Using System Dynamics ILEs to enhance Intellectual Capital policies in service businesses

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Abstract

Knowledge is a primary strategic asset impacting on business growth. It significantly affects the accumulation of other strategic resources. It is in turn influenced by learning processes generated by the fulfilment of management routines aimed to exploit and coordinate different assets.
Assessing knowledge is critical to support policy makers in balancing trade-offs related to different alternatives in business growth management.
Several approaches have been suggested by the business literature and practice to assess knowledge; also the System dynamics method has been applied to this issue.
This paper tries to contribute to the research debate in this domain by focusing the concept of Intellectual Capital (IC) and exploring cause-and-effect relationships underlying its dynamics and business growth.
Such relationships are embodied in an Interactive Learning Environment (ILE) that has been tailored to the context of service firms, where knowledge plays a crucial role for the firm success and continuity. In particular, the generic structure of the ILE has been applied to a telecom mobile service provider and to an insurance company. The first context has offered the basis for the application of the ILE into an educational setting, while the second one provided the arena where a business application was developed.
Main key-issues underlying model development and the ILE application are discussed in the paper, and some significant outcomes from simulations are commented.

Introduction

Why may the market value of a firm be significantly higher than its book value? What are the primary causes of success for a company against its competitors? How can one explain that firms relying on large capitals are likely to achieve a lower performance, compared to those competitors having limited financial resources? What are the reasons of the sudden collapse of those businesses identified as "pillars" of the economy, given their perceived strong profitability and image?

To answer the above questions an helpful concept is that of *intellectual capital* (IC). IC refers to a knowledge system that can be both related to the individuals working in a firm, and to the business organisation itself. IC originates from investment policies, whose main levers are referred to hiring, training and organisational expenditures.

IC expenditures are often budgeted on an incremental basis and conceived as discretionary costs. They are usually planned without a closer look on the impact they will be able to generate on the future business performance during the planning time horizon (Ornati *et al*, 1982; Tyson & Fell, 1986).

Conventional accounting performance measures are likely to cause managers to act myopically in planning such expenditures. Holding decision makers accountable for only short-term earnings or returns may induce them to reduce or postpone IC expenditures, even though they could promise a

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positive net present value. Such a behaviour has been defined as *investment myopia* (Merchant, 1998, p. 460).

The above problems are relevant in the management of business knowledge, as the responsibility centres focused on human and organisational resources are often oriented only on current and bureaucratic, rather than strategic, issues (Tyson & Fell, 1986, p. 7-29; Matthis & Jackson, 1984, chapters 1 and 2).

This paper proposes a shift of focus in defining the role of the Personnel/Organisation unit. Particularly when the firm operates in a business where knowledge is a main driver of success, such a unit can play a crucial role in the planning process. Adopting a strategic approach in IC policies implies other units are involved in reasoning the effects IC expenditures will generate on business performance over time.

In order to foster such a change in perspective and to tackle myopic behaviour in IC management, a methodological framework for assessing IC is provided to support decision makers in evaluating the short and long-term effects of their policies.

IC is likely to be assessed both in monetary (likewise other assets commonly included in financial statements) and non-monetary terms (Stewart, 1997, p. 222-246; Sveiby 1997; Edvinsson and Malone 1997). Its monetary evaluation is usually done according to different approaches, such as: cost (Flamholtz 1985), market (Friedman and Lev 1974), and income (Reilly and Schweihs 1998). Furthermore, other "hybrid" methods have been proposed by the literature (Tobin 1969; Stewart 1997).

The approach adopted in this paper for IC monetary assessment combines both the cost and income method. We propose to assess IC according to its potential impact on the future company performance in achieving a sustainable growth. We also remark that such a monetary evaluation must be combined with a non-monetary assessment, to provide a conceptual framework aimed to explore the impact of IC expenditures on business strategic resources, drivers and performance indicators.

According to this perspective, a dynamic feedback view of IC accumulation and depletion processes allows one to support the management of human and organisational capital development in a planning setting.

This paper shows how such processes have been embodied into an Interactive Learning Environment (ILE), tailored to the context of service firms, where knowledge usually plays a crucial role for the firm success and continuity. In particular, the generic structure of the ILE has

been applied to a telecom mobile service provider and to an insurance company. The first context offered the basis for the application of the ILE into an educational setting; the second one provided the arena where a business tool was developed.

The paper is divided into three main parts.

In the first part, an overview of the conceptual foundations of IC and different methods for its assessment proposed by the literature is provided. Main assumptions, strengths and weaknesses are remarked.

In the second part, a conceptual framework for IC assessment, aimed to combine a monetary and non-monetary evaluation of IC, is provided, and justification for applying the SD methodology is given. Further, a dynamic feedback view of IC accumulation and depletion processes and its relationships with key-intangibles assets in a service business is discussed.

In the third part, an ILE aimed to educate the Personnel/Organisation unit to plan IC expenditures in a strategic perspective is analysed. The ILE is discussed with particular reference to: 1) the structure of the ILE, 2) its main elements and their role in supporting players' learning, 3) the process through which the ILE is likely to foster decision maker learning process. On this last concern, a comparison of two scenarios is provided.

The concept of Intellectual Capital

In order to explore the conceptual context for IC assessment, it is worthwhile to firstly analyse the concepts of the terms "intellectual" and "capital". The term "intellectual" comes from the Latin *intelligere*, i.e. to understand, to learn.

The term "capital" refers to monetary investments in tangible or intangible production factors, leading to an expectation of future yields.
It follows that the concept of "Intellectual Capital" ought to be related to those expenditures done by a firm to improve the capabilities of its people and the organisation itself to *understand*, i.e. to better frame the system where decisions are made, to attain a performance increase.

Therefore, building IC means fostering the learning capability of the firm to make sound decisions about *ends/goals* to achieve, and related *means*. Such means refer to the potential utility that it is possible to obtain from resources to be acquired or built, coordinated and deployed for the achievement of business ends/goals.

Without learning, leading to a significant knowledge stock, a firm is not able to develop strategic assets (Amit and Schoemaker, 1993, p. 36-37; Kogut and Zander, 1992, p. 384-387). Hence, IC is as a primary strategic asset for the acquisition and deployment of others, to foster business growth.

Organisational *routines* and the interaction processes between the firm and its relevant environment, combined with the existing stock of knowledge (i.e. IC), will be likely to build up other strategic assets (e.g. product portfolio, distribution channels, customer base, image) (Kogut and Zander, 1992, p. 384; Dierickx and Kool, 1989, p. 1508; Morecroft 1997).

The concept of knowledge is not only referred to individuals' or business' *know-how*, i.e., the attitude to find proper means to achieve pursued goals. It can also be related to other two dimensions: the *what* and *why*. The concept of *know-what* refers to the attitude to detect specific subjects or issues on which to be focused (Kogut and Zander 1992). The concept of *know-why* is, instead, referred to the understanding of cause and effect relationships between issues and events related to business performance, as a result of a learning process which shapes the way of thinking of individuals and the company (Quinn *et al.* 1996; Nonaka 1991).

The above said perspective shifts the research focus from the concept of *intellectual property* – associated to the acquisition of patents, trade marks and other intangibles usually posted in a financial statement – to that of *intellectual resource*, i.e., a production factor profiling a capability to frame the relevant system and make proper decisions. This view suggests that IC cannot be defined as a physical resource (or a "sum" of different physical assets), which can be financially measured and posted in a financial statement. It is, rather, a system of intangible resources providing the company with a *know-how*, *know-what* and *know-why*.

Investing in IC may impact on the quality of company decisions, if it leads to knowledge building and retention [1].

Investments in education and human resource development (leading to *human capital* accumulation) are only a key-factor of IC. This also consists of *structural capital*, which results from the process of individual knowledge elicitation, in order to act on human capital as a lever to build up business knowledge (Edvinson and Malone 1997).

The individual knowledge elicitation process takes place in both internal and external activities. In the first case, investments in organisational and information structures, and procedures generate the so called *organisational capital*. In the second case, investments aimed to build strong and long term relationships with external counterparts (e.g. customers, suppliers, competitors) give rise to a shared knowledge system, which may relate to products, information, distribution systems, etc. This is the so called *customer* or *relational capital* (Stewart 1997).

[1] IC expenditures may not lead to higher IC for a variety of reasons. For instance, staff attrition would deplete knowledge for any constant rate of training costs. Likewise, lack of implementation of organisation structure redesign, recommended by consulting projects, would generate current rather than capitalised costs.

A conceptual framework for IC assessment

The method we propose for IC assessment combines a non-monetary with a monetary evaluation. The former tries to capture the impact of policies implying IC expenditures [2] on those strategic resources embodying knowledge, which in turn affect drivers and outcome performance indicators. The latter aims to define in monetary terms the synthetic value of company knowledge, based on the indirect effect of IC expenditures on future financial results.

In order to assess IC, it is not proper to add up single components, such as: human, structural and customer capital. In fact, they are an attribute of the whole business system, rather than well identified resources. This makes illusory any attempt to assess IC as a sum of the three above components [3].

A framework for such analysis is provided in figure 1, depicting the building blocks for a combined IC monetary and non-monetary assessment, referred to a service business.

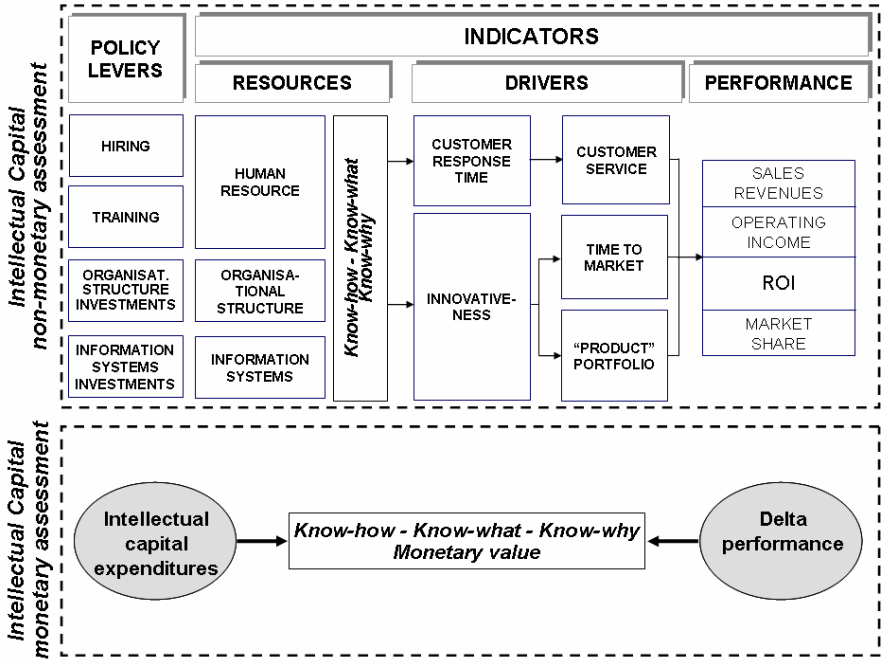


FIGURE 1 - A conceptual framework for a combined IC monetary and non-monetary assessment

Figure 1 shows how different primary strategic assets embodying business knowledge are built as an effect of IC policies (hiring, training, organisational and information systems investments).

If we refer to service firms, knowledge affects performance drivers, such as customer response time and innovativeness which in turn determine customer service, time to market and "product"

[2] It is worth remarking that financial expenditures on IC do not necessarily cover the domain of organisational knowledge. This last concept also embodies learning processes resulting from the current fulfilment of company routines and procedures. However, in this paper a narrower concept of business knowledge will be adopted, being referred to those capitalised financial expenditures budgeted by the firm in order to improve its own knowledge system.

[3] "Edvinsson and Malone (1997, p. 187) propose that intellectual capital is the arithmetic mean of all capital components in play" (Joia 2000, p. 72).

portfolio quality. The above drivers lead to four synthetic outcome measures, such as sales revenues operating income, ROI and market share.

Based on the non-monetary framework commented above, the lower section of figure 1 shows the rationale of the adopted monetary method for IC assessment. To sketch an IC plan, a desired ROI on IC expenditures must be set. By multiplying IC expenditures with desired ROI, one can determine the desired IC investment productivity in monetary terms, i.e., *desired delta performance*.

The ratio between the *actual delta performance* (in terms of both operating income and investments) and the *desired* one provides what we call *performance ratio*. Such ratio is a synthetic expression of the percentage of IC expenditures that one can capitalise each year [4].

Provided that IC assessment is done in the model in a planning context, we need to calculate each year the net present value [5] of:

a) IC expenditures;
b) Actual delta performance;
c) Desired delta performance.

An example of such an assessment is provided in table 1.

[4] The suggested method for IC monetary evaluation is focused on the capitalisation of IC expenditures. For prudential reasons, although the productivity of such expenditures might lead to a very high return, implying a performance ratio greater than one, the maximum values of capitalised IC expenditures cannot be higher than those actually sustained by the firm.

[5] In order to prudentially assess IC, the discount rate should be the highest between that which is related to the specific risk on invested capital and the average interest rate on borrowed capital. The reason for choosing the highest value is that the discounted ratio must take into account both the operating and financial risk on invested capital. The higher is the business risk the higher will be the discount rate, which will lead to a lower IC monetary value.

	Simplified Intellectual Capital plan	(All values are in Eur/.000)			
		Year 1	Year 2	Year 3	Year 4
1	IC expenditures (*)	400	400	400	400
2	Cumulative IC expenditures	400	800	1200	1600
3	Delta Performance (**)	32	60	80	88
4	Desired ROI on IC expenditures	0,10	0,10	0,10	0,10
5	Desired Delta Performance (2 x 4)	40	80	120	160
6	Discounted ratio	0,10	0,10	0,10	0,10
7	Discounted factor	1,10	1,21	1,33	1,46
8	Discounted IC expenditures (1 / 7)	363,64	330,58	300,53	273,21
9	Discounted Delta Performance (3 / 7)	29,09	49,59	60,11	60,11
10	Discounted Desired Delta Performance (5 / 7)	36,36	66,12	90,16	109,28
11	Performance ratio (9 / 10)	0,80	0,75	0,67	0,55
12	Capitalised Discounted IC expenditures (8 x 11)	290,91	247,93	200,35	150,26
13	Initial Intellectual capital	500,00	740,91	914,75	1.023,63
14	IC obsolescence rate	0,10	0,10	0,10	0,10
15	IC obsolescence (13 x 14)	50,00	74,09	91,48	102,36
16	**Intellectual capital (13 + 12 - 15)**	**740,91**	**914,75**	**1.023,63**	**1.071,53**
(*) *It is assumed that annual IC expenditures are sustained on a quarterly basis.*					
(**) *It is assumed that Invested Capital in operational activities will not change during the planning period.*					

TABLE 1 – A Simplified Intellectual Capital plan

Based on the above remarks, the adopted method tries to match the cost and income approaches to provide a monetary assessment of IC.

It is worth remarking that also this method has some drawbacks which can be referred to:

1. the indirect relationship between IC expenditures and business performance;
2. the relevance of the performance ratio for assessing IC expenditures productivity;
3. the relevance of the planning time horizon according to which the impact of IC expenditures on business performance is assessed;
4. the relevance of both the discount rate and the desired ROI on IC expenditures.

Concerning the first drawback, it is possible to assert that, although the relationship between IC expenditures and performance is indirect, without a significant knowledge stock a firm would not be able to build other strategic assets, leading to an improvement of drivers and outcome measures. Furthermore, it is possible to remark that such method does not pretend to give an exact value of IC. It only aims to suggest managers a meaningful range of IC expenditures that could be capitalised. It is worth remarking that this value is not assessed in order to be posted in a company financial statement. The main reason to estimate it is, instead, to support a learning-oriented planning process, to foster communication between the Personnel/Organisation and other units and a better understanding of the impact of IC policies on future business growth.

If one considers the second drawback, it is possible to observe that although the above synthetic performance indicator is only related to a monetary parameter that is associated to profitability,

other performance measures are captured in the non-monetary framework for IC assessment, depicted in figure 1.

Regarding the third drawback, a too short time horizon could originate managerial myopic behaviour. In fact, in order to overcome poor financial results, managers could irrationally reduce expenditures leading to the acquisition of other strategic resources (e.g., production capacity, distribution systems, patents). Although this policy would be likely to keep profits on a desired standard in the short term, on a longer time horizon it could prejudice company competitiveness and profitability. Therefore, in order to capture such phenomena, the planning time horizon must be long enough to detect them, and cannot be pre-defined. It must be calibrated according to the decided investment policy and the characteristics of the industry where the firm operates.

The same remarks are also relevant about the setting of both desired ROI and the discount rate.

The conceptual framework for IC assessment discussed above is likely to support a basic understanding of policy levers impacting on business knowledge and effects produced on drivers and outcome measures. However, a deeper comprehension of knowledge accumulation and depletion processes over time can be fostered if the system dynamics perspective is applied to the static model depicted in figure 1.

A dynamic feedback view of IC accumulation and depletion processes

By focusing stocks and flows affecting business strategic assets' dynamics, SD is adopted to frame and manage systems that are characterized by complex cause-and-effect relationships (Bianchi and Bivona, 2002). This is the case of IC accumulation and depletion processes.

To move from a static to a dynamic view of such processes, aimed to better support the Personnel/Organisation unit in IC planning, it is worth examining the causal relationships among main business variables affecting IC dynamics.

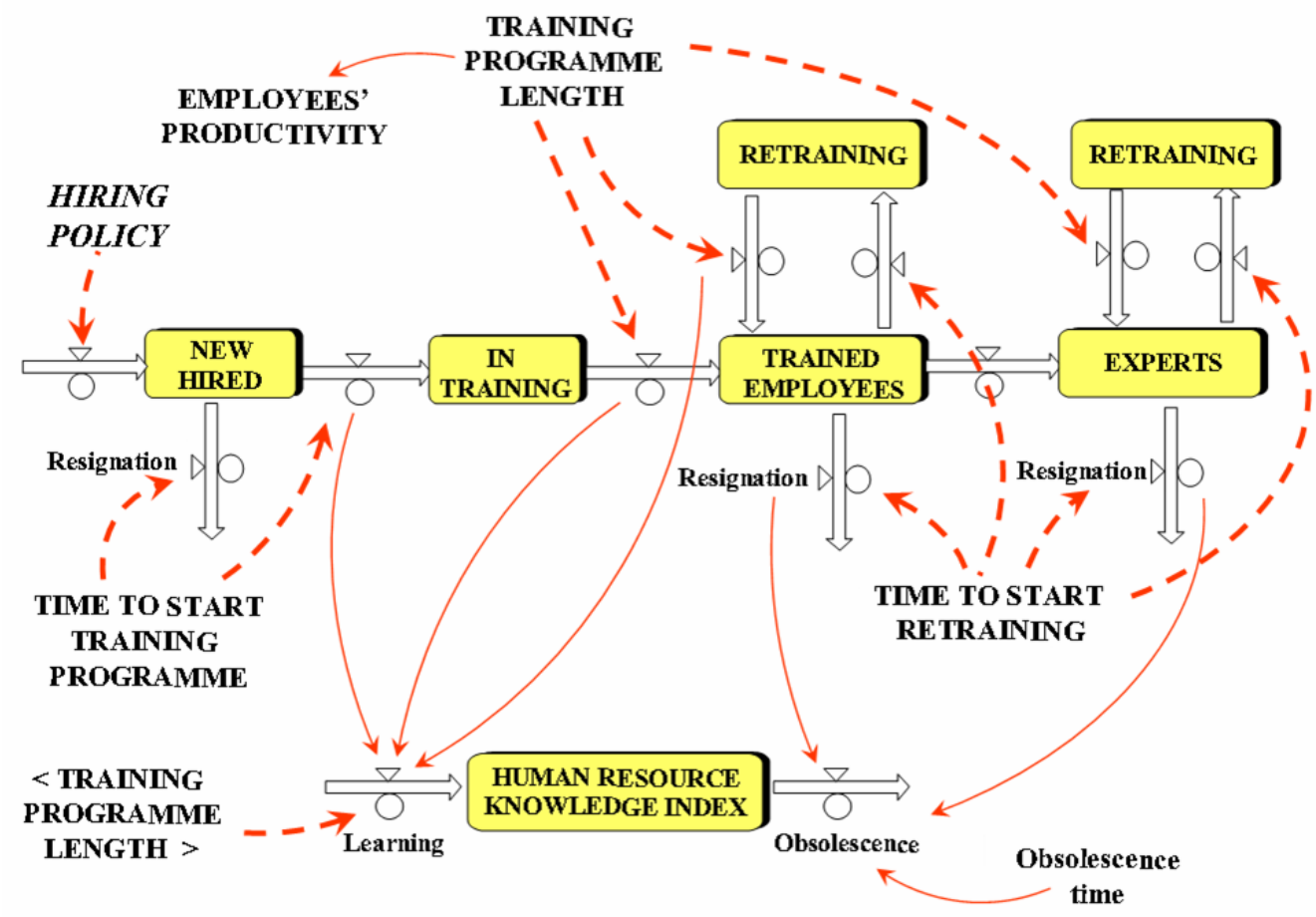


FIGURE 2 - A simplified picture of the stock-and-flow diagram depicting policy levers affecting human resource knowledge index

Figures 2 and 3 show a simplified view of the main structure embodied in the ILE that will be analysed in the last part of this paper. In particular, these figures portray the stock and flow model variables impacting on both *human resource knowledge index* and *organisational structure index*. Both indexes are the two synthetic non-monetary measures for IC assessment previously illustrated in figure 1, mentioned as know-how, know-what and know-why. Moreover, it will be analysed how the above two measures impact on main business drivers and performance indicators.

Figure 2 shows main sequential stocks portraying human resource endowment, i.e.: new hired, in training personnel, trained employees and experts [6].

The company hiring policy affects the first stock. The outflows of this stock are affected by decisions impacting on the average time to start training programmes to new hired personnel. In fact, such decision influences the number of people going to an "in training" stage. It also affects the number of new hired employees who decide to resign. In fact, if this time is too short (if compared to industry practice), the resignation rate increases.

[6] A different stock and flow analysis of the company skill resources has been provided by Winch (2001), Hafeez and Abdelmeguid (2003) and Warren (2002, p. 207-224).

The average training programme length affects the outflow of people in training into the stock of trained employees. The shorter is such period, the higher the outflow will be. However, a too shorter training programme length (if compared to the industry standards) is likely to reduce human resource productivity and, consequently, customer service.

The same reasoning is relevant for the "retraining" of trained employees and experts. Furthermore, there is a relationship between the time to start retraining and employees' turnover. In fact, this increases if the mean time between two education programmes is longer than the industry standards.

An aggregate measure of human resource knowledge is provided by a stock index, whose inflow (learning) is triggered by a co-flow associated to the number of employees moving from a level to the next, being each one characterised by a different potential.

At the same time, the human resource index level is dissipated by an obsolescence outflow, associated to the human resources resignation rates and a normal obsolescence time.

Figure 3 provides a synthetic picture of the stock-and-flow diagram, related to policy levers affecting human and organisational resource indexes and business performance drivers.

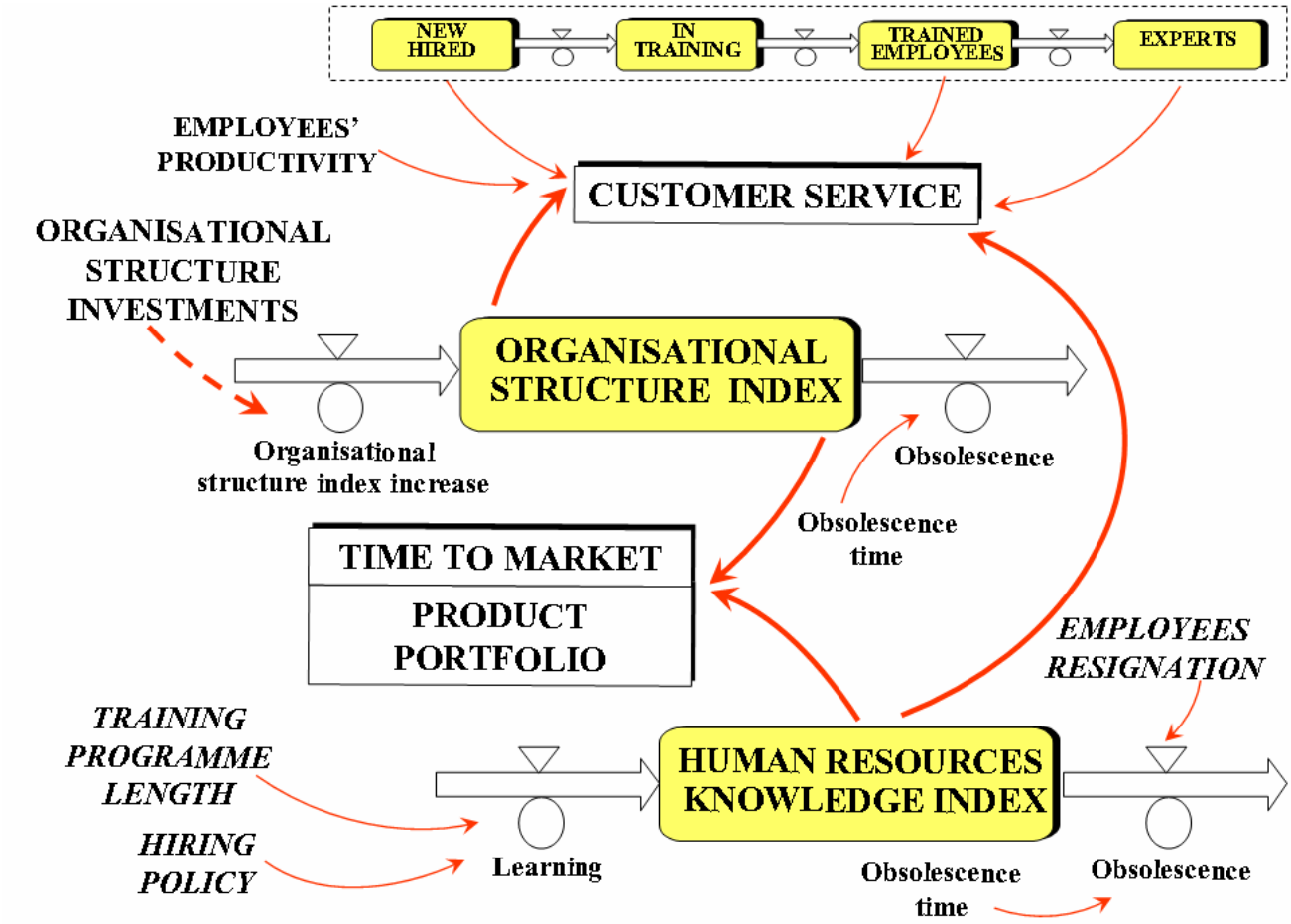


FIGURE 3 - A simplified picture of the stock-and-flow diagram depicting policy levers affecting human and organisational resource indexes and business drivers

As it is possible to observe, the organisational structure index is affected by an inflow triggered by company investments and decreased by an obsolescence rate which is related to different internal and external factors (e.g. technological progress, competitors innovation).

Both human resources and organisation structure indexes are likely to influence the three main performance drivers already mentioned in figure 1, i.e. : time to market and product portfolio and customer service.

A comprehensive picture of the net of causalities among main business variables reported in figures 1, 2 and 3 is portrayed in figure 4.

As it is possible to see from figure 4, the above drivers will impact on company image, which will affect the change in customers. The customer base will, in turn, influence sales revenues and operating income, which will affect the performance ratio. According to such ratio, the firm will be able to capitalise its IC expenditures.

The higher is the performance produced by IC expenditures, the higher capitalised IC expenditures will be. Further, the IC stock is also affected by an outflow that is associated to business knowledge obsolescence, which may depend on physical/technical issues (Knott *et al.* 2003, p. 193-194) or shifts in the industry *dominant logic*. Such a phenomenon represents a limit to knowledge growth (see balancing feedback loop B1).

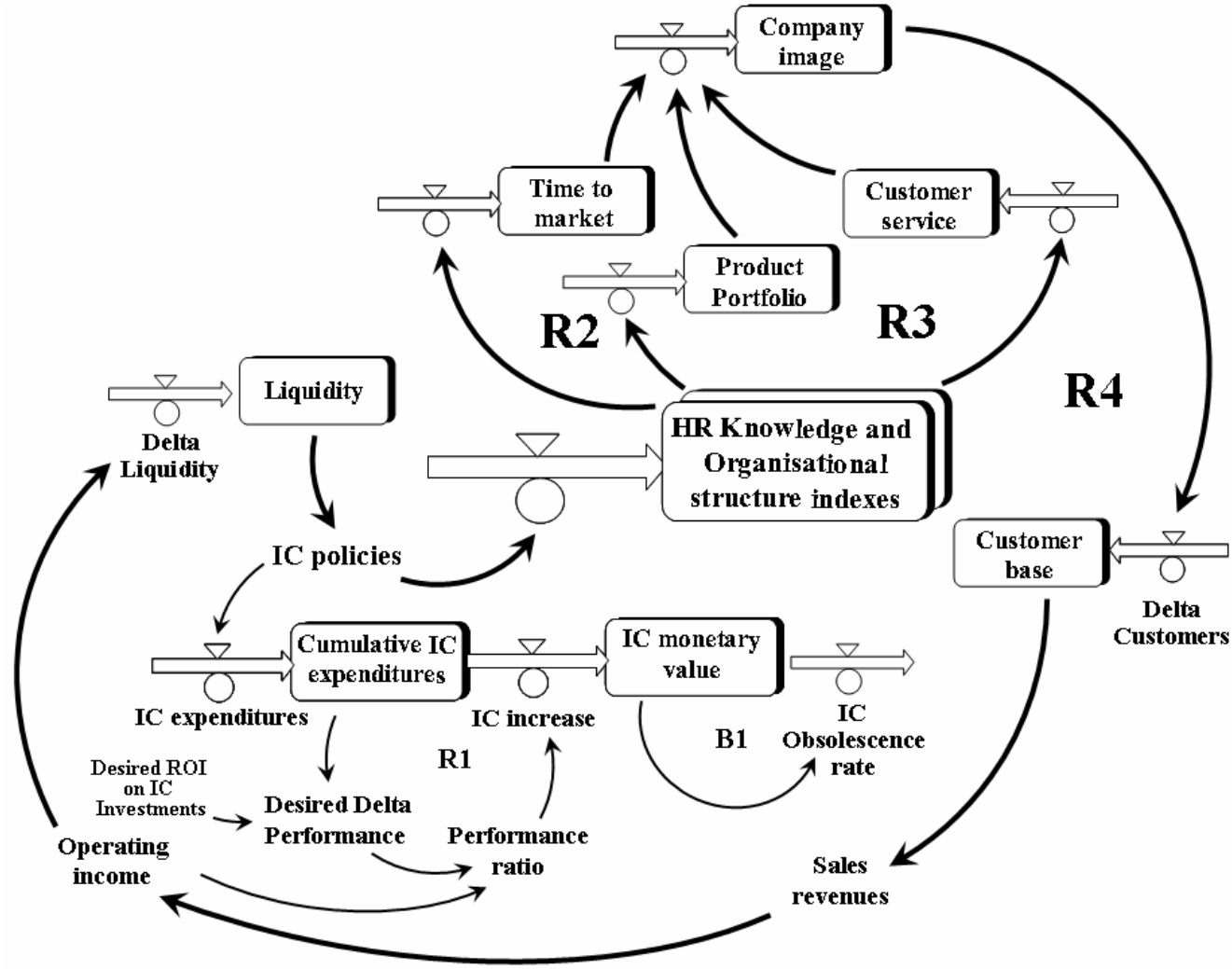


FIGURE 4 - Main relationships between IC and other strategic assets underlying a service business

Figure 4 also depicts a small reinforcing feedback (R1). The effects it produces can be significant if the firm – e.g., relying on a satisfactory level of the current IC stock – strongly reduces its annual budgeted IC expenditures. Such a myopic policy can generate in the short term illusory increasing returns, in terms of performance ratio on IC expenditures. In fact, a lower stock of cumulative IC expenditures will reduce the desired delta performance (given a desired ROI). This will increase the performance ratio [7] and, consequently, the flow of capitalised IC expenditures. However, in the medium-long term, the effects produced by such loop will become weak. In fact, the above commented limit to IC growth, underlined by the draining effects generated by the obsolescence rate, will gradually reduce the level of IC monetary value. This could imply structural problems in the strategic capability of the firm to foster future growth.

It is worth remarking that the effects generated by obsolescence are difficult to perceive by decision makers, due to the inertial depletion of IC. Quite often, the human mind or information systems are

[7] In fact, desired delta performance is the denominator of the performance ratio.

unable to promptly capture such effects (Sterman 1994, p. 299-302), which become evident only when it is too late to timely recover a satisfactory level of company knowledge.

Operating income is likely to also influence – other conditions being equal – company liquidity. The higher company liquidity is the higher the available resources to feed IC policies will be. Such investments are likely to increase human resource knowledge and organisation indexes (which are together an IC non-monetary measure) and IC expenditures.

The above analysis discloses positive feedback loops (R2-R3-R4) which make explicit the relationships between intellectual capital and other strategic assets to which company growth is associated.

An ILE embodying an SD and accounting model to support IC management in a planning setting

The conceptual framework depicted in figure 1 and the simplified stock and flow diagrams previously shown in figures 2, 3 and 4 have been used by the authors to build an ILE, based on SD ad accounting principles [8]. Its purpose is to educate managers operating in the Personnel/Organisation unit to plan IC expenditures in a strategic and systems perspective, to foster a learning-oriented planning process according to which IC expenditures are focused as developmental, rather than discretionary, costs.

Such a learning goal is likely to improve communication between the Personnel/Organisation unit and others involved in the planning process. It is also expected to question managers' mental models, to overcome myopic behaviour in IC planning policies.

The focus of the ILE is on the understanding of the IC dynamics. To this end, the ILE has been oriented to analyse the effects produced over time by IC investment policies on the accumulation of other strategic assets, which in turn affect business performance, and on IC value.

The generic structure of the ILE is derived from the analysis of the literature and the results of two research projects aimed to investigate relationships among policy levers, resources, drivers and performance indicators impacting on IC dynamics. Such research projects have been conducted in collaboration with a telecom mobile service provider and an insurance company. In particular, the first context offered the basis to customise the generic structure of the ILE to support manager training. The second one provided the arena for developing a business tool to support and assess IC investments in a planning context.

[8] Model equations are available from the authors on request.

Figures 5a and 5b show the main feedback loops related to the two analysed businesses. Such causal relationships have been used to customise the generic ILE's structure commented in the previous pages (see figures 2, 3 and 4).

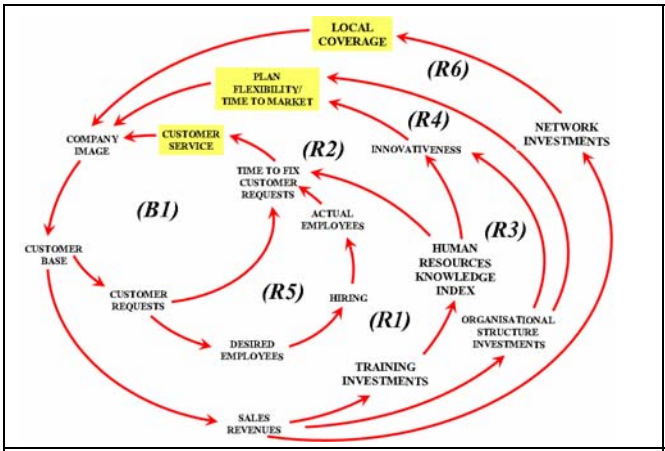


Figure 5a – Main feedback loops related to the telecom mobile service provider

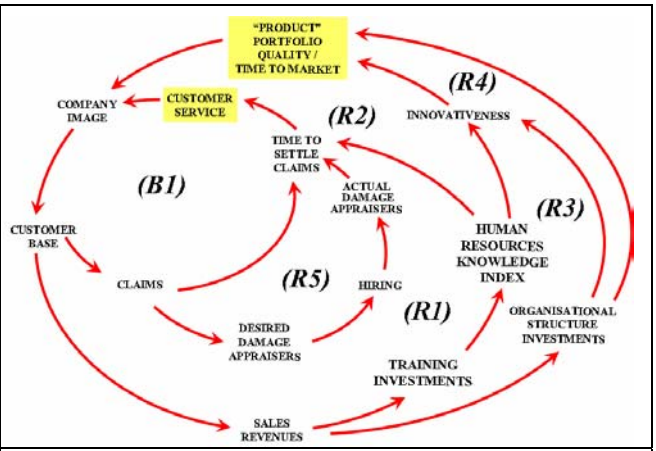


Figure 5b - Main feedback loops related to the insurance company

In particular, figure 5a is related to the telecom mobile service provider while figure 5b is linked to the insurance company.

In figure 5a it is possible to observe how hiring new employees allows the telecom mobile service provider to improve time to fix customer requests and customer service. This contributes to increase company image and customer base. Further, a larger customer base is likely to generate two effects.

On the one hand it increases sales revenues, which provide more financial resources to invest in:

- training, that boosts human resource knowledge index and, as a consequence, improves both time to fix customer requests and the level of service provided (see feedback loop R1 in figure 5a);

- and organisational structure.

An improvement of the organisational structure is likely to trigger innovativeness and two important performance drivers of company growth, such as plan flexibility and time to market. This is also likely to enhance company image, which in turn enlarges the customer base (see reinforcing loops R2, R3 and R4 in figure 5a). Such growth could be also fostered by network investments, (e.g. systems, antennas) which would improve company local coverage. This would imply an enhancement in company image and – other conditions being equal – customer base (see feedback loop R6 in figure 5a).

On the other hand, however, a larger customer base could generate bottlenecks in providing customer services, due to a given available labour force. Such a phenomenon is captured by the model through the balancing loop B1 portrayed in figure 5a, which links customer requests to

service as a result of time to fix customer requests. Hiring new employees is likely to counterbalance the above limit to growth (reinforcing loop R5 in figure 5a).

Figure 5b shows a similar feedback structure reported in figure 5a and commented above. In particular, feedback loops R1, R2, R3 and R4 are mainly the same. The main difference refers to the fact that in this case insurance company customers generates claims that contribute to increase time to settle claims, given a defined number of damage appraisers, and reduce the level of service provided to customers. This phenomenon is likely to deteriorate company image and, as a consequence, customer base (see B1 in figure 5b). In order to restore the desired level of customer service, company may act on hiring new damage appraisers (see R5 in figure 5b).

An ILE (*continued*): the main sector of the generic structure of the simulator

The simulator consists of five main sectors:

- a *guided introduction*, including the concept of IC and the case-study;
- an *input window*, which allows the user to customise the simulator, according to different issues, such as: the initial number of employees in each training stage (classroom vs. on-the-job training) or knowledge level (trained vs. expert), normal training programme length in the industry, normal organisational investments obsolescence time (see figure 6a);
- a *control panel* embodying main policy levers and scenario options. As it is possible to see from figure 6b, the control panel includes four main parts: 1) a list of navigation buttons, which allow the user to have easily access to different ILE's windows (i.e., inputs, income, financial and cash flow statements, IC monetary and non-monetary assessment graphs, and business case-study); 2) policy levers, ranging from employees to be hired each month, frequency and length in training programmes related to the different employees skill levels, organisation and network investments; 3) a set of different scenario buttons, including: market growth rate, customer mobility (churn) from one operator to another, competitors attractiveness; 4) main graphs and indicators (products, HR knowledge index, company and competitors customer base, market share and employees) aimed to give the player a first insight on the dynamics of some strategic resources. Through the control panel, users can make their decisions twice a year [9], over a four years planning time horizon;
- *reports* including financial, income, and cash flow statements, as well as an IC monetary assessment;
- *graphs* including main variables related to IC monetary and non-monetary assessment [10].

[9] The reason for choosing a six month period to set company IC policies is related to the need to replicate in the ILE the practice followed by firms, in our experience, in reviewing their IC plans.
[10] The time unit of graphs is days.

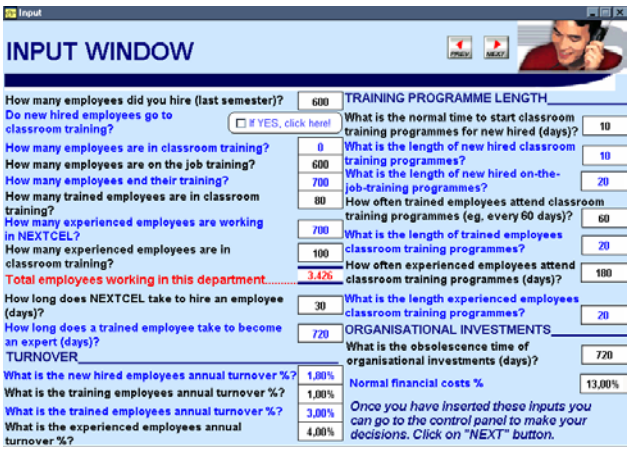


Figure 6a – The ILE input window

Figure 6b – The ILE control panel

An on-line help is available for users in order to provide them the meaning of different variables displayed in the ILE.

In order to better support learners to perceive relationships between different model sub-systems and understand effects generated by their IC policies over time, a set of window messages has also been designed. Such window messages are mainly oriented to let users know about customers complains on company service, emerging difficulties in business liquidity and available equity, and the failure of their policies due to financial reasons, or a too low service provided to customers.

In order to better understand what are the main benefits a user can get from using the above commented ILE, in the following paragraph the results of two scenarios related to the telecom mobile service provider (Nextcel) will be commented.

An ILE (*continued*): an analysis of two simulation scenarios

Through facilitated simulation sessions (Vennix 1996), users are supported to understand the hidden feedback structure of the relevant system and to envisage what changes could be made to the system's structure, through different policies, in order to affect key-variables' behaviour (Davidsen 1996). To this end, different small groups of 2-3 participants are built to work together and discuss choices and effects produced over time by adopted IC policies. When the ILE is played by managers, groups are made up by people from different units.

In order to repeat past simulations, to analyse them or change some choices according to the working hypotheses that emerge through group discussion, the ILE allows players to record their own decisions on a text file. They are also asked to distinguish stock and flow variables and sketch feedback loops related to observed behaviours from adopted policies. An important issue on which they are requested to debate concerns processes fostering or tackling business growth.

Scenario 1: a myopic IC policy

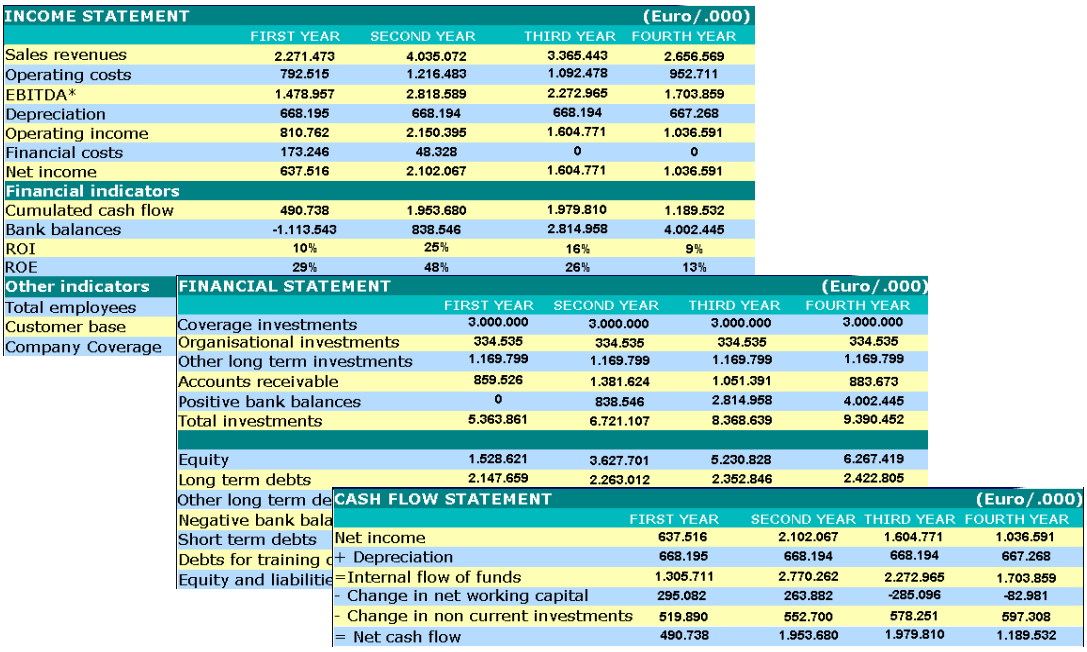
The first scenario implies a medium customer mobility (about 2.5 years), and a high attractiveness for competitor B, and medium for competitor C.

According to this scenario, Nextcel monthly hires 30 employees on average.

In order to face the sharp annual market growth rate (35%), new hired personnel is primarily allocated to deal with daily customer requests. This increases the average time to start training programmes for new hired from 10 (i.e. the industry standard) to 30 days. Likewise, training programmes length is set to 15 days (while the industry standard is 20) for all the three employees skill levels. For the same reason, also the average frequency of training programmes for both trained employees and experts (every 180 and 360 days respectively) is lower than the industry standard (i.e., 60 and 180 days).

Such scenario also implies a prudential organisation investment policy. Network investment policy is calibrated to the "medium" option.

As shown in figure 7, the company investment policy is able to produce a satisfactory yield, portrayed by positive EBITDA, ROI E ROE and growing bank balances.



INCOME STATEMENT				(Euro/.000)
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR
Sales revenues	2.271.473	4.035.072	3.365.443	2.656.569
Operating costs	792.515	1.216.483	1.092.478	952.711
EBITDA*	1.478.957	2.818.589	2.272.965	1.703.859
Depreciation	668.195	668.194	668.194	667.268
Operating income	810.762	2.150.395	1.604.771	1.036.591
Financial costs	173.246	48.328	0	0
Net income	637.516	2.102.067	1.604.771	1.036.591
Financial indicators				
Cumulated cash flow	490.738	1.953.680	1.979.810	1.189.532
Bank balances	-1.113.543	838.546	2.814.958	4.002.445
ROI	10%	25%	16%	9%
ROE	29%	48%	26%	13%

Other indicators
Total employees
Customer base
Company Coverage

FINANCIAL STATEMENT				(Euro/.000)
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR
Coverage investments	3.000.000	3.000.000	3.000.000	3.000.000
Organisational investments	334.535	334.535	334.535	334.535
Other long term investments	1.169.799	1.169.799	1.169.799	1.169.799
Accounts receivable	859.526	1.381.624	1.051.391	883.673
Positive bank balances	0	838.546	2.814.958	4.002.445
Total investments	5.363.861	6.721.107	8.368.639	9.390.452
Equity	1.528.621	3.627.701	5.230.828	6.267.419
Long term debts	2.147.659	2.263.012	2.352.846	2.422.805
Other long term de				
Negative bank bala				
Short term debts				
Debts for training c				
Equity and liabilitie				

CASH FLOW STATEMENT				(Euro/.000)
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR
Net income	637.516	2.102.067	1.604.771	1.036.591
+ Depreciation	668.195	668.194	668.194	667.268
=Internal flow of funds	1.305.711	2.770.262	2.272.965	1.703.859
- Change in net working capital	295.082	263.882	-285.096	-82.981
- Change in non current investments	519.890	552.700	578.251	597.308
= Net cash flow	490.738	1.953.680	1.979.810	1.189.532

FIGURE 7 - Main accounting reports embodied by the ILE and portraying the first scenario results

According to the adopted IC monetary evaluation method, the 100% of IC expenditures (i.e., those related to employees hiring and training, as well as, to organisation) would be capitalised.

If one would have to evaluate this scenario only based on the monetary values portrayed by the accounting reports, it can be considered very satisfactory.

However, a dynamic analysis of non-monetary IC indicators and other business strategic and intangibles variables can be useful to better understand the sustainability of such scenario over time and the meaning of the above accounting values.

As shown in figure 8, in the first eighteen months, the company hiring policy would be able to provide a reasonable customer service. Nevertheless, from the second half of the simulation, customer service significantly deteriorates. Consequently, provided the high competitiveness of the market, both the company market share and image dramatically decrease.

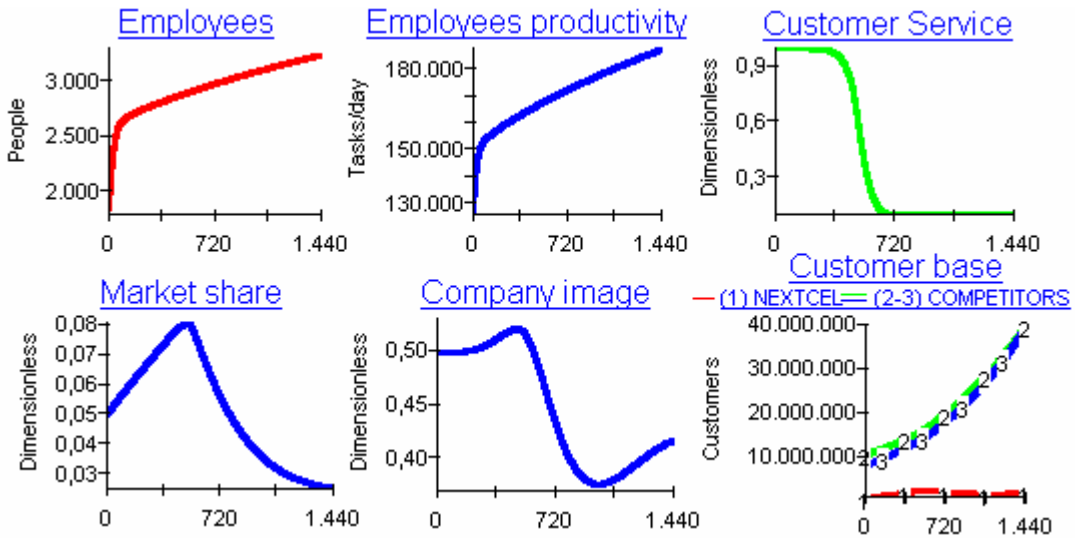


Figure 8 – Effects of IC policies on employees productivity, service and customer capital in the first scenario

As shown in figure 9, this policy does not allow the company to foster a significant increase in the human resource knowledge index. Consequently, plan flexibility performance improvement is too weak to allow Nextcel to sustain its market share. Furthermore, the low training investments are a primary cause of turnover increase, due to employees dissatisfaction. The increase in personnel turnover is the cause for the reduction of hiring and training expenditures sustained by firm.

As shown in the previous graphs, the positive financial results expected from the adopted policies are trivial. As a matter of fact, a closer analysis of the business competitiveness shows that the level of its strategic assets would be substantially reduced. Such assets (e.g. company image, customer service, plan flexibility) would not allow Nextcel to keep a sustainable competitive advantage and sustain growth in the long run [11]. The effects of such phenomenon are captured by the bottom-right graph in figure 8. In fact, although in the first half of the simulation the firm is able to subtly increase its customer base, this happens as an indirect effect of three reasons, i.e.: a) the sharp

[11] Such phenomenon has been analysed in the system dynamics literature by different scholars. The People Express case-study (Whitstone 1983) offers a good example of the risks that a company may face when a myopic policy ignoring the perils of growth can imply. See also Senge (1990, chapter 8) and Morecroft (1997).

market growth rate; b) the primary allocation of new hired personnel to front-office activities, and c) the short training programme length. The effects of such myopic policy become evident only in the second half of the simulation, when the customer base collapses, in spite of the significant market growth rate. Such a scenario provides an analysis of the causes underlying the limits to growth experienced by Nextcel.

Figure 9 – Effects of IC policies on human capital, innovation, and plan flexibility in the first scenario.

The above counterintuitive results demonstrate that the availability of only financial and other static quantitative indicators may not be able to provide decision makers a systemic and dynamic view of observed phenomena. This can be particularly true for the investigation of the impact generated by IC investment policies on service companies' performance where both knowledge and other key-intangibles resources play a crucial role. In fact, IC expenditures contribute to the accumulation of knowledge and other related strategic assets, most of which are intangible and subject to delays and inertia. For this reason, an SD model embodying financial, other quantitative measures and intangible assets can provide decision makers more fruitful insights to assess sustainable policies.

Scenario 2: a sustainable long-term oriented IC policy

A second scenario implies the same market assumptions of the previous one (i.e. medium customer mobility, a high competitor B attractiveness and medium competitor C attractiveness). In this scenario, in order to cope with the sharp growth in the customer base, implying an increasing need of people available to deal with requests and launch new products, the company decides to hire and train a growing number of employees. It starts to monthly hire 60 people and, in order to sustain

growth, it gradually reaches a rate of new hired personnel equal to 450 people per month. Network investment policy is calibrated to the "medium" option [12].

Further, such a run implies that the length of employee training is gradually increased. In the first 18 simulation months such length is kept unchanged (i.e., 15 days). In the next months, it is increased to 18 days and, only from the second half of the third year, it is set to 20 days. Likewise, the training programme frequency is gradually increased so to meet the industry standards.

To sustain such IC policy, from the end of the second year, organisational investments are also increased (from medium to high).

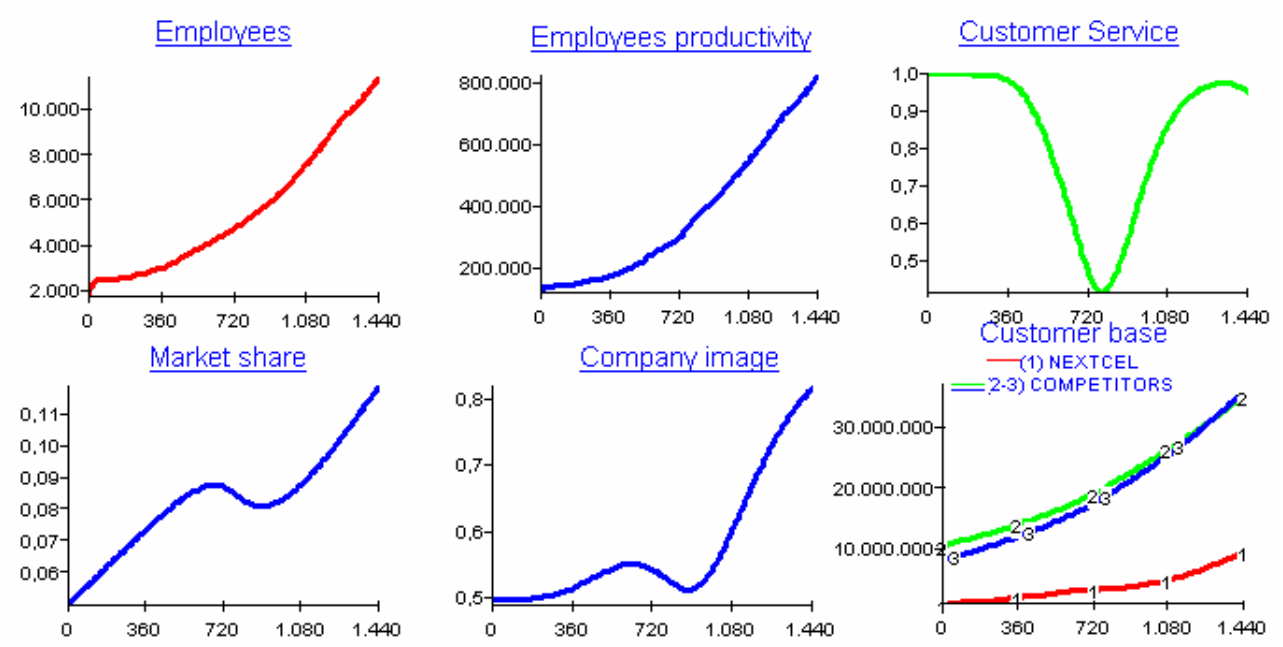


Figure 10 – Effects of IC policies on employees productivity, service and customer capital in the second scenario.

Figure 10 shows that, in the second and third year, the company would improve its competitive position (see, in particular, market share and company image). However, although competitive performance increase, such a scenario would allow the firm to earn a lower operating income, which would imply a capitalisation of only the 18% of IC expenditures related to the four years plan.

The reason why the firm finds difficulties in increasing its market share, image, customer service and operating income, particularly between the second and third year, can be associated to the effects produced by the sales growth, due to both the high market growth rate and the gradual undertaken IC policy. In fact, the number of experts is not sufficient to both support the increasing

[12] In the two scenarios network investment policy has not be changed in order to make more understandable effects generated by IC expenditures on business performance.

volume of current activities (e.g., dealing with customer requests, launching new tariff plans) and the education of the massive number of new hired employees that growth requires. Furthermore, customer service oscillates because of the difficulty of the firm to face growth through its skilled employees. Such oscillations are at the same time the cause and effect of market share fluctuations. As a matter of fact, a lower customer service reduces demand, which in turn decreases the workload for Nextcel employees. This increases – other conditions being equal – customer service again, leading to a further rise in demand.

The limits to growth in IC expenditures productivity are also captured by the behaviour of the human resource knowledge index, displayed in figure 11.

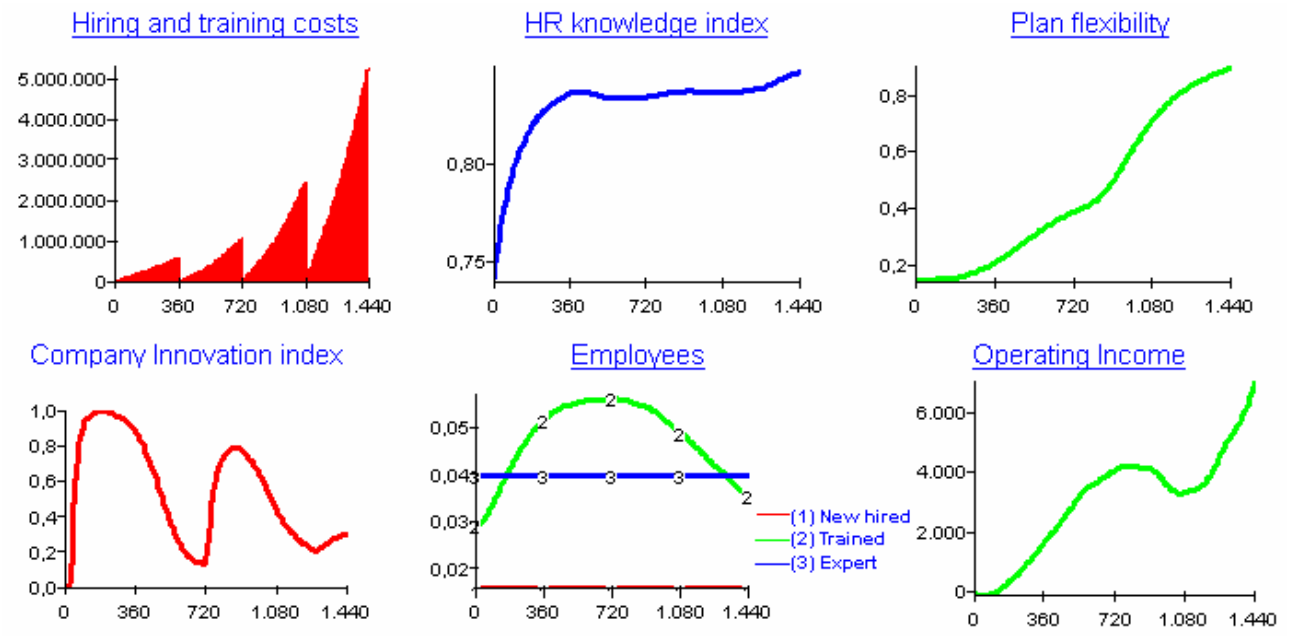


FIGURE 11 - Effects of IC policies on human capital, innovation, and plan flexibility in the second scenario

In spite of such limits, the gradual increase of hiring and training costs on a side, and organisational investments on another, allows the firm to pursue a balanced and sustainable IC growth. However, as previously remarked, according to the adopted IC evaluation method, the second scenario would allow the firm to capitalise only the 18% of IC expenditures.

How can one explain that a policy leading to better competitive results is likely to give rise to a lower percentage of capitalised IC expenditures, if compared to scenario 1?

In order to understand the reasons of this phenomenon, it is necessary to analyse the net of causalities underlying the conceptual framework for IC non-monetary assessment, previously analysed in figure 4.

A comparative analysis of Scenario 1 and Scenario 2

Concerning the first scenario, the above considerations suggest that although the performance increase achieved in the four years gives a satisfactory yield, the endowment of strategic assets would not be able to sustain future growth. In fact, customer service, image and innovativeness are significantly lower than in the second scenario. The human resource knowledge index is, instead, very close in both scenarios. It is, rather, subtly lower in scenario 2 from the second to the third year, because of difficulties in getting enough experts available for new hired training. Another reason explaining this phenomenon is that a more aggressive hiring and training policy generates a higher weight of rookies over the number of experts, whose initial level of knowledge is low. However, in the last year, the above index starts growing in scenario 2, while it levels on a constant value in scenario 1.

Furthermore, differently from scenario 1, the second scenario implies a higher endowment of strategic assets that allow the firm to sustain future growth.

Such analysis, supported by the discussion on main relationships between IC and other strategic assets underlying Nextcel growth (see figure 4) is used in the de-briefing session to help players to learn how:

- the percentage of capitalised IC expenditures refers to the *flow* of results generated by investments done in a given time period. As a consequence, although a small investment can give a satisfactory yield, it could not provide the firm the necessary *stock* of strategic assets to sustain future growth;
- such investments in strategic assets will allow the company to achieve a performance increase. This will make the capitalisation of IC expenditures possible;
- the higher is the growth rate of the firm, the higher will be the stock of its strategic assets (e.g., customer base, image and plan flexibility) needed to make growth sustainable. However, to build a higher level of strategic assets, higher IC expenditures will be necessary (see the R2, R3 and R4 reinforcing loop in figure 4);
- consequently, IC obsolescence will provide a limit to further growth in the IC stock (see the B1 balancing loop in figure 4);
- a second limit to IC growth is given by the likelihood that the positive loop enhanced by the increase of other strategic assets affecting company performance, can continue to be dominant. In fact, as far as IC reaches a threshold level, given an available technology, the productivity of further IC expenditures declines. This may reduce the capitalisation of IC expenditures.

Concluding remarks

This paper has shown the potential impact of ILEs embodying SD and accounting models to support top management decisions in allocating business resources in a planning setting for IC management.

Human resource training and organisational expenditures are often budgeted on an incremental basis, as discretionary costs. They are planned without a closer look on how the interaction between IC and other strategic assets will allow the firm to improve its performance and achieve a sustainable growth in the long run.

By focusing stocks and flows affecting business strategic assets' dynamics, the SD methodology has been adopted in this paper to provide decision makers a learning vehicle supporting them to frame and manage the complex and peculiar system characterised by IC.

A shift of mind in managing IC can be fostered by introducing a new conceptual framework for IC monetary and non-monetary assessment. Such a framework has been embodied in the ILE analysed in this paper.

The two simulation scenarios commented in the last section of the paper, suggest how managing IC only based on a monetary and static approach is likely to lead decision makers to a myopic resource allocation in the planning process. This may also happen when a non-monetary analysis of IC indicators is not supported by a dynamic view of the processes driving the accumulation and depletion of strategic assets.

Further empirical research will be necessary to experiment the contribution our methodology and the ILE are likely to give to top managers' learning processes, in both educational and planning contexts. We believe that such analysis will give us more insights for both including in the ILE more relevant issues (or re-focusing those existing ones) and developing new ILEs based on case-studies, aimed to foster decision makers' learning on other key-problems related to IC management.

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