Using System Dynamics ILEs in service business interventions to support Intellectual Capital Planning

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Abstract

Modelling knowledge in SD organisational interventions may become a puzzling task because of difficulties in achieving a common shared view among business key-actors about the impact of Intellectual Capital (IC) investments on future company performance.
Such difficulties are not only related to the intangible nature of IC, but also to the indirect role of knowledge in affecting performance drivers and outcomes. This phenomenon is particularly relevant in service businesses, where intangibles account for a high percentage of total assets.
In order to overcome such problems, a conceptual framework has been developed by the authors to build a generic SD model aimed to support business decision makers in IC planning, with particular regard to service firms.
Such model has provided the basis for developing two ILEs focused on a telecom mobile service provider and an insurance company. The first application was related to an education project, while the second one was linked to a consulting assignment.
The use of a conceptual framework as a basis to build an ILE has proved to be a successful strategy in order to better communicate business key-actors the potential of SD in modelling and assessing IC policies.
Main key-issues underlying model development and the ILEs' application are discussed in the paper, and most 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 a 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 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 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 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 the development of 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 about 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 in both monetary (likewise other tangible 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 a generic SD model, tailored to the context of service firms, where knowledge usually plays a crucial role for the business success and continuity. Such model has provided the basis for developing two ILEs focused on a telecom

mobile service provider and an insurance company. The first application was related to an education project, while the second one was linked to a consulting assignment.

The paper is divided into three main parts.

In the first part, an analysis of the IC concept and a framework for its assessment are outlined.

In the second part, the structure of a generic SD model describing IC accumulation and depletion processes and their relationships with key-intangible assets in a service business is discussed.

In the third part, an analysis of two ILEs based on the generic SD model is done, with particular reference to: 1) the structure of the two simulators, 2) main feedback loops used in debriefing simulated results; 3) what players can learn from scenario analysis in a planning context.

The concept of Intellectual Capital

The concept of "Intellectual Capital" is related to those expenditures aimed to improve the capabilities of people and the organisation to *understand*, to *learn,* i.e. to better frame the system where decisions are made, to attain a performance increase.

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) [1].

[1] According to the literature, IC not only consists of *human capital*, but also relates to *structural* and *organisational capital*. The first one 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 second one, relates to investments in organisational and information structures, and procedures, to improve decisional capabilities of the firm. The third one, relates to investments aimed to build strong and long term relationships with external counterparts (e.g. customers, suppliers, competitors) to give rise a shared knowledge system, which may relate to products, information, distribution systems, etc. (Stewart 1997).

The above said perspective shifts the focus of analysis 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*.

This paper aims to demonstrate the powerful role of SD modelling in helping planners to focus not only on the assessment of IC value, but also on understanding the impact of IC investments on other strategic assets, performance drivers and outcomes.

A conceptual framework for IC assessment

The conceptual framework used by the authors as a basis to build a generic SD model for IC planning in service businesses combines a non-monetary with a monetary assessment. 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 (Stewart 1997). 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 generic service business.

[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).

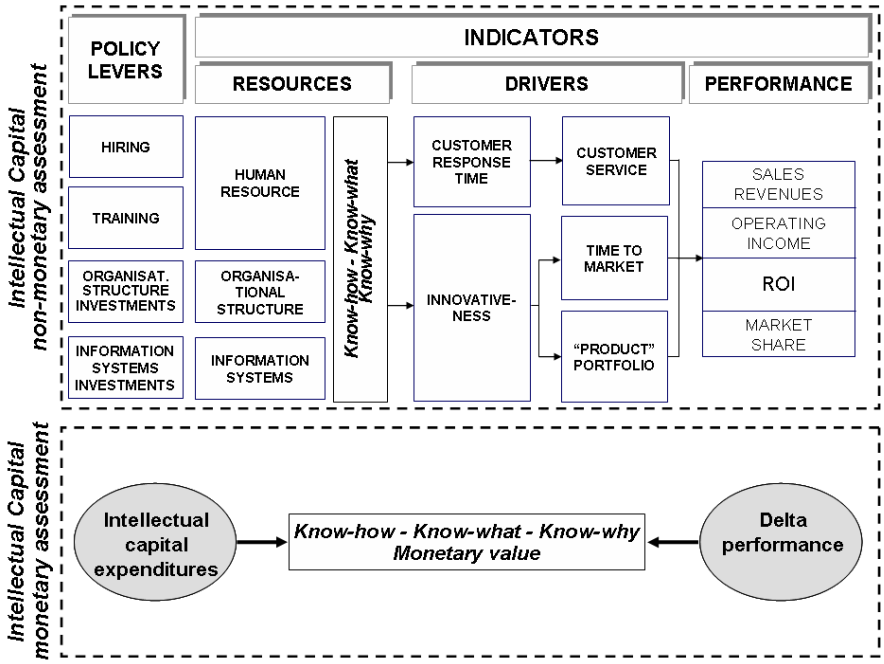

FIGURE 1 - A conceptual framework for a combined IC monetary and non-monetary assessment

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" 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. If one multiplies IC expenditures by the desired ROI, it is possible to 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.

	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.

The above method was shared by the authors with the business clients, which were in both cases the Directors of Organisation units and their staff. Main critical issues which emerged from discussion about the method were about:

[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.

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

Concerning the first issue, it was remarked that though IC value may also depend on policies which do not imply any expense, a causal relationship can be found between IC expenditures, business performance and therefore IC value. Consequently, the adopted method is focused on only monetary inputs.

Concerning the second issue, it was outlined that 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. It was suggested that such method does not pretend to give an exact value of IC. It only aims to outline a meaningful range of IC expenditures that could be capitalised. Therefore, 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 Organisation function and other units which will exploit the knowledge potential of the firm.

About the third issue, it was remarked 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 fourth issue, it was underlined that 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 the 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 a SD perspective is applied to the static framework depicted in figure 1.

Based on such framework for IC assessment a generic SD model was built by the authors to support a learning-oriented planning process for IC expenditure in service businesses.

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 Organisation unit in IC planning, the causal relationships among main business variables affecting IC dynamics were analysed through group model building sessions. Each session involved the director of the Organisational unit and three collaborators. Once sketched the main stock and flow structure of the SD model, the behaviour of key variables was validated by using company past data.

Figures 2 and 3 show a simplified view of the main structure of the model built by the authors, based on two pilot service businesses, operating in the telecommunication and insurance industries. The SD model provided the basis for an ILE that will be analysed in the last part of this paper. The above figures portray the stock and flow model variables impacting on both the *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. The above two measures impact on main business drivers and performance indicators.

As figure 2 shows, the dynamics of the company human resource endowment has been modelled as an aging chain, portraying in sequence: new hired, in training personnel, trained employees and experts [6].

[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).

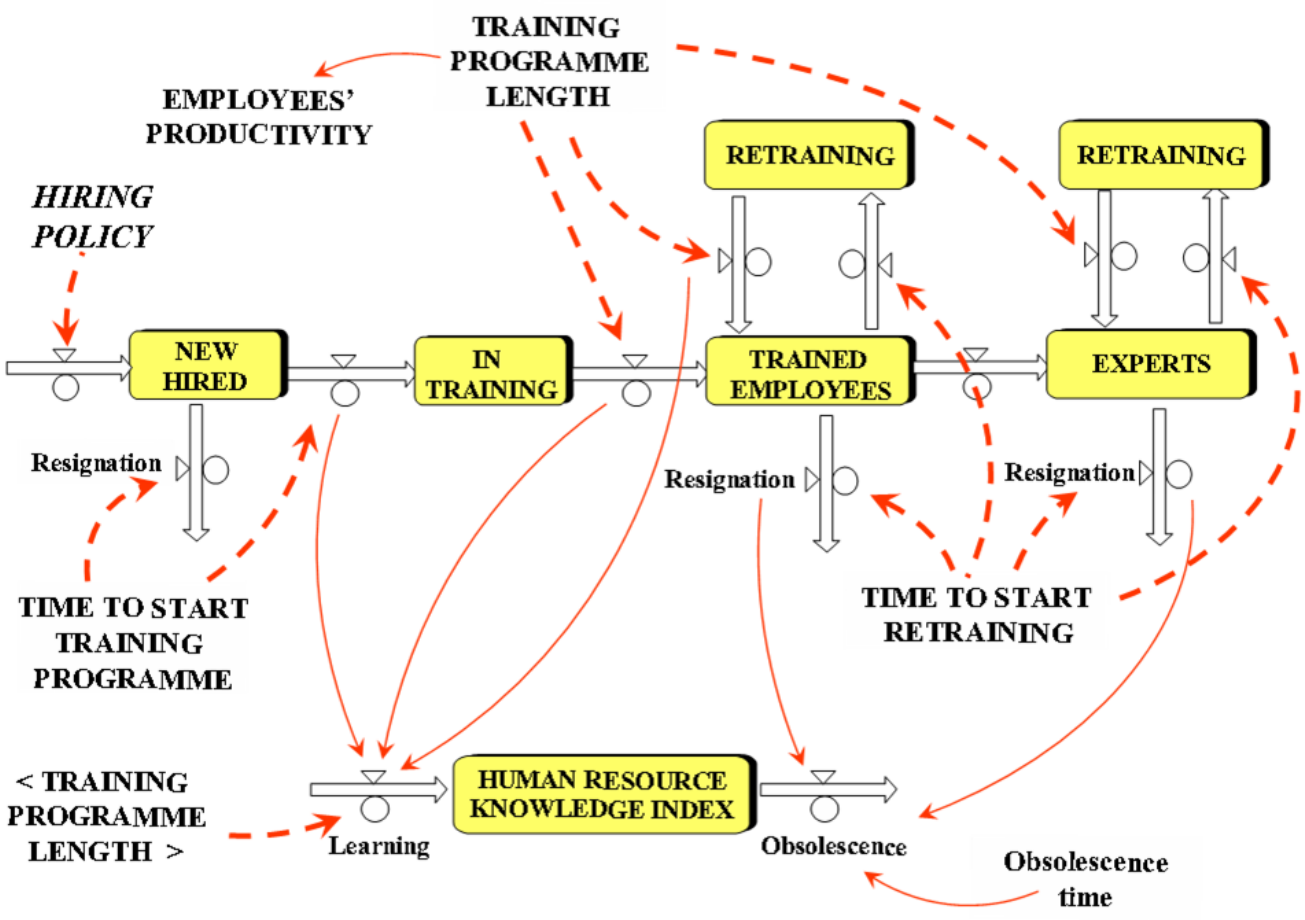

FIGURE 2 - A simplified picture of the model stock-and-flow structure affecting the human resource knowledge index

The company hiring policy affects the first stock. The outflows of this stock are affected by the average time to start training programmes for new hired personnel. This influences the number of people going to an "in training" stage and 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.

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 short 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, it was remarked 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.

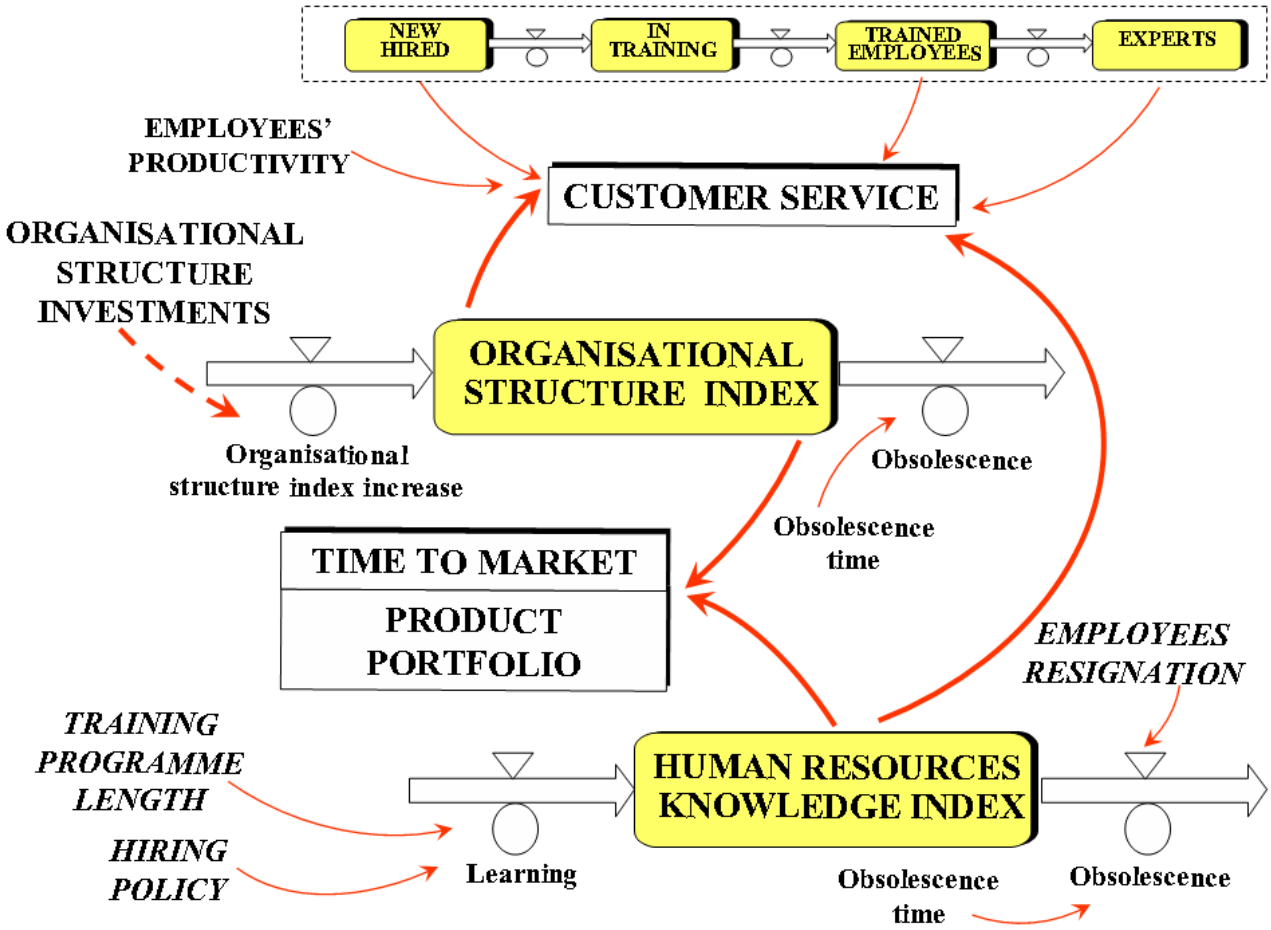

FIGURE 3 - A simplified picture of the model stock-and-flows affecting the organisational structure index and performance drivers

Figure 3 shows how 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 previously depicted in figure 1, i.e. : time to market, product portfolio and customer service.

An analysis of cause and effect relationships between IC policies, performance drivers, and other strategic assets, financial performance and IC policies is depicted in figure 4.

Figure 4 shows how the above three performance drivers impact on company image, which affects the change in customers. The customer base, in turn, influences sales revenues, operating income and liquidity, which can allow the firm to sustain an IC growth policy (R1, R2, R3).

To what extent such policy can be sustainable?

Understanding the dynamics of IC monetary value can be helpful to answer this question.

On this concern figure 4 shows how the operating income affects the performance ratio. According to such ratio, the firm will be able to capitalise IC expenditures.

The higher is the performance produced by IC expenditures, the higher capitalised IC expenditures will be.

The figure also shows how 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) [7].

Figure 4 also depicts a small reinforcing feedback (R4). 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 [8] 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 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.

[7] A second limit to IC growth, which is not made explicit in figure 4, but is embodied in the SD model developed by the authors, 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 monetary value reaches a threshold level, related to an available technology, the productivity of further IC expenditures declines. This may reduce the capitalisation of IC expenditures.

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

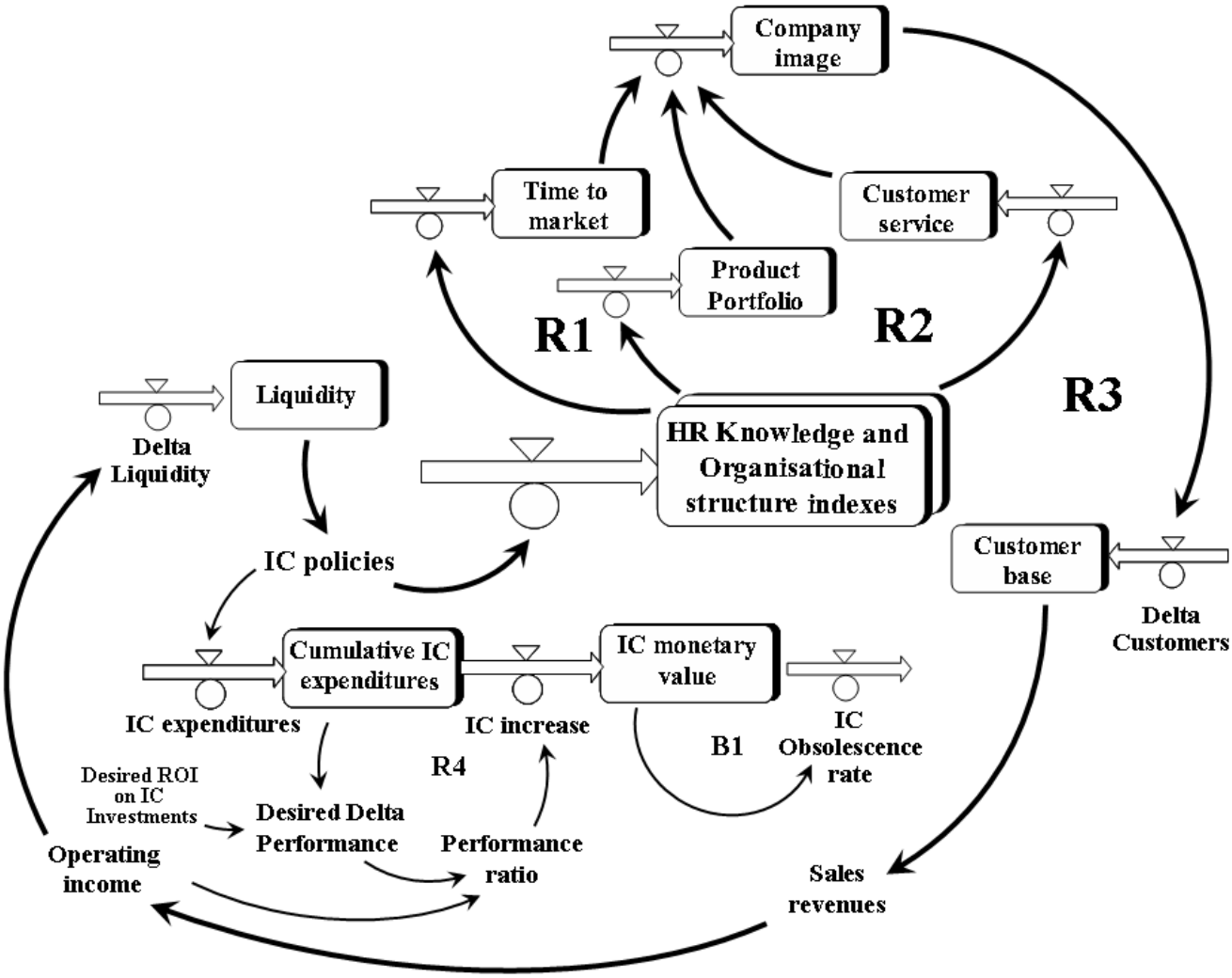

FIGURE 4 - Main relationships between IC and other strategic assets underlying a service business

An ILE embodying an SD and accounting model to support IC management in a planning setting: an application to a telecom and insurance firm

The conceptual framework depicted in figure 1 and the feedback stock-and-flow structure described in the previously figures 2, 3 and 4 have been used by the authors to build an ILE, that was customised to two firms operating in the telecom and insurance industries.

The *first context* allowed the authors to experiment and tailor the generic SD model [9] in an *educational* setting, to involve the Organisation and other units into a learning-oriented planning process, according to which IC expenditures are conceived as developmental, rather than discretionary, costs. A learning-oriented planning process is likely to improve communication between different decision makers, to detect weak points in the currently adopted budgeting methods and performance indicators, to overcome myopic behaviour in IC planning.

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

The *second context* allowed the authors to apply the ILE as a supporting planning tool in an insurance firm.

Figures 5a and 5b show the main feedback loops related to the two analysed businesses, resulting from group model building sessions conducted to customise the generic SD model structure previously commented (see figures 2, 3 and 4).

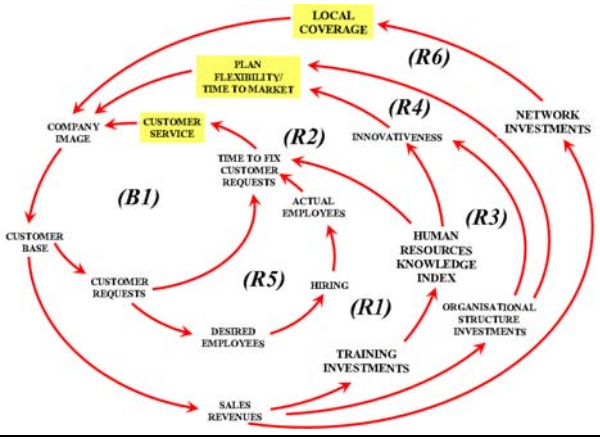

Figure 5a – Main feedback loops related to the telecom mobile service provider

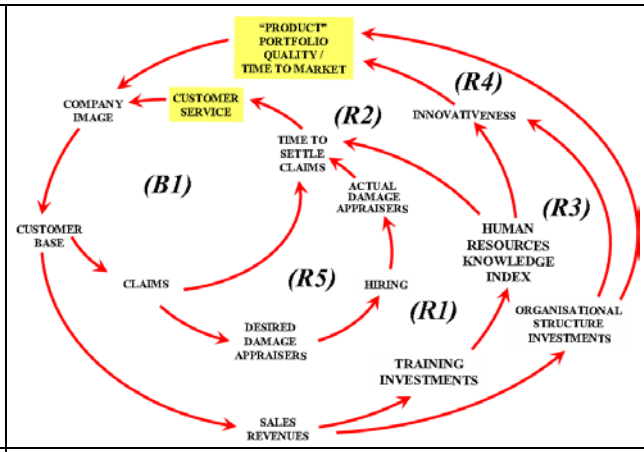

Figure 5b - Main feedback loops related to the insurance company

Figure 5a shows how hiring new employees allows a 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 be invested in:

- training, that boosts the 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);

- 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 the same feedback structure described above, referred to an insurance company operating in the non-life market segment. In particular, in this context a higher customer base increases – other conditions being equal – the number of claims. A growing number of claims tends to increase the average time to process them, if neither staff (appraisers) nor its skill are increased in the short run. This reduces the level of service provided to customers, and deteriorates company image. As a consequence, customer base decreases (see loop B1 in figure 5b). In order to restore the desired level of customer service, the firm may hire new damage appraisers and/or train them more intensively (see loop R5 in figure 5b).

An ILE (*continued*): the main sectors of the ILEs' structure

The two ILEs developed by the authors consist of five main sectors:

- a *guided introduction*, including the concept of IC and the problem context. In the first application (telecom) this was also supported by a case-study aimed to raise relevant debating points for class discussion and group simulation;
- 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 a company 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 strategic resources. Through the control panel, users can make their decisions twice a year [10], 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 [11].

[10] 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.
[11] The time unit of graphs is days.

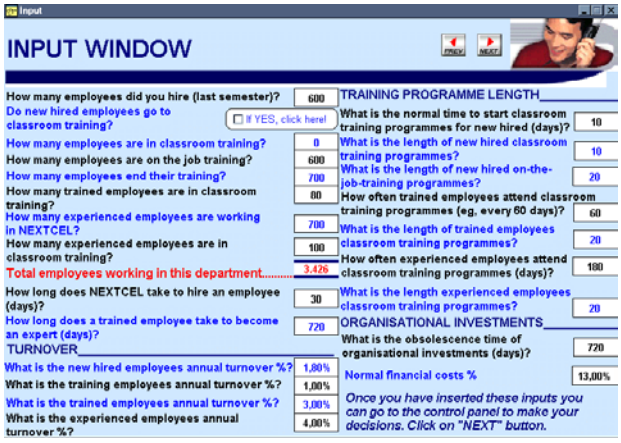

Figure 6a – The ILE input window (telecom application)

Figure 6b – The ILE control panel (insurance application)

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 the following section the results of two scenarios related to the telecom mobile service provider (Nextcel) and the insurance company (Non-life Insurance Spa) [12] will be commented.

An ILE (*continued*): an analysis of two simulation scenarios in a telecom mobile firm

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 IC policies to adopt and analyse their effects produced over time.

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

[12] The names of both firms have been disguised.

own decisions on a text file. During the small group discussion, players 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 their analysis is focused by facilitators is about 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 intangible 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.

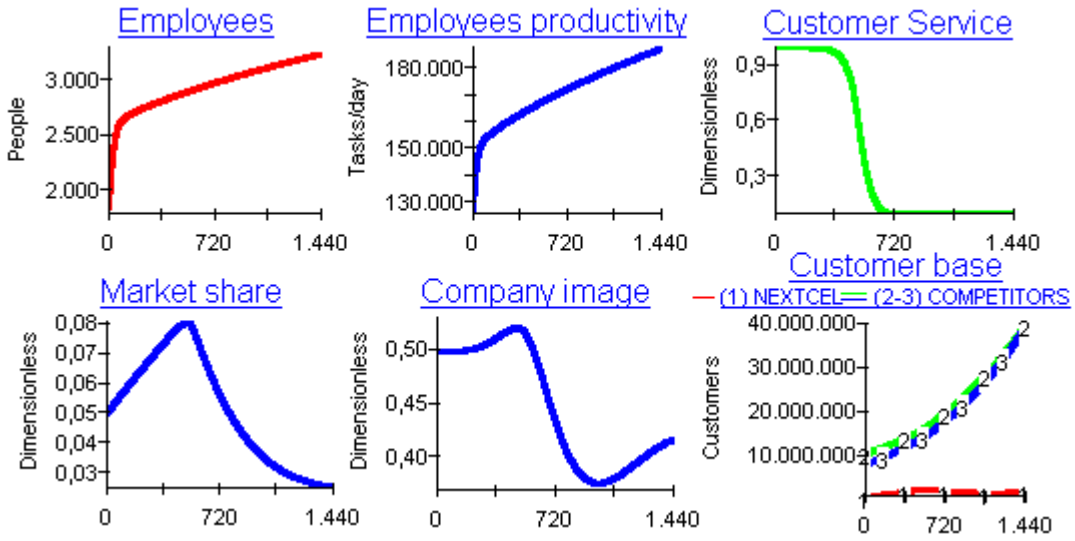

Figure 8 – Effects of IC policies on employees productivity, service and customer base in the first scenario

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 [13]. 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 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 resource knowledge index, 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-intangible 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 have provided business decision makers more fruitful insights to assess sustainable policies.

Scenario 2: a sustainable long-term oriented IC policy

[13] 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).

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 [14].

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).

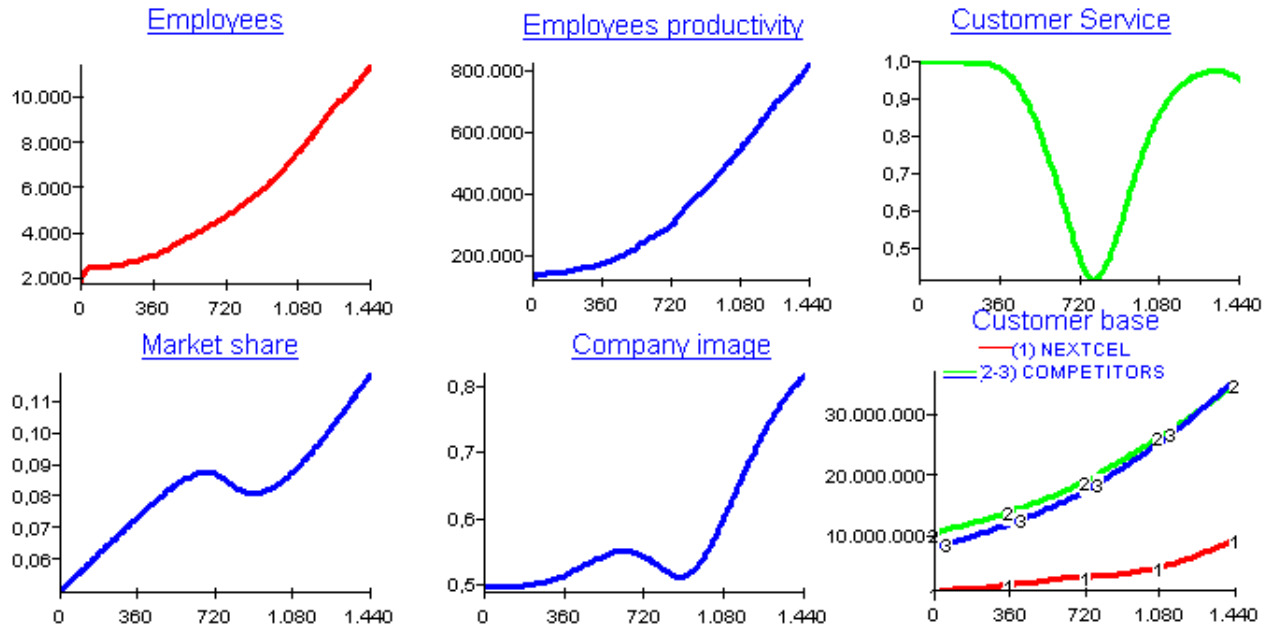

Figure 10 – Effects of IC policies on employees productivity, service and customer base in the second scenario.

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 increases, 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.

[14] 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.

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 undertaken IC policy. In fact, the number of experts is not sufficient to both support the increasing 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.

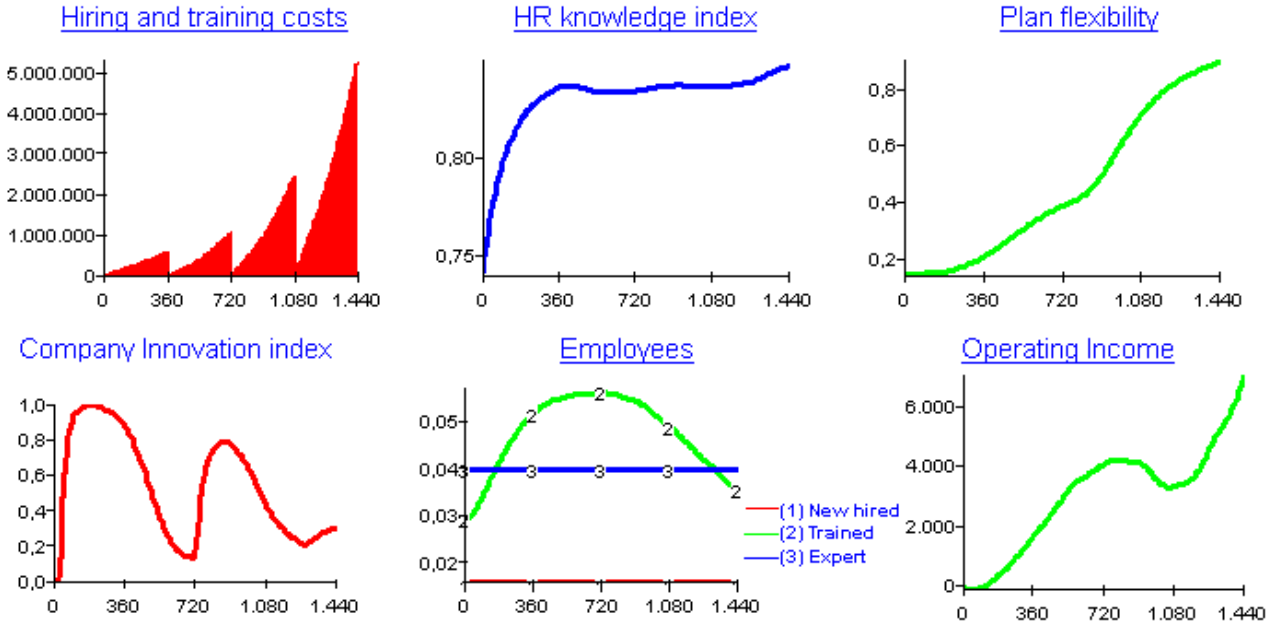

FIGURE 11 - Effects of IC policies on human resource knowledge index, innovation, and plan flexibility in the second scenario

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, portrayed in figure 4.

A comparative analysis of Nextcel Scenario 1 and 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, slightly 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-off 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 R1, R2 and R3 reinforcing loops 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).

An ILE (continued): an analysis of two simulation scenarios in an insurance firm

The ILE previously discussed has been also customised to an insurance firm, in order to support its IC planning processes. The firm will be referred hereinafter as *Non-life Insurance Spa*. The model was calibrated on the past behaviour of the business key-variables, and the ILE was used with the

management to test and validate different scenarios. In particular, two runs will be analysed and discussed in the following pages.

Both scenarios imply a low annual market growth rate (about 3%), a medium customer mobility (about 2 years), and a high attractiveness of the "top 10" competitors and medium for other competitors. It was also assumed that competitors adopt low monetary incentives to their sales managers.

The company market share is 3%. It has about 500 agencies, 180 damage appraisers and 25 sales managers. The company personnel is very qualified if compared with the industry standard.

The company combined ratio (the percentage of the premium paid out in claims and expenses) is 0.98 while the loss ratio (the percentage of each premium dollar spent on claims and associated costs) is 0.79. A drop in both such ratios represents an improvement, while an increase represents a deterioration. The simulation covers a four years time span, through which the management aims to increase the number of agencies up to 570 and company market share from 3 to 4.5%. It is also expected that company growth policies have to contribute to reduce the combined ratio of 1 or 2%. Furthermore, the management is very concerned about the assessment of IC value resulting from alternative growth policies. In fact, company growth can not be achieved to the detriment of IC monetary value.

The model was developed and calibrated with the Organisation unit of the firm, and simulation sessions facilitated by the authors, were run together with participants from the following units: Organisation, IT, Finance, Commercial and Appraisal.

Non-life insurance Spa was used to focus the IC planning process on only accounting and monetary values and some IC expenditures (e.g., education) were considered as a current expense.

The conceptual framework described in figure 1, on which the simulator was based, was therefore illustrated to the participants to the project and share with them in order to foster a shift of mind in the way the firm was used to plan IC expenditures.

Scenario 1: a myopic IC policy

In a first simulated scenario, the management decided to monthly:

- acquire 10 new agencies in the first year and 15 in the remaining planned period;
- hire 1 sales manager;
- hire 10 junior damage appraisers in the first year, 8 in the first half of the second year and 5 in the remaining planned period.

A weak training policy for both sales managers and damage appraisers was also undertaken. In particular, training programme frequency was the double of the industry standard.

To meet the desired market share, sales managers' commercial efforts were supported through high monetary incentives and growing marketing investments. To cope with the expected increasing number of claims, the management also decided to invest in IT and provide high monetary incentives to damage appraisers. Moreover, in order to maintain a satisfactory financial yield, after the second year, company investments in product portfolio were substantially reduced.

As shown in figure 12, the company investment policy was proved to be able to produce a satisfactory yield, in terms of operating and net income and related performance indicators (i.e., ROI and ROE). In fact, both combined and loss ratios show a positive trend during the planned period.

INCOME STATEMENT				(Euro /.000)
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURFTH YEAR
(1) Non-life insurance gross written premiums	1.272.916	1.364.743	1.474.595	1.555.672
(2) Insurance losses	962.632	964.865	923.967	953.948
(3) Net change in reserves for unearned premiums	95.977	74.243	78.290	88.693
(4) Loss and net chaneg in reserves (2) +/- (3)	1.058.609	1.039.107	1.002.257	1.042.640
(5) Commercial expense	159.498	174.695	192.920	206.422
(6) First Margin (1) - (4) - (5)	54.809	150.940	279.419	306.610
(7) Training and personnel costs	13.486	13.408	13.947	14.439
(8) Second Margin (6) - (7)	41.323	137.532	265.471	292.171
(9) Administrative expenses	69.965	81.590	92.861	98.370
(10) IT depreciation & agencies acquisition costs	6.053	7.820	9.998	11.635
(11) Operating income (8) - (9) - (10)	-34.695	48.122	162.613	182.166
(12) Financial result	3.904	5.759	11.356	18.072
(13) Taxes	0	22.630	73.067	84.100
(14) Net income (11) +/- (12) - (13)	-30.791	31.251	100.902	116.138
Other performance indicators				
Combined Ratio (*)	1,03	0,96	0,89	0,88
Loss Ratio (**)	0,83	0,76	0,68	0,67
Expense Ratio (***)	0,20	0,20	0,21	0,21
ROI	0%	2%	8%	8%
ROE	0%	14%	37%	33%
Company Customers	1.019.421	1.113.057	1.179.000	1.242.519
Total Sales Managers	27	29	30	32
Total Damage appraisers	196	204	210	215

FIGURE 12 – Non-life Insurance Spa operating income related to first scenario results

According to the adopted IC monetary evaluation method, figures resulting from first scenario allow to capitalise the 100% of IC expenditures. Such business results would seem to achieve management goals.

However, from the analysis of IC non-monetary indicators and other business strategic factors reported in figures 13 and 14, it is possible to argue that the sustainability of such scenario is weak. In fact, in spite of an acceptable customer service provided by the company, due to an initial reduction in the time to settle claims, and a stable sales managers' knowledge index, this policy produces a significant deterioration of company product portfolio quality and damage appraisers' knowledge index. Such a phenomenon is due to the low IC investments, if compared to the commercial investments aimed to significantly increase the number of agencies.

Further evidence of the limits of this policy is provided by the fact that although company image initially shows a growing trend, in the fourth year it starts to decline. The same behaviour can be also referred to the dynamics of customer service.

The above analysis suggested participants how the desired market share cannot be achieved by only a sustained commercial investment policy, if this is not supported by proper investments in damage appraisers and sales manager training.

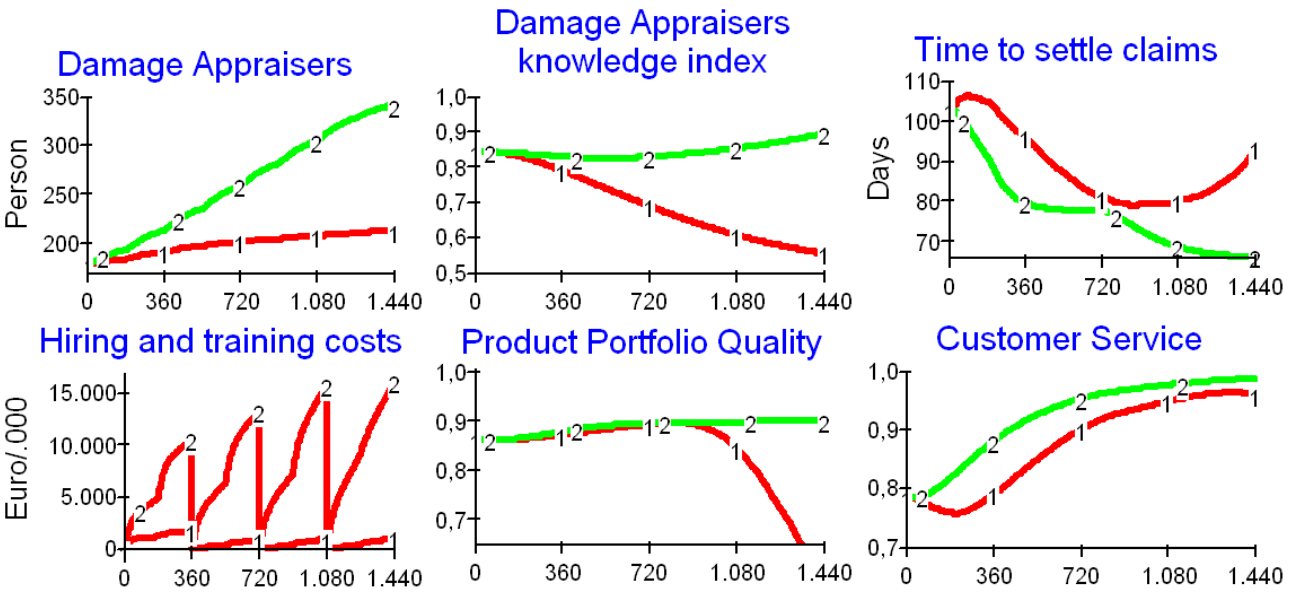

Figure 13 – Effects of IC policies on damage appraisers knowledge index, time to settle claims, product portfolio quality and customer service (*1= first scenario ; 2 = second scenario*)

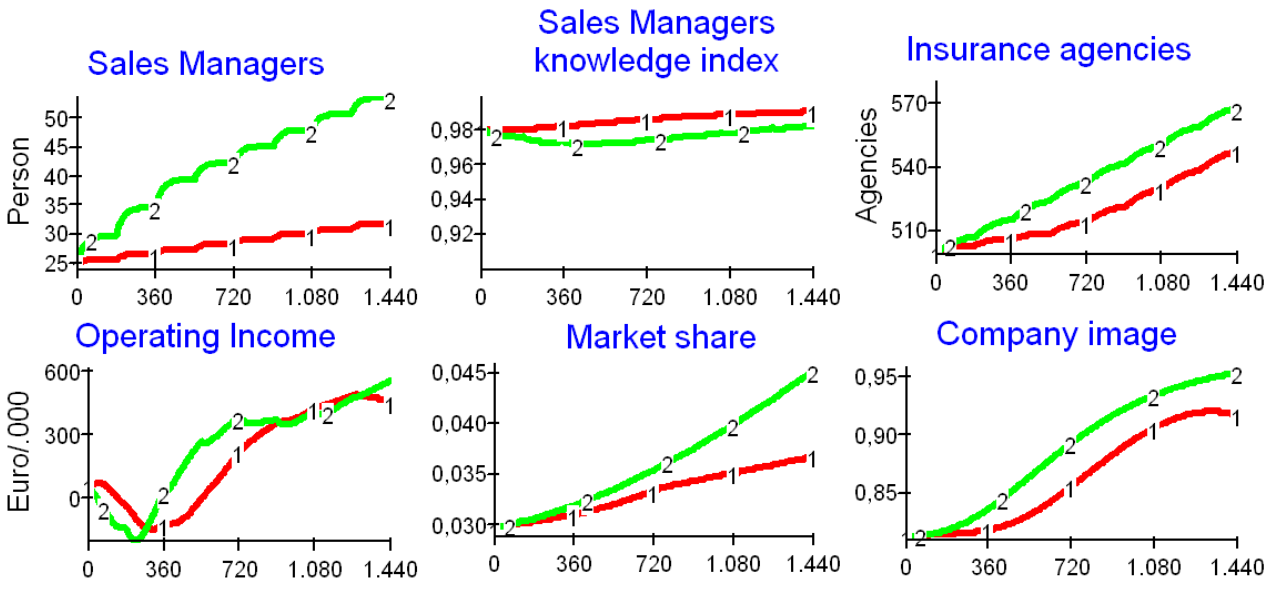

Figure 14 – Effects of IC policies on sales manager knowledge index, operating income, company image and market share (*1= first scenario ; 2 = second scenario*)

From figures 13 and 14, it is possible therefore to observe that company strategic assets dynamics (i.e. damage appraisers' knowledge index, product portfolio quality, company image and customer

service) would not allow the firm to keep a sustainable competitive advantage and sustain growth in the long run.

The analysis of the dynamics commented above was supported by managers group discussion, framed according to the rationale depicted in figure 5b.

Likewise, in the first run previously commented about the Nextcel case, also in this context financial results proved not to be sufficient to provide decision makers a comprehensive and a systemic picture of the relationships between relevant variables for IC policies.

Scenario 2: a balanced long-term oriented IC policy

A second scenario was developed according to the same market and competitors assumptions adopted in the first run.

This scenario differs from the first one, since the analysis of previous simulations suggested managers to balance investments in both commercial and damage appraisal sectors, in order to increase personnel knowledge and skills. The explored issue was about weather a stronger IC policy would have allowed the firm to sustain commercial growth in the long run.

The above scenario was outlined through a gradual increase of both the duration and frequency of personnel training programmes. Such strategy was also based on a monthly:

- acquisition of 15 new agencies since the first year;

- hiring of 5 sales managers in the first year and 3 in the remaining simulation time;

- hiring of 20 junior damage appraisers in the first three years and 5 in the last year;

- hiring of 5 senior damage appraisers in the first three years and 6 in the last year.

Investments in personnel monetary incentives, marketing and IT systems were also increased, if compared to the previous scenario.

The above decisions allowed the firm to build a sustainable competitive advantage and profitability in the medium/long term, in spite of the negative operating income produced in the first year because of the intensive investment policy (see figure 15).

INCOME STATEMENT				(Euro /.000)
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURFTH YEAR
(1) Non-life insurance gross written premiums	1.287.643	1.427.698	1.620.498	1.856.809
(2) Insurance losses	949.717	891.755	1.005.484	1.114.278
(3) Net change in reserves for unearned premiums	100.219	87.948	101.156	123.492
(4) Loss and net chaneg in reserves (2) +/- (3)	1.049.936	979.703	1.106.640	1.237.771
(5) Commercial expense	161.973	185.180	217.142	253.688
(6) First Margin (1) - (4) - (5)	75.734	262.815	296.716	365.350
(7) Training and personnel costs	23.209	28.747	34.363	37.101
(8) Second Margin (6) - (7)	52.525	234.068	262.353	328.249
(9) Administrative expenses	81.282	97.277	113.545	127.557
(10) IT depreciation & agencies acquisition costs	6.891	9.231	11.015	12.389
(11) Operating income (8) - (9) - (10)	-35.649	127.561	137.794	188.302
(12) Financial result	3.396	7.673	13.855	20.450
(13) Taxes	0	56.798	63.693	87.676
(14) Net income (11) +/- (12) - (13)	-32.252	78.436	87.956	121.076
Other performance indicators				
Combined Ratio (*)	1,03	0,91	0,91	0,90
Loss Ratio (**)	0,82	0,69	0,68	0,67
Expense Ratio (***)	0,21	0,22	0,23	0,23
ROI	0%	7%	7%	8%
ROE	0%	35%	30%	30%
Company Customers	1.049.102	1.180.096	1.347.833	1.547.640
Total Sales Managers	35	43	48	54
Total Damage appraisers	226	273	319	349

FIGURE 15 – Non-life Insurance Spa operating income related to second scenario results

A comparison of the two scenarios allowed managers to perceive how higher investments in damage appraisers hiring and training, in the second scenario, were able to increase knowledge, which in turn contributed to improve customer service and product portfolio quality. Both performance drivers, together with a higher endowment of agencies and sales managers, increased the business competitive position (see, in particular, market share and company image).

According to these decisions, managers were able to reach both targets: desired market share (4.5%) and number of agencies (470). The operating income depicted, at the same time, a better profile than in scenario one. Such financial results also allowed the firm to capitalise the 100% of the IC expenditures at the end of the fourth year.

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 by the authors to provide business 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 was fostered by introducing a new conceptual framework for IC monetary and non-monetary assessment. Such a framework was embodied in ILEs that were customised to the two firms on which the SD intervention was done.

The 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 of both the conceptual framework for IC analysis and assessment, and the ILEs to top managers' learning processes, in an educational and a planning setting.

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