.

Figure 38. Sociotechnical systems view of the learning subsystem.

Nine key processes were selected in order to be analyzed in parallel by each one the employees that were involved in their execution, coordinated by a sub director. Due to the fact that the analysis of the nine processes was done in a similar way, in the following will be presented the revision and redesign of one of them, the process of *Resolutions to Customer Doubts*.

The process of Resolutions to Customer Doubts is part of the responsibility of the Customer Service Section. Three main roles are involved in the process: "In-Voicer", "Faxer" and "Clarificator". The specific activities of these roles are presented in Figure 38a. These roles are distributed among the eleven employees of the Section. Out of the eleven employees three were directly involved in the project of revision, one for each role. They worked together with the coordinator of the section, forming what was nominated a *process-group*.

The Executive Team defined the overall revision process for the project as follows: once every week each process-group would present its progress at an intra section meeting, receiving feedback from the members of the section. Once every three weeks each process-group would present its advance to an inter section meeting, coordinated by the sub directors and director of the department together with the representative of the ORDIC Users.

During the revision of the process of Resolutions to Customer Doubts, initially the Stakeholder Analysis Table was used (see Figure 39), to define the activities of each role, the main problems related to these activities as they were perceived by the role holders, and define possible routes to solutions.

Position	Principal Objectives and Tasks	Principal Problems	Requirements / Proposed Solutions
In Voice	1. Receive Customer's Information and Doubt. 1.1. Consult corresponding information in the information system "Altamira". 1.2. Register event in the information system "Altamira".	- Lack of access to information due to technical problems of the "Altamira" system.	- Simplify searching functions of "Altamira" system. - Eliminate technical problems
	2. Decide if an clarification should proceed. 2.1. Consult general criteria and mortgage proceedings in the information system "Altamira". 2.2. Apply criteria to case in hands.	- Lack of skills for interpreting information on the "Altamira" system. - Lack of knowledge of the basic mortgage proceedings.	- Redesign and update information manuals according to the particular needs of this role. - Develop skills and supporting tools for this function.
	3. Inform the Customer.	- Customers often have aggressive attitude	- Develop skills for treating "difficult" Customers.

Figure 39. Example of Stakeholder Analysis Table of the Customer Services Section[3].

- The information generated was then used to redesign the process. The Group decided to focus on the human aspect rather on the process itself. They decided to use ORDIC's Socio-Intellectual-Technological tool, instead of tools they already knew, such as the traditional Data Flow Diagrams or its variants used in Business Process Reengineering or Information Systems development projects. Initially, the actual distribution of activities among the members of the social system and information system was modeled (see Figure 38a).

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3 Presented with permission from the Mortgage Department of Bancomer Bank.

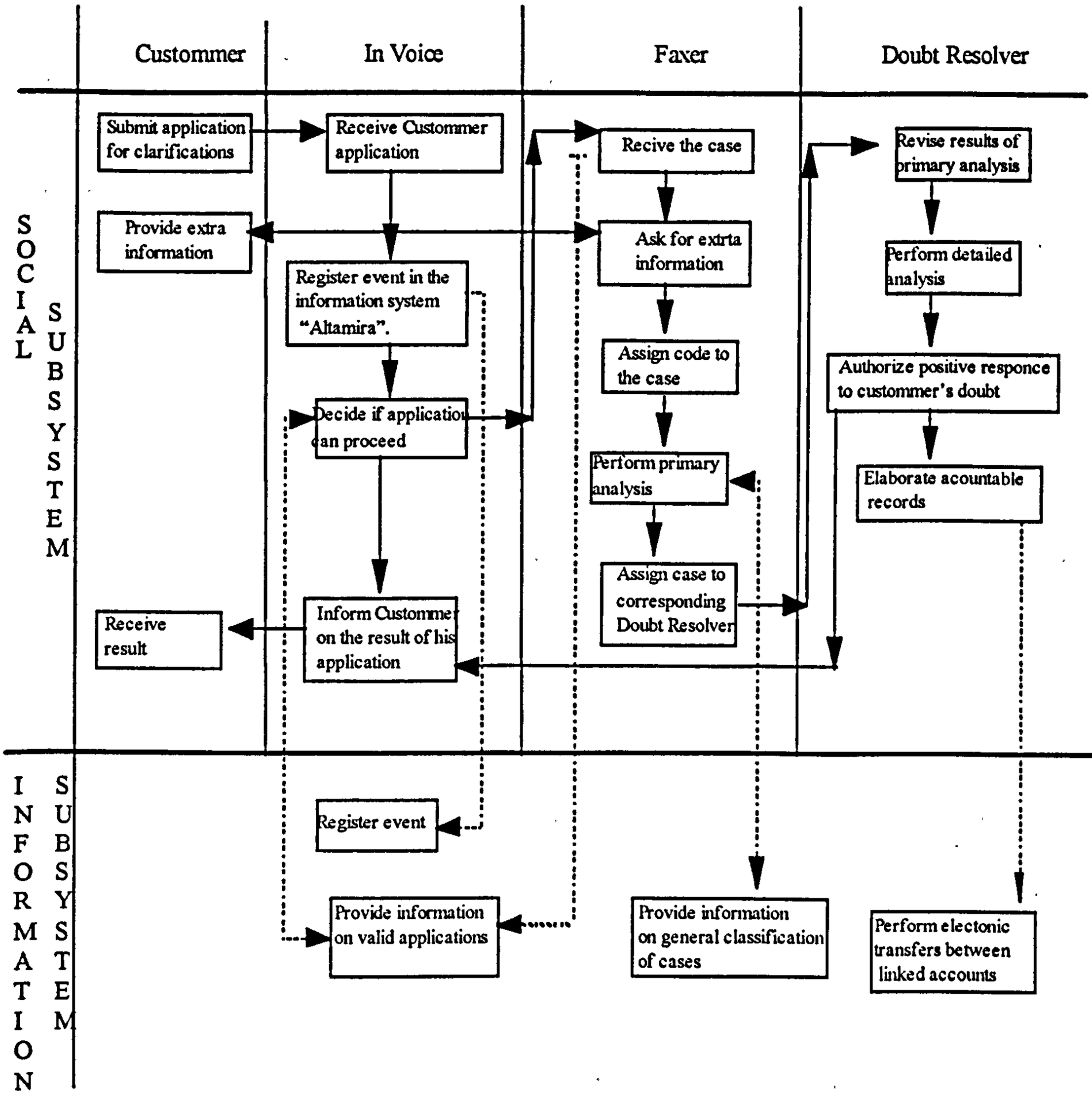

Figure 40a. Socio-Intellectual-Technological representation of the actual process of Resolutions to Customer's Doubts[4].

The model was revised participatively by the members of the Customer Service section as well as by the Department. The following conclusions were reached:

- There is an excess of repetitive activities when a case is passed from one role to

another.

- The customer gets the impression that several employees and a lot of time is needed to provide a simple service.
- Intermediate information is not captured at the moment that it is initially generated.

The information systems need to be redesigned to support users in a more efficient way.

Based on these conclusions, a new meeting was set to define the principal lines of change towards the new process for Resolving Customer Doubts. These were defined as follows:

- The interface with the information system should be more user friendly to facilitate queries.
- A new role should be designed (*Analyst/Advisor*), integrating the activities of the three actual roles.
- The empowered role should be in charge of a case from its generation to its resolution.
- Skill normalization, development and certification processes should be established, to ensure that all Analysts/Advisors were equally skilled.

Using ORDIC's Socio-Intellectual-Technological tool, the new distribution of activities between the members of the social system (analyst/advisor) and information system was modeled (see Figure 40b). This diagram became the basis for the change that was proposed in the Customer Service section.

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[4] Presented with permission from the Mortgage Department of Bancomer Bank.

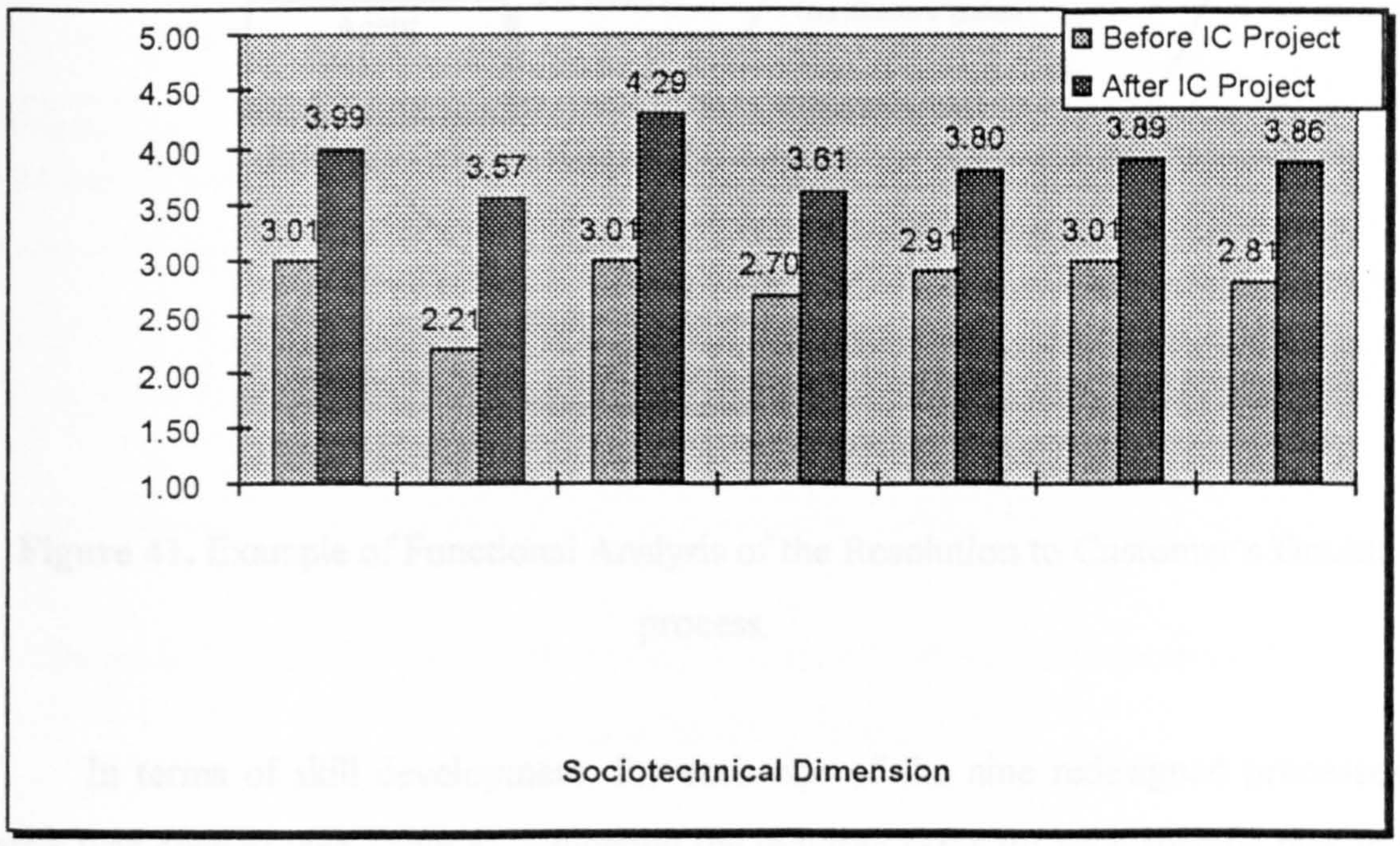

Figure 40b. Socio-Intellectual-Technological representation of the proposed process of Resolutions to Customer's Doubts[5].

Due to the type of activities to be performed by the new role of Customer's Doubts Analyst/Advisor, it became evident that actual employees needed to receive training in order to be able to assume this role. Furthermore, due to the fact that each employee had already developed different skills related to the new role, general purpose courses were considered inappropriate and time consuming. Training should be customized to the specific needs of each employee. To define the specific training needs, it was decided first to generate the general inventory of required skills for the Customer's Doubts Analyst/Advisor. ORDIC's Functional Analysis Tool was used in order to help determine IC (learning and information) and technological requirements for each activity of the new process (see Figure 41). A similar approach of analysis and design was followed in all nine critical processes of the Department. In the inventory generated requirements were classified as (i) *skills* (registered in *italics*); (ii) Information resources (registered in normal) and (iii) **Hardware** resources (registered in **bold**).

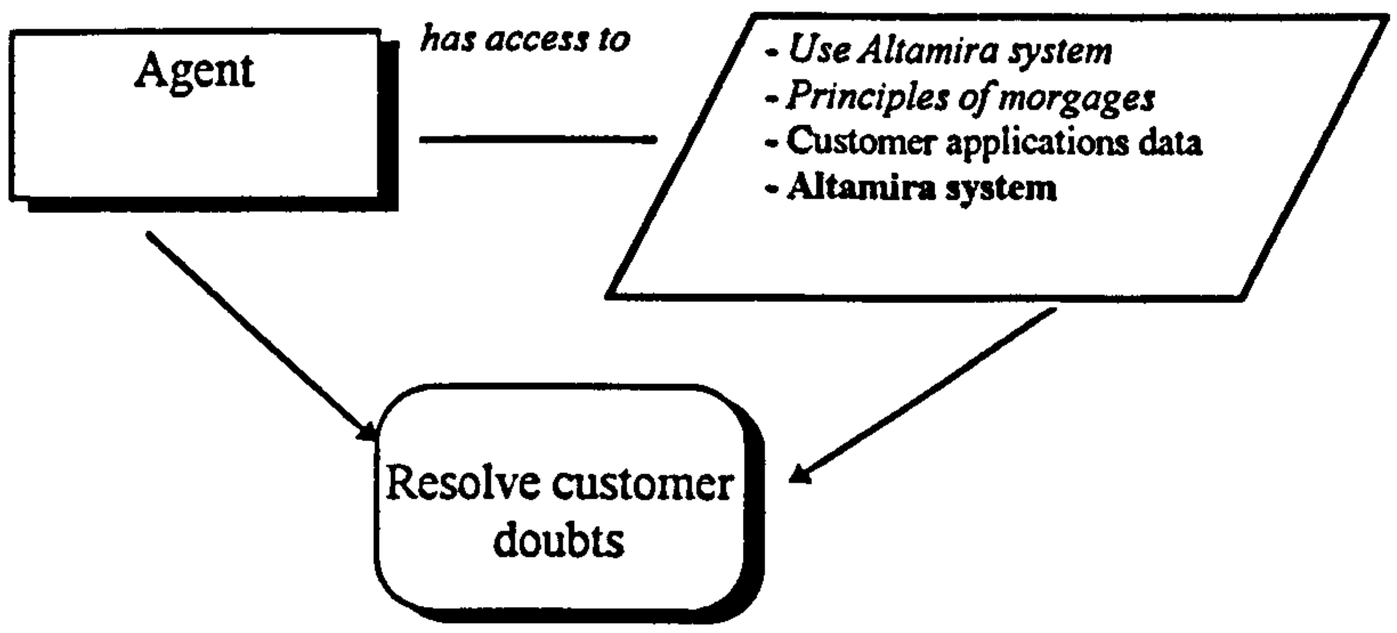

Figure 41. Example of Functional Analysis of the Resolution to Customer's Doubts process.

In terms of skill development, for each one of the nine redesigned processes, a matrix was created (see Table 8), indicating the required skills for each specific task in the department versus the work role responsible for this task. Based on this 'map' of required skills, a 'map' of the existing skills was created for each employee of the Department, including the Director and sub directors. The gap between required and existing skills determined the design of customized training systems for each member of the department, depending on the roles he was performing in the redesigned processes. A similar process of determining required information needs, existing information system's functionality and required hardware permitted redesign the interface of the Altamira information system and renovate the existing information technology infrastructure of the Department. Based on the definition of skill development, information and equipment requirements, the Department invited different provider organizations to present proposals on solutions. The result of this process was the establishment of contractual relationships for development and implementation of customized learning and information systems, and the acquisition of hardware that permitted the implementation of the redesigned processes and the achievement of the overall objectives of the project.

	Employees (Initials)

[5] Presented with permission from the Mortgage Department of Bancomer Bank.

PROCESS	REQUIRED SKILLS	JC	AD	RF	PR	BM	AM	SZ
Resolution to Customer's Doubts	Basic Principles of Mortgages	x		Ä	Ä	x	x	x
	Basic steps for consulting Altamira information system.	x		Ä	x	Ä	x	x
	Basic interpersonal communication skills	Ä		Ä	x	x	Ä	Ä

Ä = *Lack of required skill* **x** = *Existence of skill at required level of expertise* **blank**= *Lack of non required skill*

Table 8. Example of personnel required skill-development for the Resolution to customer's Doubts process[6].

8.3.3. Evaluation of the results obtained through the IC intervention in the Bancomer Bank.

8.3.3.1. Sociotechnical systems evaluation.

The Sociotechnical Systems questionnaire (see Appendix I) was applied to the 73 employees before and after the Intellectual Capital management activities were carried out. As with all 10 cases a change towards more positive assessment on all six Sociotechnical dimensions is apparent after the Intellectual Capital management (see Figure 42).

[6] Presented with permission permission from the Mortgage Department of Bancomer Bank.

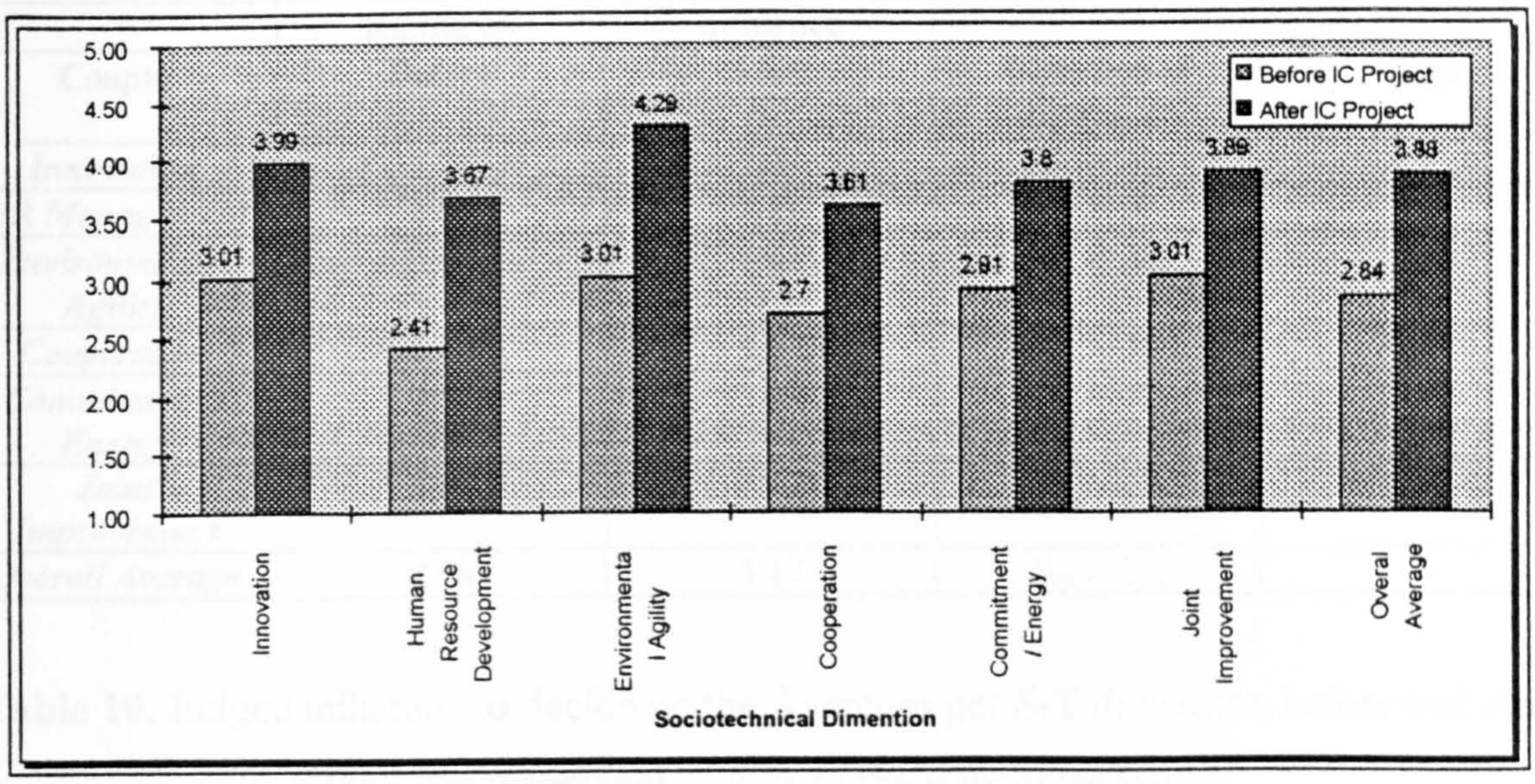

Figure 42. Averages per S-T dimension before and after the IC management project in the Department of Mortgage Services of the Bancomer Bank.

In the chart it can be observed that, although a change towards a more positive assessment in all six dimensions was registered in the Department of Mortgage Services, the *Innovation, Human Resource Development* and *Environmental Agility* dimensions had relatively more change than the rest of the dimensions. This was explained by the fact that these dimensions were directly related to the primary goal of the project, defined as "become the best option for customers in terms of mortgage services in the country, and decreasing rate of delinquent portfolio by innovating the way work is done and the service provided to customers". The detailed results for each dimension are presented in Appendix VI.

Due to the fact that the data from which the chart in Figure 42 is drawn are neither ratios nor interval, the use of averages is not considered acceptable. So a Sign test was performed on the data in Table 10, treating the averages as ordinal measures. The Null hypothesis of no change from Before to After was rejected at a = 0.05.

	Rating on	Influence		
Couple	**Before**	**After**	**Direction of difference**	**Sign**
Innovation	3.20	3.36	$X_B > X_A$	+
HR Management	2.84	3.49	$X_B > X_A$	+
Environmental Agility	3.67	3.83	$X_B > X_A$	+
Cooperation	2.49	3.27	$X_B > X_A$	+
Commitment / Energy	2.67	3.09	$X_B > X_A$	+
Joint Improvement	2.98	3.77	$X_B > X_A$	+
Overall Average	2.98	3.47	$X_B > X_A$	+

Table 10. Judged influence to decide on the Averages per S-T dimension before and after the IC management project in the Bancomer Bank.

8.3.3.2. Evaluation of the ORDIC tools from the Organizational Participants of the Department of Mortgage Services of Bancomer Bank.

In order to measure the functionality of each one of the ORDIC tools and receive feedback from the users-employees of the Department of Mortgage Services of Bancomer Bank, the ORDIC questioners were applied (see Appendix II). Since all 73 employees of the Department participated in the projects either as designers or by revising the models and providing feedback, ORDIC questionnaires were applied to all of them.

In general, from the responses one can see the acceptance the tools had among the members of the Department. In Figure 43 is presented the mode of the evaluation of each tool used in the Bancomer project, as well as the overall mode of the five tools.

The detailed results of the data analysis for each one of the ORDIC tools are presented in Appendix VII. In the Department, some of the employees were familiar with Business Process Reengineering (BPR) tools for redesigning organizational processes. Others were familiar with Information systems design methods and tools. They compared these tools with ORDIC's Task Analysis and S-I-T tools. According to their comments,

they liked better the ORDIC tools because apart from the process: (i) both Task Analysis and S-I-T tools invite designers to explicitly consider requirements on information technology and people skills development; (ii) the S-I-T tool makes even more explicit these requirements at individual employee level.

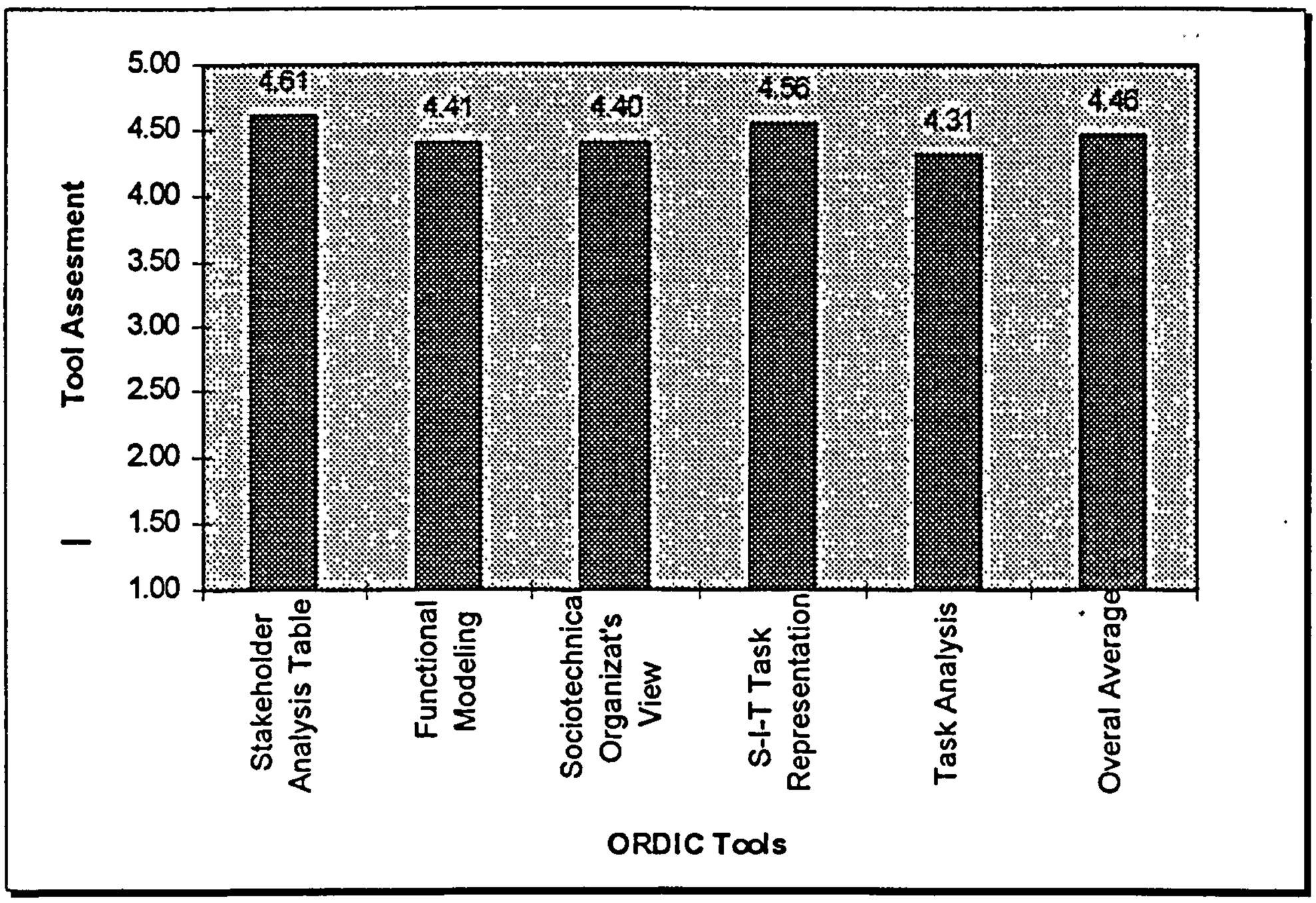

Figure 43. ORDIC Tools evaluation by Organizational Participants in the Bancomer case study.

8.3.3.3. Evaluation of the ORDIC tools from the ORDIC Users of the Department of Mortgage Services of Bancomer Bank.

In order to measure the functionality of each one of the ORDIC tools and receive feedback from the 6 ORDIC Users who participated in the Bancomer project, the ORDIC questionnaires were applied (see Appendix II). In general, from the responses one can see the acceptance the tools had among the ORDIC Users. In Figure 44 is presented the rating each tool received by ORDIC Users and the overall mode of ORDIC tools used in the

Bancomer project. The detailed results of the data analysis for each one of the ORDIC tools are presented in appendix VIII. ORDIC Users consider the contribution of each one of tools as valuable as far as participative requirement definition, scenario generation and evaluation is concerned. Furthermore, after the end of the Bancomer project, all six ORDIC Users joint the Virtual Center for Intellectual Capital Management and continued promoting the ORDIC tools as part of consulting services they provided to companies.

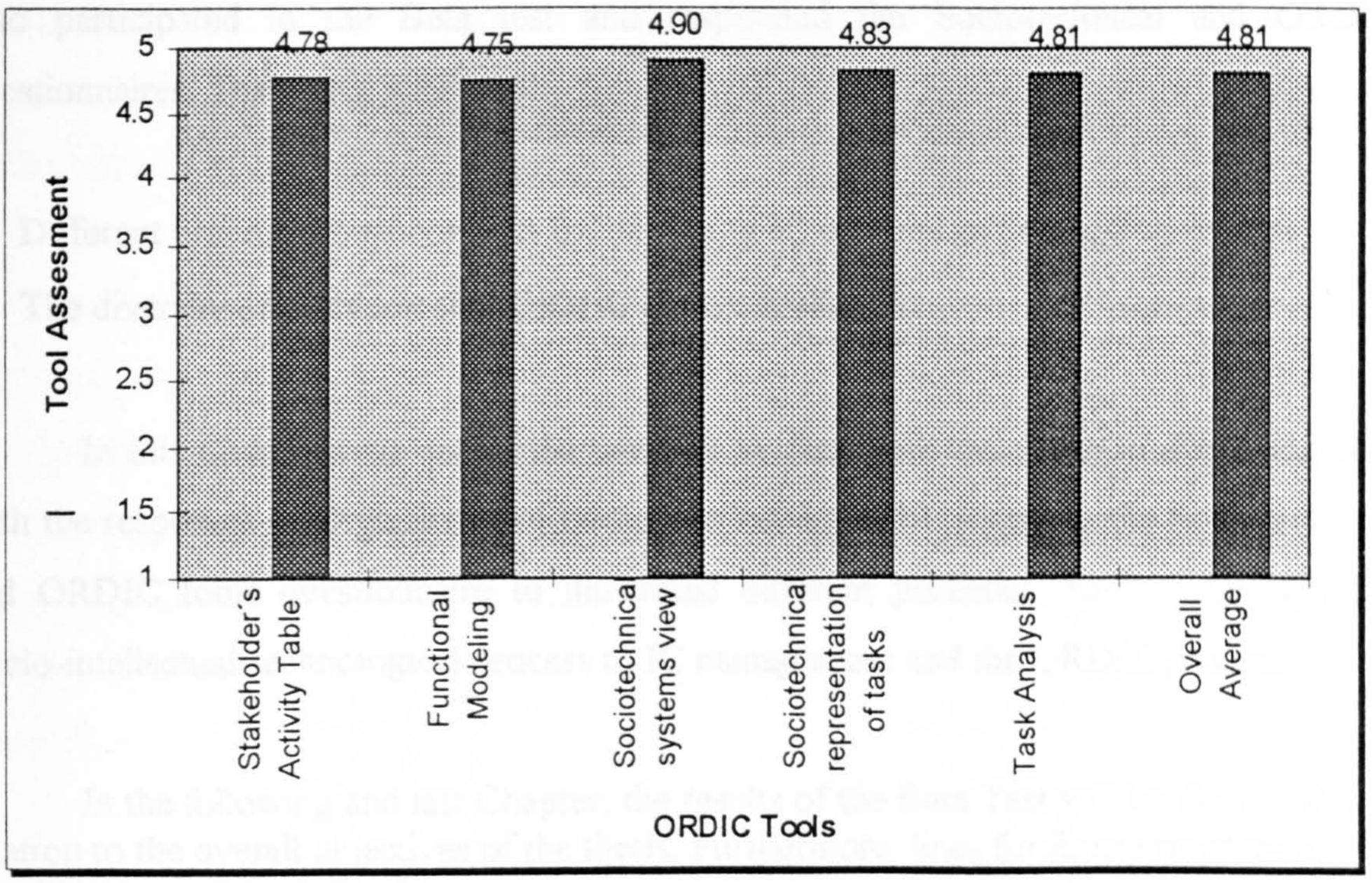

Figure 44. ORDIC Tools evaluation by ORDIC Users in the Bancomer case study.

8.4. Conclusions.

In the previous Chapter were presented 10 IC case studies developed as a result of consulting projects carried out during the ORDIC Beta Test. Postgraduate students that participated to the virtual course "Participative Working Systems" during the first semester of 1997 performed these projects. In Chapter 7 were also presented the results of the macro analysis of the responses of 233 Organizational Users and 58 ORDIC Users who participated in the Beta test and responded the Sociotechnical and ORDIC questionnaires. The above illustrated:

- Different organizational contexts for designing IC systems and managing change.
- The diversity of problems that ORDIC can be applied to.

In this Chapter two out of the ten case studies were described in depth together with the responses of Organizational Participants and ORDIC Users to the Sociotechnical and ORDIC tools questionnaire to illustrated different potential "routes" through the Socio-intellectual-technological process to IC management and the ORDIC process.

In the following and last Chapter, the results of the Beta Test will be discussed in relation to the overall objectives of the thesis. Furthermore, lines for future research and development will be defined.

CHAPTER 9.

DISCUSSION

9.1. A summary of the major findings.

In this thesis, Intellectual Capital of an organization was studied. That, in order to define its elements in administrative terms and facilitate the proposal of a method appropriate to its human oriented nature for managing it. A method was then developed and tested in the field.

Initially, the evolution of social and organizational systems was presented with the objective to position the reader in the Knowledge era, were Intellectual Capital is the main force of economic development. Romer's theory of endogenous economic growth was introduced, were the main source of development is people's ideas. Florida and Kenney's [1993] participative model of a knowledge based innovation mediated process of mass production for achieving endogenous growth was then presented.

Based on these antecedents, the different views of academics and practitioners on the concept of the Intellectual Capital of organizations were introduced and analyzed. This analysis was based on the distinction between Tacit and Explicit Knowledge and the fact that knowledge creation occurs through the interaction of these two types of knowledge. As part of this analysis the three predominant views on knowledge creation were presented:

- The Western, were the interaction between tacit and explicit knowledge tends to take place mainly at individual level, with a few individuals playing a critical role.
- The Japanese, were the interaction between tacit and explicit knowledge takes place at group level, and its tendency is to overemphasize the use of figurative language and symbolism at the expense of a more analytical approach and documentation.

- The one presented by Nonaka and Takeuchi [1995] that integrates the merits of the previous two models of knowledge creation.

In this terms, being compatible with Nonaka and Takeuchi's view to knowledge creation and parting from a management perspective, in the context of this thesis specific steps were taken in terms of developing the theoretical basis and practical tools for managing organization's Intellectual Capital.

First, Intellectual Capital was defined as the combination of intangible assets, referring to the skills, information, innovation, experience and attitudes of the individuals of an organization that they help them perform with excellence their activities, supporting the effort for achieving organizational goals.

Then, in order to facilitate the management of Intellectual Capital of organizations, the iterative Process of Intellectual Capital management was developed.

Furthermore, a systemic and human oriented approach was proposed for managing IC, the Socio-Intellectual-Technical approach. According to this approach an organization should facilitate the implementation of participative development of IC systems to support the management of innovation, skills, information, experience and attitudes as the means for managing Intellectual Capital.

Then, in order to implement the above mentioned process and approach in an organizational context, the need for a method became apparent. The characteristics of the method were defined. Existing methods for facilitating change management as well as information systems design were revised to find out whether they were satisfying the requirements for the IC management method. Due to the fact that only some of the methods were satisfying part of the requirements, a new method, ORDIC, and its corresponding tools were developed. ORDIC (Organizational Requirements Definition for Intellectual Capital management) is a formal method for requirements definition to be used as the basis for the design of Intellectual Capital systems.

To develop ORDIC, the iterative Intellectual Capital management process was followed. During the first part of this development, ORDIC was implemented by its developer in more than 35 projects in the corresponding companies and passed successfully its Alpha test. A Beta test was designed and implemented, were the operational version of the method was applied by practitioners others than its developer. Ten Intellectual Capital management projects were performed and documented in the corresponding case studies. The analysis of the results of these projects showed the following:

- The ten companies managed effectively their Intellectual Capital by applying the process and approach and developing the corresponding systems.
- What the companies did in order to manage skill development, innovation, information, experience and attitudes is compatible and congruent with the theoretical background of IC management.
- In general, the experience of using ORDIC in managing organizations Intellectual Capital, was very satisfying due to the fact that it was well accepted by the client-companies and their employees.
- An additional factor to this acceptance was the fact that due to their positive influence on business results, Intellectual Capital management projects with a particular division or company of large corporate consortiums, escalated to contracts that contemplate the development of Intellectual Capital systems for all companies of the consortiums.
- On the other hand, people who used ORDIC during the IC management projects, adopted it for doing there everyday activities and/or decided to become IC management consultants.
- Feedback from people who compared ORDIC tools with TQM or BPR tools showed that ORDIC tools address effectively the Agent problem and were preferred over other tools.
- Furthermore, the fact that during the Beta test no elements of improvement on the tools were necessary is considered an advantage of the iterative way the tools were developed during the Alpha test of the method and additional evidence to the success of the Process for managing organizations IC that was used to develop

ORDIC.

These results of the Beta test, show that the Socio-Intellectual-Technical approach, the IC management Process and ORDIC method and tools work, which is considered by the author a success.

9.2. Lessons Learned.

9.2.1. Introducing participative concepts to autocratic environments.

It is the author's opinion that the most important lesson learned during the development of this thesis is related to the introduction of participative concepts, methods and tools to highly hierarchical environments. As it has already been mentioned, the development of the approach and method to manage IC was based on their continuous application and improvement, through consulting services provided to companies in Mexico, Honduras and Venezuela. The predominant organizational culture in these companies was highly hierarchical. Ideas such as democratization of the working place, increasing employee participation or participative decision making were not welcomed in the majority of the cases. The author was not aware of that at the beginning of this work. Accustomed to the British and Scandinavian approach to this kind of research, he tried unsuccessfully to persuade prospect clients-companies on the advantageous of participation.

Reflecting on the reasons for the negative response the author realized that promoting a new method such as ORDIC as a participative method, or talking about the benefits of participative design of IC systems in organizations with an autocratic culture was not an appropriate strategy for achieving the objectives of the research. Furthermore, the author realized that both ORDIC and the IC approach and process could be applied by decision makers independently of the organizational culture.

A different approach was then adopted. Instead of talking about participation, attention was focused on the problem the client company was facing, on analyzing it, and looking for solutions and their implications. In other words, instead of promoting the characteristics of ORDIC and the advantageous of participation, the effort was focused on the process of IC management and its implementation. During this process participation of new members was progressively increasing: without making any reference to participation, a participative approach was followed, through which more and more organizational members were invited to participate. Invitation were based

on:

- The domain knowledge required by the problem in hand.
- The incompetence of current participants to solve the problem, define specific IC requirements and/or design corresponding systems due to their lack of required domain knowledge.

Once implemented this strategy, one of the findings was that in this way the research could proceed very quickly. Another finding was that client companies were receiving the benefits of participation and solving their problems without realizing that the whole organizational culture was changing towards a more democratic one. In other words, they were applying participative design and receiving its benefits at tacit level without realizing at explicit level.

From the above it was concluded that to implement ORDIC and the IC management approach one should focus on the clients problem and apply the process of IC management and participation rather than "convince" or talk about it.

9.2.2. Integrating the academic and business approach to the process of Research and Development.

Derived from the above, another lesson learned was that in order to involve a company to field research the results of the research must be beneficiary for the company in the sense that they must provide a practical solution to a real problem the organization faces. Which brings up the subject of the importance of applied research and pure research, a subject that in certain extent defines the differences between the way many academics and businessmen see research. This work gave the author of this thesis the opportunity to experience both:

- the world of an academic who develops a idea and tries to prove its congruency and value at theoretical level, and
- the world of a practitioner - consultant, who tries to sell this idea in a practical and applicable way to companies whose interest is to increase their revenue.

What the author found out is that generally speaking, academics and businessmen see themselves as people who leave in two different worlds and do not have the interest or can not communicate. Academics are interested on pure research funded by someone else who just put the money for them to investigate and does not ask for practical and sustainable results. Businessmen on the other hand are interested on practical and financially sustainable applied research or innovation.

The author's experience during this research is that both views of the world are equally important. As an academic one should develop a new idea for solving a problem and create a solid theoretical background to support it. That is necessary not only for defending it against other theoretical approaches to the same problem, but also to make sure that once brought into practice, the new idea would not collapse from its lack of consistency at theoretical level. Now, once brought into practice, the idea should be practical, cost effective, easy to understand, use and apply in everyday problems, providing sort and long term positive results.

Based on the results presented in previous Chapters, in these terms the author believes that the ORDIC method and the Intellectual Capital management approach developed in this research project satisfy both academic and business requirements, something that the author considers a success.

9.3. Future research.

9.3.1. Trying out ORDIC and IC management approach in different environments.

According to Eva Kras [1991], in Mexico, the characteristic that play a major role in the administration of the organizations is the paternal style of management combined with authoritarism. Historically, Mexicans have lived in a culture where the main social behavioral pattern has been the one of having the father protecting his children, combined with an unconditional obedience to the father. This paternalism is reflected in the society as well as the companies. Most Mexican companies belong to families, they have been born and grown from the father and inherited to the son for various generations [Kras, 1991].

Within the Mexican industry, the implementation of change in organizations, is done in an autocratic pattern. Due to the cultural background, decisions in this country are made by the high ranking managers, without considering the opinion of the people who will be affected by these decisions. On the other hand, the predominant tendency in Mexico is to individualize the benefits obtained in projects. Consequently, the leaders keep a tight control, generating mistrust and disbelief to employees. This makes change to be implemented just because the boss wants and not for its own essence [Kras, 1991].

This paternal and authoritarian environment is not compatible with participative concepts and principals. According to Kras [1991], viewing it from the decision making point of view, employees, supervisors and in some cases even managers have lost their skill of taking decisions. The can not take initiatives. Their actions depend totally to the opinion of their boss or the authorities. Employees lack of satisfaction and most of the time resist to change. According to the author's experience, the above mentioned situation in Mexican companies is representative for Latin American companies in general.

ORDIC and the Socio-Intellectual-Technological approach to IC management, worked successfully in such an environment. Furthermore, there is evidence that has influenced the organizational culture of the companies towards a more participative one. In terms of further research it would be interesting to test both of them on environments less authoritarian and in countries other than Latin American.

9.3.2. The development and evaluation sub process of the process of IC management.

Generally speaking, it is far easier to diagnose a problematic situation of a system than to find an inventive solution to the problematic situation that makes the system evolve. Focusing at the scenario development and evaluation Sub process of the IC management process (see Sub process 3.0 of Figure 1 in Chapter 3), this is the one that Intellectual Capital consultants usually do not address, limiting their services to the first two "diagnostic" sub processes (*1.1 Define desired state of affairs (goals/needs)* and *1.2 Define actual state of affairs*), leaving the toughest one to their clients. As an example of the above, see the process of IC management proposed by Any Brooking [1996]. That is mainly due to the fact that action plans (design scenarios) generation and evaluation has to do with predicting the future (forecasting) and with inventive problem solving (innovation).

But what is it that makes forecasting and inventive problem solving so difficult? Are there any supporting tools and techniques and why are their advantageous and disadvantageous? And most important, how can they be used in the implementation of the Intellectual Capital management process? ORDIC method and tools, and the approach proposed provides a solution towards this problem by facilitating participative modeling of possible solutions and participative forecasting of there implications. Nevertheless, considering the developments in forecasting technologies, these, once incorporated, could enrich the implementation of IC management process.

Although forecasting technologies are not considered part of this research,

results of preliminary investigations performed by the author showed the following: as a response to the great demand, various forecasting techniques have been developed. Several of them, such as linear extrapolation, morphological method, Delphi method, interlocking matrix, relevance tree, dynamic simulation model, have found some applications. While being different and generally useful, these techniques share common philosophy and constraints [Martino, 1993]:

- Traditional forecasts deal with parameters (e.g., speed, weight, power, fuel efficiency, etc.) rather than with structures that realize these parameters. They say nothing as how to achieve these parameters.
- It has been almost unanimously concluded among the experts that inventions and discoveries shaping the future fundamentally cannot be forecasted.
- There are no objective criteria that allow for selection of the most promising forecast alternatives and their successive evaluation.
- The reference ground for the traditional forecast is a technological capability of the systems being foreseen. Yet, many consumer products intended to please various people's tastes (e.g., jewelry, perfume, apparel, furniture, etc.), cannot be described only in conventional engineering dimensions and, therefore, are not subjects for such a forecasting analysis.

These constrains, should be considered as additional specifications for future improvements of the ORDIC method for managing organizations Intellectual Capital.

In terms of IC management, it is the author's belief that the *participative, analytical, modeling* and *solution tools* of ORDIC can be applied together with other forecasting methods to support forecasting, evolution, development and implementation of IC management systems. As it has been already mentioned, although ORDIC tools are actually capable of supporting the above mentioned activities, the author believes that the combined use of other forecasting tools and ORDIC tools:

- Would still enrich the conceptual solutions obtained participatively.

- Would help to reveal *faster* and eliminate *earlier* any feasible harmful effects associated with various factors such as possible flaws in the future IC systems performance, environmental and/or social impact they might put forth, their influence on the overall system, etc.
- Would support the most effective development and implementation strategy, or scenarios and in this way.
- Would convert forecasting results into the development of specific designs and/or processes whose implementation could start immediately.

9.3.3. Development of Computer based modeling tools for ORDIC to facilitate design and manage the documentation generated with ORDIC.

Due to the acceptance and use of ORDIC, there is a great demand for computer based ORDIC tools. Although this is not considered as part of this research work, the development of this tools has already been started. It follows a brief description of the initiatives already taken in this direction, which are also considered as part of the future research based on this research work.

The development of ORDIC software tools surged from the need to enable and facilitate activities such as: (a) social interaction in multi-user information and knowledge visualization systems; (b) visualization of multidimensional information spaces; and (c) visualization of large, dynamic information collections; generated during the process of Intellectual Capital management.

A collaborative project has already been defined between the CVACI (Virtual Center for Intellectual Capital management) and the Laboratory for Advanced Learning Systems (LALS) of the ITESM university system in Mexico. Furthermore, search for other partners continuous. The objective is to "develop computer - based Modeling Tools for ORDIC, that facilitate social interaction for the design of systems to manage Intellectual Capital."

The final product is defined as "a data base together with a strong visualization

interface". As a first step this visualization tool should be based on applications on the Internet (Netscape interface) or Lotus Notes. As a second step, the visualization tool should be replaced by virtual reality applications. This is in order to (a) satisfy the short term need of clients (manage Intellectual Capital and use a Netscape-like interface); (b) generate a strong income for the CVACI through the projects of IC management supported by ORDIC software product version 1.0.; (c) create the market need for managing Intellectual Capital by using Virtual Reality tools - so that clients will not think of virtual reality as "science fiction"; and (d) develop and promote ORDIC software product version 2.0 (Virtual Reality ORDIC).

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APPENDIX I

STS ASSESSMENT QUESTIONNAIRE (STSAS)

Introduction: This instrument is intended for use in assessing organizations to determine the extend to which their designs are consistent with sociotechnical systems (STS) principles, which have been demonstrated to produce high levels of commitment and performance. The STSAS may be administrated to an entire organization or to sub units. It may be used prior to a sociotechnical systems intervention to guide organizational improvement; or during or after an intervention to assess progress in designing the organization for high performance.

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Dimensions: The STSAS measures six dimensions of sociotechnical systems designs, defined as follows:

Innovativeness: The extent to which organizational leaders and members maintain a futuristic versus historical orientation; their propensity for risk taking; rewards for innovation.

Human Resource Development: The extent to which the talents, knowledge, skills and ability of organizational members are developed and tapped; work design; supervisory roles; organizational structure; workflow structure.

Environmental Agility: The extend to which organization maintains awareness of the environmental and responds appropriately to it; customer importance; proactivity vs. reactivity; structural flexibility; technical flexibility; product-service flexibility.

Cooperation: The extend to which individuals and sub units work together to accomplish goals; teamwork; mutual support; share values; common rewards.

Commitment-Energy: The extend to which organizational members are dedicated to accomplishing organizational goals and are prepared to expend energy in doing so; reward systems; information availability.

Joint Optimizations: The extent to which organization is designed to use both its social and technical resources effectively; variance control; the appropriateness of technology; the extent to which technology is designed to support teamwork, flexibility and changes in organizational structure.

Instructions: Each dimension of STS design is measured by several questions. Since organizations are unique in terms of their history, goals, social systems, technical systems and environments, not all questions will apply to every organization; nor will the high end of each scale be ideal in every instance. Generally speaking, however, the closer the organization is to the high end of each question ("5" on the five-point scale) the more it conforms to STS design principles.

respondents should read the descriptions of the endpoints and midpoint for each question and then circle a number from 1 to 5 which most closely approximates their view of their organization or unit. For example, the "2" circled in the question below would indicate that the person

completing the survey felt that his-her boss shared some, but a relatively small amount of information concerning the state of the business:

Sample Question:

My boss never shares any information about the state of the business with me	My boss shares some information about the business with me, but not on a regular basis	My boss shares a great deal of information about the business with me in regularly scheduled meetings for this purpose

1 ② 3 4 5

Once all questions have been completed, respondents may choose to transfer their scores for each question to the summary sheet at the end of the survey in order to view the overall pattern of scores.

INNOVATIVENESS

Time Orientation

Question 1

Management is more concerned with preserving the status quo than with what is happening now or what will happen in the future	Management is more concerned with what happens today than what happened yesterday or will happen tomorrow	Management is more concerned about the future than it is with what is happening today or what has happened in the past

1 2 3 4 5

Question 2

Most people here are c concerned about security; they resist change	Some people here are open to change if it is absolutely necessary and not too disruptive	Most people here welcome change and view it as healthy and non-threatening

1 2 3 4 5

Question 3

New ideas are ignored; the motto is, "Don't fix it if it's not broken"	New ideas are sometimes listened to	New ideas are constantly sought and tried

1 2 3 4 5

Question 4

Past mistakes are never forgiven	Past mistakes are sometimes forgiven	Past mistakes are forgiven; the focus is on how to do it better

1 2 3 4 5

Risk taking

Question 5

Most people here are afraid to take risks	Some people here take some risks, but not big ones	Most people here are not afraid to take risks, especially when they are important

1 2 3 4 5

Question 6

When people take a risk here, they do it alone	When people take a risk here, they are supported by a few others	There is widespread support for risk taking here

1 2 3 4 5

Question 7

People who take risks and fail are punished	People who take risks and fail are not punished, but are told not to try again	People who take risks and fail are not punished and are told to try again

1 2 3 4 5

Rewards for innovation

Question 8

People who help make changes are seldom recognized for their efforts	People who help make changes are sometimes recognized for their efforts	People who help make changes are frequently recognized for their efforts
1	2 3	4 5

Question 9

New ideas are viewed as bothersome and are not rewarded	New ideas are neither encouraged nor discouraged; token rewards are sometimes offered	New ideas are sought and rewarded in a meaningful way
1	2 3	4 5

Question 10

People who try to change things here are not promoted	People who try to change things here are sometimes promoted	People who try to change things here are usually promoted
1	2 3	4 5

HUMAN RESOURCES DEVELOPMENT-UTILIZATION

Opportunities for Learning

Question 11

There are few opportunities here for people to learn new skills or knowledge	There are some opportunities to learn, but few people take advantage of them	There are many opportunities for people to learn new skills or knowledge and most people take advantage of them
1	2 3	4 5

Question 12

People have a lot of potential for growth that hasn't been tapped here	People have grown here, but not as much as I would have liked	People feel like they are working to their full potential here; they have grown a lot
1	2 3	4 5

Question 13

This organization makes it difficult to acquire the skills you need to progress	This organization provides some help in getting the skills you need to progress	This organization makes it easy to get the skills you need to progress
1	2 3	4 5

Question 14

There are no rewards for learning here	There are few rewards for learning here	Learning is well rewarded here

1 2 3 4 5

Question 15

It's difficult to learn much outside of the scope of one's own job	People are allowed to learn a few things outside the scope of their job	People are encouraged to learn as much as they can about all aspects of the organization

1 2 3 4 5

Question 16

No time is set aside for learning	A small time is set aside for learning, but only when it's absolutely necessary	Time is regularly set aside for learning

1 2 3 4 5

Work design

Question 17

Jobs require almost no skill at all; anyone could do them	Jobs require just a few skills, most of which can be learned in a few months	Jobs require many skills which take a long time to learn

1 2 3 4 5

Question 18

People make no important decisions on their jobs; they just do the work as they are told	People make a few important decision about how their work gets on	People make almost all the important decision about how their work gets on

1 2 3 4 5

Question 19

People never knows how their work turns out	People occasionally know how their work turns out but usually only when they make a mistake	People almost always know how their work turns out, whether it's good or bad

1 2 3 4 5

Question 20

People work alone	People work with a team, but they don't switch jobs	People work with a team where they regularly switch jobs with one another

1 2 3 4 5

Question 21

People do the same thing all the time	People do mostly the same thing but occasionally get to do something	People do a variety of different things

	different	

1 2 3 4 5

Question 22

People can't do anything their manager does	People can do a few things their manager does	People can do everything their manager does

1 2 3 4 5

Question 23

People have no technical skills	People have a few technical skills	People's technical skills are excellent

1 2 3 4 5

Question 24

People do only a small piece of the overall task	People do a few pieces of the overall task	People do a whole and complete piece of work

1 2 3 4 5

Question 25

Most jobs make no direct contribution to the final product or customer	Most jobs make a small contribution to the final product or customer	Most jobs make a major contribution to the final product or customer

1 2 3 4 5

Question 26

Most jobs get a little or no respect	Some jobs get respect	Most jobs get a great deal of respect

1 2 3 4 5

Question 27

There are no opportunities to learn new skills	There are few opportunities to learn new skills	There are many opportunities to learn new skills

1 2 3 4 5

Question 28

People don't do any of the support work for their job (maintenance, set-up, quality control, supply, record keeping, etc.	People do a little of the support work when they are told to	People frequently do almost all of the support work required by their jobs

1 2 3 4 5

Question 29

The pace for work is dictated	People have some flexibility over the pace of their work	People have complete flexibility over the pace or their work

1 2 3 4 5

Question 30

People are told what work to do	People can occasionally influence which work they do	People decide which work they want to do

1 2 3 4 5

Question 31

People never get involved in problem solving	People occasionally get involved in problem solving	People are frequently involved in problem solving

1 2 3 4 5

Question 32

People have no influence over the things that determine how well their work gets done	People have some influence over the things that determine how well their work gets done	People have great deal of influence over the things that determine how well their work gets done

1 2 3 4 5

Question 33

Most jobs don't require people to think	Jobs require some thought on people's part	Jobs require a great deal of thought on people's part

1 2 3 4 5

Question 34

Supervisors tell subordinates exactly what to do and then watch to make sure they do it the right way	Supervisors usually tell people how to do things, but are open to a few suggestions	Supervisors explain what needs to be done and let subordinates figure out how to do it

1 2 3 4 5

Question 35

When a problem arises, supervisors step in to solve it	When a problem arises, supervisors will let subordinates solve it if it's not too important	When a problem arises, supervisors count on subordinates to solve it

1 2 3 4 5

Question 36

Supervisors view their role as being in charge and giving orders	Supervisors view their role as fire-fighters, they stay away unless there is a problem; then they step in to make a decision	Supervisors view their role as facilitators; their role is to help the subordinates succeed, not to give orders; they participate in decision-making as a member of the team

1	2	3	4	5

Question 37

Supervisors care only about their own part of the organization	Supervisors focus some energy on what is happening outside of their own part of the organization	Supervisors focus a lot of energy on what is happening outside of their own part of the organization

1	2	3	4	5

Question 38

Supervisors see their role as making sure all the rules are followed, not improving things	Supervisors see their role as improving things as long as no rules are broken	Supervisors see their role as encouraging innovation, even if it means breaking rules

1	2	3	4	5

Question 39

Supervisors seldom tell employees how well they are doing	Supervisors sometimes provide feedback on performance	Supervisors regularly let people know how well they are doing

1	2	3	4	5

Question 40

Supervisors are never selected or evaluated by their subordinates	Supervisors are selected and evaluated by management with employee input	Supervisors are selected and evaluated by their subordinates

1	2	3	4	5

Question 41

Supervisors use meetings for one-way communication from themselves to employees	Supervisors control the agenda al meetings and allow limited discussion	Supervisors facilitate discussion at meetings on topics chosen by their subordinates

1	2	3	4	5

Question 42

When performance problems arise, supervisors deal with the individual one-on-one	When performance problems arise, supervisors ask for input for subordinates and then take action themselves	When performance problems arise, supervisors help subordinates decide what should be done about it as a team

1	2	3	4	5

Question 43

All decisions regarding rewards are decided by the supervisor	Decisions about rewards are made with some input from subordinates	Decisions about rewards are made by subordinates as a team

1	2	3	4	5

Question 44

Supervisors make assignments, schedule work, provide training, review performance and decide on working procedures with no input from subordinates	Supervisors make assignments, schedule work, provide training, review performance and decide on working procedures with some input from subordinates	Supervisors help subordinates make assignments, schedule work, provide training, review performance and decide on working procedures

1 2 3 4 5

Question 45

Supervisors speak to higher management on behalf of their subordinates	Supervisors sometimes allow direct communication between higher management and their subordinates	Supervisors encourage free and open communication between higher management and their subordinates

1 2 3 4 5

Question 46

Supervisors view their presence as essential to the work getting done	Supervisors feel to leave their areas for a short period of time without worrying about the work getting done	Supervisors view their presence as helpful but nonessential to the work getting done

1 2 3 4 5

Question 47

Supervisors are selected strictly on the basis of their technical skills	Supervisors are selected primarily because of their technical skills, but skill in dealing with people are also important	Individuals will not be selected as supervisors unless they have excellent skills in dealing with people

1 2 3 4 5

Question 48

There are many levels of management in this organization	There is an average number of levels of management in this organization	There are few levels of management in this organization

1 2 3 4 5

Question 49

Many polices restrict innovation in this organization	Some policies restrict innovation in this organization	Few polices restrict innovation in this organization

1 2 3 4 5

Question 50

Job descriptions limit what most people get involved with here	Job descriptions are somewhat limiting	Job description either do not exist or do not limit what a person may become involved with

1 2 3 4 5

Question 51

Boundaries between departments and-or divisions often interfere with solving joint problems	Boundaries between departments and-or divisions sometimes interfere with solving joint problems	Boundaries between departments and-or divisions rarely interfere with solving joint problems

1 2 3 4 5

Question 52

Meetings seldom occur across levels or between departments in this organization	Meetings occur across levels or between departments, but not on a regular basis	Meetings across levels or between departments occur regularly

1 2 3 4 5

Question 53

Most people would say that they don't feel as if they were running their own small business within the larger organization	Some people would say that they feel as if they were running their own small business within the organization	Many people would say that they feel as if they were running their own small business within the larger organization

1 2 3 4 5

Question 54

Work is divided so that each sub unit of the organization does only a piece of the overall task; people do not know who complete the task	Work is divided so that each sub unit does only a piece of an overall task; people know who completes the task	Work is divided so that each sub unit of the organization is responsible for making a whole product or providing a complete service

1 2 3 4 5

Question 55

Work is divided so that core work (production, customer interaction) is separated from support work (maintenance, record keeping) and belong to different departments	Work is devided so that core work and support work are separate, but report to the same supervisor	Work is designed so that core work and support work are integrated

1 2 3 4 5

Question 56

There is not stability among the people who work together on tasks	There is some stability among the people who work together on tasks	There is stability among the people who work together on tasks

1 2 3 4 5

Question 57

No one who performs a task knows how his-her work will affect the work of the next person or the quality of the final product or service	Some people know how their work will affect others or the final production or service	Everyone knows how their work will affect the work of the next person or the quality of the final product or service

1 2 3 4 5

Question 58

People identify more with their function or technology than the product they are making or service they are providing	People identify primarily with their technology or function, but are aware of how the product is made or service is provided overall	People identify primarily with the product or service and seldom identify with one piece of technology or function

1	2	3	4	5

ENVIRONMENTAL AGILITY

Environmental awareness

Question 59

The organization does not know what its competitors are up to	The organization has only a partial picture of what its competitors are up to	The organization is well aware of what its competitors are up to

1	2	3	4	5

Question 60

The organization is unaware of technological developments in its area	The organization is somewhat informed about technological developments	The organization is well informed about technological developments

1	2	3	4	5

Question 61

The organization is unaware of political-legal-social developments that might affect it	The organization is somewhat informed about political-legal-social developments that might affect it	The organization is well informed about political-legal-social developments that might affect it

1	2	3	4	5

Customer importance

Question 62

The organization is unaware of what customers think about its products or services	The organization has some idea of what customers think about its products or services	The organization is constantly striving to determine what the customer wants and how to meet customer needs

1	2	3	4	5

Question 63

Only a few people in the organization talk directly to customers to find out what the organization could do to better serve them	More than a few people talk directly to the customers, but most do not	Many people talk directly to the customers to find out what they could do to better serve them

1	2	3	4	5

Question 64

People working on one step of the operation do not regard the people in the next step as their customers. They are not interested in meeting the others needs	People working on one step of the operation will try to meet the needs of the people on the next step only if they are told to do so	People working on one step of an operation regard the people in the next step as their customers and try to meet their needs

1 2 3 4 5

Question 65

No one knows the standards used by customers to judge the quality of the final product	A few specialists know the standards used by customers to judge the final product	Everyone the standards used by customers to judge the final product and how their own work impacts quality

1 2 3 4 5

Proactivity versus reactivity

Question 66

The organization does not respond to changes in its environment unless it is forced to do so	The organization sometimes responds to changes in its environment without being forced to do so	The organization anticipates changes in its environment and prepares itself for them in advance

1 2 3 4 5

Question 67

The organization simply accepts all demands the environment makes and tries to meet them	The organization accepts most of the demands the environment makes	The organization works actively to change certain demands the environment makes if those demands are likely to do harm to the organization

1 2 3 4 5

Structural Flexibility

Question 68

The organization is unable to adapt to changes because of its existing structure and policies	The organization can adapt to some changes but not to others	The organization can adapt to most changes because its policies and structure flexible

1 2 3 4 5

Technical flexibility

Question 69

The organization is unable to adopt new technologies or to convert existing technologies to new purposes	The organization can change its technology , but only slightly and with a fair amount of disruption	The organization can adopt new technologies or change existing ones with minimal disruption

1 2 3 4 5

Product-Service flexibility

Question 70

The organization is capable of producing only one product or providing only one service	The organization can produce new products or service if given a large amount of time to do so	The organization can introduce new products or services quickly and easily

1 2 3 4 5

COOPERATION

Sub unit interdependence

Question 71

Different parts of the organization do not toward the same goal; there is often destructive conflict between them	Different parts of the organization work together, but not very well	Different part of the organization work together well; when conflict arises, it is often productive

1 2 3 4 5

Teamwork

Question 72

People look out only for themselves	People look out for themselves and few others	People work in teams and look out for one another

1 2 3 4 5

Mutual support

Question 73

People will not help one another if it is beyond their normal duties	People will help one another if they are ordered to do so	People help one another without being told to do so, even if its beyond their normal duties

1 2 3 4 5

Shared Values

Question 74

No one can state the values behind decisions that are made	A few people know what values are used in making decisions	Everyone can state the values of the organization and how they are used to make decisions

1 2 3 4 5

Question 75

Values, if stated at all, concern only quality and profit	Values maintain teamwork, participation, innovation, etc. as important but secondary to quality and profit	Values are stated clearly and place teamwork, participation, innovation, etc., on an equal level with quality and profit

1 2 3 4 5

Common rewards

Question 76

Most people would say that what	A few people would say that how	Many people would say that what

they do has no effect on rewards *others* receive	others are rewarded depends on how well they do	they do affects the amount of rewards others receive

1 2 3 4 5

Question 77

Most people would say they have no influence on the performance ratings their peers receive	A few people would say they have no influence on the performance ratings their peers receive	Many people would say that they have influence on the performance ratings their peers receive

1 2 3 4 5

COMMITMENT-ENERGY

Dedication

Question 78

Few people here feel personally responsible for how well the organization does	Some people here feel personally responsible for how well the organization does	Many people here feel personally responsible for how well the organization does

1 2 3 4 5

Question 79

Few people are willing to put in effort above the minimum require to help the organization succeed	Some people are willing to put in effort above the minimum require to help the organization succeed	Many people are willing to put in effort above the minimum require to help the organization succeed

1 2 3 4 5

Question 80

Most people slack off when their supervisors are not present	A few people slack off when their supervisors are not present	Almost no one slack off when their supervisors are not present

1 2 3 4 5

Reward Systems

Question 81

People are rewarded the same whether they perform well or not	Some people are recognized for outstandingly good or bad performance	Most people are rewarded based upon their performance

1 2 3 4 5

Question 82

People are rewarded for seniority, not for what they know	People are rewarded primarily for seniority, but also for what they know	People are rewarded primarily for what they know, not their seniority

1 2 3 4 5

Question 83

There are large differences in the ways in which managers and their subordinates are rewarded	There are some differences in the ways in which managers and their subordinates are rewarded	There are few differences in the way in which managers and their subordinates are rewarded

1 2 3 4 5

Question 84

Gains in profits due to improvements in performance are not shared with employees	Gains in profits due to improvements in performance are shared with a few employees	Gains in profits due to improvements in performance are shared with all employees

1 2 3 4 5

Question 85

People are rewarded on an individual basis	People are rewarded primarily as individuals, but some group rewards are also given	People are rewarded primarily for their teamwork rather than as individuals

1 2 3 4 5

Information availability

Question 86

Little information about the state of the business is shared with employees	Some information about the state of the business is shared with employees	A great deal of information about the business is shared with employees

1 2 3 4 5

Question 87

Most people would say that they did not know what information was being used to make decisions	A few people would say that they know what information was being used to make decisions	Most people would say that they knew what information was being used to make decisions

1 2 3 4 5

Question 88

Managers and technical experts withhold a great deal of information from employees	Managers and technical experts share information on a "need to know" basis	Managers and technical experts share information openly

1 2 3 4 5

JOINT OPTIMIZATION

Sociotechnical Balance

Question 89

Technology is much more important than people in this organization	Technology is somewhat more important than people	Technology and people are of equal importance in this organization

1 2 3 4 5

Question 90

When new technology is considered the people who will operate it are not consider at all	When new technology is considered, some thought will be given to what work will be like for the people who will operate it	When new technology is considered the people who operate it are intimately involved in decisions regarding its design and development

1 2 3 4 5

Question 91

Only a few technical experts understand how the technology works and how to maintain it	Departments of specialists exist who maintain the technology	Most people are capable of performing at least routine maintenance on their equipment

1 2 3 4 5

Variance control

Question 92

Variances (equipment malfunctions or other problems with getting the work done according to standards) are not controlled at their source	Variances are sometimes controlled at their source	Variances are detected and controlled at their source

1 2 3 4 5

Question 93

The technology runs poorly (high downtime, low quality)	The technology runs fairly well	The technology runs almost perfectly

1 2 3 4 5

Question 94

Most people would say they have no control over the technology they operate	Most people would say they have some control over the technology they operate	Most people would say they have complete control over the technology they operate

1 2 3 4 5

Question 95

Most people would say that they needed help in keeping their technology running properly	Some people would say that they needed help in keeping their technology running properly	Few people would say that they needed help in keeping their technology running properly

1 2 3 4 5

Technological Appropriateness

Question 96

There is a tremendous excess capacity in the technology for the demand being met	There is a more than adequate excess capacity in the technology for the demand being met	The technology is well-matched to the demand that is being met

1 2 3 4 5

Question 97

Technology is poorly understood and maintained by the people operating it	Technology is barely understood and only adequately maintained by the people operating it	Technology is well understood and only adequately maintained by the people operating it

1 2 3 4 5

Technological Support for Teamwork

Question 98

Technology inhibits teamwork in this organization	Technology neither inhibits nor supports teamwork here	The way the technology is designed supports teamwork in this organization

1 2 3 4 5

Question 99

The layout of the operation inhibits teamwork in this organization	The layout of the operation neither inhibits nor support teamwork here	The layout of the operation supports teamwork in this organization

1 2 3 4 5

Technological Adaptability

Question 100

The technology used by this organization is difficult to change	The technology used by this organization can be changed, but not without difficulty	The technology used by this organization is easily changed

1 2 3 4 5

STSAS SUMMARY SHEET

Instructions: To transfer scores from the survey to the summary sheet, simply place a check mark in the column corresponding to your answer for each question.

INNOVATIVENESS

Time Orientation

Risk taking

Rewards for innovation

HUMAN RESOURCE DEVELOPMENT-UTILIZATION

Opportunities for learning

Work design

Supervisory roles

Organizational structure

Question #					
1					
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9					
10					

Question #					
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51					

Work flow structure	52 53 54 55 56 57 58	
ENVIRONMENTAL AGILITY	Question #	
Environmental Awareness	59 60 61 62 63 64 65	
Proactivity-Reactivity	66 67	
Structural flexibility Technical flexibility Product-Service flexibility	68 69 70	
COOPERATION	Question #	
Subunit interdependence Teamwork Mutual support Share values	71 72 73 74	
Common rewards	75 76 77	
COMMITMENT-ENERGY	Question #	
Dedication	78 79 80	
Reward systems	81 82 83 84	
Information availability	85 86 87 88	
JOINT OPTIMIZATION	Question #	
Sociotechnical balance	89 90 91	
Variance control	92 93 94 95	
Technological appropriateness	96 97	
Tech. support for teamwork	98 99	
Technological adaptability	100	

APPENDIX II

ORDIC TOOL QUESTIONNAIRE

The objective of this questionnaire is to evaluate the organisational analysis and design tools of ORDIC methodology.

In order to answer the questions, first read the descriptions given under the numbers 🗁, 2 to 5. Then mark in the option that is closest to your opinion. We would like to thank you in advance for the time that you dedicated and the sincerity with which you answered the questions.

General Information.

In which organisation do you work? _____

In which business sector does your organisation belong (i.e. education, banking, manufacturing, etc.)?

_____

How many organisational levels conform the structure of your organisation (i.e. 2, 3, 5). _____

In which organisational level are you positioned? _____

For how many years do you work in this organisation? _____

How many years do you occupy your current position? _____

Your academic qualifications include (tick were appropriate):

Primary School	
Secondary School	
High School	
Technical School	
Undergraduate Degree	
Postgraduate Degree	

Tool I. - Activity Description Table.

Position	Activities and Principal Objectives	Principal problems	Requirements / Proposed Solutions

1.- Have you used this tool ?

☐ YES ☐ NO

If your answer is affirmative please continue.

2.- What was your purpose in using this tool ?

3.- How long ago did you use the tool ?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

4.- How long did you work with the tool?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

5.- It is difficult to learn how to use the tool | It is not difficult to learn how to use the tool. | It is easy to learn how to use this tool.

1	2	3	4	5

6.- The tool made it difficult for me to understand how my activities are done. | The tool did not help me understand the way my activities are done. | The tool really helped me understand the way my activities are done.

1	2	3	4	5

7.- The tool made it difficult for me to clearly represent how my activities are done. | The tool did not help me to clearly represent the way my activities are done. | The tool really helped me to clearly represent the way my activities are done.

1	2	3	4	5

8.-	The tool made it difficult for me to identify the problems I am having with my activities.	The tool did not help me to identify the problems I am having with my activities.		The tool really helped me to identify the problems I am having with my activities.
	1	2	3	4 5

9.-	The tool made it difficult for me to propose solutions for my problems and/or my requirements.	The tool did not help me propose solutions for my problems and/or my requirements.		The tool really helped me to propose solutions for my problems and/or my requirements.
	1	2	3	4 5

10.-	A lot of training is required to be able to use this tool.	Moderate training is required to be able to use this tool.		There is no need for training to be able to use this tool.
	1	2	3	4 5

11.-	I would definitely NOT recommend this tool to someone who wants to represent his activities, problems and there possible solutions.	I would recommend this tool to someone who wants to represent his activities, problems and possible solutions, ONLY if he does not have a better tool.		I would definitely recommend this tool to someone who wants to represent his activities, problems and possible solutions.
	1	2	3	4 5

12.-	The tool makes communication difficult between the user and the consultant.	The tool does not have any influence in the communication between the user and the consultant.		The tool facilitates efficient communication between the user and the consultant.
	1	2	3	4 5

13.- Do you know of any other tool(s) similar to this one?

.- Yes 2.- No

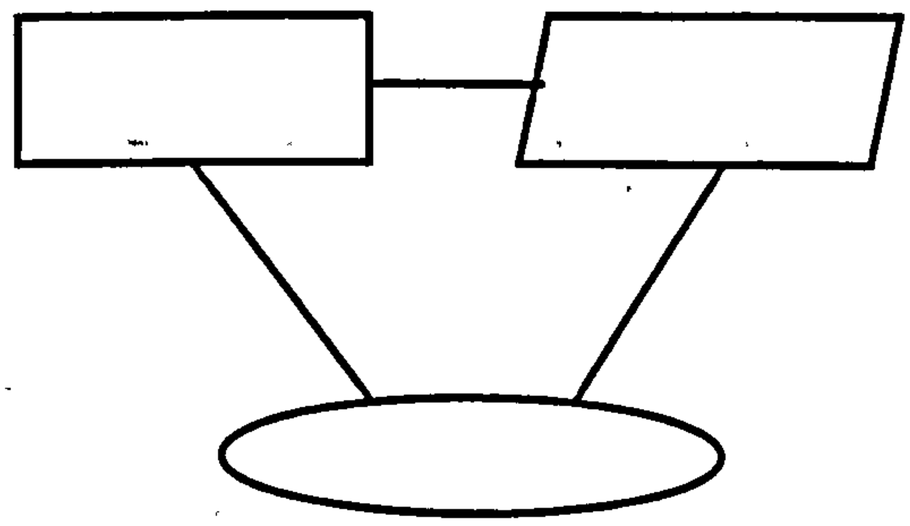
If Yes:

Mention the name of the tool, if you remember it : _____

Which do you like best?

.- ORDIC Tool .- Other Tool

Tool II. - Functional Modelling.



1.- Have you used this tool ?

☐ YES ☐ NO

If your answer is affirmative please continue.

2.- What was your purpose in using this tool ?

3.- How long ago did you use the tool ?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

4.- How long did you work with the tool?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

5.-

It is very difficult to learn how to use the tool.	It is not difficult to learn how to use the tool.	It is very easy to learn how to use this tool.
1	2 3	4 5

6.-

The tool made it difficult for me to understand how my activities are done.	The tool did not help me to understand the way my activities are done.	The tool really helped me to understand the way my activities are done.
1	2 3	4 5

7.-

The tool made it difficult for me to clearly represent how my activities are done.	The tool did not help me to clearly represent the way my activities are done.	The tool really helped me to represent the way my activities are done.
1	2 3	4 5

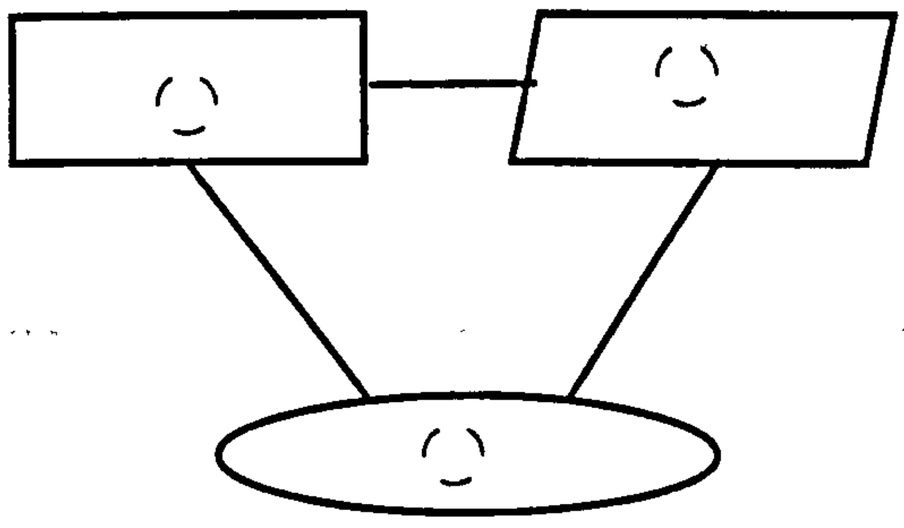
8.-	A lot of training is required to be able to use this tool.	Moderate training is required to be able to use this tool.	There is no need for training to be able to use this tool.	
	1	2	3	4	5

9.-	I need to revise the tool continuously in order to be able to interpret diagrams.	From time to time I need to revise the tool in order to be able to interpret diagrams.	I can interpret a diagram even if I do not use the tool for some time.	
	1	2	3	4	5

10.-	I definitely would NOT recommend this tool to someone who wants to represent his activities.	I would recommend this tool to someone who wants to represent his activities, ONLY if he does not a better one.	I would definitively recommend this tool to someone who wants to represent his activities.	
	1	2	3	4	5

11.-	The tool makes communication difficult between the user and the consultant.	The tool does not have any influence in the communication between the user and the consultant.	The tool facilitates efficient communication between the user and the consultant.	
	1	2	3	4	5

12.- Mach its figure with the option that you consider reflects the earning of the figure (put the number of the option in the circle of its corresponding figure).



1.- Position, role 2.- Information, recourses 3.- Activity, task

13.- Do you know of any other tool(s) similar to this one?

.- Yes .- No

If Yes:

Mention the name of the tool, if you remember it : _____

Which do you like best?

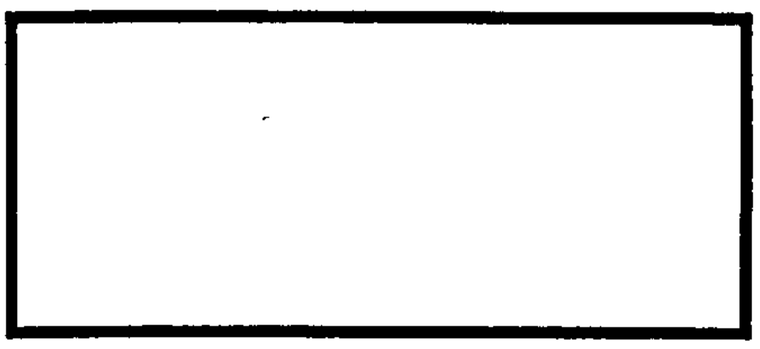
.- ORDIC Tool .- Other Tool

Tool III.- Sociotechnical Organisation's View.

SYSTEM:

Environment

Inputs | Requirements | Goal



Structural Problems

1.- Have you used this tool ?

☐ YES ☐ NO

If your answer is affirmative please continue.

2.- What was your purpose in using this tool ?

3.- How long ago did you use the tool ?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

4.- How long did you work with the tool?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

5.-

It is very difficult to learn how to use the tool.	It is not difficult to learn how to use the tool.	It is very easy to learn how to use this tool.
1 2	3 4	5

6.-

The tool made it difficult for me to define and structure the goals, objectives and requirements of the organisation.	The tool did not help me to define and structure the goals, objectives and requirements of the organisation.	The tool really helped me to define and structure the goals, objectives and requirements of the organisation.
1 2	3 4	5

7.-	The tool made it difficult for me to analyse the structural problems that do not permit the organisation to meet its objectives.		The tool did not help me to analyse the structural problems that do not permit the organisation to meet its objectives.	The tool really helped me to analyse the structural problems that do not permit the organisation to meet its objectives.
	1	2	3	4 5
8.-	The tool made it difficult form to identify the environmental factors and how they affect the organisation.		The tool did not help me to identify the environmental factors and how they affect the organisation.	The tool really helped me to identify the environmental factors and how they affect the organisation.
	1	2	3	4 5
9.-	I need to revise the tool continuously in order to be able to interpret diagrams.		From time to time I need to revise the tool in order to be able to interpret diagrams.	I can interpret a diagram even if I do not use the tool for some time.
	1	2	3	4 5
10.-	A lot of training is required to be able to use this tool.		Moderate training is required to be able to use this tool.	There is no need for training to be able to use this tool.
	1	2	3	4 5
11.-	I definitely would NOT recommend this tool to anyone who wants to represent and understand better the goals and objectives of the organisation.		I would recommend this tool to someone who wants to represent and understand better the goals and objectives of the organisation ONLY if he does not have a better one.	I would definitively recommend this tool to anyone who wants to represent his activities.
	1	2	3	4 5
12.-	The tool makes communication difficult between the user and the consultant.		The tool does not have any influence in the communication between the user and the consultant.	The tool facilitates efficient communication between the user and the consultant.
	1	2	3	4 5

13.- Do you know of any other tool(s) similar to this one?

1.- Yes 2.- No

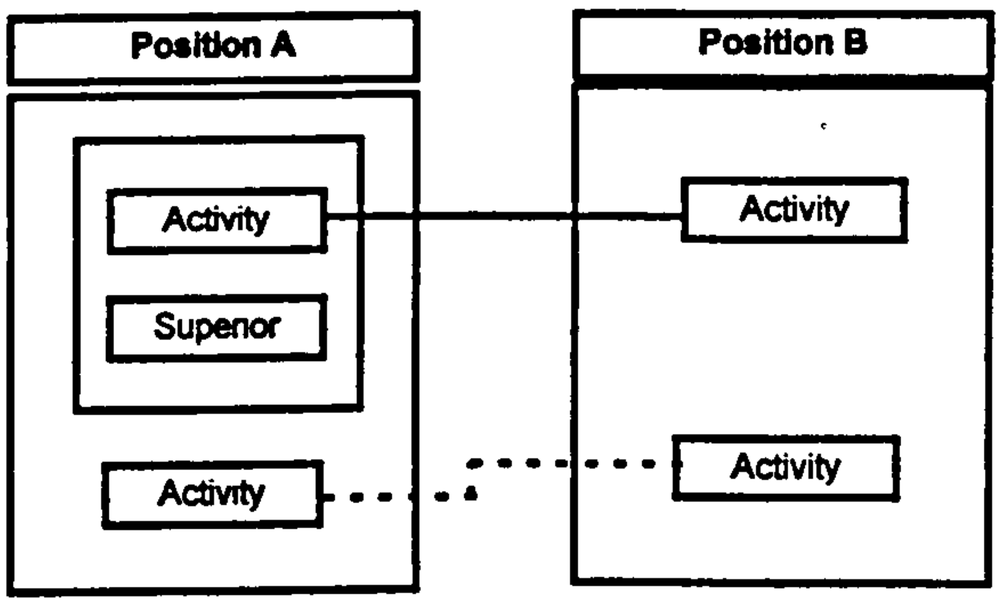
If Yes:

Mention the name of the tool, if you remember it : _____

Which do you like best?

1.- ORDIC Tool 2.- Other Tool

Tool IV. - Structural Relations Modelling Tool.



1.- Have you used this tool ?

☐ YES ☐ NO

If your answer is affirmative please continue.

2.- What was your purpose in using this tool ?

3.- How long ago did you use the tool ?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

4.- How long did you work with the tool?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

5.-

It is very difficult to learn how to use the tool		It is not difficult to learn how to use the tool.		It is very easy to learn to use this tool.
1	2	3	4	5

6.-

The tool made it difficult for me to represent the activities associated to a position in the organisation and the relations with other positions.		The tool did not help me to represent the activities associated to a position in the organisation and the the relations with other positions.		The tool really helped me to represent the activities associated to a position in the organisation and the relations with other positions.
1	2	3	4	5

7.- A lot of training is required to be able to use this tool. | Moderate training is required to be able to use this tool. | There is no need for training to be able to use this tool.

1 2 3 4 5

8.- I need to revise the tool continuously in order to be able to interpret diagrams. | From time to time I need to revise the tool in order to be able to interpret diagrams. | I can interpret a diagram even if I do not use the tool for some time.

1 2 3 4 5

9.- I definitely would NOT recommend this tool to someone who wants to represent and understand better the activities associated to a position and the structural relationships among positions. | I would recommend this tool to someone who wants to represent and understand better the activities associated to a position and the structural relationships among positions ONLY if he does not have a better one. | I would definitely recommend this tool to someone who wants to represent and understand better the activities associated to a position and the structural relationships among positions.

1 2 3 4 5

10.- The tool makes communication difficult between the user and the consultant. | The tool does not have any influence in the communication between the user and the consultant. | The tool facilitates efficient communication between the user and the consultant.

1 2 3 4 5

11.- Do you know of any other tool(s) similar to this one?

.- Yes .- No

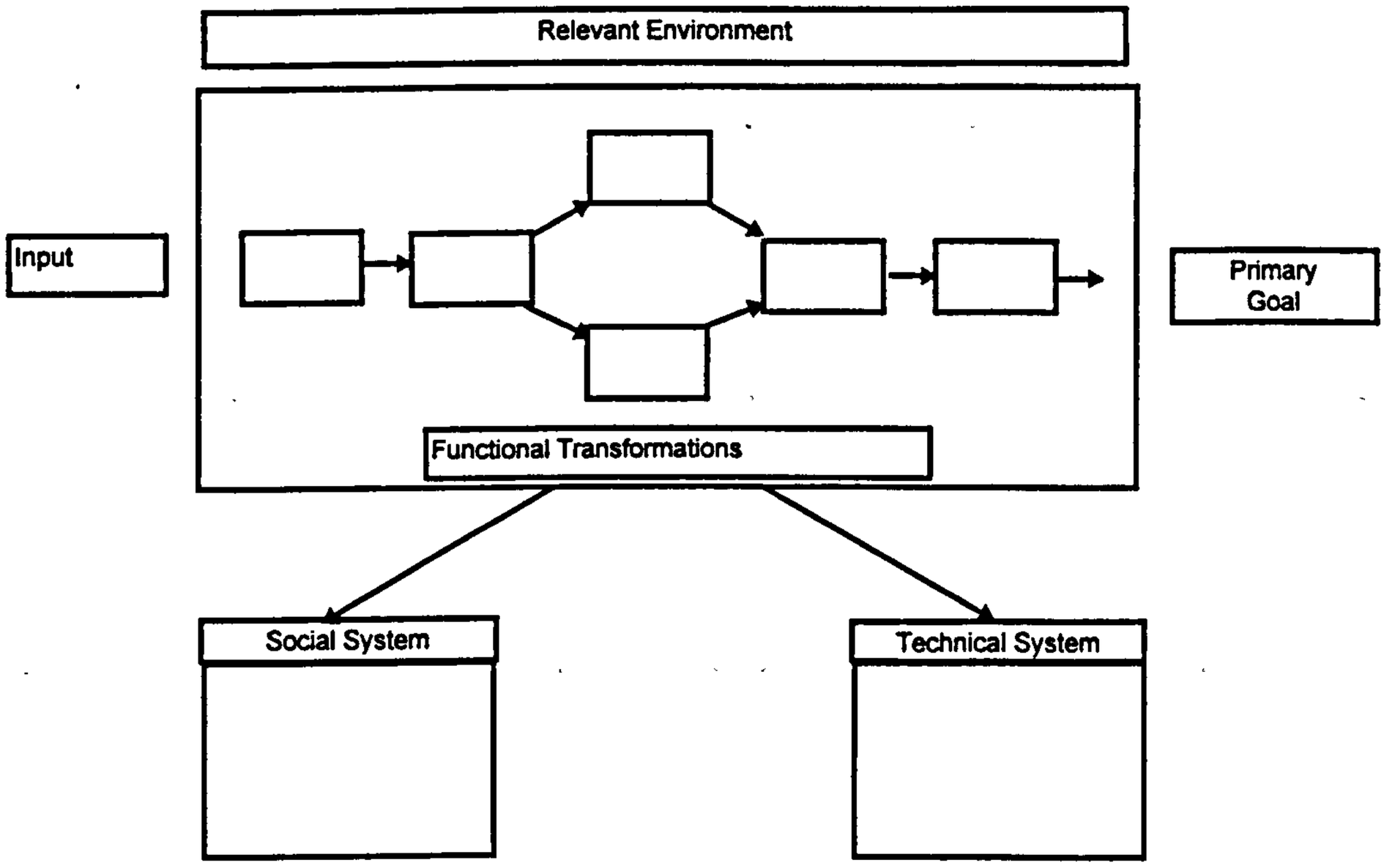
If Yes:

Mention the name of the tool, if you remember it : _____

Which do you like best?

.- ORDIC Tool 2.- Other Tool

Tool V.- Activity Analysis Tool.



1.- Have you used this tool ?

☐ YES ☐ NO

If your answer is affirmative please continue.

2.- What was your purpose in using this tool ?

3.- How long ago did you use the tool ?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

4.- How long did you work with the tool?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

5.- It is very difficult to learn how to use the tool. | It is not difficult to learn how to use the tool. | It is very easy to learn how to use this tool.

1	2	3	4	5

6.-	The tool made it difficult for me to understand how my activities are done.	The tool did not help me to understand the way my activities are done.	The tool really helped me to understand the way my activities are done.	
	1	2	3	4	5
7.-	The tool made it difficult for me to analyse how my activities are done.	The tool did not help me to clearly analyse the way my activities are done.	The tool really helped me to analyse the way my activities are done.	
	1	2	3	4	5
8.-	A lot of training is required to be able to use this tool.	Moderate training is required to be able to use this tool.	There is no need for training to be able to use this tool.	
	1	2	3	4	5
9.-	I need to revise the tool continuously in order to be able to interpret diagrams.	From time to time I need to revise the tool in order to be able to interpret diagrams.	I can interpret a diagram even if I do not use the tool for some time.	
	1	2	3	4	5
10.-	I definitely would NOT recommend this tool to someone who wants to analyse his activities.	I would recommend this tool to someone who wants to analyse his activities ONLY if he does not have a better one.	I would definitely recommend this tool to someone who wants to analyse his activities.	
	1	2	3	4	5
11.-	The tool makes communication difficult between the user and the consultant.	The tool does not have any influence in the communication between the user and the consultant.	The tool facilitates efficient communication between the user and the consultant.	
	1	2	3	4	5

12.- Do you know of any other tool(s) similar to this one?

1.- Yes ☐.- No

If Yes:

Mention the name of the tool, if you remember it : _____

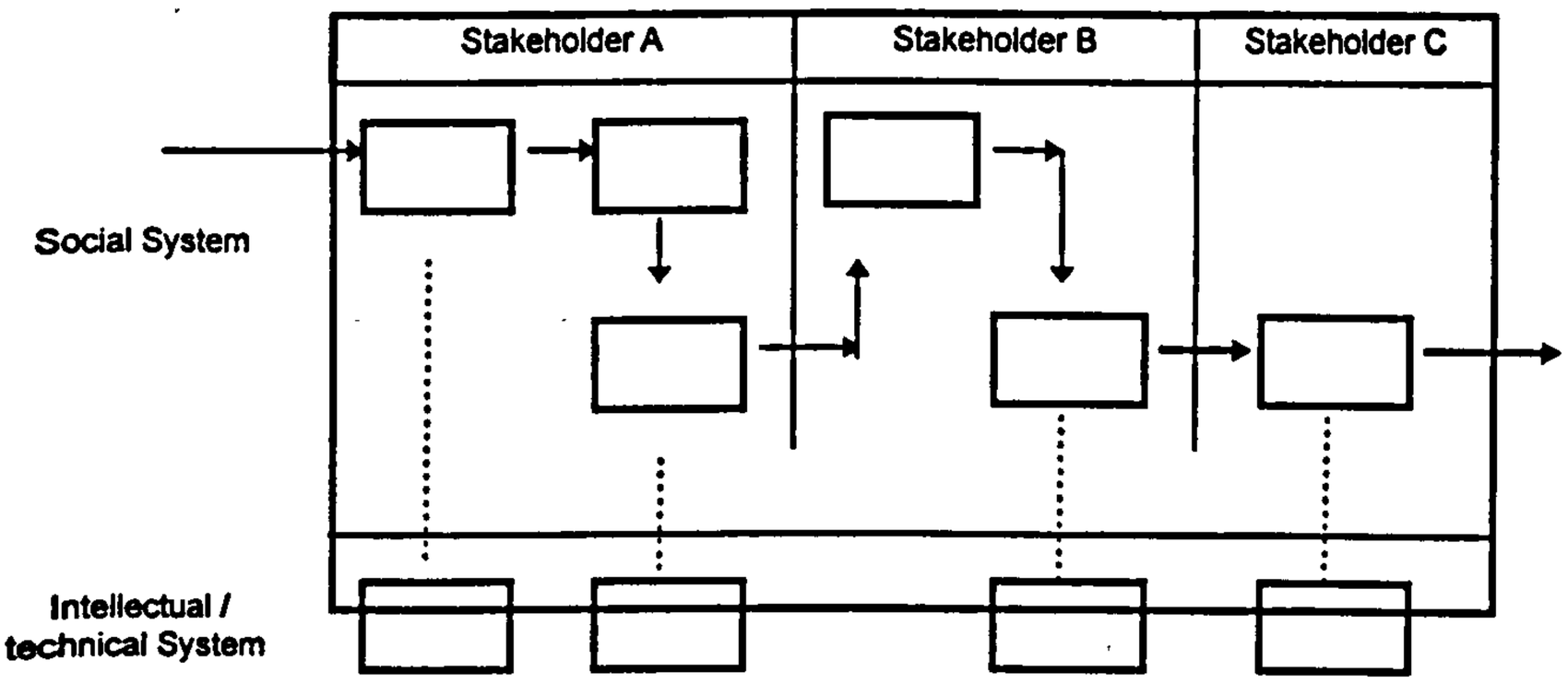
Which do you like best?

☐.- ORDIC Tool ☐.- Other Tool

_____

_____

Tool VI.- Process's Sociotechnical Representation Tool.



1.- Have you used this tool ?

☐ YES ☐ NO

If your answer is affirmative please continue.

2.- What was your purpose in using this tool ?

3.- How long ago did you use the tool ?

less than a week	less than a month	less than six months	less than a year	more than a year
1	2	3	4	5

4.- How long did you work with the tool?

more than a year	less than a year	less than six months	less than a month	less than a week
1	2	3	4	5

5.-

It is very easy to learn how to use the tool.	It is very difficult to learn how to use the tool.	It is not difficult to learn how to use this tool.
1	2	3	4	5

6.-

The tool made it difficult for me to understand how my activities are done.	The tool did not help me to understand the way my activities are done.	The tool really helped me to understand the way my activities are done.
1	2	3	4	5

7.-	The tool really helped me me to analyse how my activities are done.	The tool did not help me to clearly analyse the way my activities are done.	The tool made it difficult for to analyse the way my activities are done.
	1	2 3 4	5
8.-	A lot of training is required to be able to use this tool.	Moderate training is required to be able to use this tool.	There is no need for training to be able to use this tool.
	1	2 3 4	5
9.-	I can interpret a diagram even if I do not use the tool for some time.	From time to time I need to revise the tool in order to be able to interpret diagrams.	I need to revise the tool continuously in order to be able to interpret diagrams.
	1	2 3 4	5
10.-	I definitely would NOT recommend this tool to someone who wants to analyse his activities.	I would recommend this tool to someone who wants to analyse his activities ONLY if he does not have a better one.	I would definitely recommend this tool to someone who wants to analyse his activities.
	1	2 3 4	5
11.-	The tool facilitates efficient communication between the user and the consultant.	The tool does not have any influence in the communication between the user and the consultant.	The tool makes communication difficult between the user and the consultant.
	1	2 3 4	5

12.- Do you know of any other tool (s) similar to this one?

1.- Yes 2.- No

If Yes:

Mention the name of the tool, if you remember it : _____

Which do you like best?

1.- ORDIC Tool 2.- Other Tool

APENDIX III

Results of the application of the sociotechnical systems questionnaire to the Hazardous Residues Laboratory.

In the following will be presented in details the results of the variables corresponding to each dimension of the sociotechnical systems questionnaire. On the charts, in parenthesis is presented the average of the questions corresponding to each variable of the dimension on a 1 to 5 scale (1 is minimum and 5 is maximum).

- ***Innovation***: the general average on this dimension is 3.38 as compared to 3.20 before the IC management project; the particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure III-1.

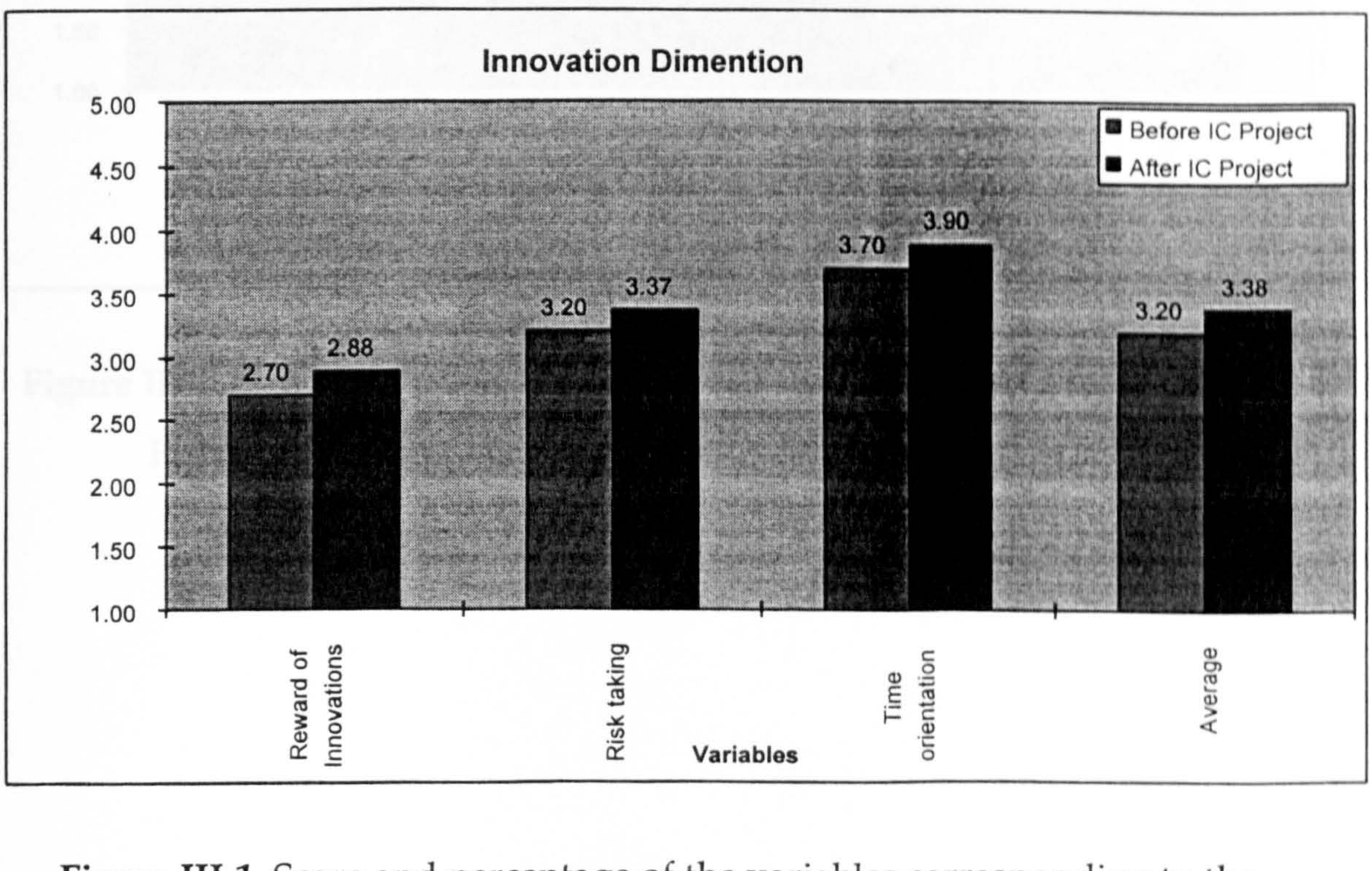


Figure III-1. Score and percentage of the variables corresponding to the Innovation Dimension in the HRL.

- ***Human Resources Development***: the general average on this dimension is 3.49 as compared to 2.84 before the IC management project; the particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure III-2.

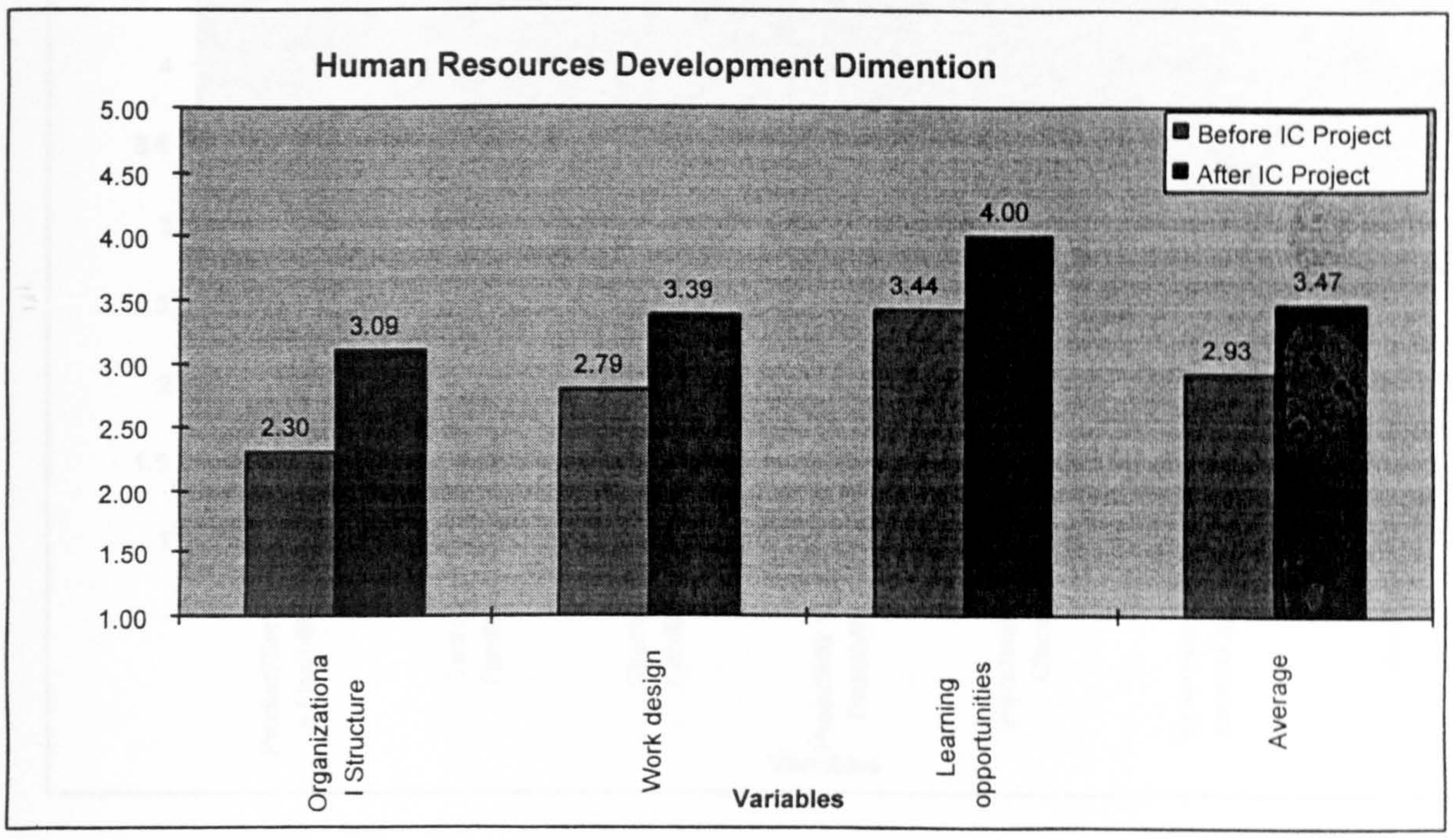


Figure III-2. Score and percentage of the variables corresponding to the Human Resources Development Dimension in the HRL.

- ***Environmental Agility***: the general average on this dimension is 3.83 as compared to 3.67 before the IC management project; the particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure III-3.

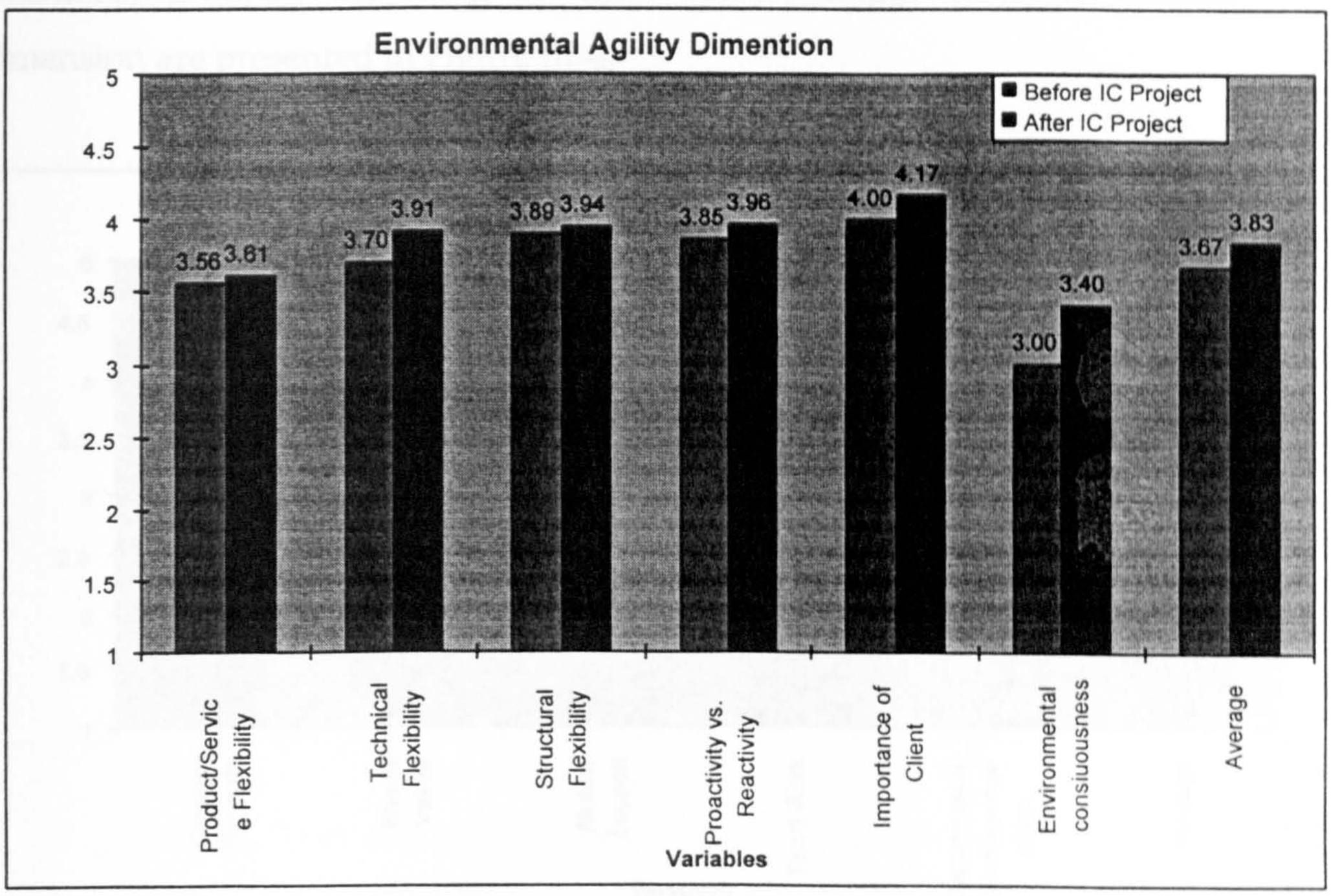


Figure III-3. Score and percentage of the variables corresponding to the Environmental Agility Dimension in the HRL.

- ***Co-operation***: the general average on this dimension is 3.27 as compared to 2.49 before the IC management project. The particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure III-4.

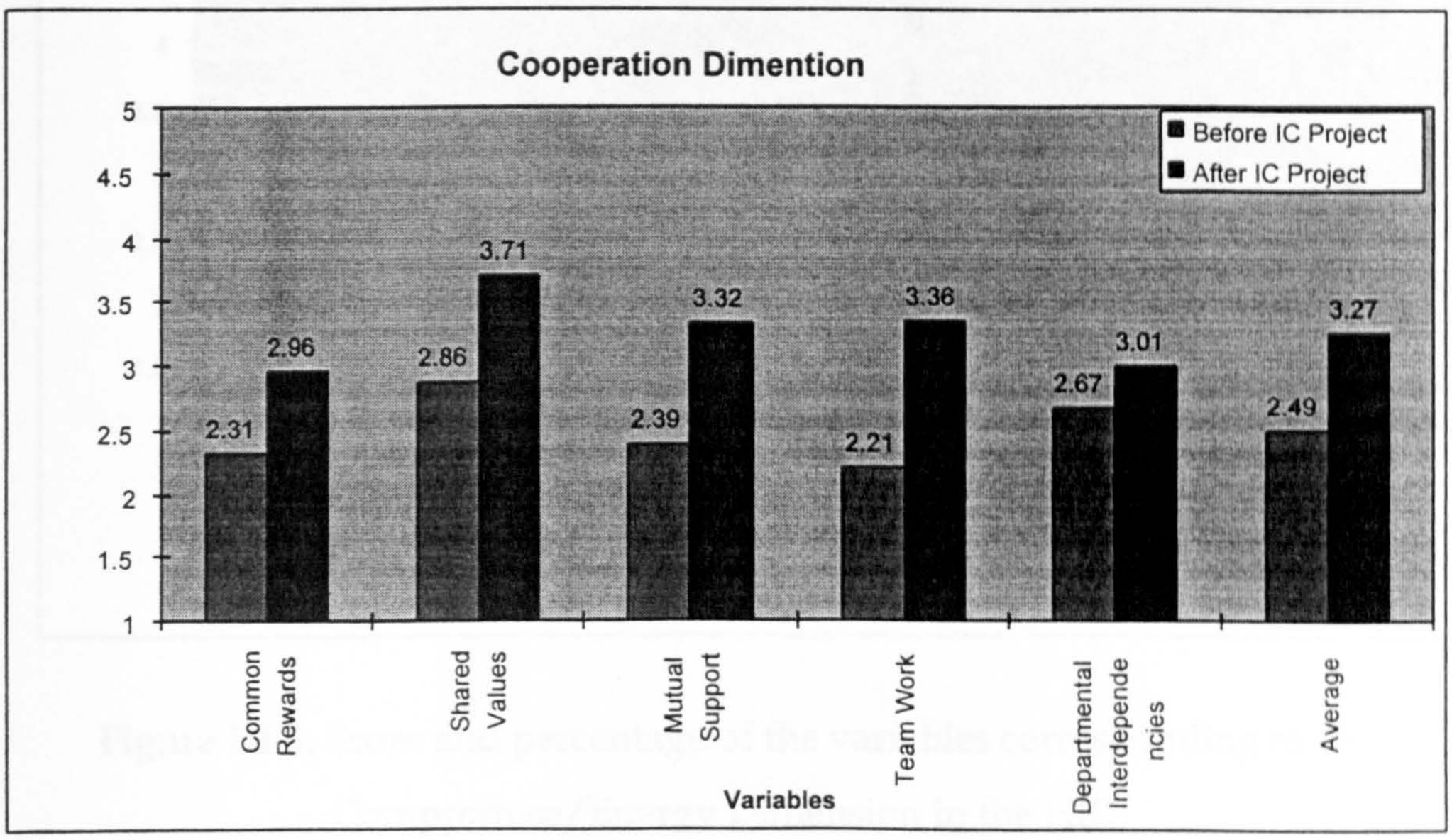


Figure III-4. Score and percentage of the variables corresponding to the Co-operation Dimension in the HRL.

- ***Commitment/Energy***: the general average on this dimension is 3.09 as compared to 2.67 before the IC management project. The particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure III-5.

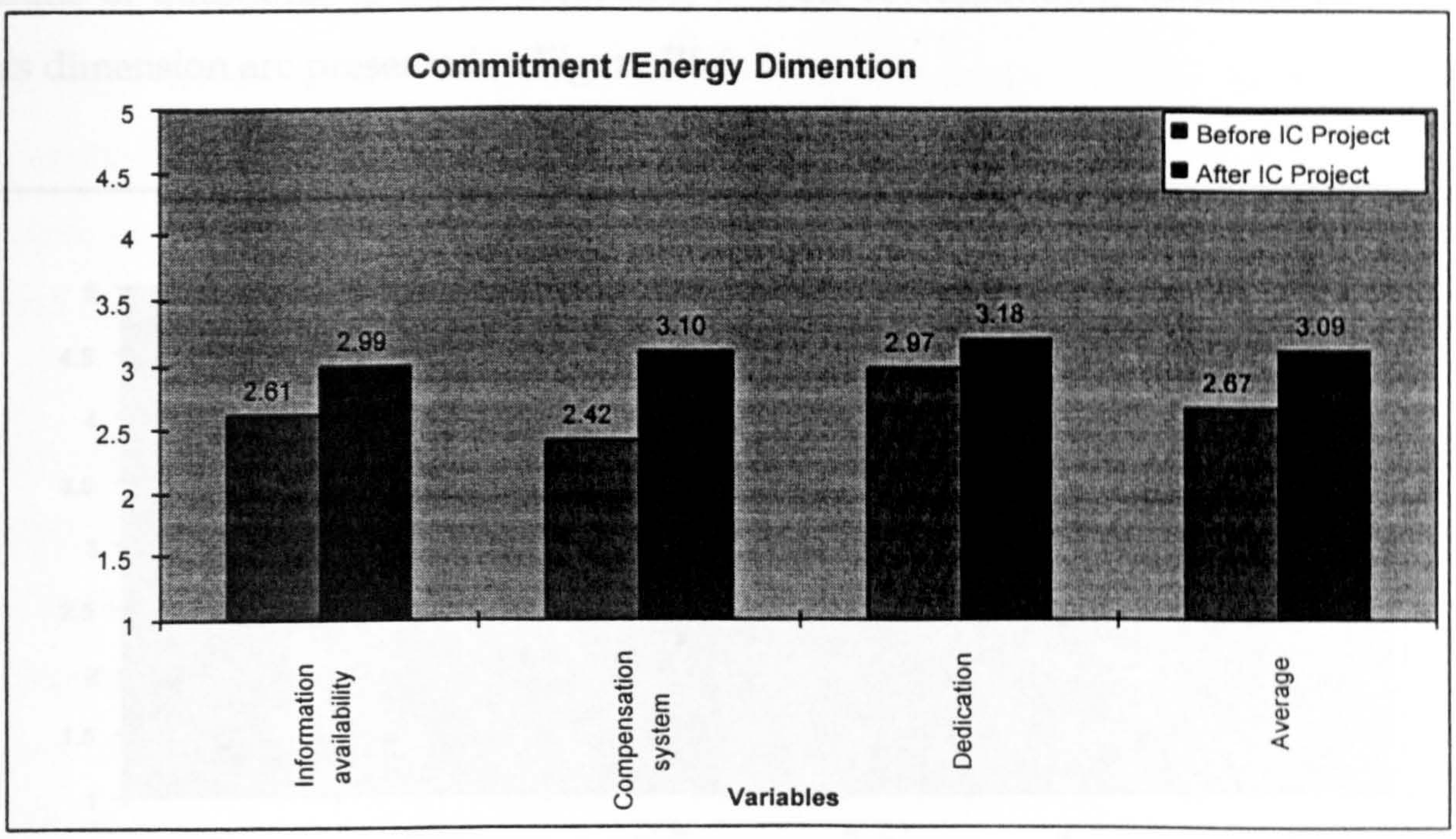


Figure III-5. Score and percentage of the variables corresponding to the Compromise/Energy Dimension in the HRL.

- ***Joint improvement:***: the general average on this dimension is 3.77 as compared to 2.98 before the IC management project; the particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure III-6.

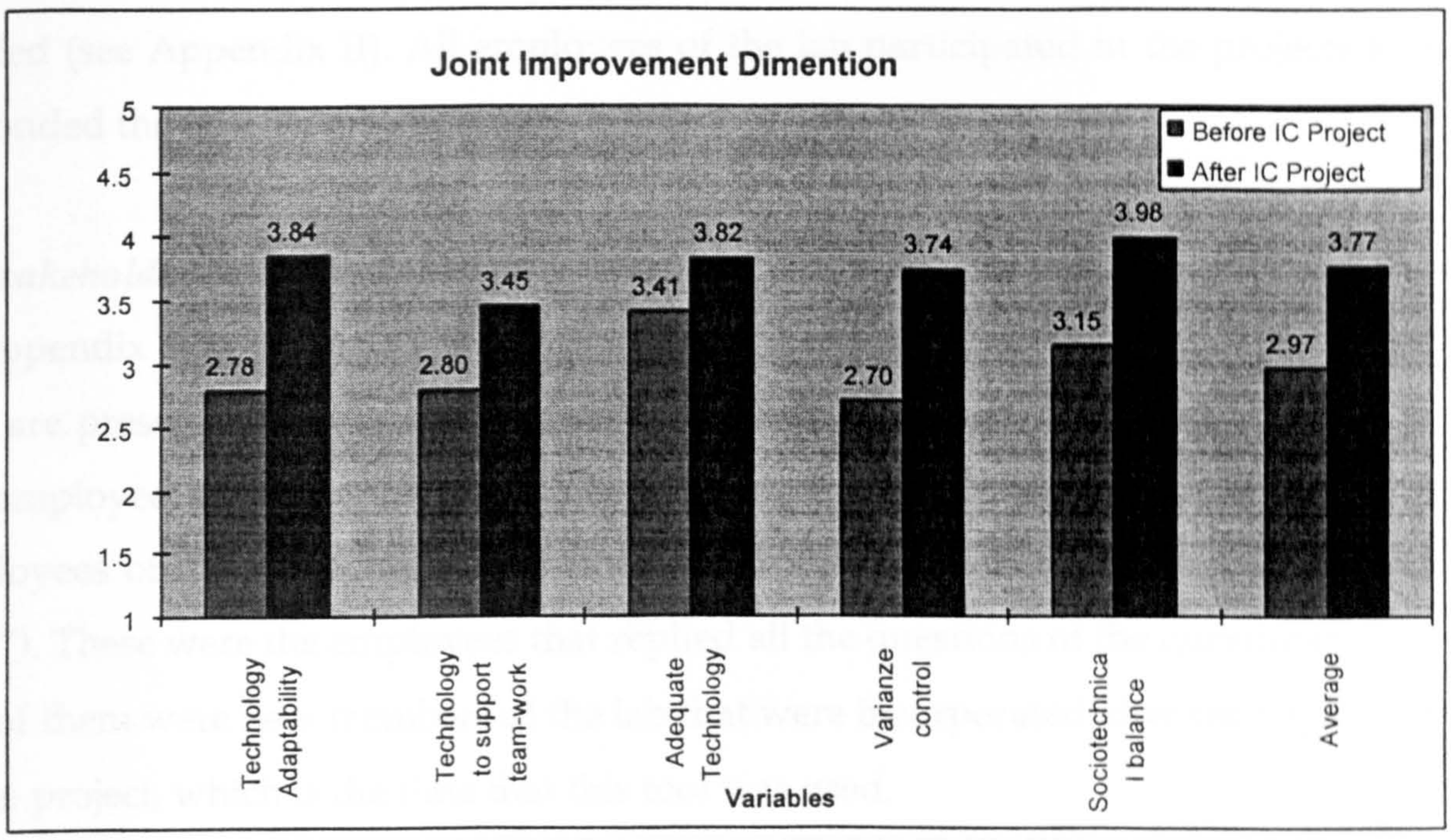


Figure III-6. Score and percentage of the variables corresponding to the Joint Optimization Dimension in the HRL.

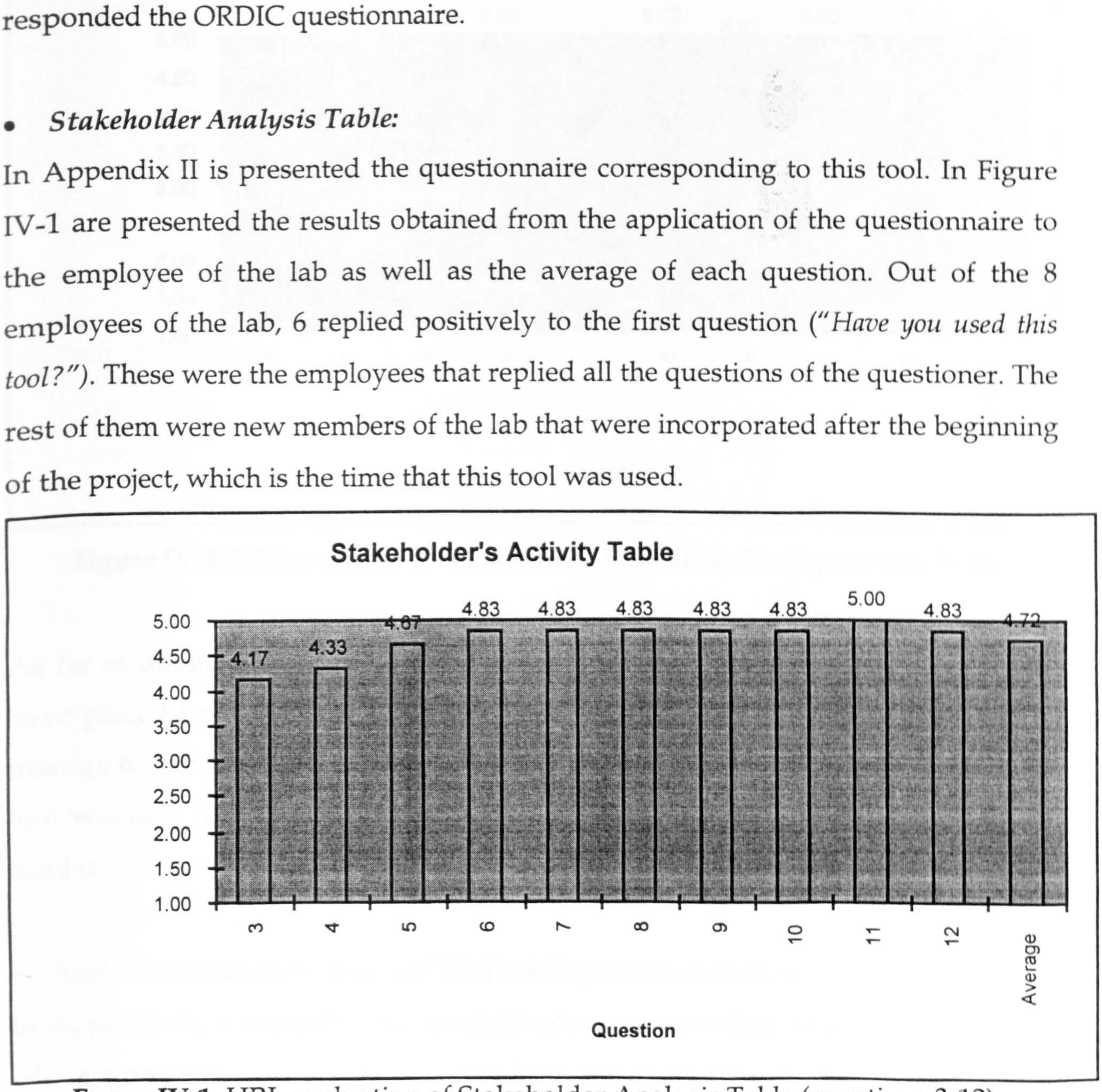
APPENDIX IV

ORDIC tools evaluation
by the Organisational Participants
of the Hazardous Residues Laboratory.

In order to measure the functionality of each one of the ORDIC tools and receive feedback from the users-employees of the Lab, the ORDIC questionnaire was applied (see Appendix II). All employees of the lab participated in the projects and responded the ORDIC questionnaire.

- ***Stakeholder Analysis Table:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure IV-1 are presented the results obtained from the application of the questionnaire to the employee of the lab as well as the average of each question. Out of the 8 employees of the lab, 6 replied positively to the first question (*"Have you used this tool?"*). These were the employees that replied all the questions of the questioner. The rest of them were new members of the lab that were incorporated after the beginning of the project, which is the time that this tool was used.



Fugue IV-1. HRL evaluation of Stakeholder Analysis Table (questions 3-12).

- ***Functional Modelling Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure IV-2 are presented the results obtained from the application of the questionnaire to the employee of the lab as well as the average of each question. Out of the 8 employees of the lab, 5 replied positively to the first question (*"Have you used this tool?"*).

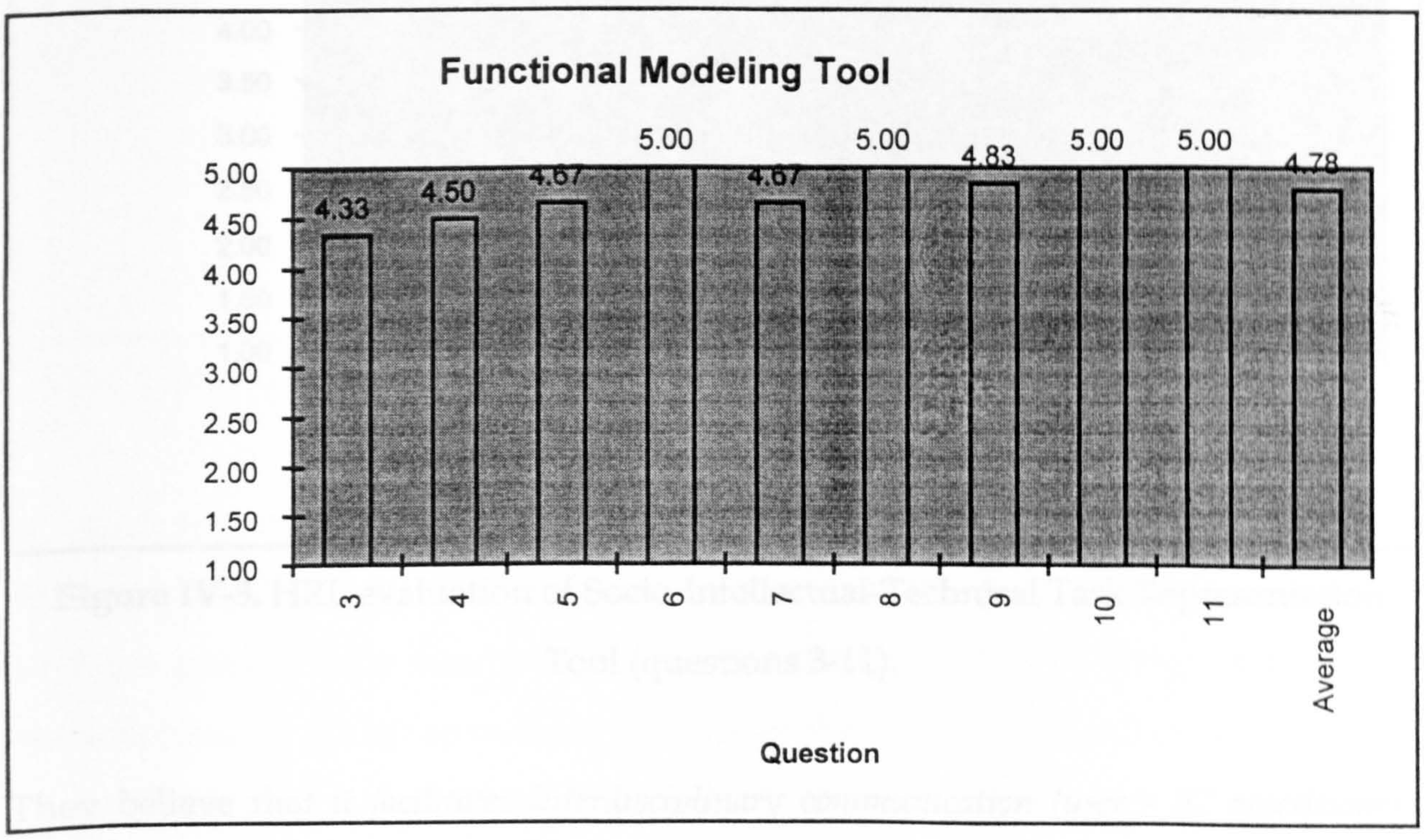


Figure IV-2. HRL evaluation of Functional Modelling Tool (questions 3-11).

As far as question number 12 is concerned, although approximately four months have passed from the time the project had finished, only one out of five did not manage to identify correctly the elements of the tool; which justifies the fact that the tool was easy to understand, learn and remember for the members of the lab who used it.

- ***Socio-Intellectual-Technical (SIT) Task Representation Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure IV-3 are presented the results obtained from the application of the questionnaire to

the employee of the lab as well as the average of each question. Out of the 8 employees of the lab 2 did not work with this tool.

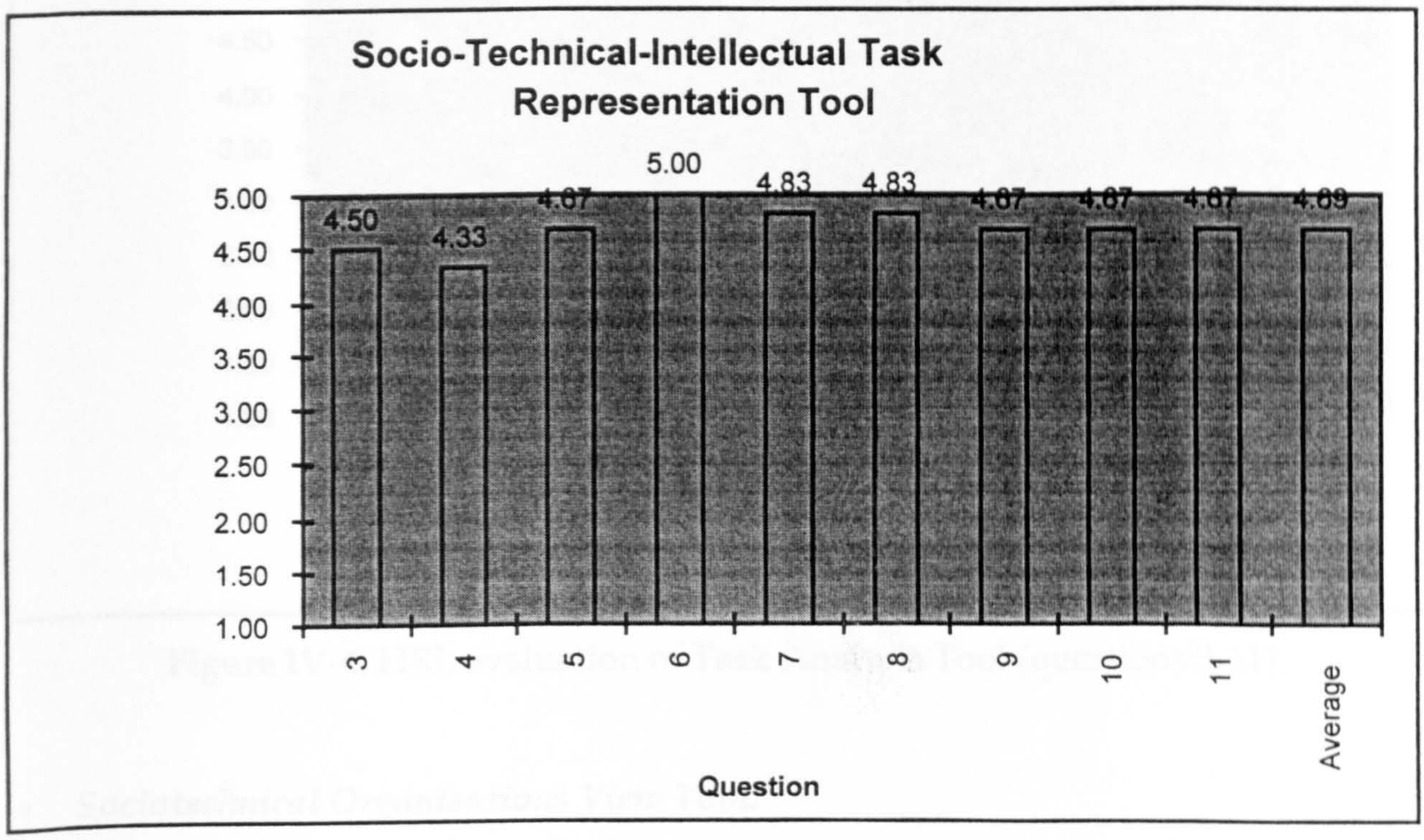


Figure IV-3. HRL evaluation of Socio-Intellectual-Technical Task Representation Tool (questions 3-11).

They believe that *it facilitates interdisciplinary communication (user - IC practitioner),* they are not familiar with a similar tool and they would be glad to recommend it to others.

- ***Task Analysis Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure IV-4 are presented the results obtained from the application of the questionnaire to the employee of the lab as well as the average of each question. Three out of the 8 employees of the lab did not work with this tool. Although two of them are familiar with a similar tool called "Data Flow Diagrams", they think that it does not contemplate a number of analysis elements that the ORDIC tool does, which the consider better.

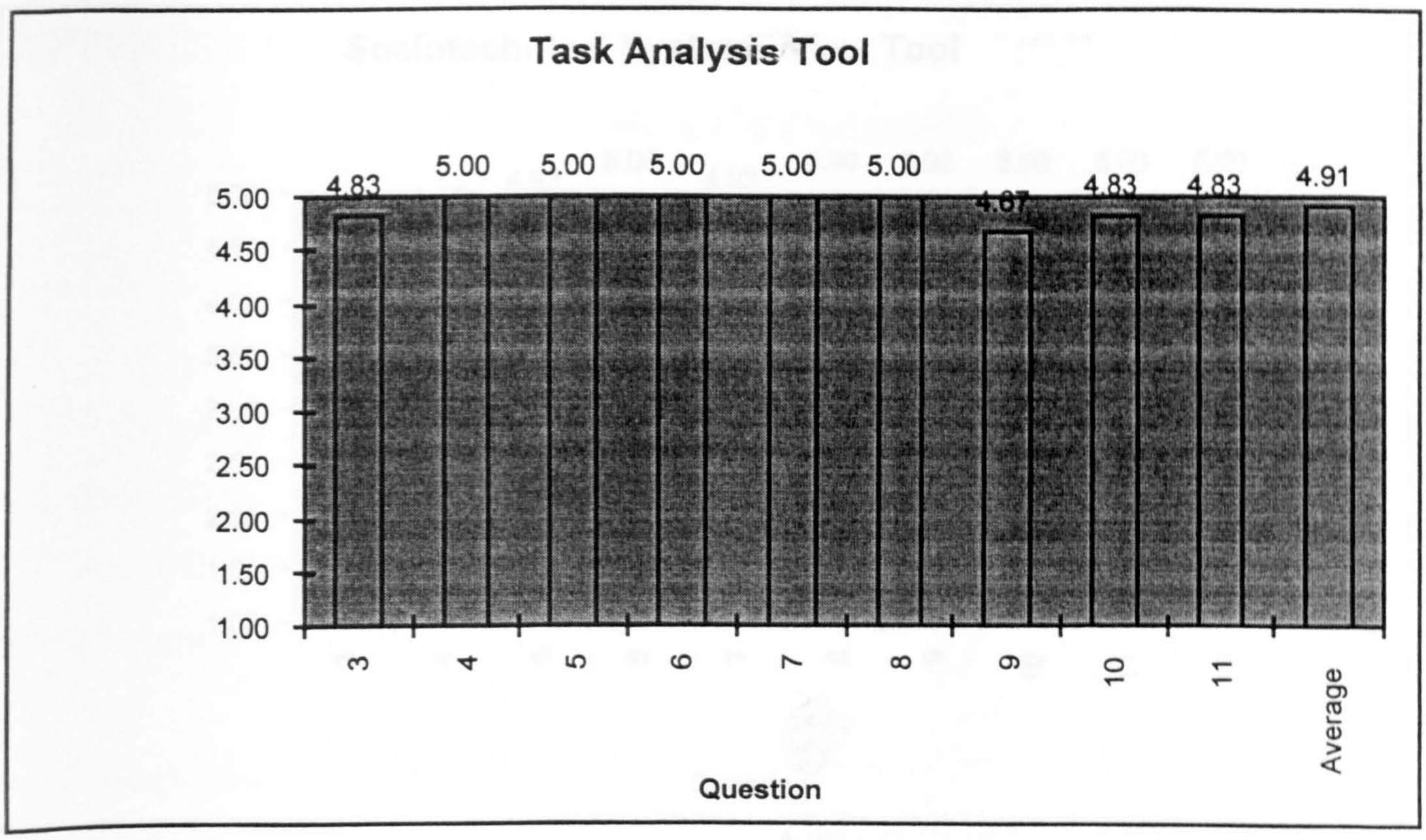


Figure IV-4. HRL evaluation of Task Analysis Tool (questions 3-11).

- ***Sociotechnical Organisations View Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure IV-5 are presented the results obtained from the application of the questionnaire to the employee of the lab as well as the average of each question. All of the employees of the lab worked with this tool. This is due to the fact that although that it was used at the beginning of the project, reference was made to the models generated with this tool during the whole project, thus the members of the lab who were incorporated later, are also familiar with the tool. They believe that *it facilitates interdisciplinary communication (user - IC practitioner),* they are not familiar with a similar tool and they would be glad to recommend it to others.

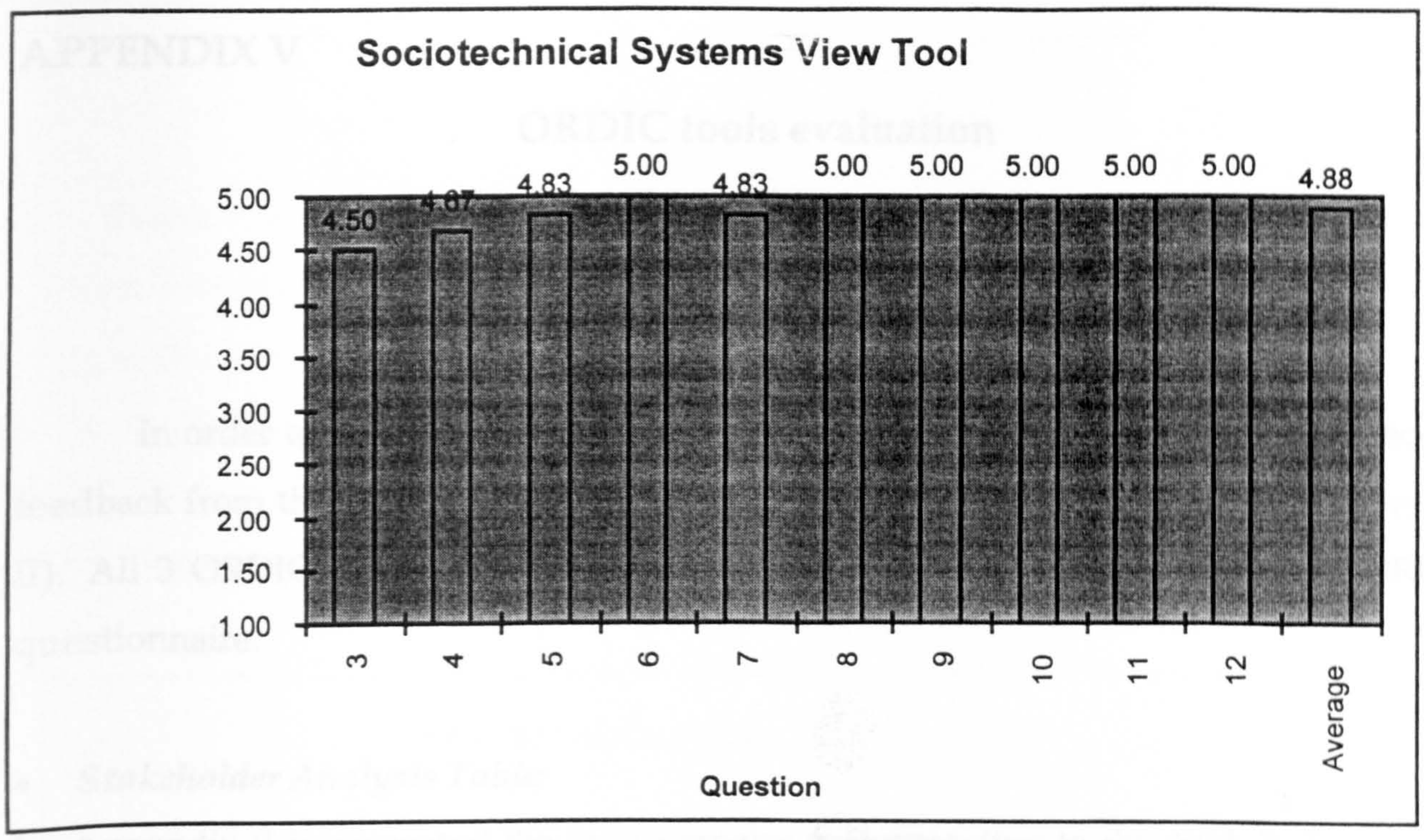


Figure IV-5. HRL evaluation of Sociotechnical Organisations View Tool (questions 3-12).

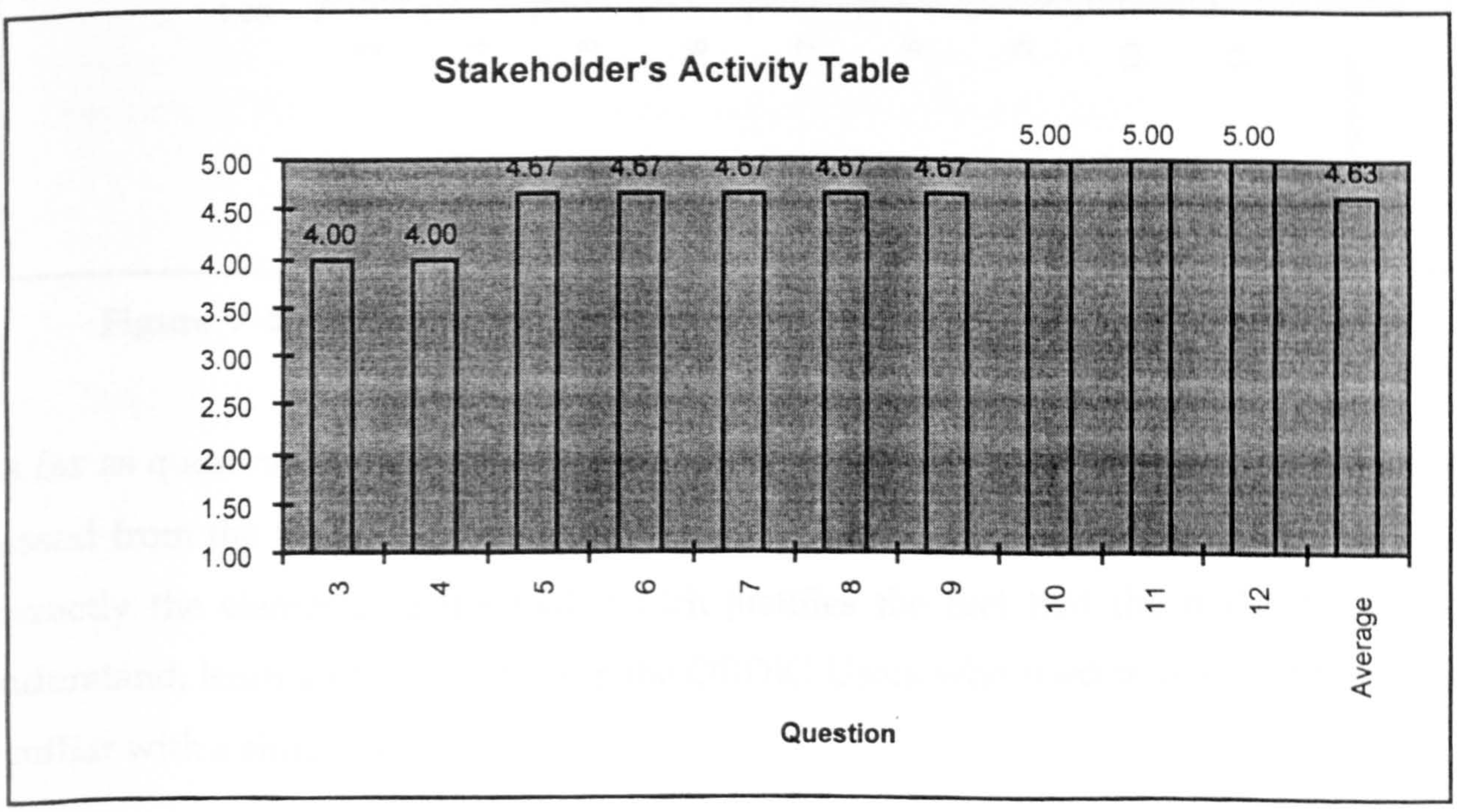
APPENDIX V

ORDIC tools evaluation by the ORDIC Users at the Hazardous Residues Laboratory.

In order to measure the functionality of each one of the ORDIC tools and receive feedback from the ORDIC Users, the ORDIC questionnaire was applied (see Appendix II). All 3 ORDIC Users who facilitated the project at the Lab responded the ORDIC questionnaire.

- ***Stakeholder Analysis Table:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure V-1 are presented the results obtained from the application of the questionnaire to the ORDIC Users of the lab as well as the average of each question. All 3 ORDIC Users replied positively to the first question (*"Have you used this tool?"*). None of them was familiar with a similar tool.



Fugue V-1. HRL evaluation of Stakeholder Analysis Table (questions 3-12).

- ***Functional Modelling Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure V-2 are presented the results obtained from the application of the questionnaire to the ORDIC Users of the project at the lab as well as the average of each question. All 3 ORDIC Users replied positively to the first question (*"Have you used this tool?"*).

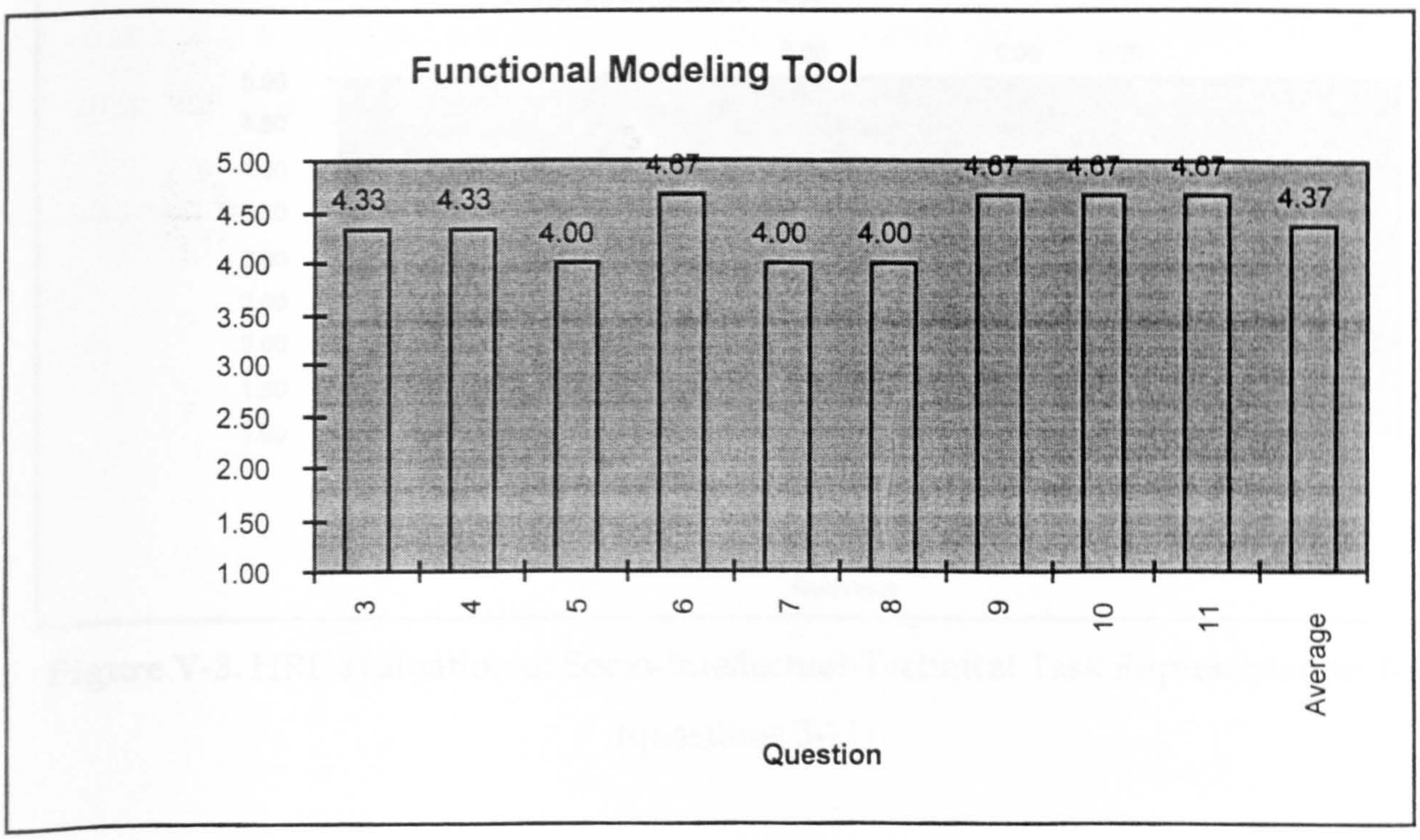


Figure V-2. HRL evaluation of Functional Modelling Tool (questions 3-11).

As far as question number 12 is concerned, although approximately four months have passed from the time the project had finished, all 3 ORDIC Users managed to identify correctly the elements of the tool; which justifies the fact that the tool was easy to understand, learn and remember for the ORDIC Users who used it. None of them was familiar with a similar tool.

- ***Socio-Intellectual-Technical (SIT) Task Representation Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure V-3 are presented the results obtained from the application of the questionnaire to the employee of the lab as well as the average of each question. All 3 ORDIC Users worked with this tool.

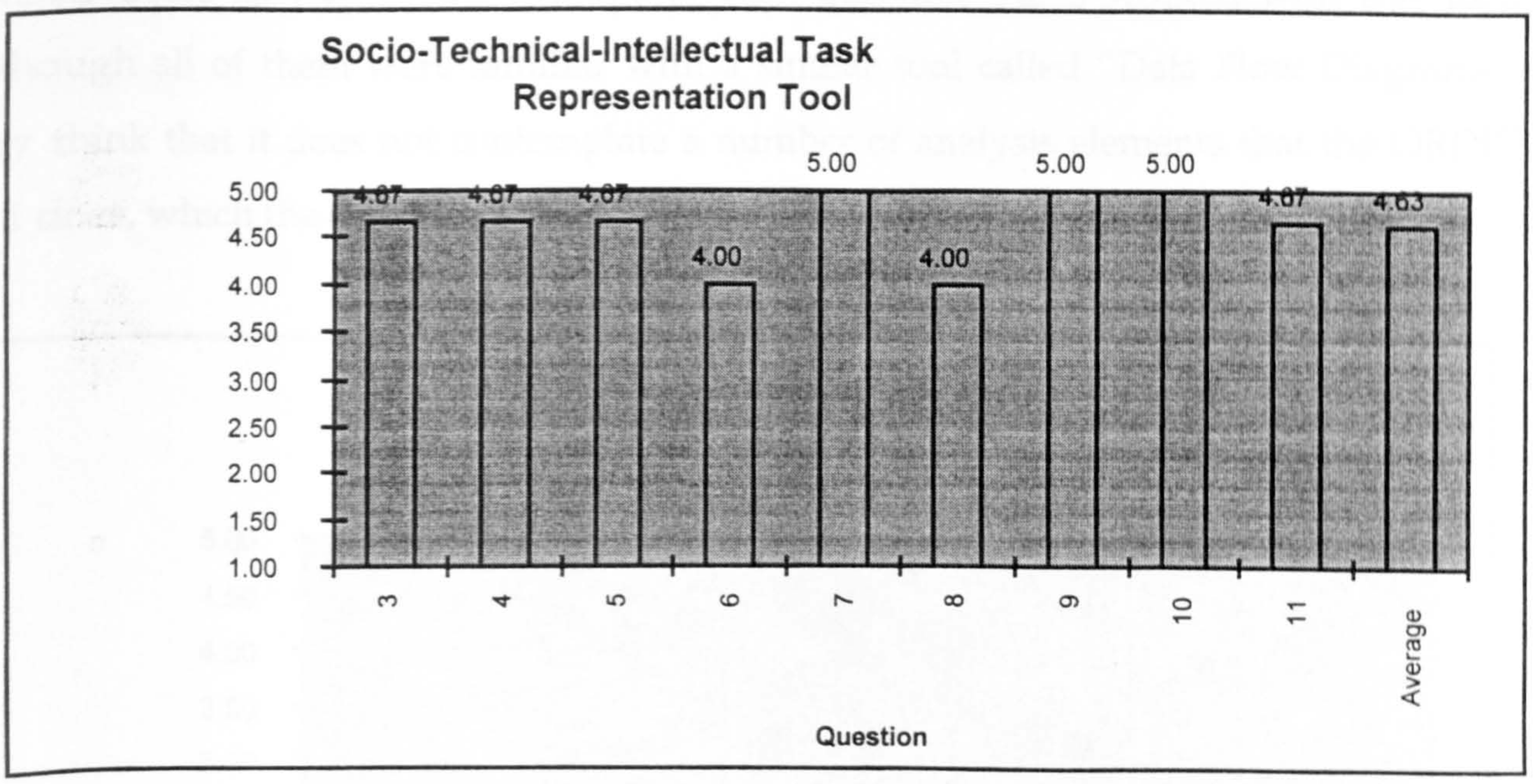


Figure V-3. HRL evaluation of Socio-Intellectual-Technical Task Representation Tool (questions 3-11).

They believe that *it facilitates interdisciplinary communication (employee - IC user),* they are not familiar with a similar tool and they would be glad to recommend it to others.

- ***Task Analysis Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure V-4 are presented the results obtained from the application of the questionnaire to the ORDIC Users as well as the average of each question. All 3 worked with this tool. Although all of them were familiar with a similar tool called "Data Flow Diagrams", they think that it does not contemplate a number of analysis elements that the ORDIC tool does, which the consider better.

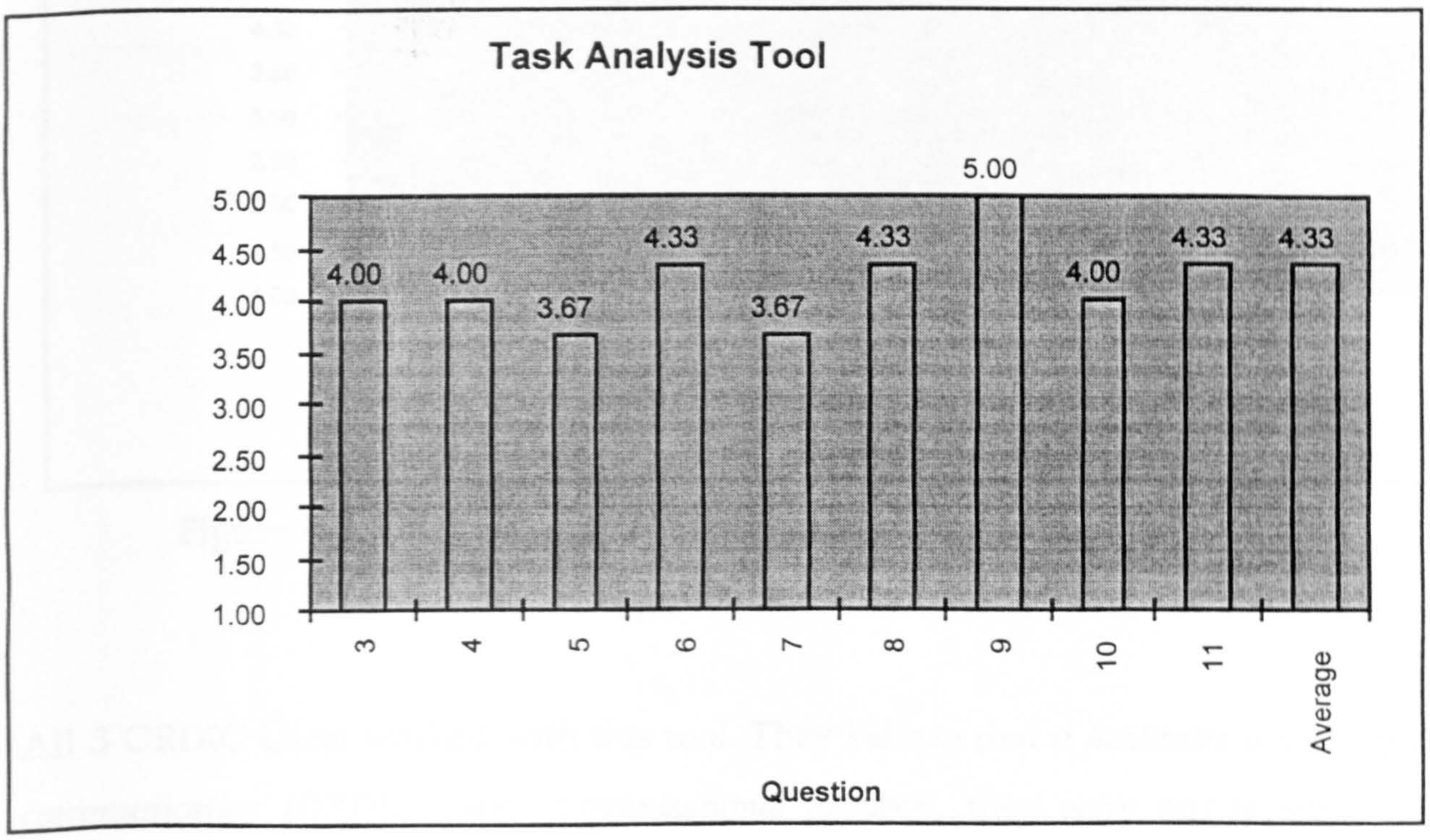


Figure V-4. HRL evaluation of Task Analysis Tool (questions 3-11).

- ***Sociotechnical Organisations View Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure V-5 are presented the results obtained from the application of the questionnaire to the ORDIC Users as well as the average of each question.

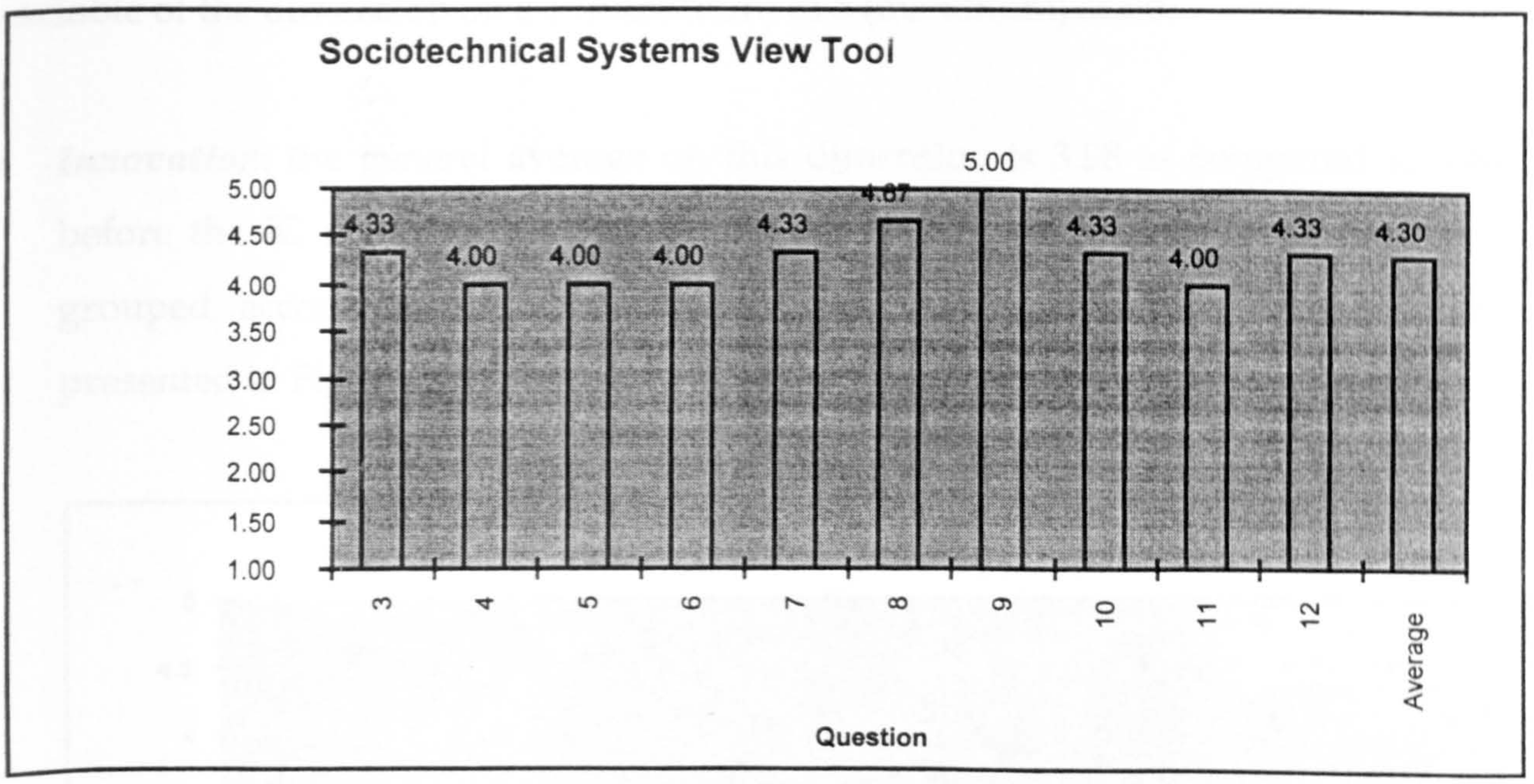


Figure V-5. HRL evaluation of Sociotechnical Organisations View Tool (questions 3 - 12).

All 3 ORDIC Users worked with this tool. They believe that *it facilitates interdisciplinary communication (ORDIC User - Organisational member),* they were not familiar with a similar tool and they would be glad to recommend it to others.

APENDIX VI

Results of the application of the sociotechnical systems questionnaire to the department of Mortgage Services of Bancomer Bank.

In the following will be analyzed in details specific questions of the variables corresponding to each dimension of the sociotechnical systems questionnaire. On the charts, in parenthesis is presented the average of the questions corresponding to each variable of the dimension on a 1 (minimum) to 5 (maximum) scale.

- ***Innovation***: the general average on this dimension is 3.88 as compared to 2.84 before the IC management project; the particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure V-1.

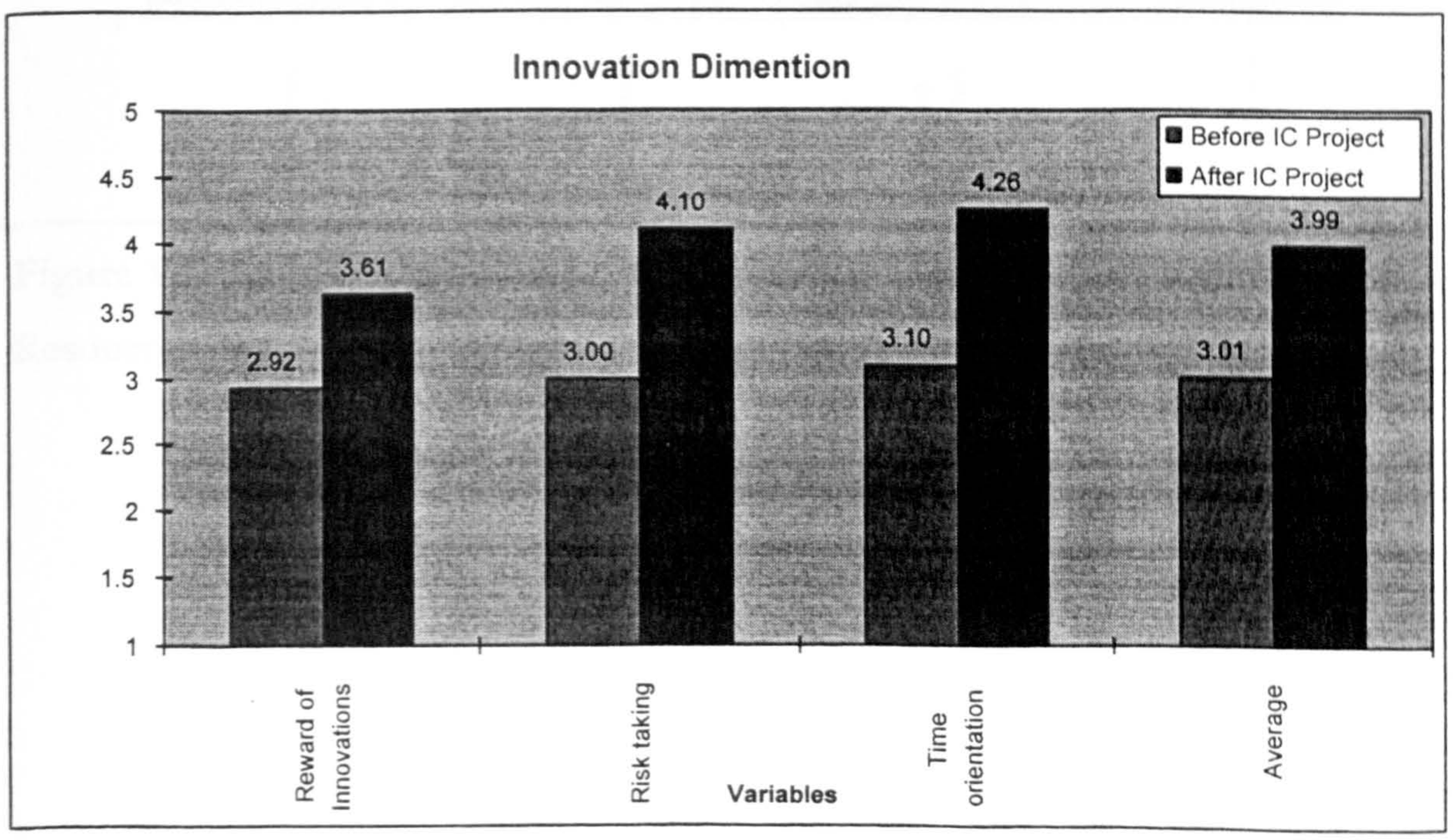


Figure V-1. Score and percentage of the variables corresponding to the Innovation Dimension in the Department of Mortgage Services of the Bancomer Bank.

- ***Human Resources Development***: the general average on this dimension is 3.67 as compared to 2.41 before the IC management project; the particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure V-2.

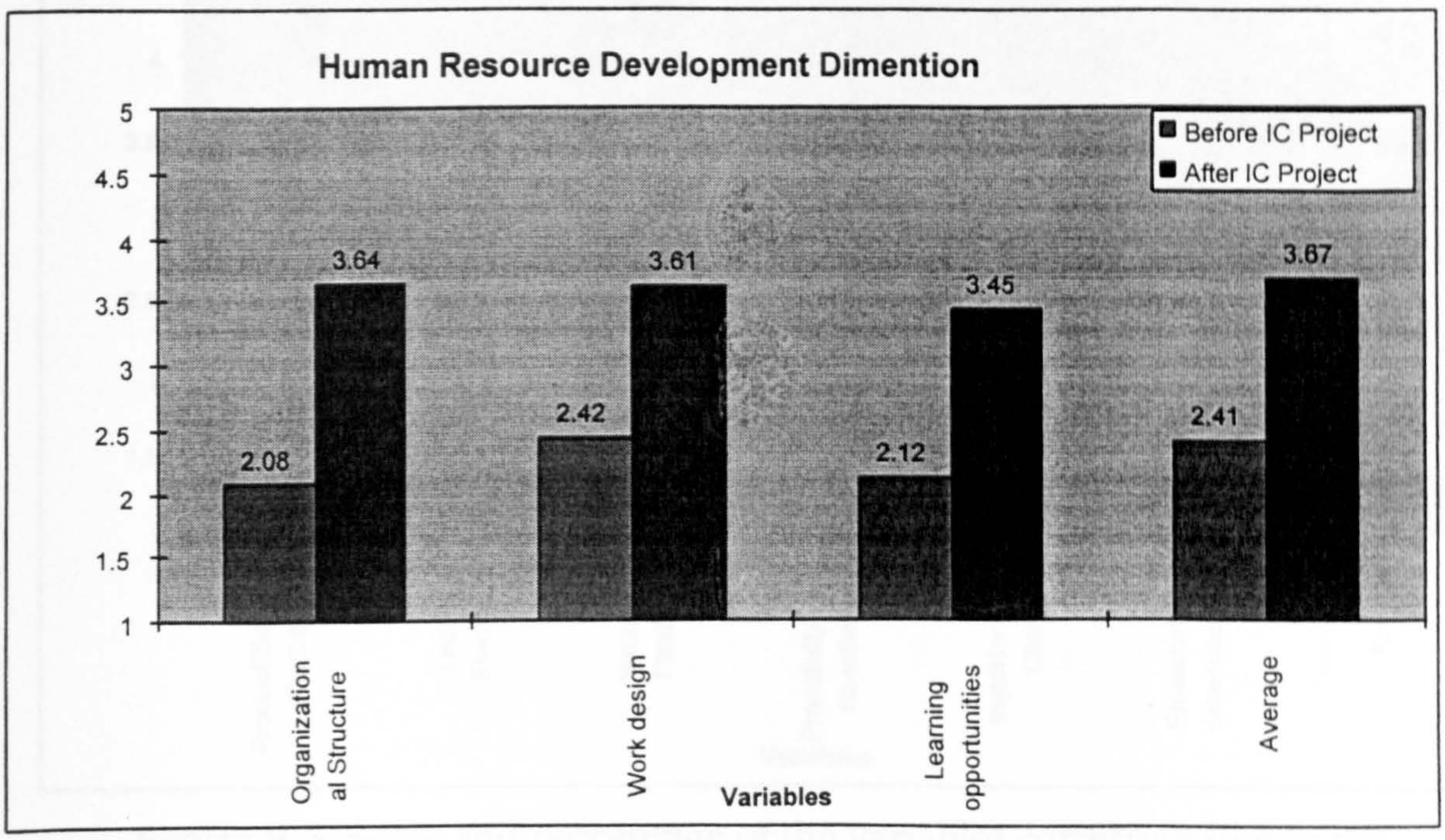


Figure V-2. Score and percentage of the variables corresponding to the Human Resources Development Dimension in the Department of Mortgage Services of the Bancomer Bank.

- ***Environmental Agility***: the general average on this dimension is 4.29 as compared to 3.01 before the IC management project; the particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure V-3.

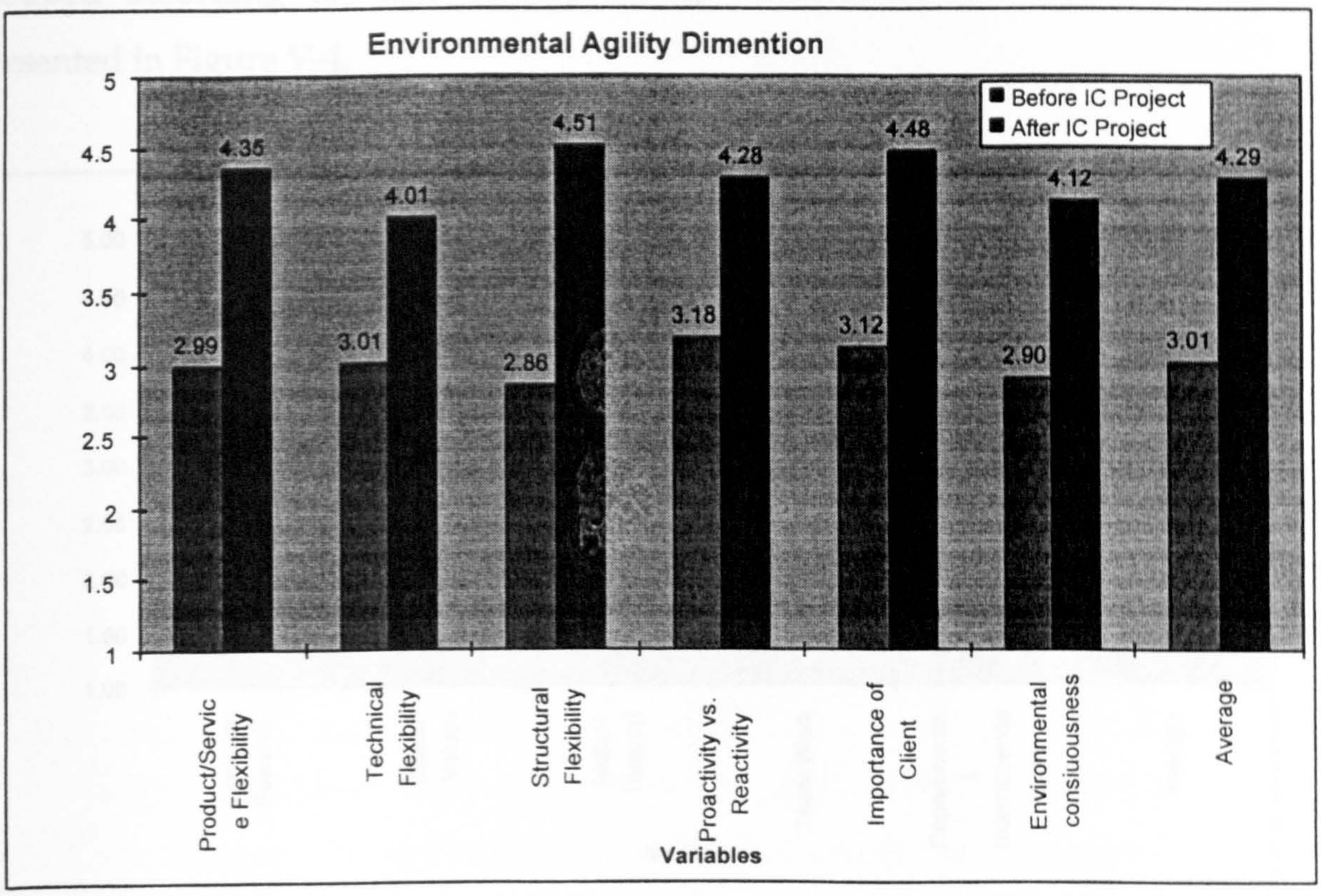


Figure V-3. Score and percentage of the variables corresponding to the Environmental Agility Dimension in the HRL. in the Department of Mortgage Services of the Bancomer Bank.

- ***Co-operation***: the general average on this dimension is 3.61 as compared to 2.7 before the IC management project. The particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure V-4.

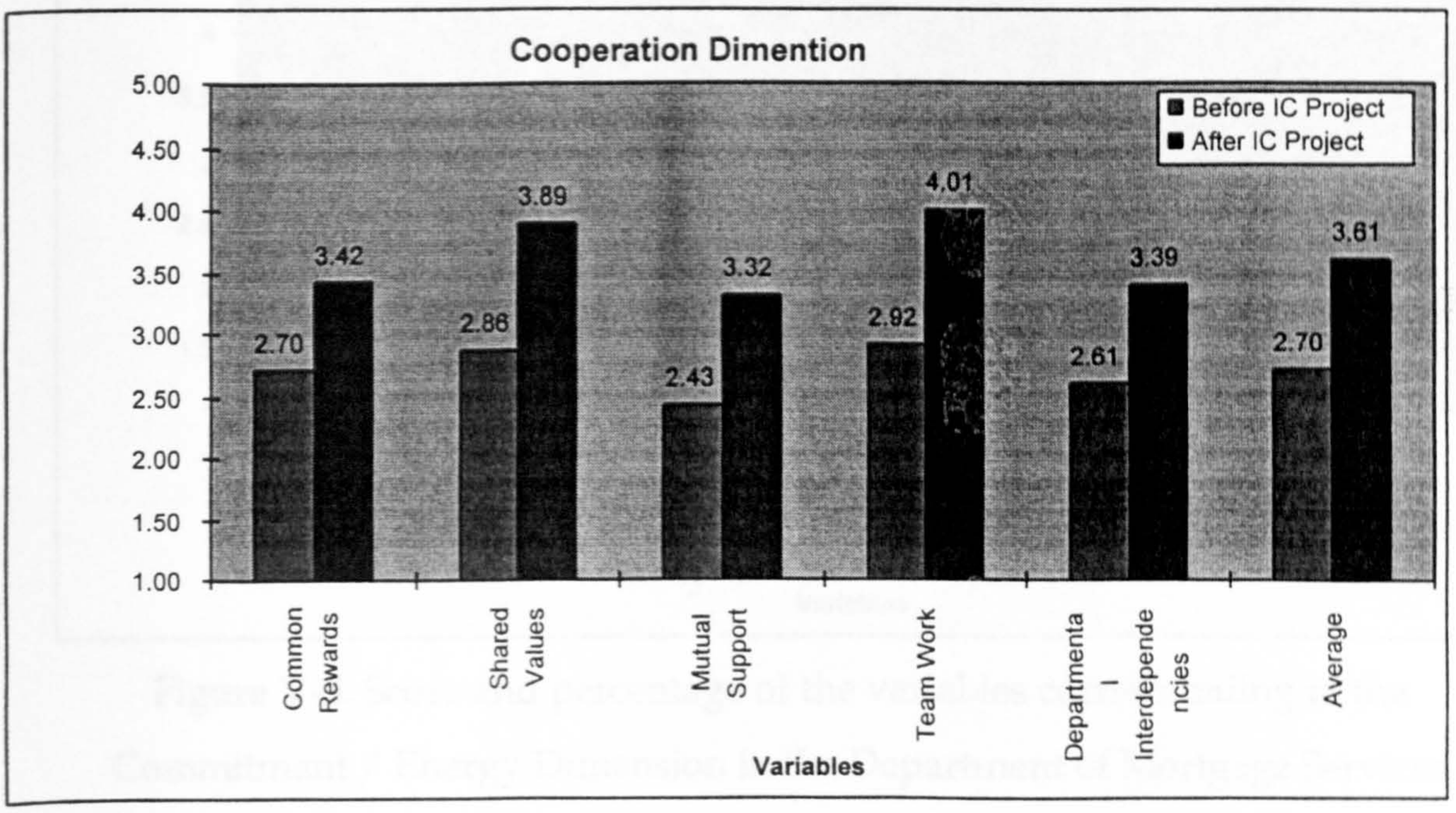


Figure V-4. Score and percentage of the variables corresponding to the Co-operation Dimension in the Department of Mortgage Services of the Bancomer Bank.

- ***Commitment/Energy***: the general average on this dimension is 3.8 as compared to 2.91 before the IC management project. The particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure V-5.

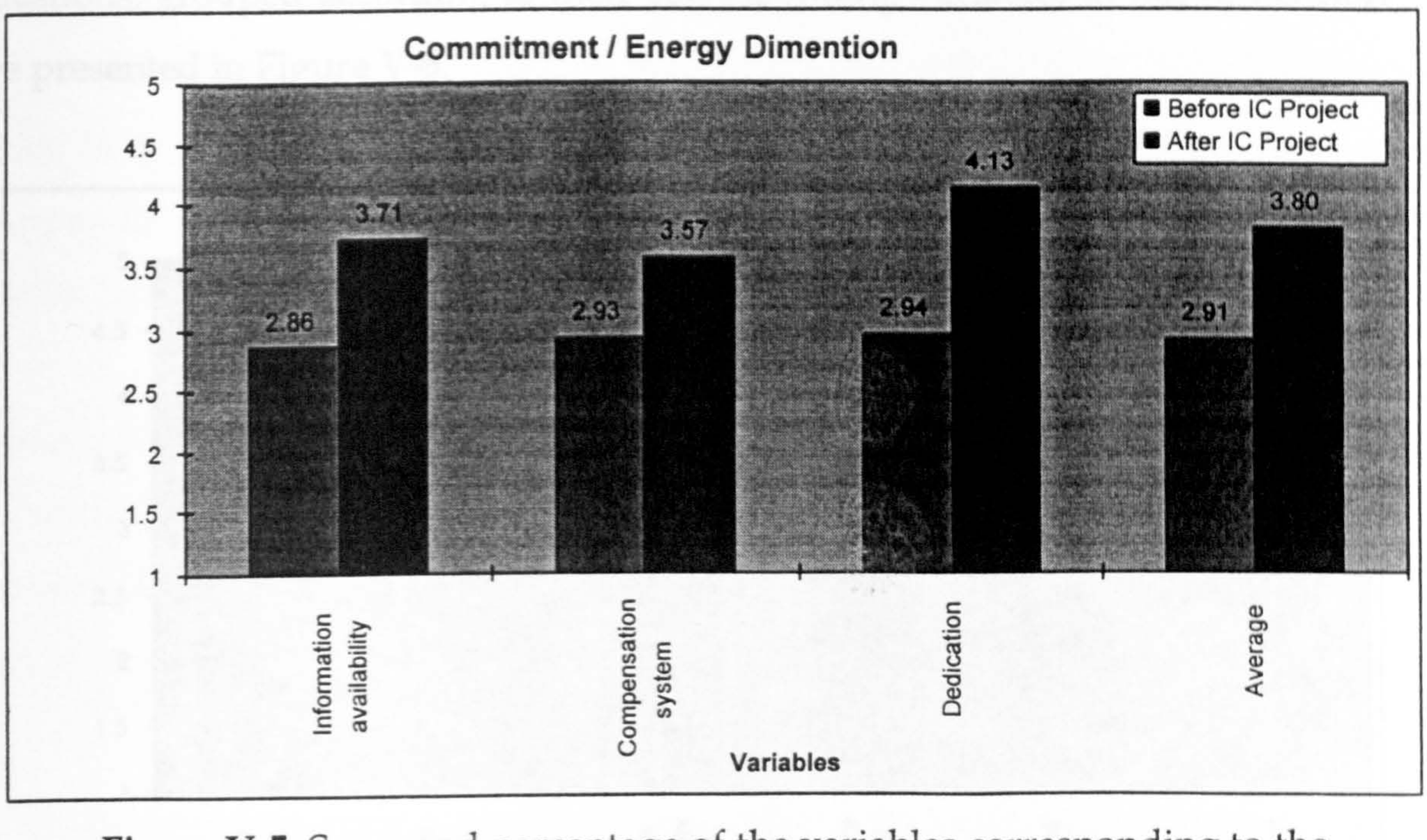


Figure V-5. Score and percentage of the variables corresponding to the Commitment / Energy Dimension in the Department of Mortgage Services of the Bancomer Bank.

- ***Joint improvement:***: the general average on this dimension is 3.89 as compared to 3.01 before the IC management project; the particular average results of questions, grouped according to their corresponding variables in this dimension are presented in Figure V-6.

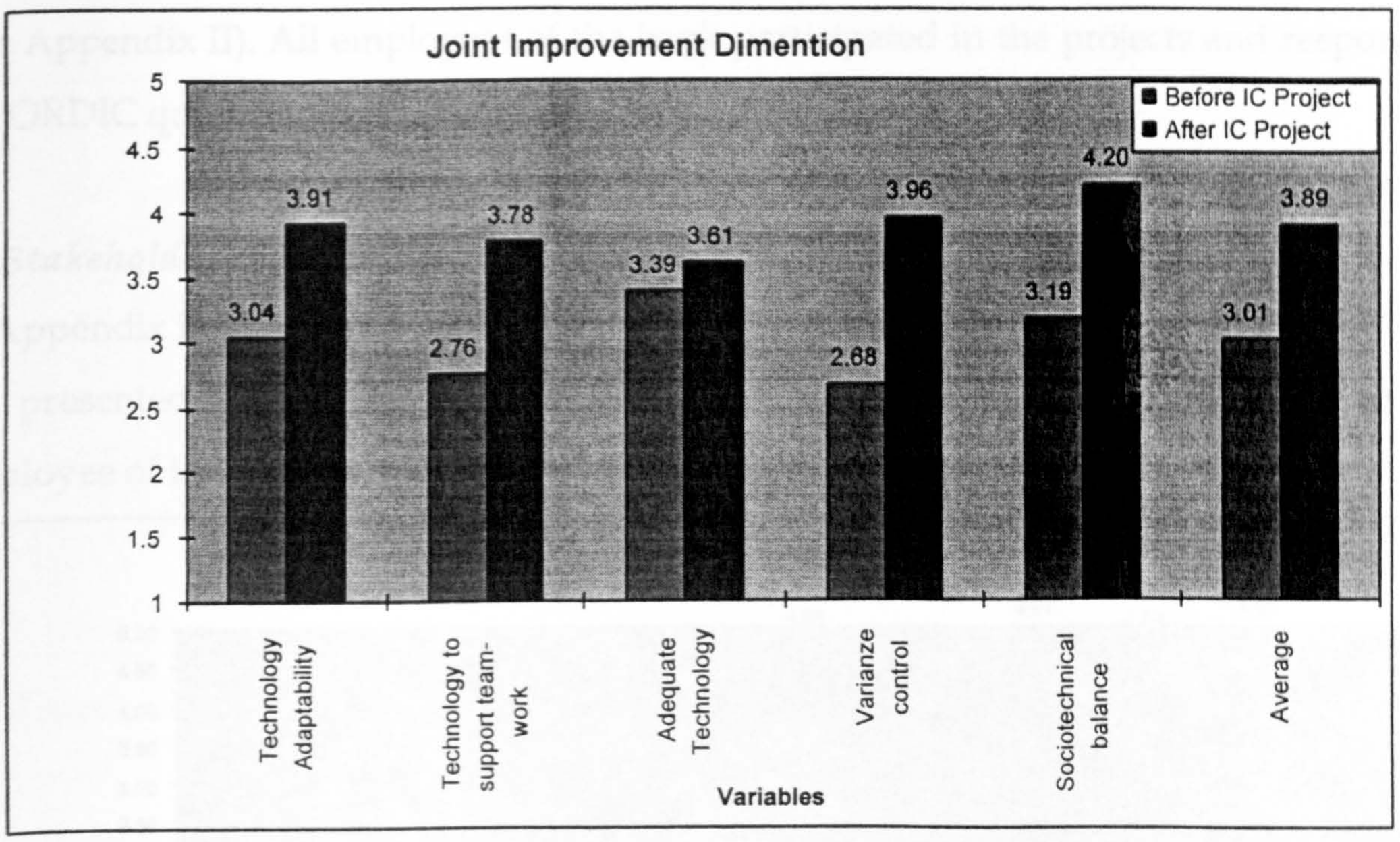


Figure V-6. Score and percentage of the variables corresponding to the Joint Optimization Dimension in the Department of Mortgage Services of the Bancomer Bank.

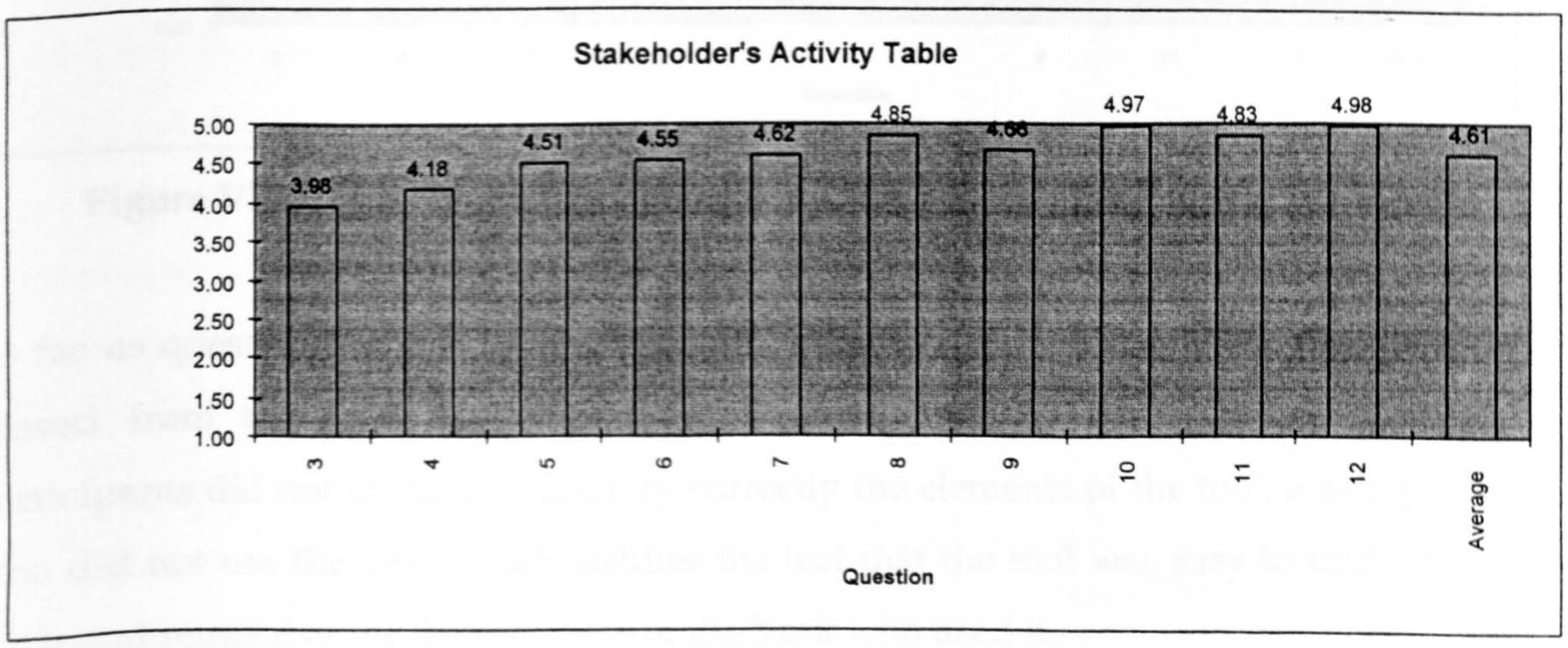
APPENDIX VII

ORDIC tools evaluation
from the Organisational Participants of the department
of Mortgage Services of the Bancomer Bank.

In order to measure the functionality of each one of the ORDIC tools and receive feedback from the users-employees of the Bank, the ORDIC questionnaire was applied (see Appendix II). All employees of the bank participated in the projects and responded the ORDIC questionnaire.

- ***Stakeholder Analysis Table:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure VII-1 are presented the results obtained from the application of the questionnaire to the employee of the bank as well as the average of each question.



Fugue VII-1. HRL evaluation of Stakeholder Analysis Table (questions 3-12).

Out of the 73 employees of the bank, 71 replied positively to the first question (*"Have you used this tool?"*). These were the employees that replied all the questions of the questioner. The rest of them were either sick or on vacations at the beginning of the project, which is the time that this tool was used.

- ***Functional Modelling Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure VII-2 are presented the results obtained from the application of the questionnaire to the employee of the bank as well as the average of each question. Out of the 73 employees of the bank, 67 replied positively to the first question (*"Have you used this tool?"*).

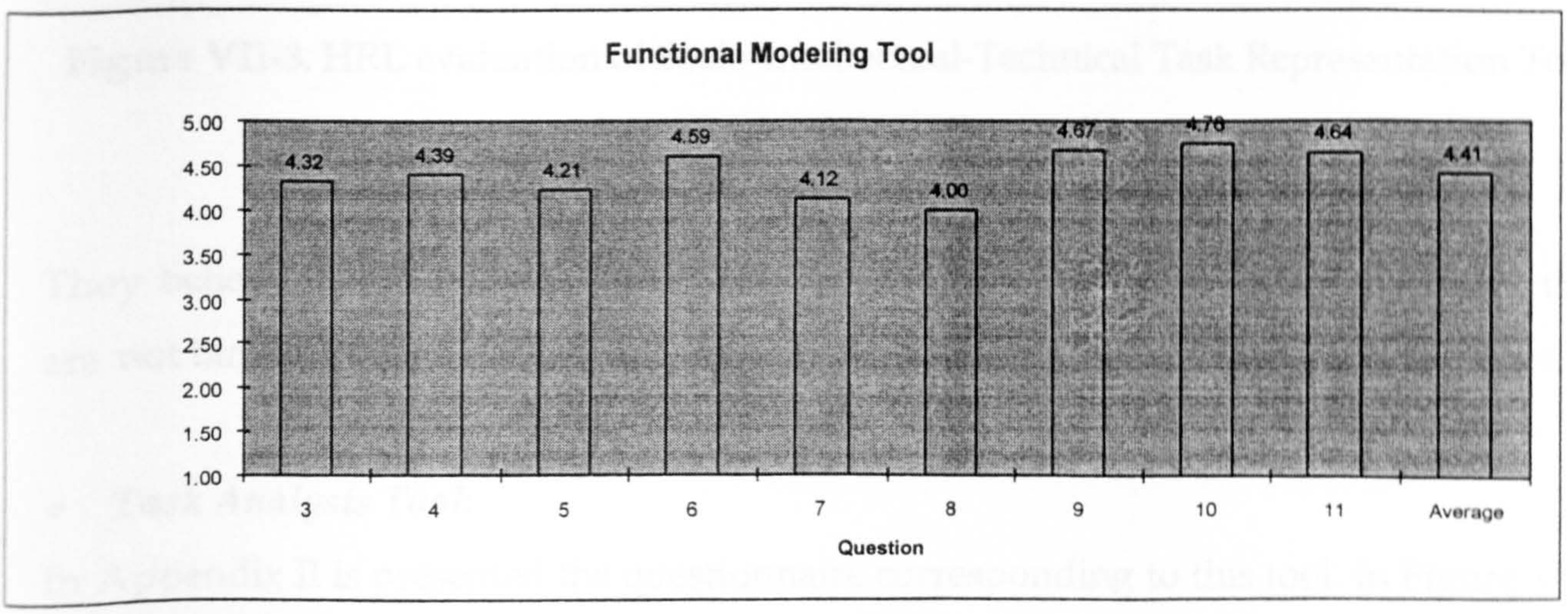


Figure VII-2. HRL evaluation of Functional Modelling Tool (questions 3-11).

As far as question number 12 is concerned, although approximately six months have passed from the time the project had finished, only 8 out of 73 organisational participants did not manage to identify correctly the elements of the tool, 6 being those who did not use the tool; which justifies the fact that the tool was easy to understand, learn and remember for the members of the bank who used it.

- ***Socio-Intellectual-Technical (SIT) Task Representation Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure VII-3 are presented the results obtained from the application of the questionnaire to the employee of the bank as well as the average of each question. All employees of the bank worked with this tool.

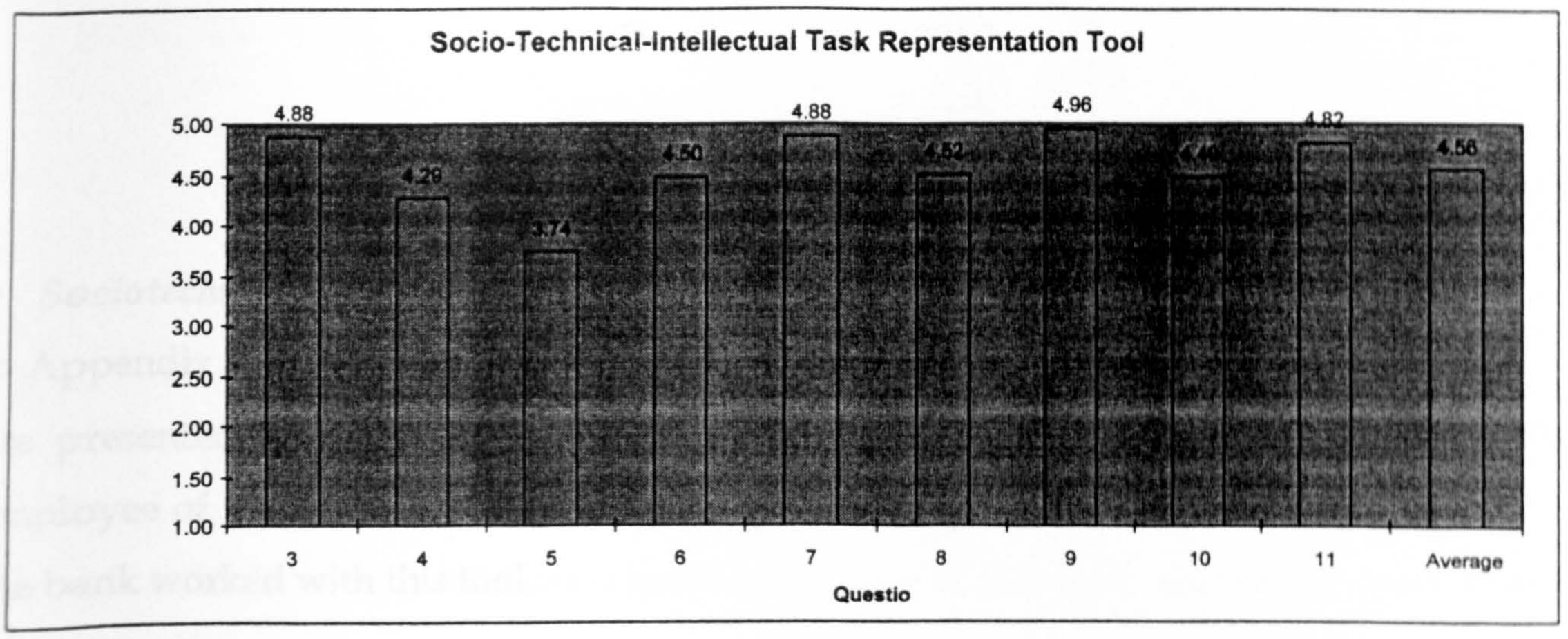


Figure VII-3. HRL evaluation of Socio-Intellectual-Technical Task Representation Tool (questions 3-11).

They believe that *it facilitates interdisciplinary communication (user - IC practitioner),* they are not familiar with a similar tool and they would be glad to recommend it to others.

- ***Task Analysis Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure VII-4 are presented the results obtained from the application of the questionnaire to the employee of the bank as well as the average of each question. Three out of the 70 employees of the bank did not work with this tool.

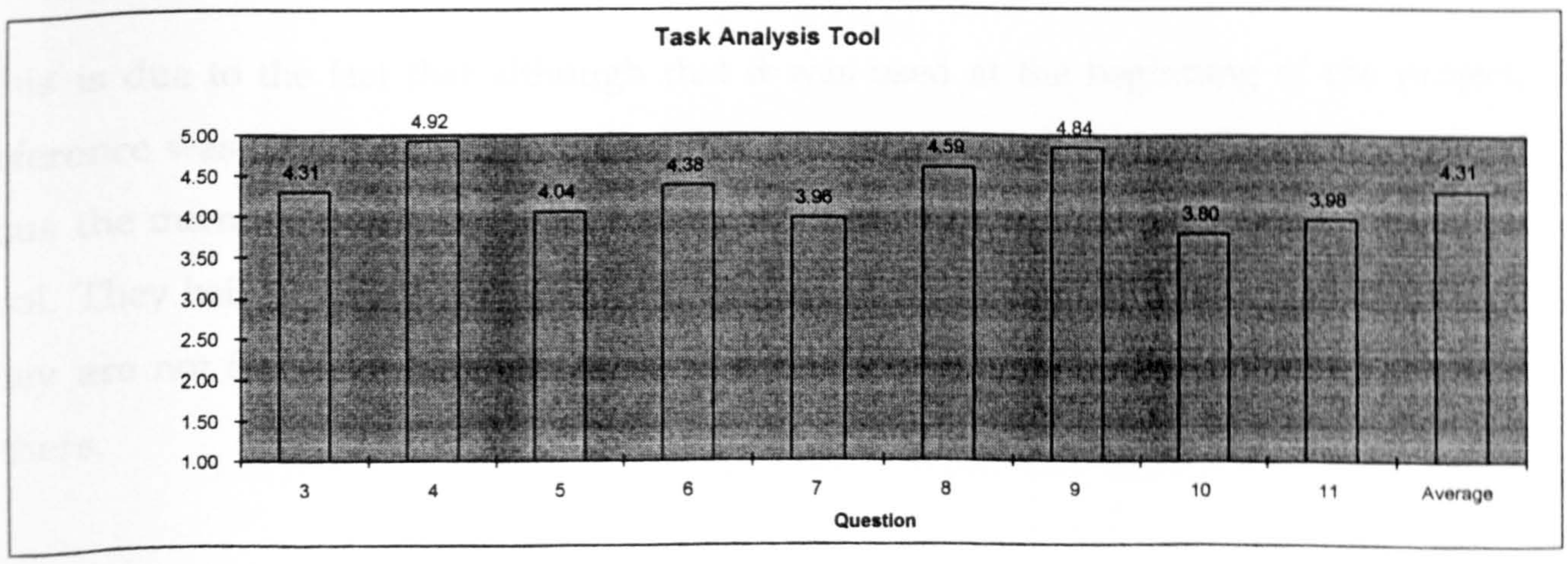


Figure VII-4. HRL evaluation of Task Analysis Tool (questions 3-11).

- ***Sociotechnical Organisation's View Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure VII-5 are presented the results obtained from the application of the questionnaire to the employee of the bank as well as the average of each question. All of the employees of the bank worked with this tool.

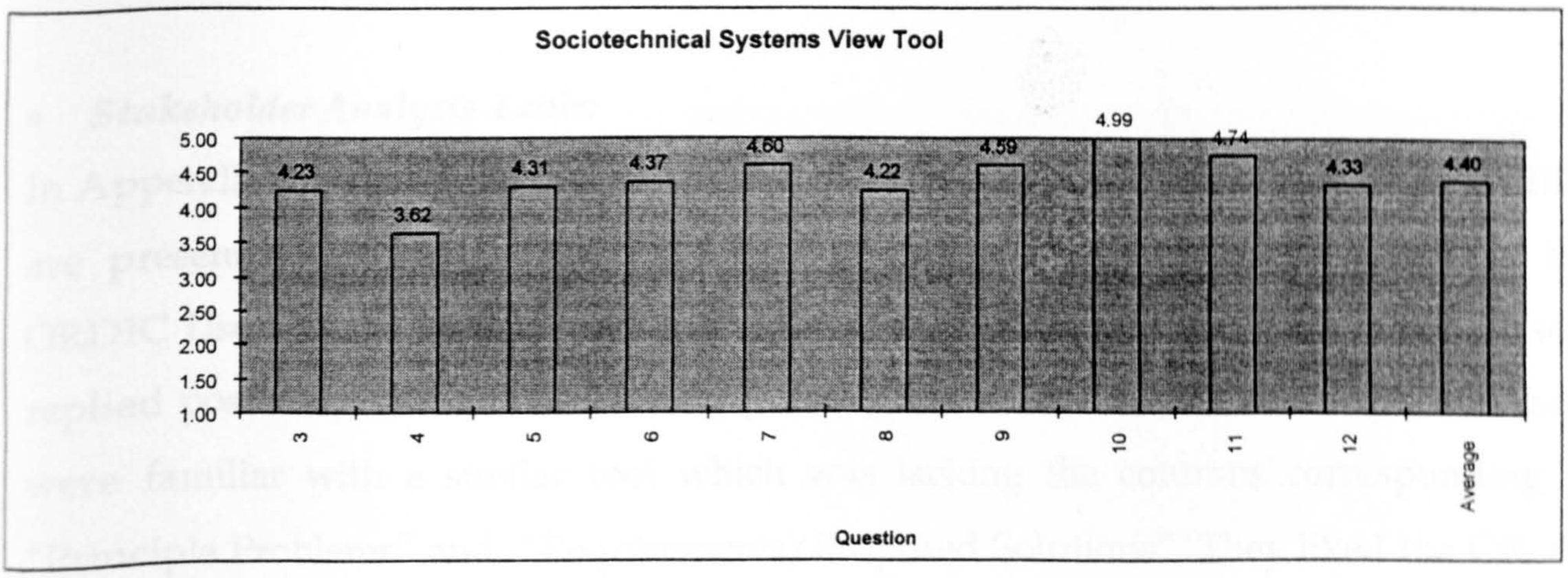


Figure VII-5. HRL evaluation of Sociotechnical Organisationís View Tool (questions 3-12).

This is due to the fact that although that it was used at the beginning of the project, reference was made to the models generated with this tool during the whole project, thus the members of the bank who were incorporated later, are also familiar with the tool. They believe that *it facilitates interdisciplinary communication (user - IC practitioner),* they are not familiar with a similar tool and they would be glad to recommend it to others.

APPENDIX VIII

ORDIC tools evaluation
by the ORDIC Users of the IC project at the
department of Mortgage Services of Bancomer Bank.

In order to measure the functionality of each one of the ORDIC tools and receive feedback from the ORDIC Users, the ORDIC questionnaire was applied (see Appendix II). All 6 ORDIC Users who facilitated the project at the Bank responded the ORDIC questionnaire.

- ***Stakeholder Analysis Table:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure VIII-1 are presented the results obtained from the application of the questionnaire to the ORDIC Users of the bank as well as the average of each question. All 6 ORDIC Users replied positively to the first question (*"Have you used this tool?"*). Although 2 of them were familiar with a similar tool which was lacking the columns corresponding to "Principle Problems" and "Requirements/Proposed Solutions". They liked the ORDIC tool better because they consider it more participative.

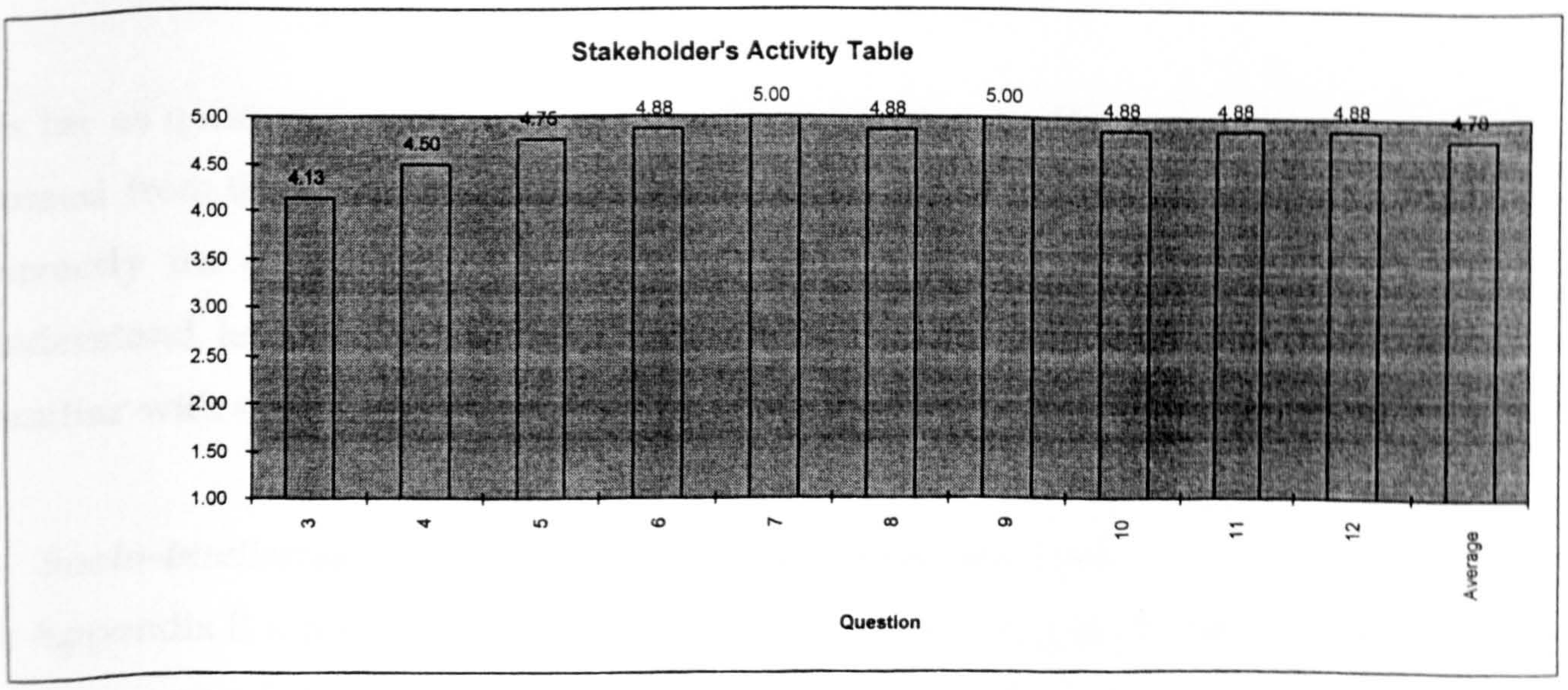


Figure VIII-1. HRL evaluation of Stakeholder Analysis Table (questions 3-12).

- ***Functional Modelling Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure VIII-2 are presented the results obtained from the application of the questionnaire to the ORDIC Users of the project at the bank as well as the average of each question. All 6 ORDIC Users replied positively to the first question (*"Have you used this tool?"*).

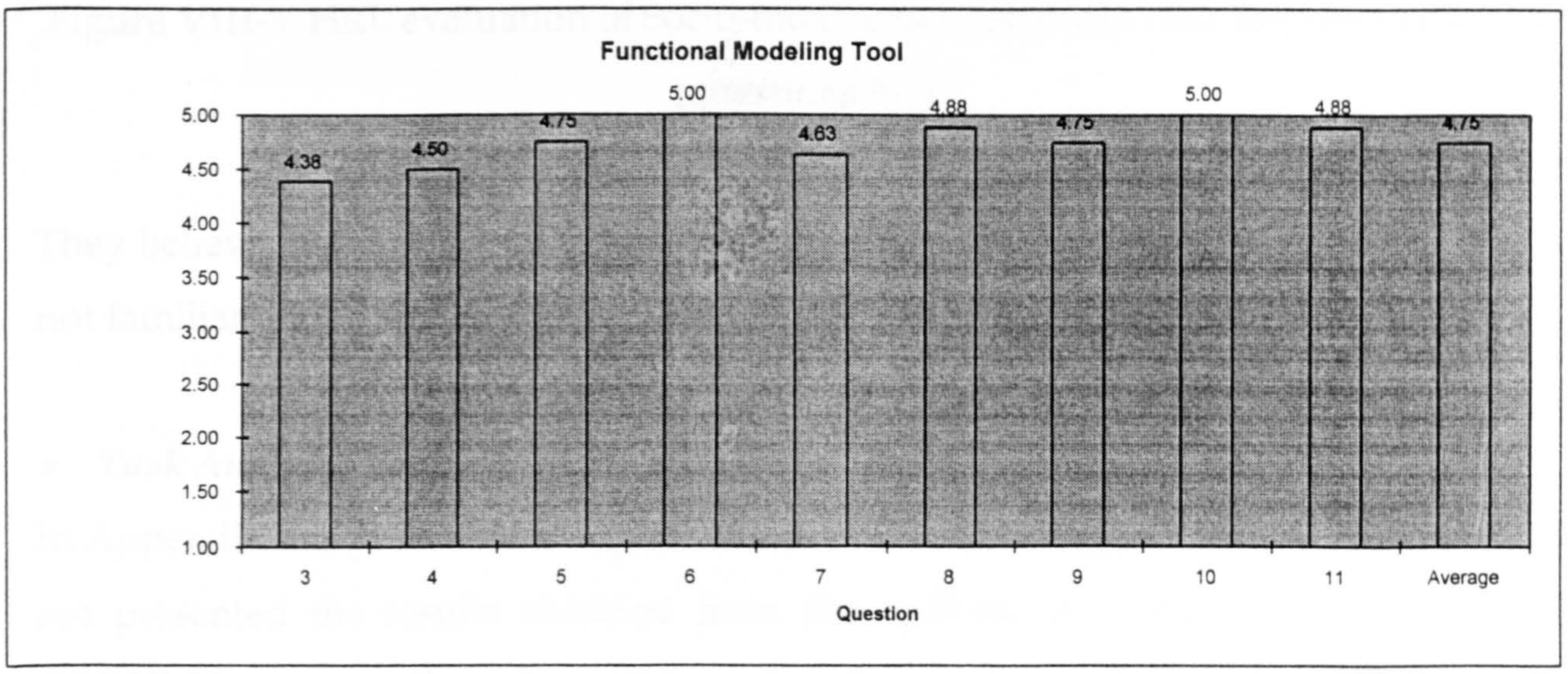


Figure VIII-2. HRL evaluation of Functional Modelling Tool (questions 3-11).

As far as question number 12 is concerned, although approximately four months have passed from the time the project had finished, all 6 ORDIC Users managed to identify correctly the elements of the tool; which justifies the fact that the tool was easy to understand, learn and remember for the ORDIC Users who used it. None of them was familiar with a similar tool.

- ***Socio-Intellectual-Technical (SIT) Task Representation Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure VIII-3 are presented the results obtained from the application of the questionnaire to the employee of the bank as well as the average of each question. All 6 ORDIC Users worked with this tool.

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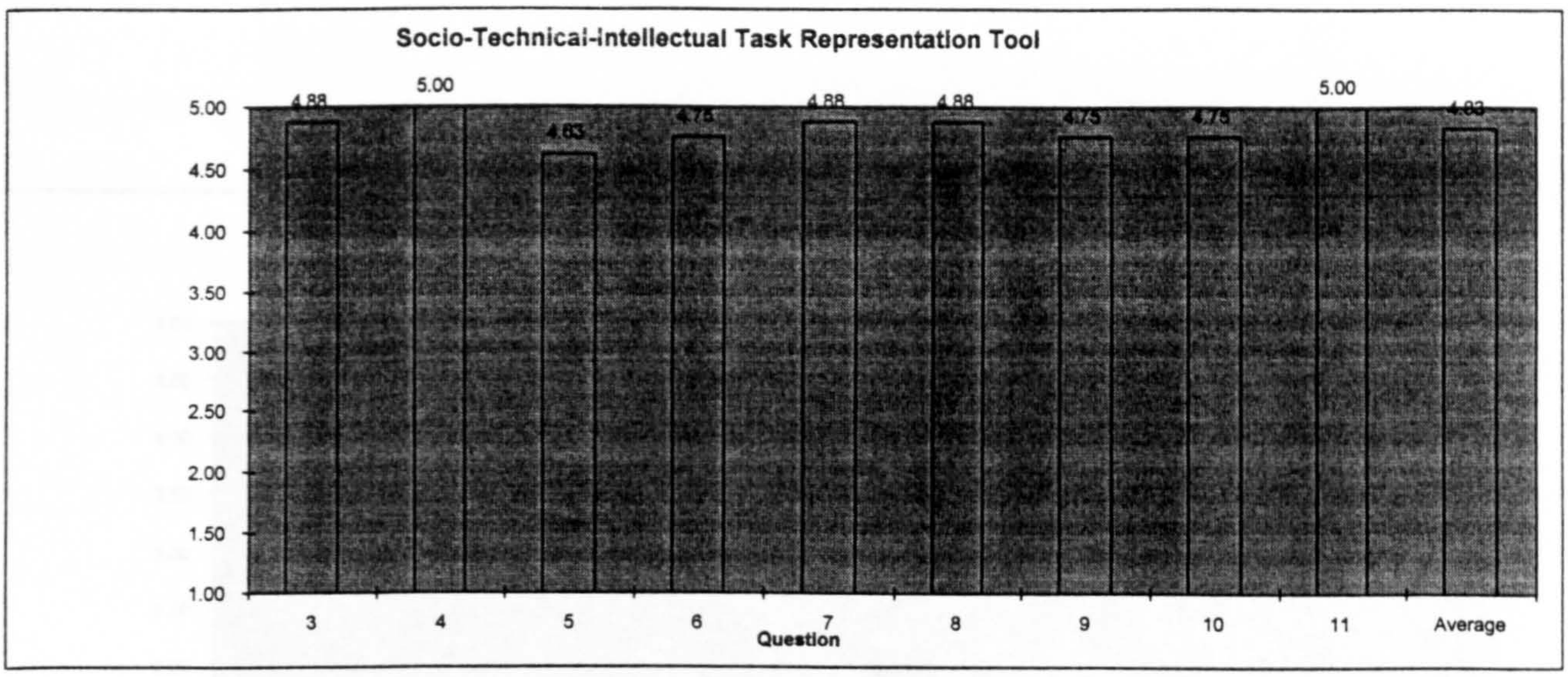


Figure VIII-3. HRL evaluation of Socio-Intellectual-Technical Task Representation Tool (questions 3-11).

They believe that *it facilitates interdisciplinary communication (employee - IC user),* they are not familiar with a similar tool and they would be glad to recommend it to others.

- ***Task Analysis Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure VIII-4 are presented the results obtained from the application of the questionnaire to the ORDIC Users as well as the average of each question. All 6 worked with this tool. Although four of them were familiar with a similar tool called "Data Flow Diagrams", they think that it does not contemplate a number of analysis elements that the ORDIC tool does, which the consider better.

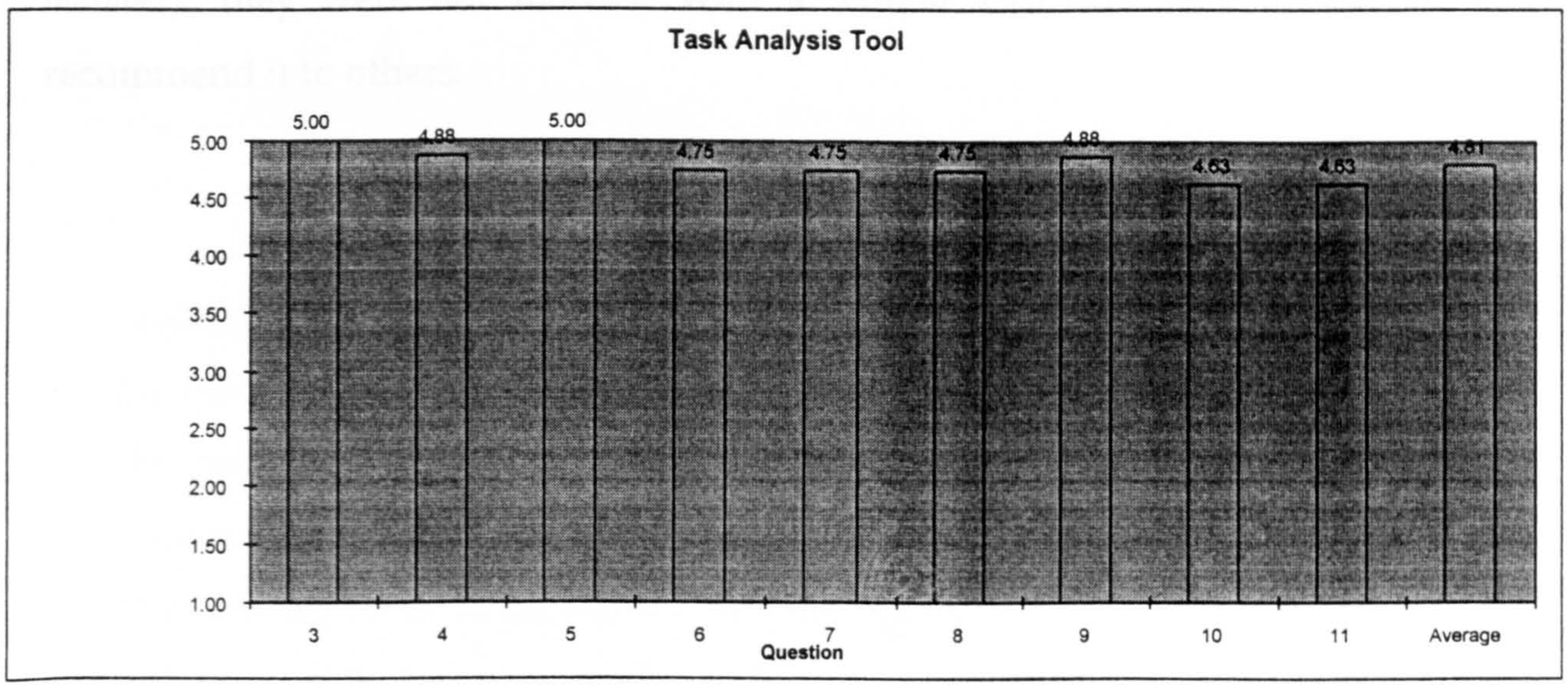


Figure VIII-4. HRL evaluation of Task Analysis Tool (questions 3-11).

- ***Sociotechnical Organisations View Tool:***

In Appendix II is presented the questionnaire corresponding to this tool. In Figure VIII-5 are presented the results obtained from the application of the questionnaire to the ORDIC Users as well as the average of each question. All 6 ORDIC Users worked with this tool.

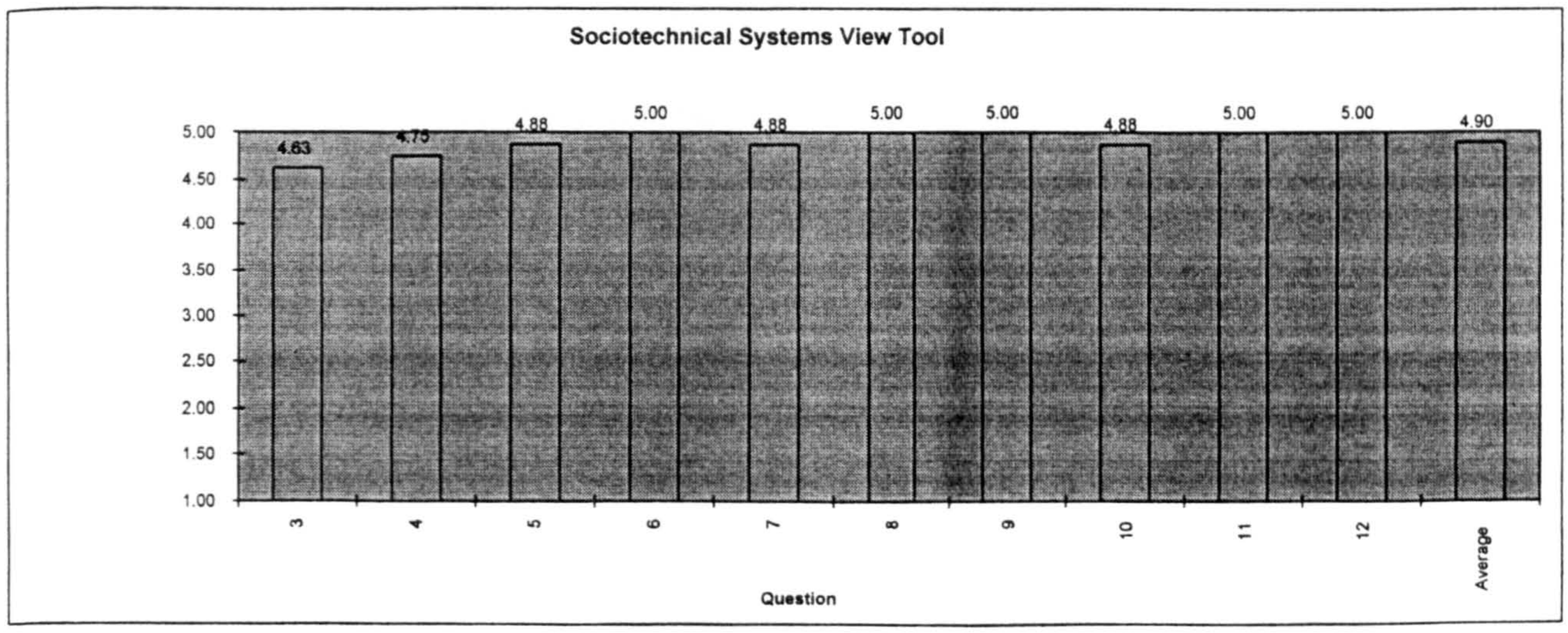


Figure VIII-5. HRL evaluation of Sociotechnical Organisations View Tool (questions 3 to 12).

They believe that *it facilitates interdisciplinary communication (ORDIC User - Organisational member),* they were not familiar with a similar tool and they would be glad to recommend it to others.

APPENDIX IX.

ORDIC Methodology.

1. The ORDIC Philosophy.

ORDIC is a set of methods for the articulation of organizational requirements by modeling future systems and exploring the implications of the different possibilities. At the heart of ORDIC is a modeling language which uses responsibility analysis to explore the way in which social, intellectual and technical systems combine to achieve *cooperative tasks*. The underlying concept is that large tasks are achieved by assigning responsibility for different sub-tasks to members of the organization. These members, in order to execute their responsibilities, need to "*have access to*" skills, tools, information and experience appropriate to their role. Furthermore, their selection process as well as their evaluation, reward and career development should be such that will assure they will correspond not only to their job responsibilities, but also to those related to their coworkers and the organization.

The responsibilities assigned to work roles are then the pivot upon which an effective IC system must rest; the responsibilities define role relations between members of the social system and the necessary distribution of technical and intellectual resources. ORDIC methodology models the IC character of a *co-operative group* by defining the work roles in the work system as a series of responsibilities they undertake. Each responsibility carries with it rights and obligations, including rights and obligations with respect to IC and technological resources.

In any co-operative work setting there exist relations between work roles. We should distinguish between ***functional relations***, where responsibilities for work are passed from one role to another to enable the next function to be undertaken, and ***structural relations*** such as supervision which imply a power relationship enabling one role holder to exercise co-ordination and control over another. With ORDIC these

relations can be modeled. Furthermore, since the co-operative group is unlikely to be independent of all other groups and each work role is likely to be part of other co-operative teams, ORDIC also permits modeling of these type of interdependencies.

An advantage of using ORDIC is the fact that it ensures that key employees are identified and their concerns and requirements are explored. In order to support a user-centered design process, the method attaches key importance to *enhancing communication* between problem owners and solution designers. Furthermore, ORDIC was developed in such a way so that it can be adapted to the particular needs of any organization.

It has been found that seeing the organization as a *network of responsibilities* provides a useful communication medium between parties involved in systems development. Furthermore, it helps identify organizational requirements, and represent them in a form that both system designers and problem owners can understand and evaluate [Olphert and Harker, 1994].

Recognizing the fact that employees at the beginning of the design process are unlikely to be fully aware of there skill development needs, information access and/or technology requirements, there is a need to be prepared to *revisit earlier stages* as their awareness increases and their perceptions change. The methodology is compatible with the *evolving nature of requirements*, allowing for revision and growth.

Possessing new skills, having access to information, experience and new technology developments provides an opportunity to look at different ways of doing things and of reorganizing work procedures. It is important that IC systems design does not confine itself to creating solutions to problems by fossilizing existing practices which may have arisen historically for reasons which themselves no longer hold.

2. The Premises of ORDIC.

In terms of IC management, ORDIC is based on the following premises:

- *Successful systems design is user-centered*; the technology must be designed as a tool to serve the needs of users - employees
- *Employees learning facilitation* must be customized and designed to develop the creative competencies (skills) needed to perform with excellence organizational activities that add value to the organization, while simultaneously enriching the quality of work life of employees. Such activities form part of processes that are aligned with the goals of the organization and the needs of the individuals.
- *Reward systems* must be designed to support the creation of a structure in which it is psychologically safe for employees to make errors, to practice, learn and innovate in a safe environment. Furthermore they must be designed to reinforce new responses learned and tried by the employees, to provide a motive, a sense of direction, and the opportunity for trying out new things without fear of punishment.
- *Experience management mechanisms* must be designed in such a way that facilitate employees in reusing organizational experience in order to perform their job related activities and innovate when necessary. Through the execution of these activities, individual and organizational obligations are fulfilled, corresponding responsibilities are discharged and individual rights and perceived needs are satisfied. Experience mechanisms must also be integrated to the everyday work activities and organizational culture.

ORDIC encourages the *generation* and *evaluation* of different Socio-intellectual-technical options of possible futures with the aim of expanding the problem space and exploring a wider territory rather than producing "a solution". As a result ORDIC, through the use of participative design, encourages a relationship of joint exploration between experts/designers and problem owners/stakeholder. In ORDIC a Stakeholder can

be interpreted either as an individual working role, or a department, an organization, or even a group of organizations.

3. The ORDIC Process.

ORDIC process (see Figure IX.1.) is an iterative one, motivating and facilitating user-employee participation and feedback at each stage of the process.

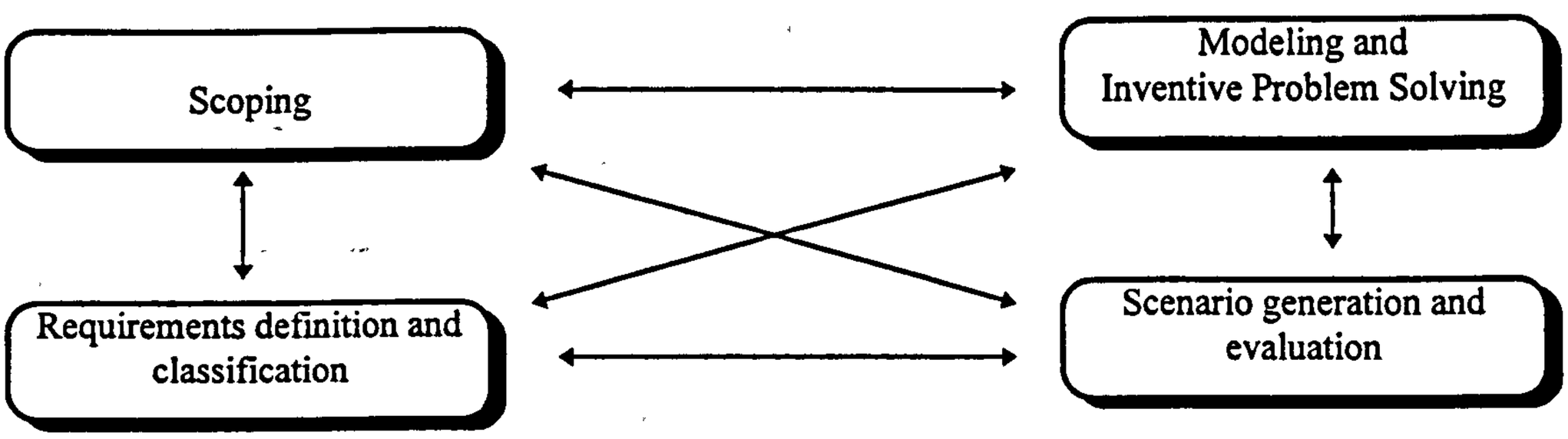


Figure IX.1. Sub processes of the ORDIC process.

There are four sub processes of the ORDIC process: *Scoping*, individual and organizational *Requirements Definition and Classification*, *Generation and Evaluation of Scenarios* of possible solution and *Modeling and Inventive Problem Solving* Subproceses. The four sub processes of ORDIC are interactive, their execution does not follow a specific order. The execution of the first three is facilitated by the Modeling and Inventive Problem Solving sub processes.

The *Scenario Generation and Evaluation* sub processes produces a modeled solution, an organizational systems design, that responds to an organizational need for Socio-Intellectual-Technical development. It is there where feasible and required organizational changes are identified, where organizational processes are integrated with the social, technological and intellectual systems. In this sense, ORDIC is considered to be quite flexible since it can be used in different ways according to the nature of the situation in which it will be applied. During the joint exploration of future/possible scenarios there

are specific activities that are performed (see Table IX.1).

• Revision of organizations *vision, mission* and *strategic objectives and value ideals*;
• *Participative process modeling* of organizations Sociotechnical systems and subsystems.
• Participative modeling of *roles*, definition of *functional* and *structural relationships* as well as *responsibilities* of roles.
• Definition of *knowledge, information, equipment, material, time, rewarding, etc.* requirements based on the functional and structural relationships, and responsibility modeling.
• Classification of requirements.
• Gap analysis between existing and required needs.
• Participative development of *corresponding systems.*

Table IX.1. Activities of an Intellectual Capital project using ORDIC.

The execution of these activities is the objective of collaborative work sessions between those involved in the decision making process. Participants can play a range of different roles. The type of roles and the number of participants is largely dictated by the particular needs of each stage of the design process.

4. The Set of ORDIC Tools.

ORDIC method includes a group of tools whose objective is:

- to support stakeholders participation in the ORDIC process and IC systems design;
- to capture and present organizational requirements by modeling, generating and evaluating future scenarios (possible systems designs);
- to facilitate participative and inventive problem solving;
- to document individual, group and organizational experience and facilitate its use as an input for innovation.

Following is presented and described each one of the ORDIC tools. The order in which they are presented does not necessarily imply that they have to be used in such. Which tool(s) to use at each stage of the IC project and for what reason depends mainly on the specific context of the problem in hand and is decided by the design group. Due to the wide variety of context specific problems, limiting the design team to follow specific and predefined roots to design is considered by the ORDIC developer non-functional. In this sense, ORDIC is flexible enough and empowers its Users and IC systems designers to take all the decisions related to the problem in hand without limiting them to predefined checklists of actions to be implemented.

4.1. Stakeholder Analysis Table.

The *Stakeholder Analysis Table* (Figure IX.2.) is used to study the activities

Position in the Organization	Principal Objectives and Tasks	Principal Problems	Requirements / Proposed Solutions

Figure IX.2. Stakeholder Analysis Table.

performed by people who are or will be affected by any process of change. Apart from describing the activities, the tool permits to represent systematically the problems, solutions and requirements related to the functions or tasks performed, something that permits the creation of a base for generating integrated scenarios of solutions.

4.2. Functional Modeling Tool.

The purpose of the *Functional Modeling Tool* is of two fold:

(a) to identify the owners of the requirements, their roles and positions in the organization, and

(b) identify the primary, secondary and tertiary users as well as other people affected by any proposed system, together with their roles and responsibilities in the organization. In the Functional Modeling Language are included three basic elements: *agent, activity* and *resources* (see Figure IX.3.).

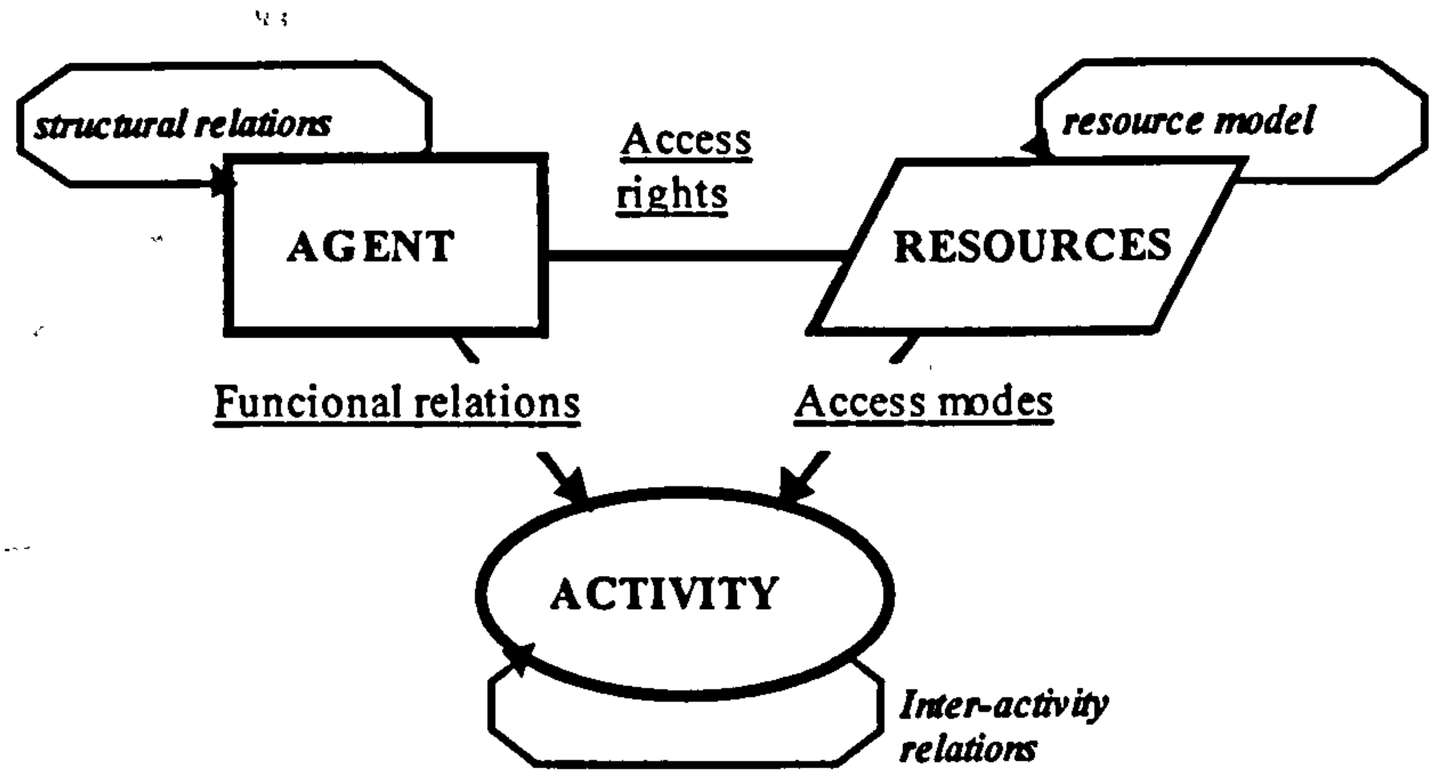


Figure IX.3. Basic elements of the Functional Modeling Language and their inter relations.

An *agent* represents a group of responsibilities assigned to a person. An *activity* is an intervention made by the agent that produces a change on the actual state of a system. *Resources* are the means an agent needs to use in order to perform an activity. Resources are classified in equipment, tools, materials, financial support, information, skills and experience. In Figure IX.3 and IX.4 are presented the basic elements of the Functional Modeling Language and their inter relations (adopted from [Dobson, 1990] and adapted by Masoulas).

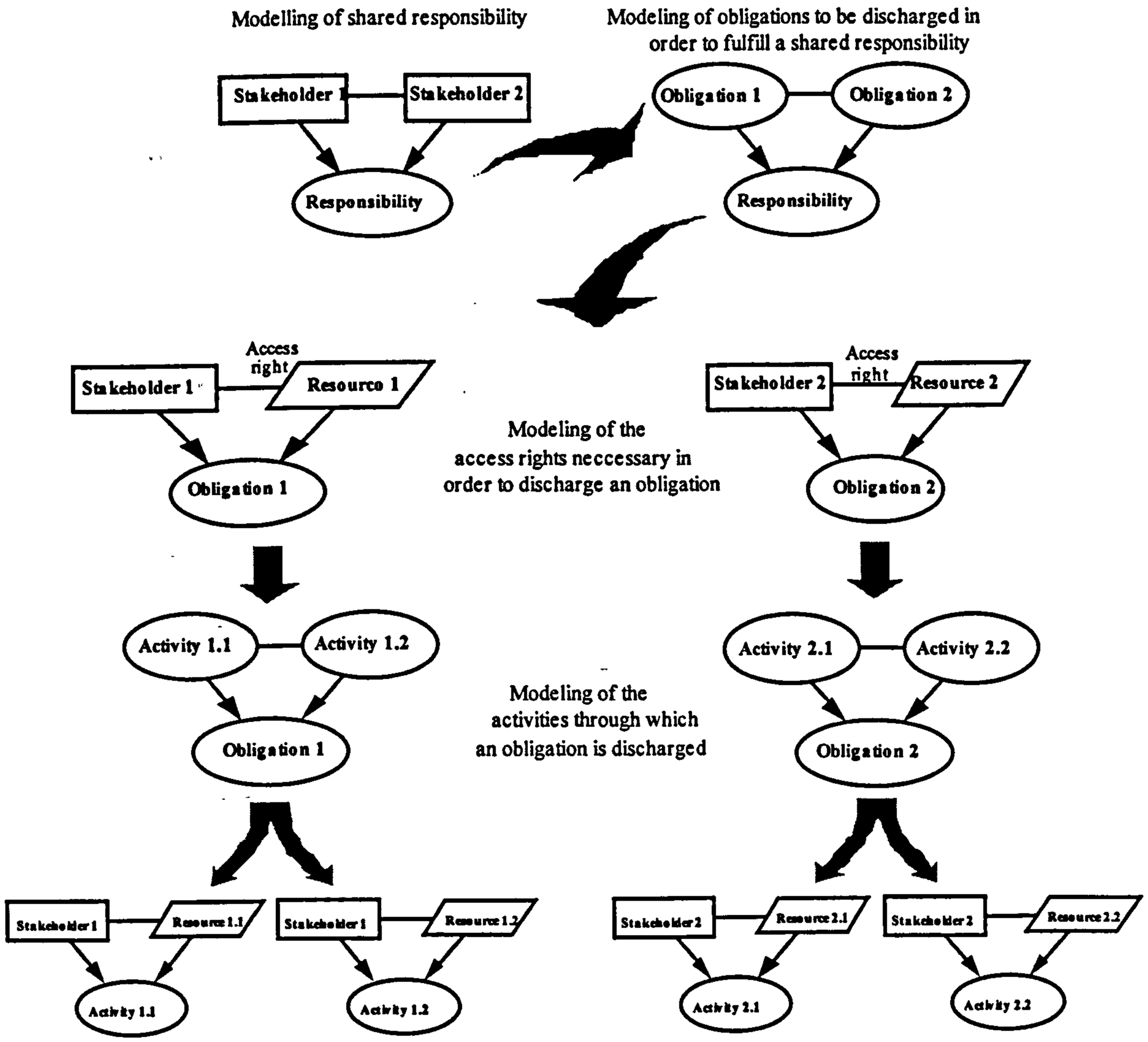


Figure IX.4. Functional Modeling and Analysis of a Shared Responsibility to Individual Obligations and Particular Activities.

4.3. Sociotechnical Organization's View Tool.

The *Sociotechnical Organization's View* (Figure IX.5) permits to model the organization from a Sociotechnical systems perspective, according to which the organization is presented as a system that functions in a changing environment, from which receives inputs that processes in order to achieve established goals. The tool:

a. supports the stakeholders define and

b. shows

the requirements that the organization must satisfy as well as the structural problems that have to be solved in order to reach its highest effectiveness as a system.

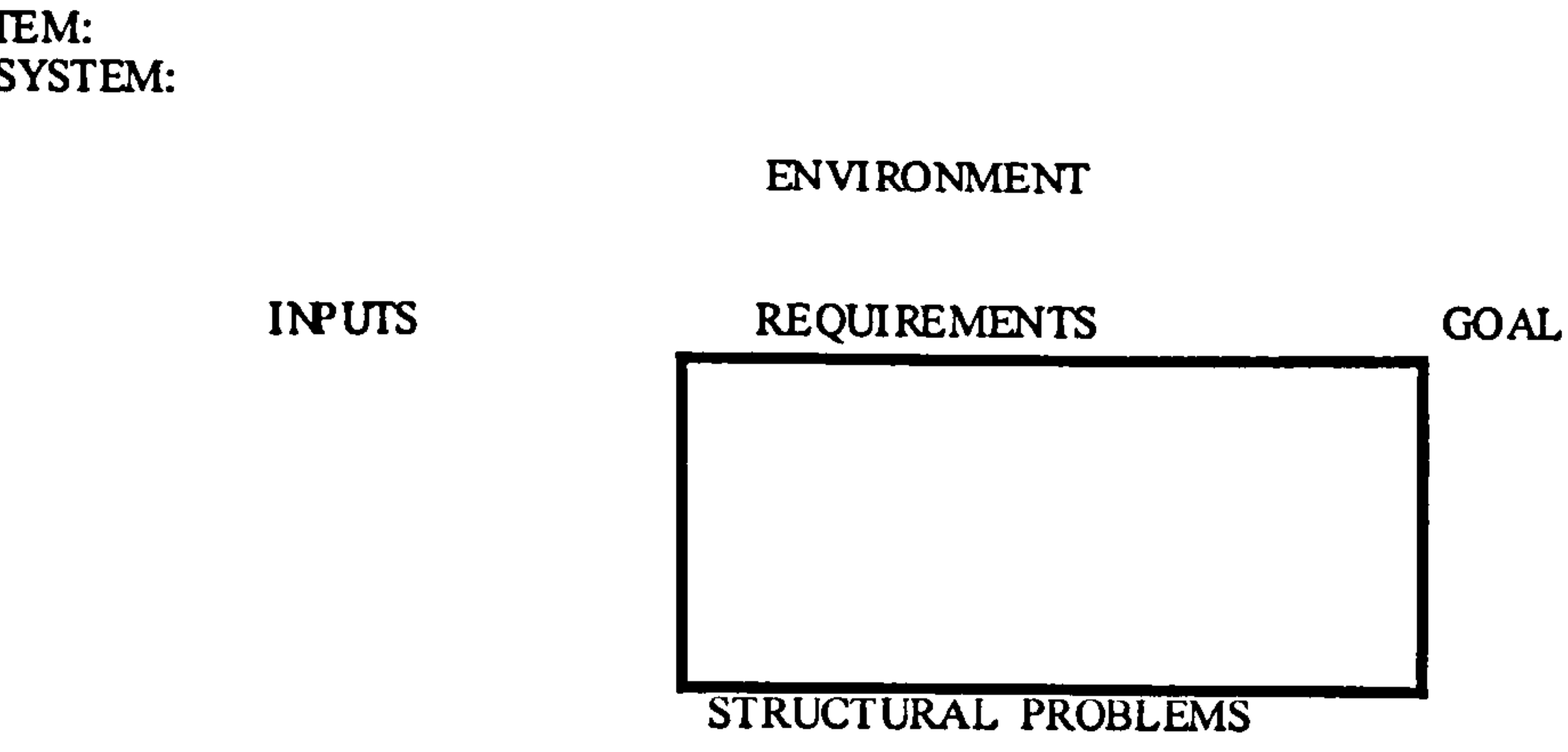


Figure IX.5. Sociotechnical Systems View of the Organization.

4.4. Task Analysis Tool.

The *Task Analysis Tool* (Figure IX.6.) shows the flow of the organizational

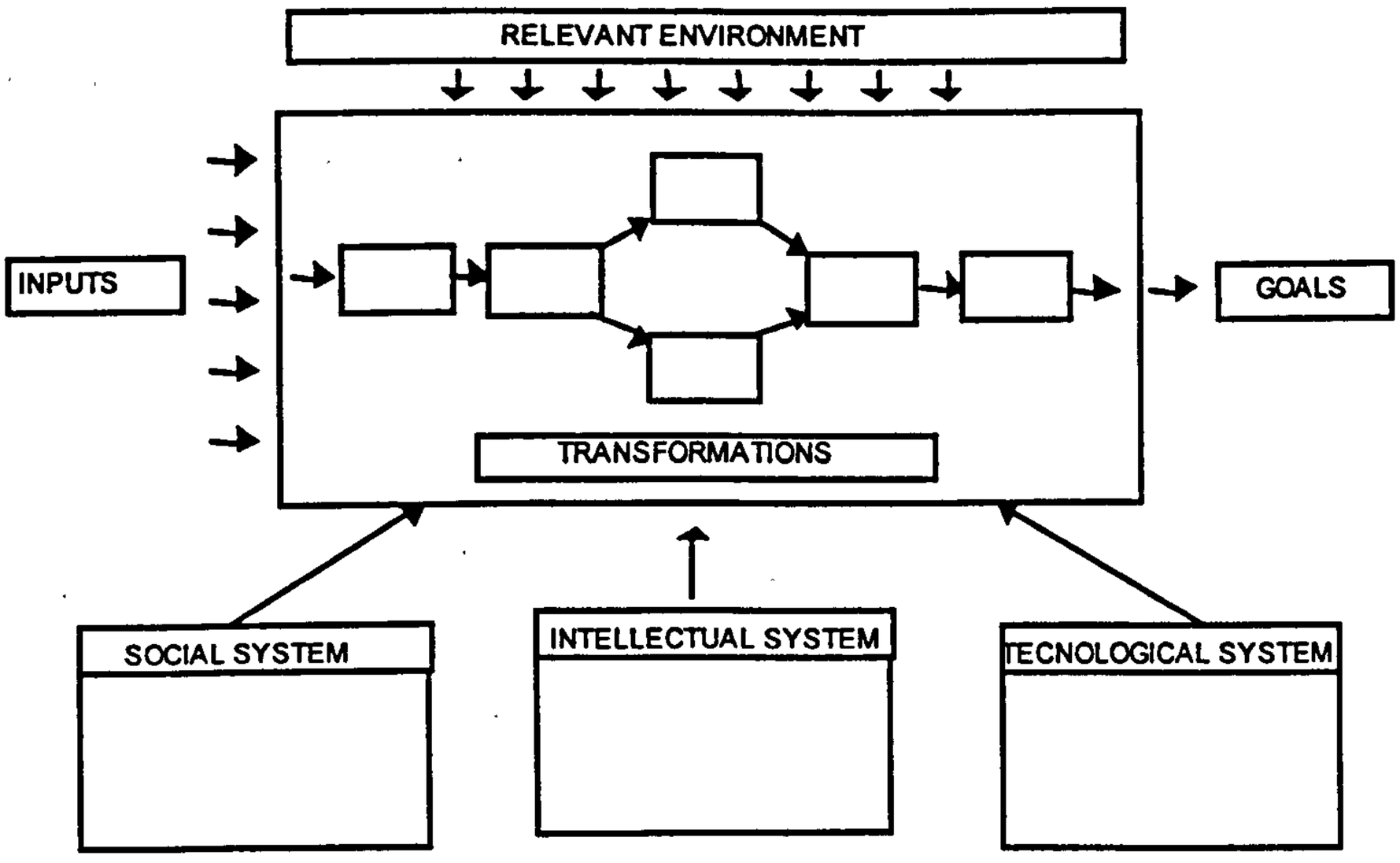


Figure IX.6. Task Analysis Tool.

processes, activities and tasks, together with their inputs and outputs as well as their social, intellectual and technical requirements in order to implement them efficiently.

4.5. Socio-Intellectual-Technical (SIT) Task Representation Tool.

Starting from the task distribution as it is modeled with the Task Analysis tool, the enriched process flow can be modeled using the *SIT Tool* (Figure IX.7). With this tool the distribution of the activities and tasks among the members of the social system can be modeled together with the distribution of the supporting activities/functions of technical and intellectual systems. The objective is to analyze the process flow and evaluate possible alternatives of activity and task distribution among the different systems in order to decide participatively on the most efficient and feasible one for achieving organizational objectives.

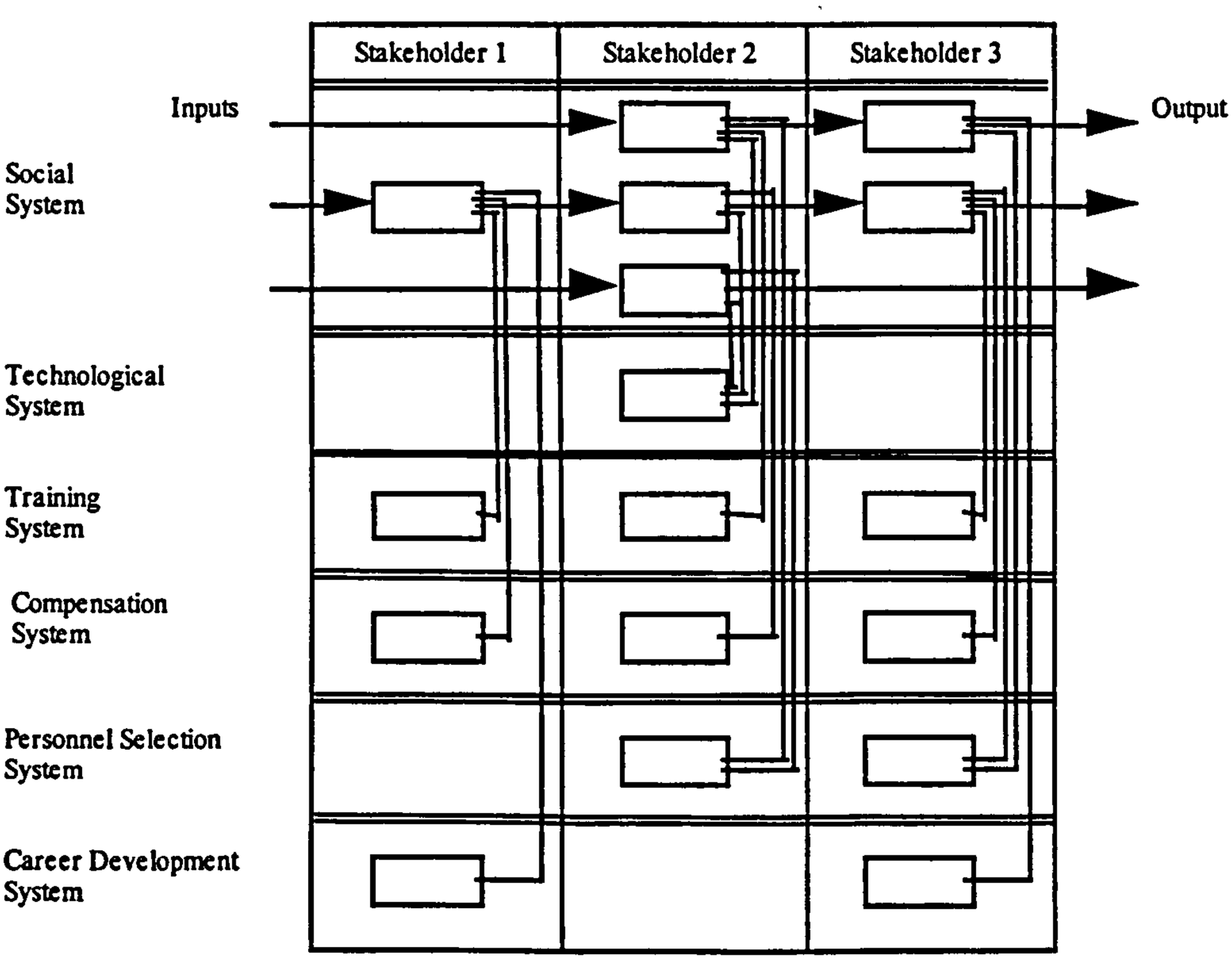


Figure IX.7. Socio-Intellectual-Technical Task Representation.

This tool is flexible in the sense that it can be "dismantled" in order to model/show specifically how the social system interacts with each one of the following systems: technological, innovation, information, experience, learning, reward, career

development, evaluation, selection, or retirement system (see Figures IX.8 to IX.12). With this ORDIC tool, as with the Functional Modeling tool, the Stakeholder (agent) can be interpreted either as an individual working role, a department, an organization, or even a group of organizations. In this way the tool facilitates modeling of the flow of the process at the level of detail and organizational structure required in order to visualize clearly the interaction of the process with each one of the contemplated systems.

The *Socio-Intellectual-Technical Representation Tool (Social system - Technical system)* (Figure IX.8.) has as its objective to facilitate the analysis and present the technological requirements of the process in question. The tool facilitates modeling in a way that it can help identify the specific needs on technology for each activity or group of activities (according to the level of detail in which the process is modeled), of the general process of the social system, including the agent(s) who executes the specific activity(ies) of the process. The technical system is presented in the inferior part of the tool, showing how this interacts with the activities of the social system (middle part of the tool) and the stakeholders (superior part of the tool).

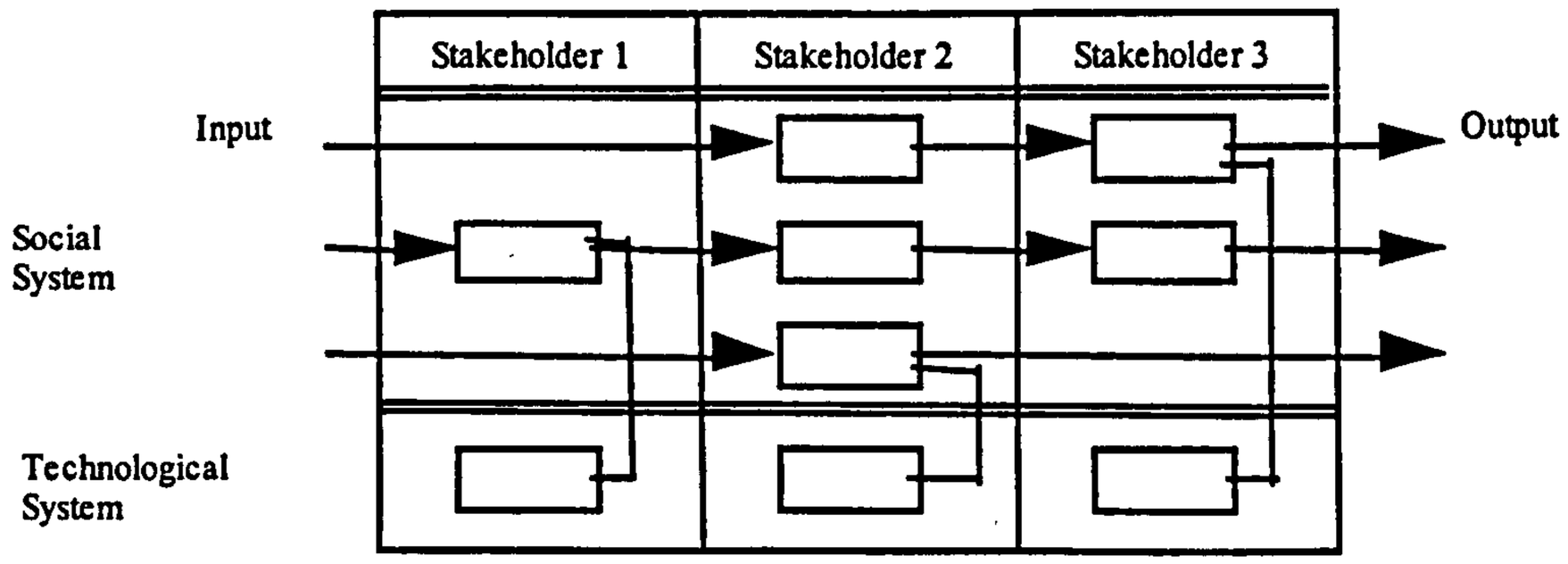


Figure IX.8. Task representation of the Social and Technical System.

A specific activity of the social system is represented under the specific Stakeholder who executes it. If the Stakeholder, in order to execute this activity, requires support from any kind of technology, in the technical system is added an activity which, once executed by the technical system, provides the support required by the Stakeholder. The relation between the social activity and the task that the technical system has to execute in order

to support is then represented by a connecting line between the two.

In Figure IX.9. can be observed how the same tool is used to model the distribution of the activities among the members of the social system and the learning (or training) system. The latter should be designed in such a way that

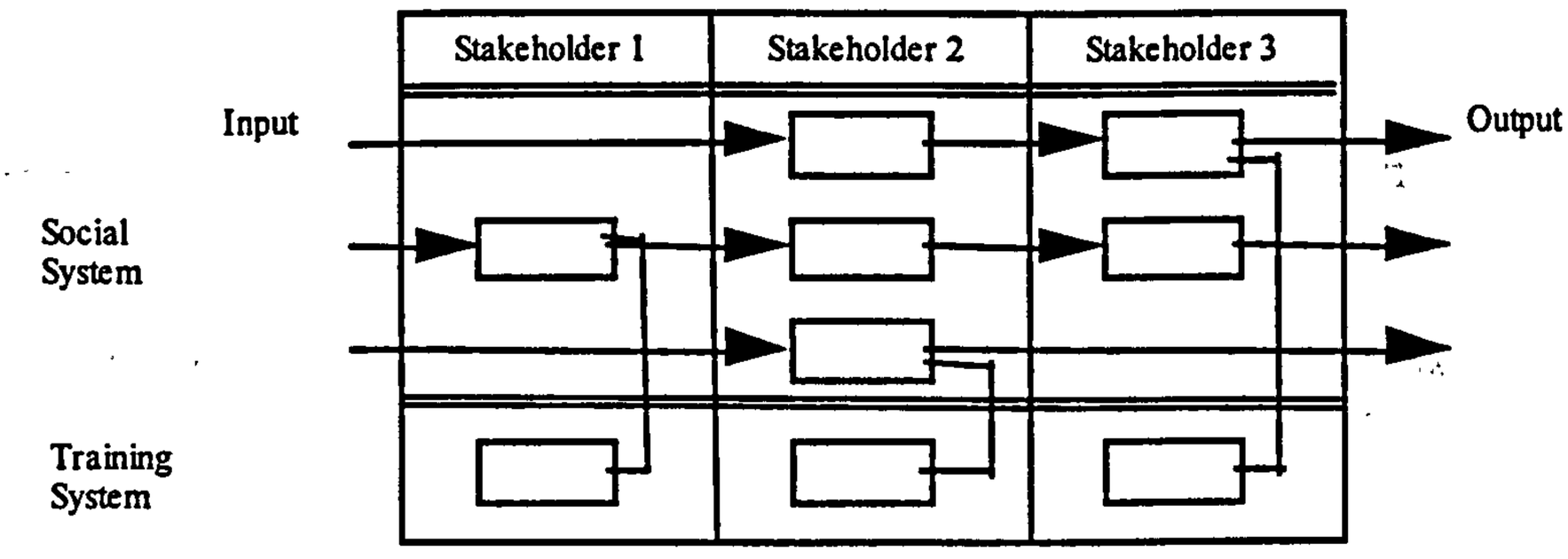


Figure IX.9. Task representation of the Social and Learning system.

develops working skills specific to the activities that Stakeholders should perform with excellence. The tool is used to model different alternatives of learning activities that develop the appropriate working skills to Stakeholders. Furthermore, the tool can also be used to support the evaluation of these learning alternatives, for example in order to train those employees that are more "convenient" for the organization from the point of view of the organizational investment and the effort required to develop the specific working skills.

On the other hand, the SIT tool can be used to facilitate the design of the *Compensation* or *Reward system*, customizing it to each specific task and Stakeholder involved in the process under study. In Figure IX.10 is shown how the Reward system interacts directly with the tasks related to each Stakeholder, being aligned to the objectives of the organization, the social system (team) and the Stakeholder (individual employee).

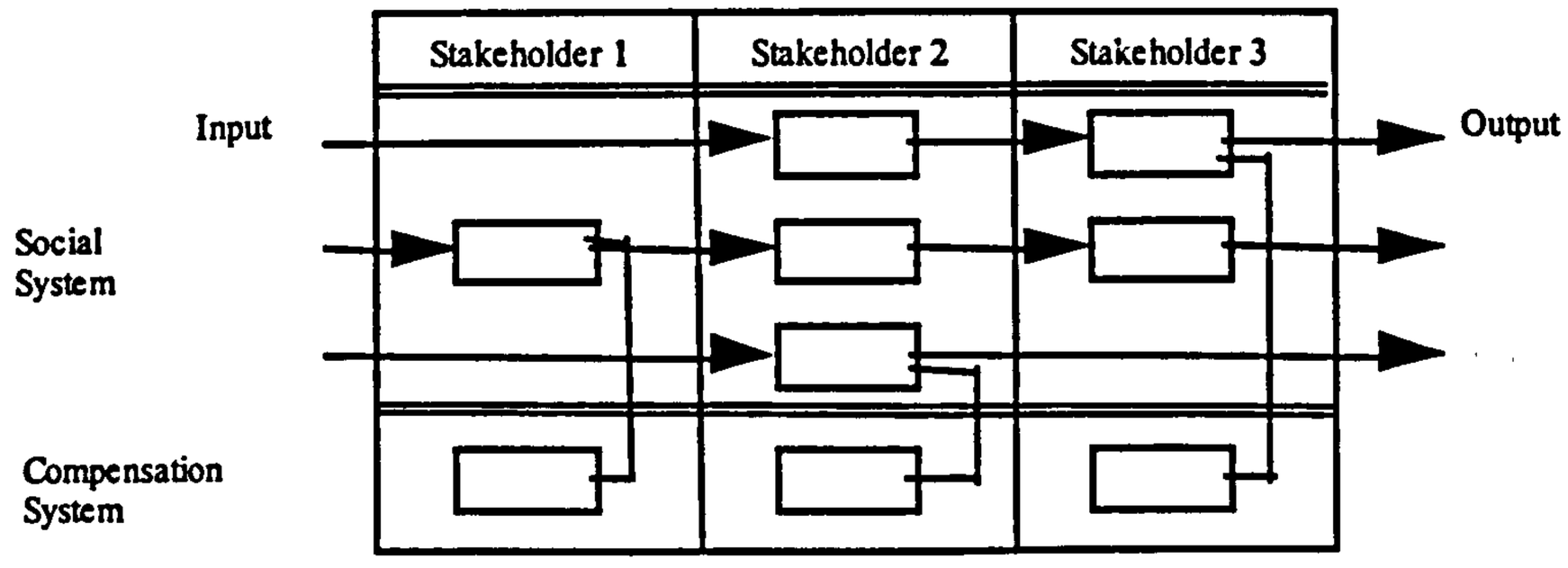


Figure IX.10. Task representation of the Social and Compensation System.

The SIT tool can be further used to analyze and design the distribution of the activities among the members of the social system, the organizational structure and the personnel selection system (see Figure IX.11.). Apart from facilitating the analysis of and presenting the required profile for the job, the tool simplifies the process for selecting the most appropriate among a number of candidates, making the selection process more job and task specific.

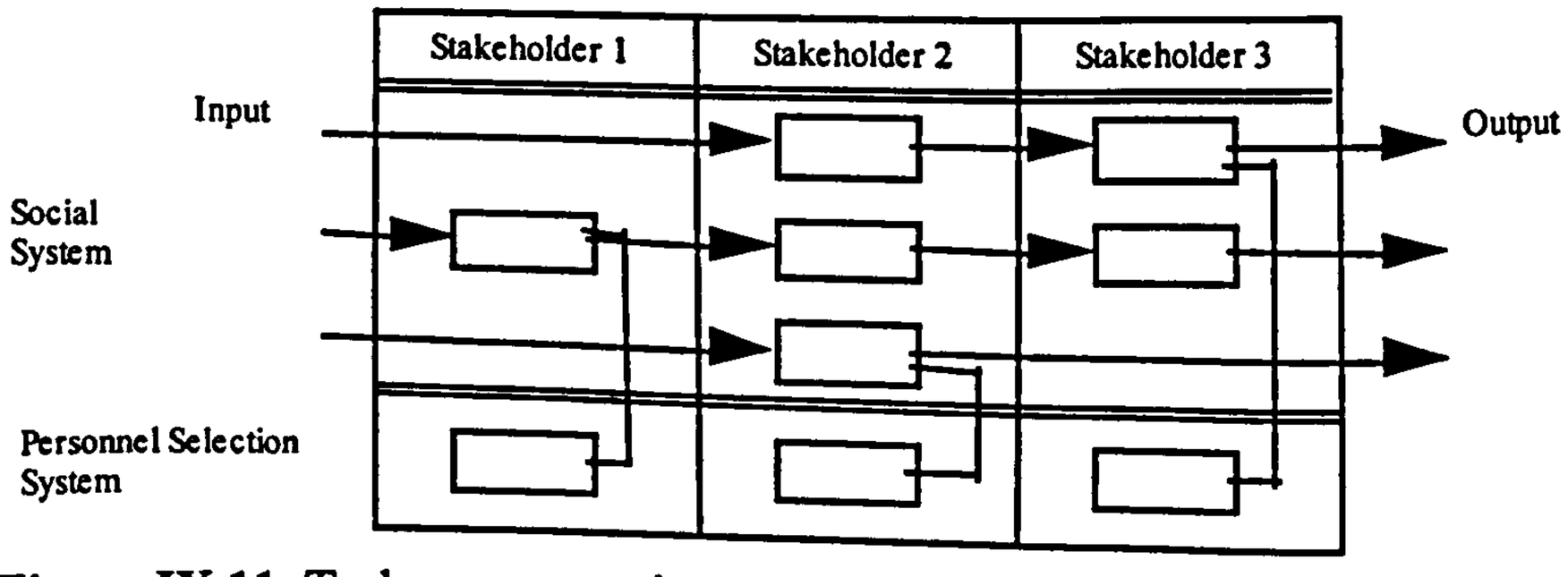


Figure IX.11. Task representation of the Social and Personnel Selection system.

Finally, the Socio-Intellectual-Technical Task representation tool supports the career development of each employee of the organization (see Figure IX.12).

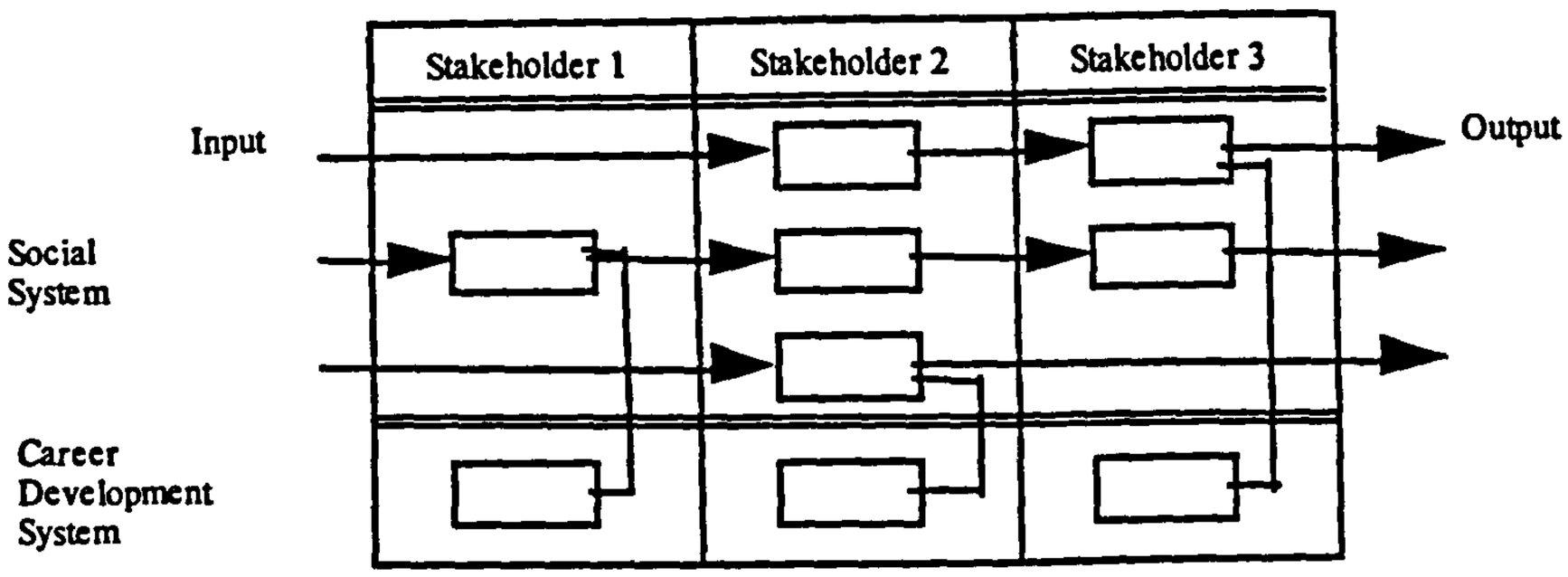


Figure IX.12. Task representation of the Social and Career Development System.

That is by:

- presenting/modeling different career paths of horizontal or lateral development, starting from the specific position an employee actually occupies or even plans to occupy;
- presenting the job-tasks related to each step of the career development and consequently the skills that have to be developed by the employee through the corresponding learning system, before moving ahead in his career plan and personal development.

In order to avoid resistance to change and achieve the most appropriate design of the corresponding systems, employees should be involved in the ORDIC process using the above described ORDIC tools.

5. How do the Tools support Intellectual Capital management.

A question that may arise now is "How ORDIC tools support the systemic and participative IC management?"

As can be observed in the previous section, each tool, by design, evidently addresses the systemic and Socio-intellectual-technical issues. That is because each one takes up the issues of the systemic diagram of IC management.

On the other hand, it is probably not so obvious how the ORDIC tools support the goal of human participation. This is also done because by their very nature the tools require the users to become involved in the modeling of the possible and/or future scenarios as well as the design of the corresponding IC systems.

6. The sequence of tools.

The tools are designed to be used either independently or together, in order to facilitate the work of any individual or team in tackling any kind of problem. The decision of which tool(s) to use for what is not predetermined. There are no specific steps or stages that should be followed. In this sense ORDIC is designed to empower the user - designer letting him decide on the root to follow for solving the problem in hand. The idea behind that is that every problem is unique. Therefore, following a predefined set of steps and related tools such as the ones offered by most structural design methodologies limit both the designers creativity and the diversity of solutions produced. Furthermore, they make the solution of a problem depend on the knowledge of the specific method, in other words, to solve a problem you always need the existence of someone who knows how to apply the corresponding method. Two of the main requirements for designing ORDIC methodology and its corresponding tools were:

- learning and using the method should be easy
- implementation of IC management activities should not depend on the continuous advise by an expert on the method

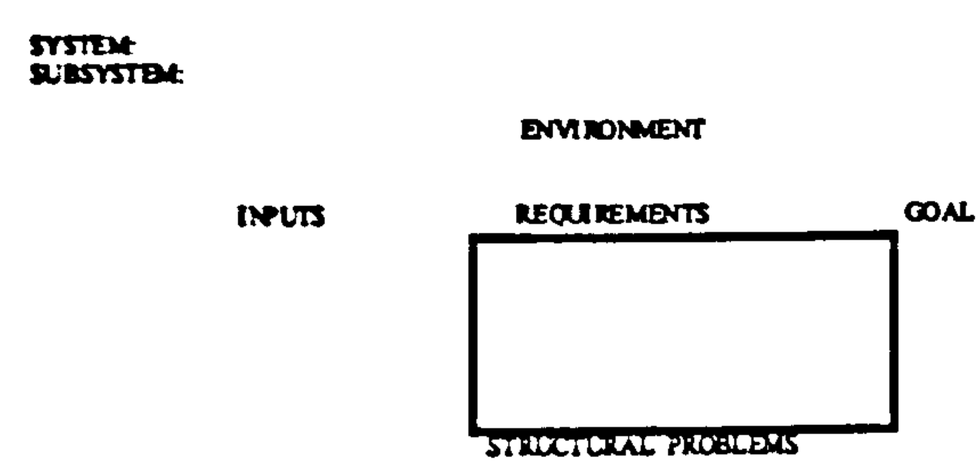
Having said that, continuous observation of the way ORDIC tools have been used showed that there are two patterns ORDIC users follow when using the tools. In the following will be presented these patterns and there corresponding process steps for implementing them. Furthermore, in the second pattern numeric indicators have been included to show how the tools relate to each other.

6.1. Pattern #1 of the use of ORDIC tools.

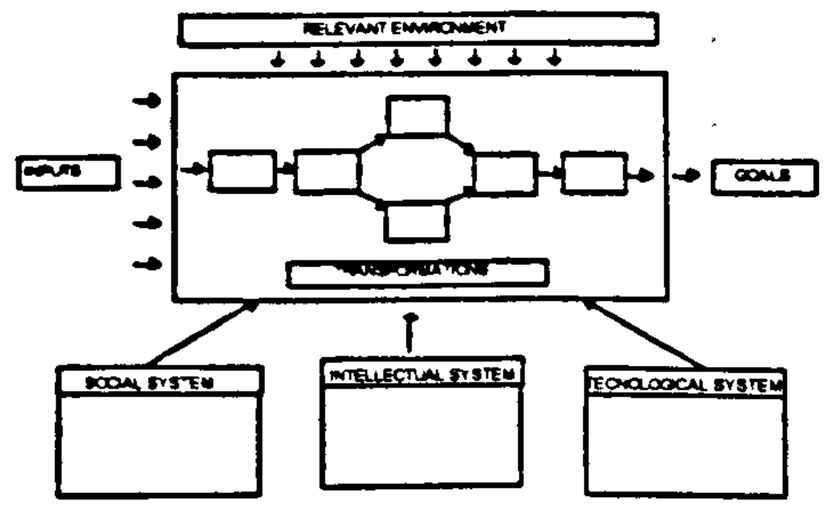
Step 1. Stakeholder Analysis.

Position in the Organization	Principal Objectives and Tasks	Principal Problems	Requirements / Proposed Solutions

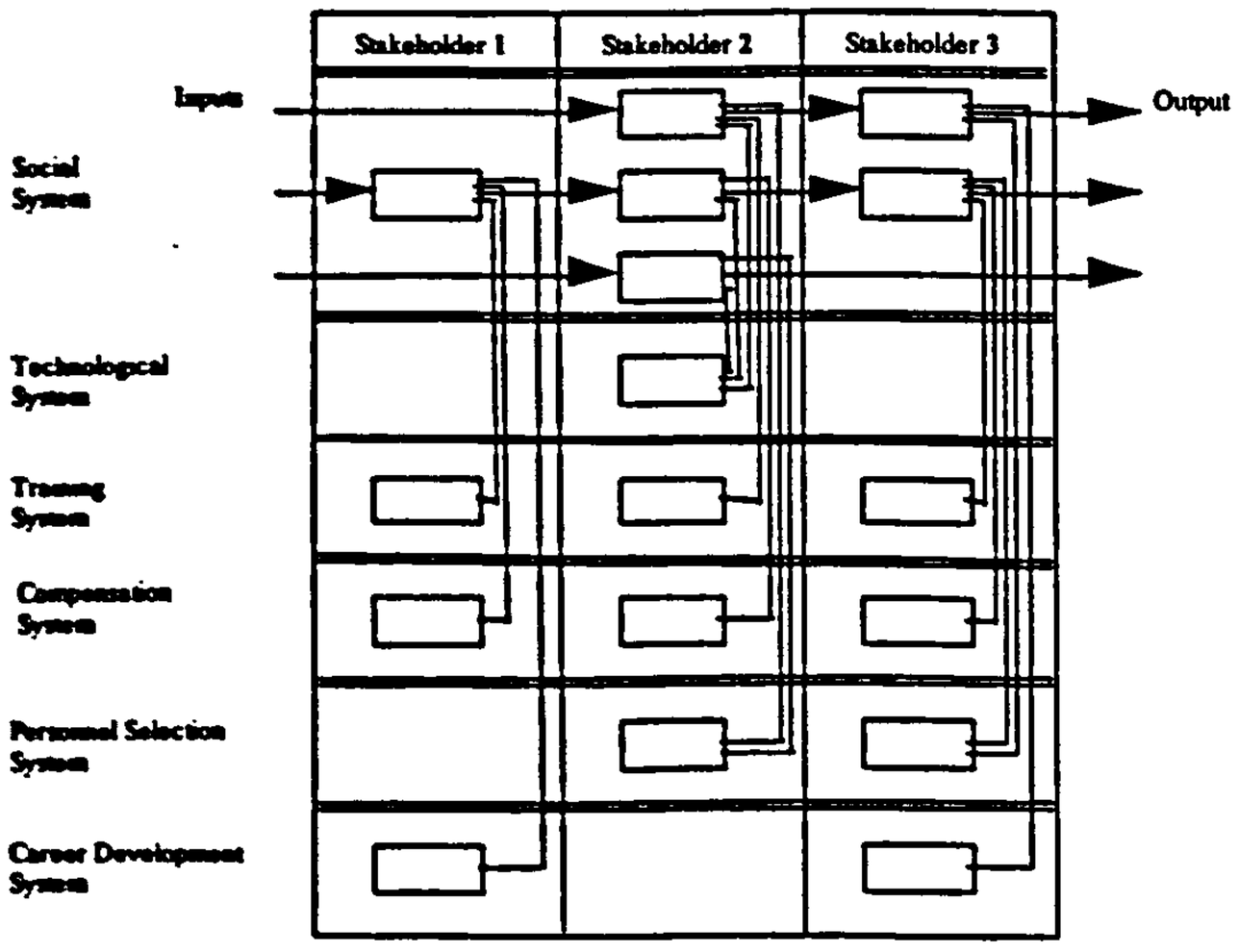
Step 2. Sociotechnical systems view.



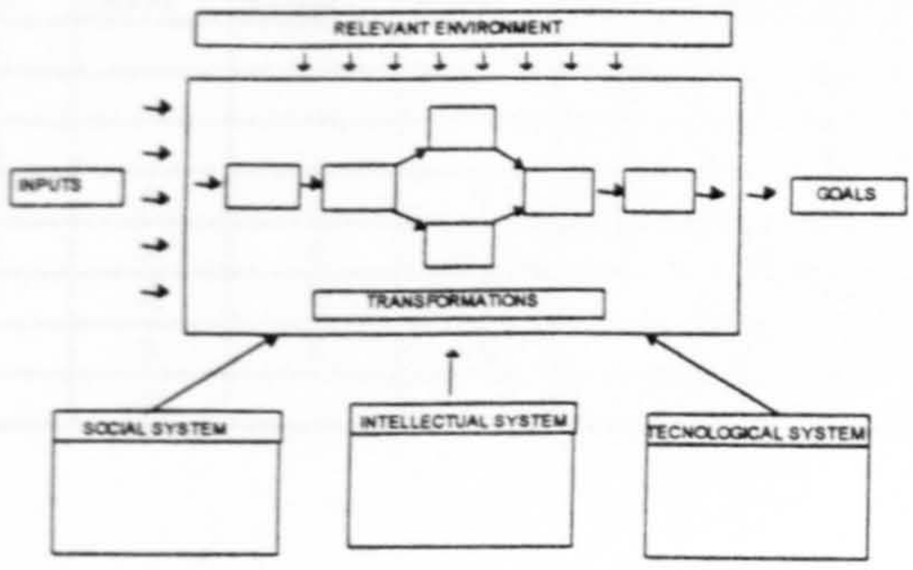
Step 3. Socio-Intellectual-Technical task analysis of the actual system.



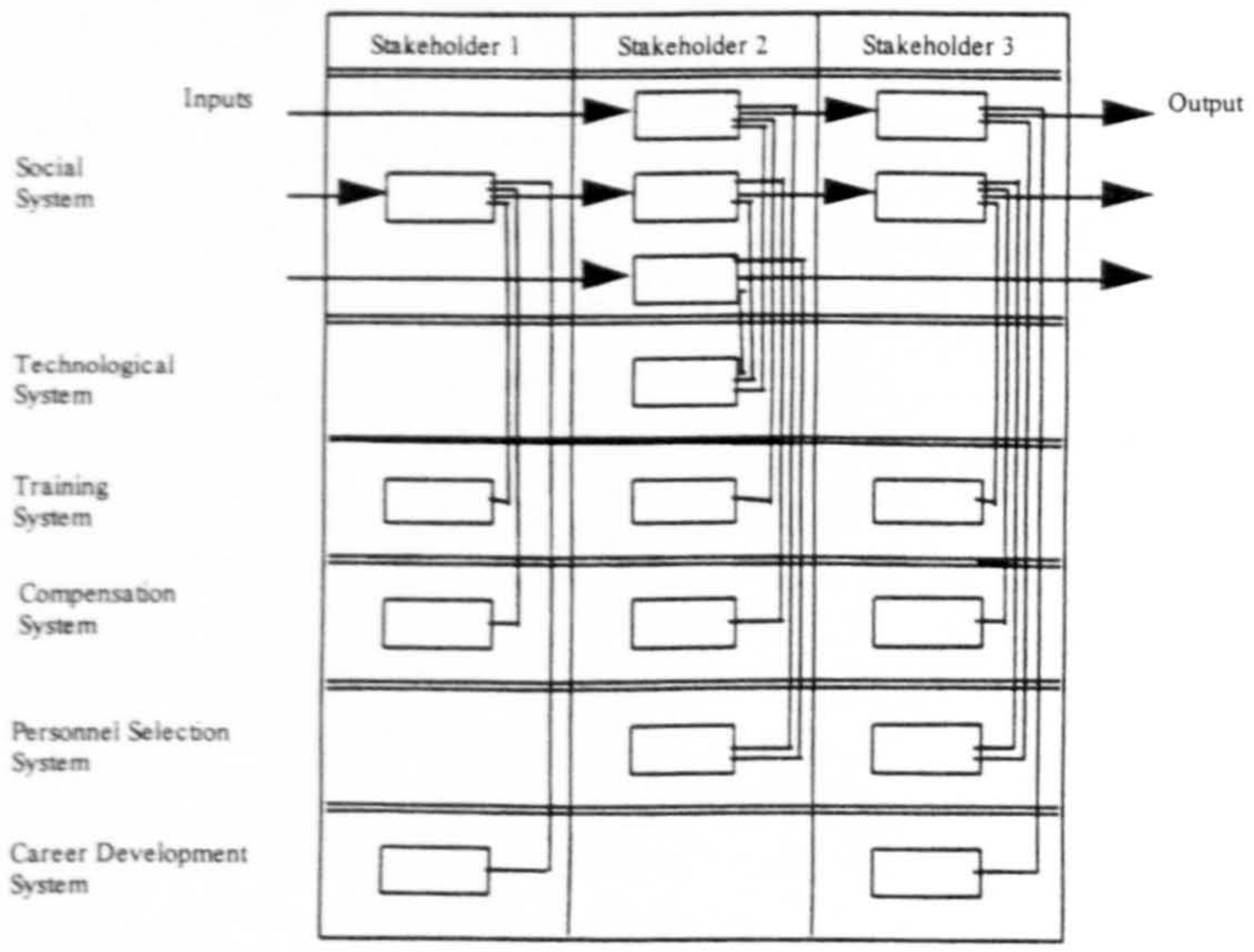
Step 4. Socio-Intellectual-Technical representation of actual system's tasks.



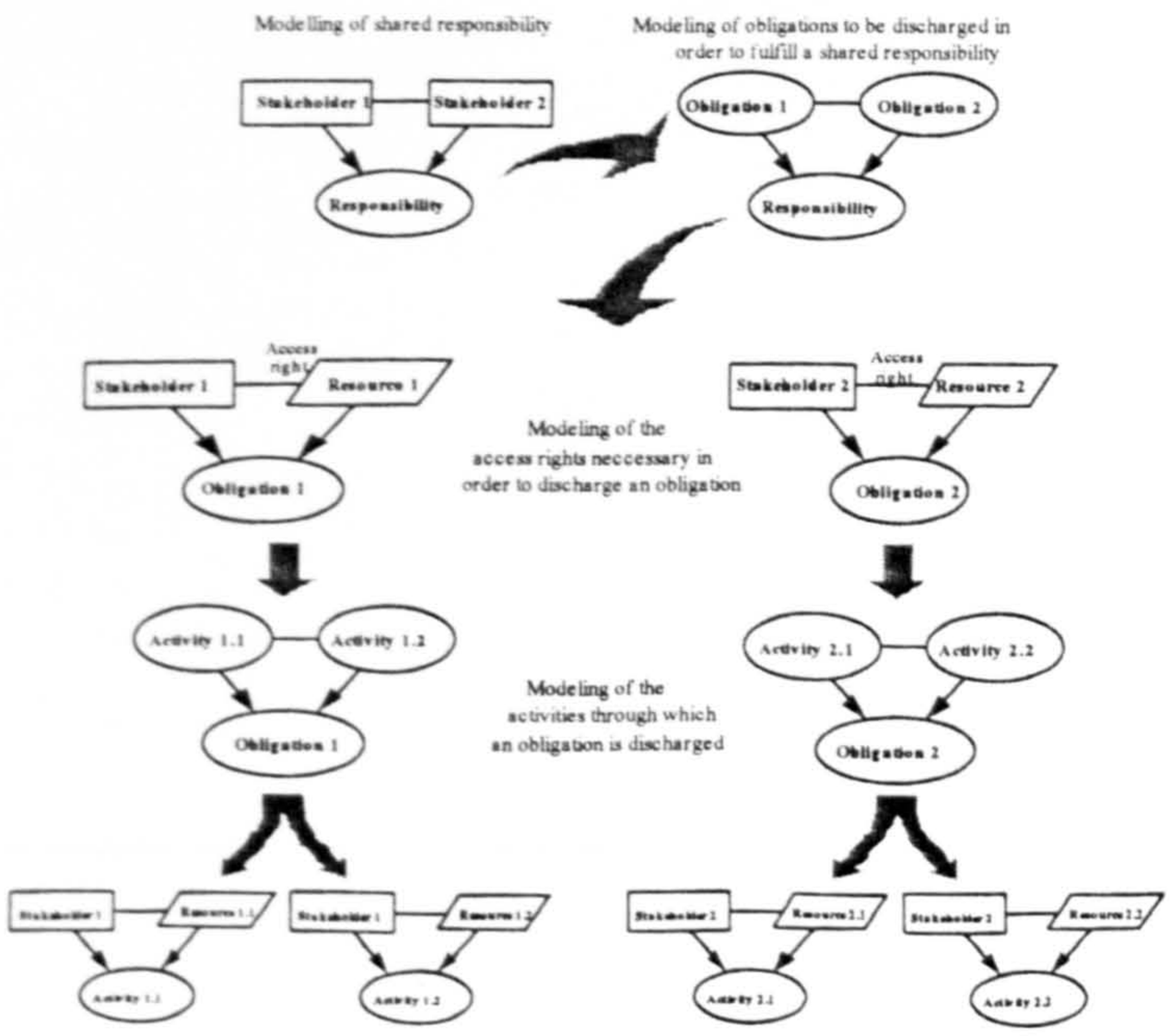
Step 5. Socio-Intellectual-Technical task analysis of the new system.



Step 6. Socio-Intellectual-Technical representation of new system's tasks.



Step 7. Functional task analysis and IC requirements definition.



Step 8. Classification of requirements of IC systems (i.e. skills development systems).

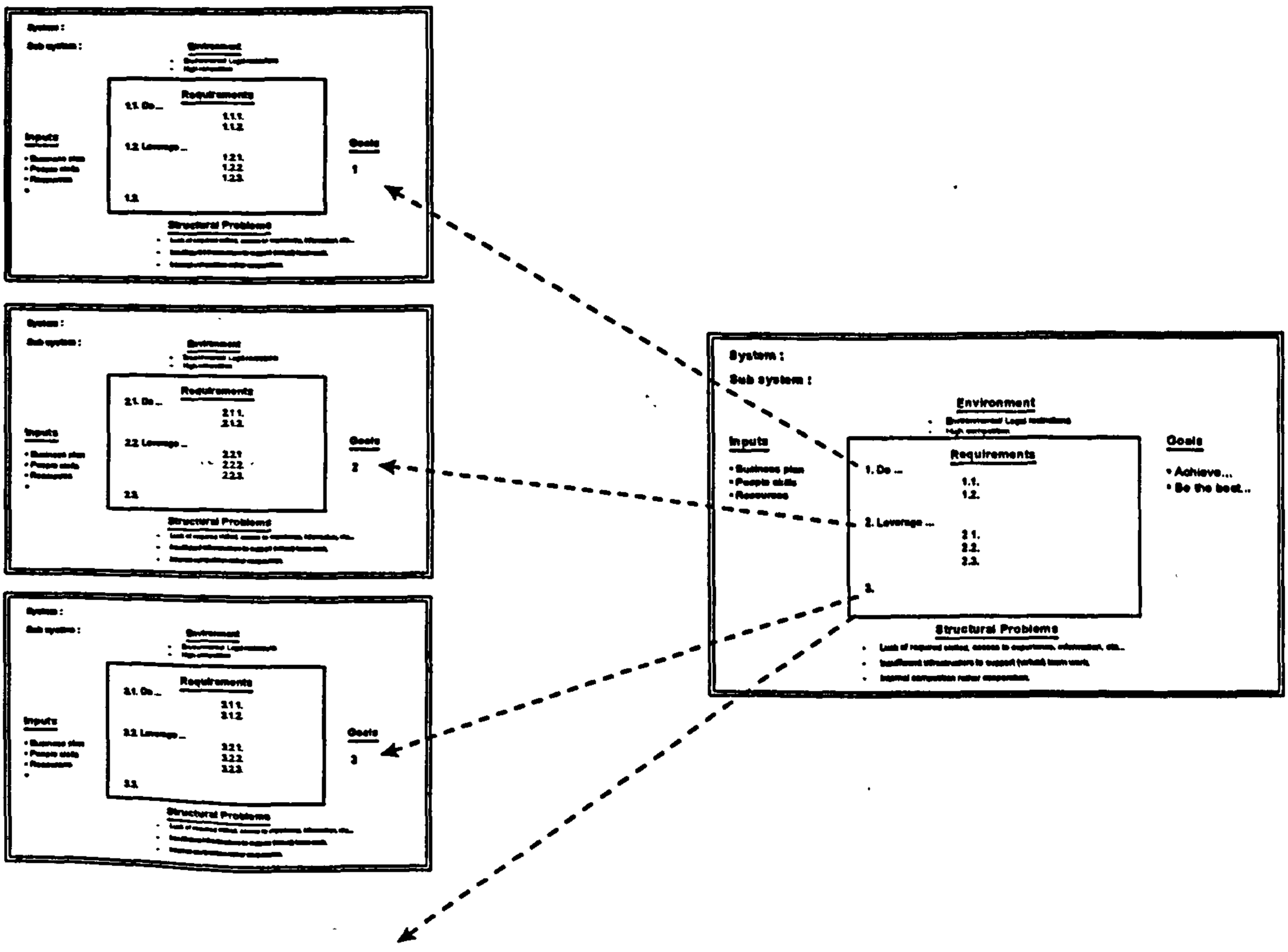
Skills requirements for designing customized learning systems for the Employees								
		Employees (Initials)						
PROCESS	**REQUIRED SKILLS**	**GMC**	**MFA**	**CMG**	**RMP**	**EAA**	**YVC**	**MAE**
		x				x		x
Process 1.	Required skill 1.	x				x		x
Sub process 1.1.	Required sub skill 1.1.	A				x		A
Sub process 1.2.	Required sub skill 1.2.	x	x		x	x		x
Sub process 1.3.	Required sub skill 1.3.	x	x	x	x	x	x	
Process 2.	Required skill 2.		A	x	x			
Sub process 2.1.	Required sub skill 2.1.		x	x	A			
Sub process 2.2.	Required sub skill 2.2.		x					

Step 9. Design of corresponding IC systems.

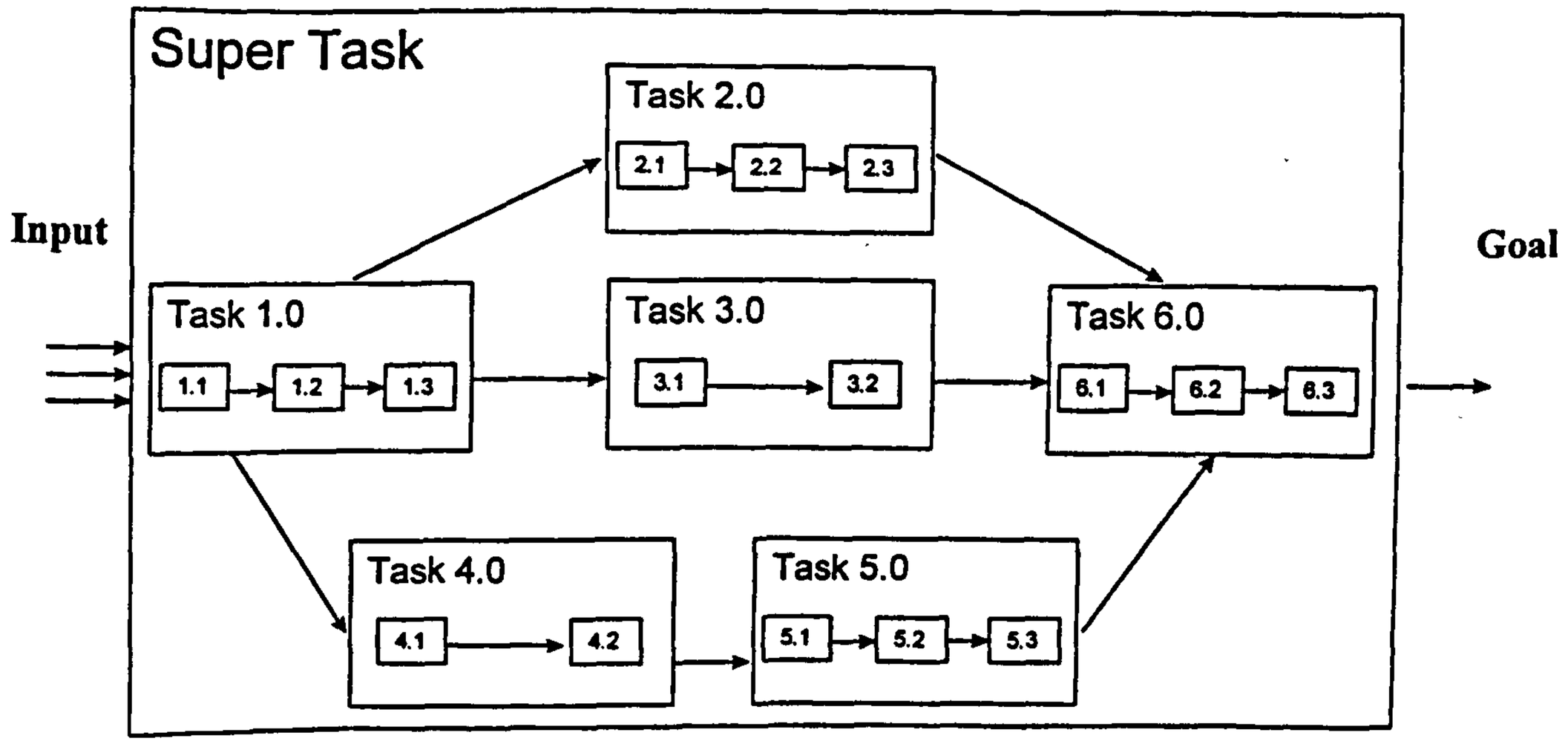
Use any of the tools to design systems processes, roles, responsibilities, etc.

6.2. Pattern #2 of the use of ORDIC tools.

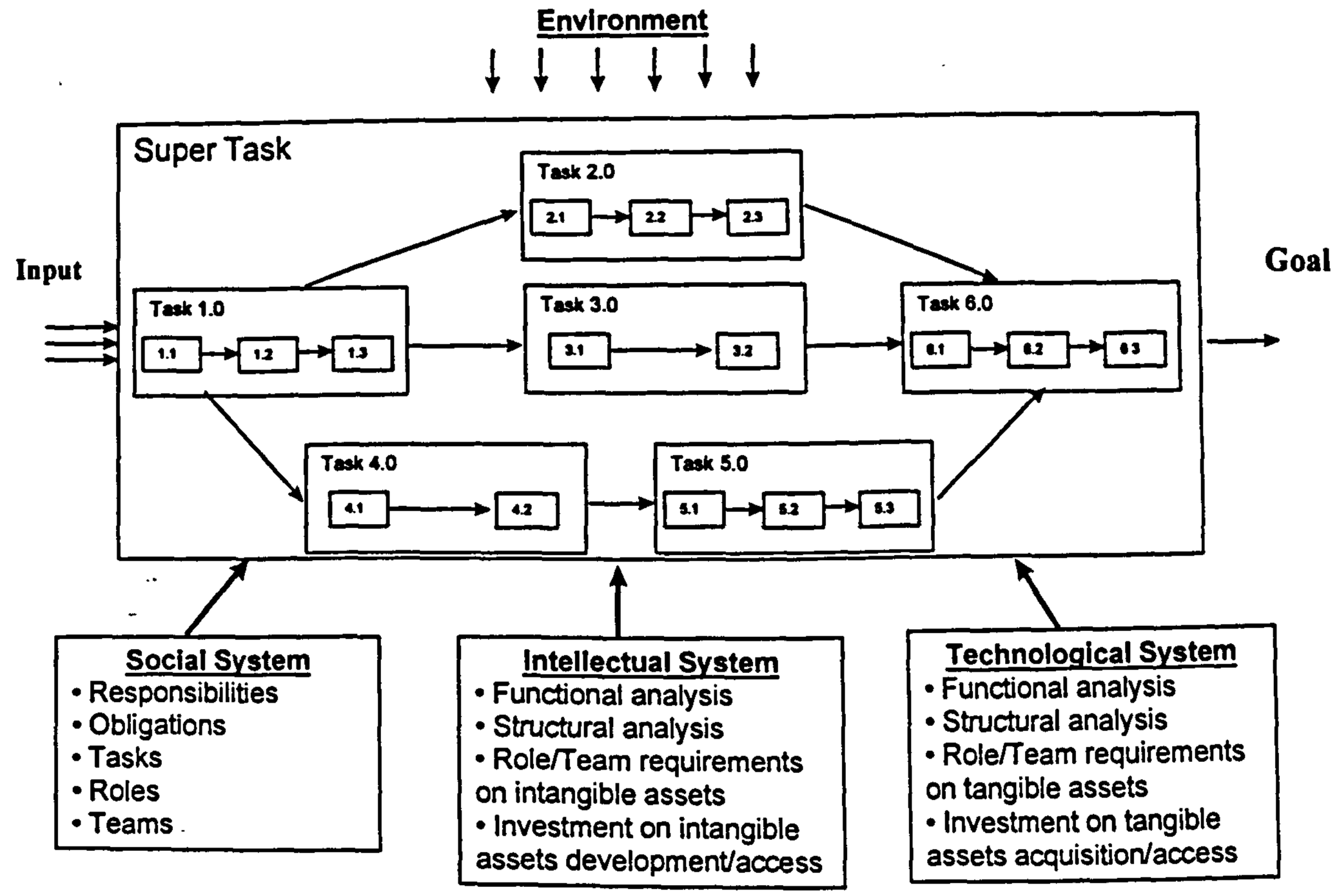
Step1. Build socio-technical systems view.



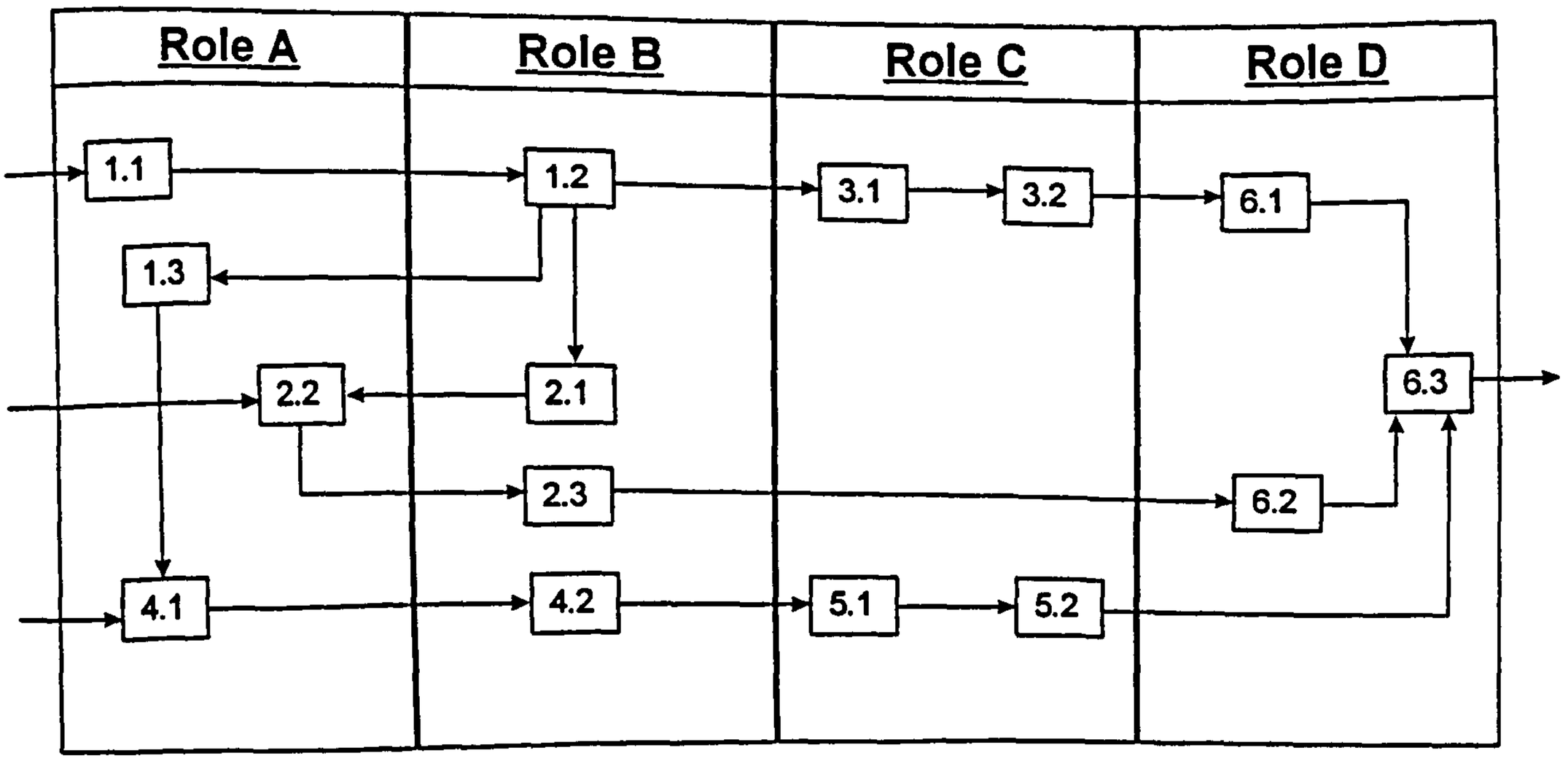
Step 2. Structure tasks and sub tasks to achieve goals.



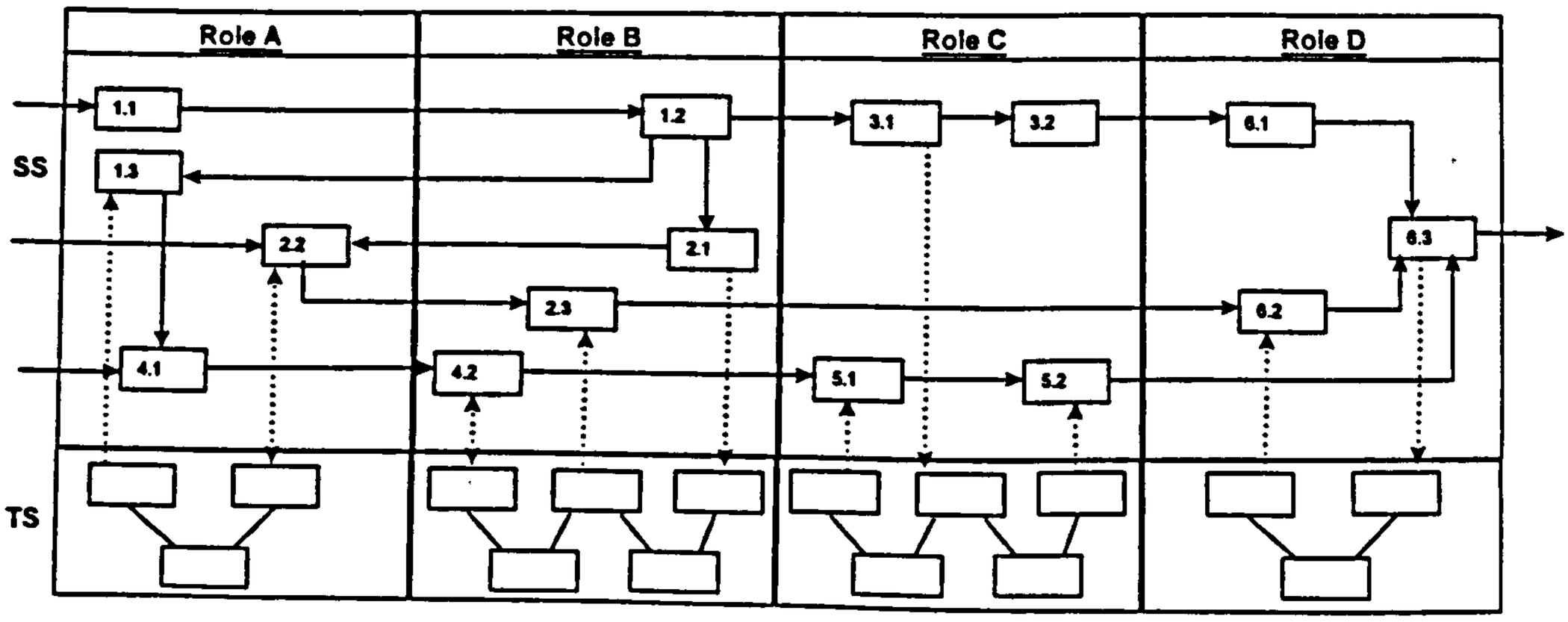
Step 3. Define generic requirements of Social, Intellectual and Technical systems in order to implement tasks and sub tasks to achieve goals.



Step 4. Model and agree on the allocation of tasks to roles of the social system to transform inputs to goals.



Step 5. Model and agree on the allocation of tasks to roles of the social system to transform inputs to goals.



7. Intellectual Capital Management Training Program.

In order to complete the development of the methodology, the author designed a customized learning system to support IC management *skill development* (IC training program). *As part of this learning system, trainees, supported by the corresponding instructional tools are developing the skills for managing organization's IC. The specific* objective of the learning system is to provide an environment of learning and working cooperation, where trainees:

a. Will develop strong awareness, conceptual background and skills on:
    - IC management (including among others a revision of the related concepts, such as endogenous growth, knowledge management and knowledge creation).
    - Change management (including a revision of different alternatives for implementing change such as Total Quality Management, Business Process Reengineering, Socio-Technical systems, Participative Design and a constructive reflection on the implications of adopting each one of them).
b. Supported by senior ORDIC consultants, will be "learning by doing"; this is achieved by involving themselves in IC management projects with real clients, satisfying specific IC needs, generating the corresponding cases studies and sharing their knowledge and experience among themselves.

In terms of the instructional material used by the trainees in Changeland, three manuals where developed. The instructional material includes:

- *a Manual of ORDIC tools*: in this manual the set of ORDIC tools is presented together with their corresponding description;
- *a Process Manual*: this manual gives practical advises for performing IC management projects, and different implementation approaches of the IC concepts and ORDIC tools;
- *a Manual with Case Studies*: in this manual examples of participative development of systems for managing organization's intellectual capital with

ORDIC are presented. These case studies form part of the *Alpha-test* of ORDIC, since they were prepared by the author based on projects that were executed either by himself or by others coordinated by him. A wide variety of organizations of different sizes, industrial sectors, and with different Intellectual Capital management needs are included in the manual.

All three manuals are implemented on the World Wide Web (Internet). The decision to mount the instructional material on the Internet was based on an additional requirement for the design of learning system: to support virtual learning of trainees located in different physical places, with different learning schedules and needs.

Access to the training material and to the learning environment is given after corresponding agreements. Then the trainee is given authorization for becoming a candidate for the CVACI (Virtual Center for Intellectual Capital management). This Center has members in different parts of the world, who are dedicated to provide IC management services to companies, organizations and countries. Once an trainee has proven his competency in IC management skills to the senior members of CVACI, he can become a member.

The above-mentioned learning environment is called "Changeland". Since Changeland is also designed and used in order to perform the *Beta-test* of ORDIC (consisting on having others implementing the method in IC projects and evaluating it), Changeland will be described in the following Chapter as part of the research method. In the last section of this Chapter the differences between the ORDIC and the ORDIT method will be presented.