Introducing SD modelling into planning and control systems to manage SMEs' growth: a learning-oriented perspective

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Abstract

This article emphasises the need for a learning-oriented approach to planning and control as a prerequisite for SMEs' survival and growth. Such a perspective can be effectively pursued through the development of interactive learning environments linking system dynamics (SD) and accounting models, which provide two complementary views of business phenomena. In order to properly support the drawing up of business plans and the evaluation of results associated with their implementation, the use of financial SD models embodying the accounting perspective is recommended. This is likely to enhance a shift in SME key actors' minds, as they will be able to analyse under the feedback view financial variables they are used to frame only through the accounting 'lens'. The article remarks how the specific features that sharply differentiate SMEs from larger firms discourage any systematic replication of the approaches commonly adopted in bigger companies practice, where SD has been more widely utilised. Copyright © 2002 John Wiley & Sons, Ltd.

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One of the most puzzling issues in small-medium enterprise (SME) research is related to the impact of planning and control[1] (P&C) tools on business performance. Based on field research findings, some authors (Braker *et al.* 1988; Foster 1993) have advocated that SME entrepreneurs can significantly benefit from formal business plans to set objectives, generate and evaluate strategies, monitor and commit to their implementation, and communicate with different stakeholders. On the other hand, empirical analysis conducted by other scholars (Hutchinson and Ray 1986; Robinson and Pearce 1984; Sexton and Van Auken 1985) has demonstrated the perils associated with a structured and sophisticated approach to P&C in SMEs. In fact, smaller firms often lack managerial and financial resources; this inhibits them from using formal control systems. Their strategic management also refers to quite simple problems (if compared to larger firms), in terms of scope and interrelationships among relevant variables.

Such different perspectives have led to the formulation of very controversial hypotheses on the causes of SMEs' crises. In fact, lack of planning has been indicated as a primary factor of failure for SMEs (O'Neil and Duker 1986). This implies a weak understanding of both the impact of current decisions on future growth and which policies to undertake in order to cope with major change.

Conversely, a ''passive'' approach to planning has proved to be counterproductive for the understanding of business processes and enhancing

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communication with company stakeholders. Field research (Bianchi *et al*. 1998; Parks *et al*. 1991; Shuman *et al*. 1985) has shown that many entrepreneurs view drawing up their business plans as a bureaucratic constraint, rather than as a learning tool that may help them to be aware of the ''business formula'' they are going to adopt. In order to quickly submit business plans to various external funders (e.g., banks or public agencies), entrepreneurs are often prone to delegate their drawing up to external professionals (e.g. accountants), being only marginally involved in their writing process (Gibb 1998; Olson and Gough 1996). Such an approach to planning is usually based on linear and static hypotheses: past balance sheets are extrapolated to elaborate projected end results, referred to a generic future time. Furthermore, *dual business planning* is often an outcome of the above perspective, in the sense that SMEs are prone to have two plans: one for the bank and one for the actual operations. In fact, applications for grants/development loans are accompanied by business plans that are often completed with the reader's wishes at the forefront, rather than the business's (Bianchi *et al*. 1998).

The outcome of such a mechanistic approach is a static and non-systemic document. It emerges from the aggregation of disparate data (e.g., commercial, financial, statistical, macro-economic) that does not allow entrepreneurs or their stakeholders to understand the structure and dynamics of the system in which the firm operates.

Other scholars (Hannon and Atherton, 1995; Sadler-Smith *et al*. 2001) have also remarked that SME performance is not directly related to planning *per se*. It is, rather, associated with the capability of decision makers to generate visions through the planning process. Instead of focusing on *forecasting*, the entrepreneur ought to be oriented to *learning*, i.e., the attitude to question mental models through the generation of new visions on how the business system will be likely to behave in the future as a consequence of current and long-term decisions embodied by the P&C system.

This article shares the above view of P&C for smaller firms. It shows the usefulness of system dynamics (SD) models for supporting entrepreneurial learning processes in SME growth management.

The article also emphasises that, in order to introduce SD modelling into SMEs' P&C systems, a unique approach is required. Seldom can one systematically replicate common approaches that have proved successful in larger firms, where SD is more widely utilised. Concerning this, the article remarks that an SME system is very specific and is likely to affect:

- *the modelling object*, in terms of issues on which learning ought to be primarily focused;
- *the modelling framework*, regarding views (i.e., perspectives of reality) to embody in the model;

- *the model validation*, i.e., ''the process by which we establish sufficient confidence in a model to be prepared to use it for some particular purpose'' (Coyle 1977, p. 181);
- *the model building process*, concerning which internal and external ''actors'' to involve.

Based on fieldwork developed by the author in the last five years, the above four issues will be analysed in this article. A conceptual framework describing how to build generic SD models embodying the financial perspective and to tailor them to a specific SME will be also provided.

The lack of learning-oriented planning and control systems as a major cause of crisis in SMEs' growth management

It has been emphasised that SMEs face structural difficulties in surviving the early stages of their own life-cycle (Tepstra and Olson 1993). Most small business failures occur in the first two years of their existence. About 80 percent of U.S. family businesses[2] fail before reaching the third generation and only the 3–5 percent will grow beyond this limit (J. L. Ward in a speech to the members of Institute de la Empresa Familiar, Barcelona, 1994).

In such companies, a recurring cause of failure is due to a lack of understanding the blurred boundaries between the firm and the equity-owning family (Landsberg 1983). Small-business owner–entrepreneurs often conceive their companies as a source of employment and wealth for all members of their families and involve them in decision making, regardless of their skills and motivation. Likewise, SMEs' failures are often caused by entrepreneurs who are inclined to centralise decision making and discourage communication, analysis and debate of the ''business idea'' with the younger generation of the business-owning family, or with potential new incoming managers.

Undercapitalisation and creditor problems have also been indicated as major effects of a *gut-feeling* approach to business management (Lussier and Corman 1995).

SMEs crises are also originated by opportunistic search for profit, which takes advantage of contingent external favourable conditions (e.g., competitors' failure, financial grants allowed by Government, economic trends) without reinvesting cash flows.

A too fast growth rate is considered as an important consequence of weak P&C systems, leading to poor understanding of inertial effects generated by policy makers' decisions, and to unintended results, which often give rise to crisis (Churchill and Mullins 2001). This phenomenon is mainly due to flaws in decision makers' assumptions concerning dynamic cause-and-effect relationships between activity volumes and to:

- the endowment of resources (capital, production capacity, etc.) needed to sustain growth;
- affordable liquidity withdrawals from company bank accounts, based on profit and cash-flow expectations, to satisfy family needs (Bianchi and Bivona 2000);
- the changing set of external variables (e.g., related to the competitive system).

It is not unusual, for instance, that SME crises are caused by an excessive rise of terms of payment allowed to customers, or a too sharp decrease of negotiated sale prices or promised delivery delays on goods sold, aimed to increase market share. Even though such ''aggressive'' commercial strategies may lead to a higher income rate in the short term, very often they cause a financial crisis over a longer time.

In such cases, small business entrepreneurs may not understand why their growth rate, which initially led to higher sales revenues and profits, suddenly threatens their firm's survival. They do not timely detect the causes of a drastic and progressive reduction in bank balances, despite increasing sales revenues (Peel and Wilson 1996). It may seem a contradiction that a remarkable order backlog cannot be filled because of a lack of inventory. The rationale of customer behaviour can be unclear and demand reduced in spite of the business's aggressive commercial strategies. Other puzzling issues are the causes of sales revenues and cash flow overshoot and collapse, due to flaws in product portfolio, dividend and cash-flow policies.

Very seldom are the above phenomena generated by chance, as it might appear at first sight to those unsuccessful entrepreneurs who are used to blaming external factors, such as public institutions or macro-economic cycles, or even destiny. Usually, the deep causes of crises are far from being related to sudden and inescapable events. On the contrary, they gradually arise as a product of the concurrent action over time of different variables pertaining to the *relevant system*.

The relevant system, related to a given problem behaviour (Forrester 1961, pp. 117–118; Richardson and Pugh 1981, pp. 42–43; Sterman 2000, pp. 222–225), does not usually coincide with the internal boundaries of the firm. It also embodies a wider range of variables belonging to other external sub-systems, e.g., related to the competitive, social and equity-owning family environment.

Misperceiving the relevant system's boundaries and dynamic relationships between the system's feedback structure and behaviour (Davidsen 1996; Sterman 2000, pp. 107–133) often leads SME entrepreneurs to make their decisions according to a linear, static and bounded point of view, in terms of time horizon and relationships between variables. In order to be able to foster SME growth, entrepreneurs do not only need to acquire capital, managerial concepts, technical capabilities, and qualified professional management. They also, and particularly, need to frame better the system where they operate, i.e., to learn.

The modelling object: framing complexity factors in SMEs as a pre-requisite to design planning and control systems in a learning-oriented perspective

This section aims to show how:

- learning must be focused on understanding and framing SME complexity;
- SME complexity can be framed according to three interrelated variables (internal, external and property-related).

Such factors have implications for introducing SD so as to foster a learning-oriented approach to P&C in SMEs. In fact, they define the specific context that is unique to developing an SD model for SMEs.

Figure 1 depicts three main interrelated complexity factors in smaller enterprises, i.e.:[3]

- internal-related factors;
- external-related factors;
- property-related factors.

Internal factors are those that are related to variables located inside the firm. Among them, the most influential may concern: entrepreneurial managerial attitudes (e.g., propensity to delegate), business inclination to satisfy financial needs through either debts or equity, available P&C systems, professional management, etc.

External factors are mainly associated with competitors, customers, financial institutions and other outside actors that interact with the firm. Perceptions about external factors are a key linking mechanism between internal and external factors.

Property-related factors refer to the tight overlap between the firm and its owners, such as the equity-owning family, or partners in small–medium co-operatives.[4]

Owing to their tendency to be subject to environmental unpredictability, much more than in larger firms, the boundary between ''short'' and ''long'' term

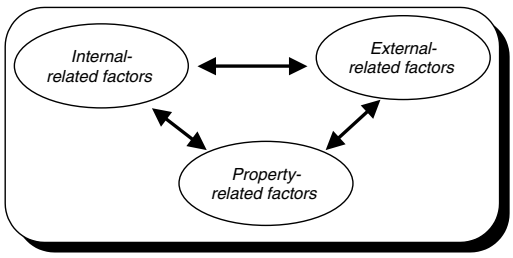


Fig. 1. Three categories of the causes of small business failure (adapted from Bianchi & Bivona, 2000)

is usually soft in SMEs. Small business entrepreneurs are often emotionally involved in current activities for three main reasons (Bianchi *et al.* 1998; Hutchinson and Ray 1986):

- they are not prone to delegate;
- they do not use prompt and selective information to anticipate future events;
- they are forced to adopt reactive decision making, because of the low relative weight of the firm in the relevant environment.

Managing SMEs is a matter of a continuous striving aimed at evading unexpected external or internal events. It is a kind of *muddling through* (Limblom 1959), which often does not allow for the pursuit of formal or conscious definition and planning of strategies. This does not mean, however, that smaller firms do not have strategic information needs and do not need to plan for their future. On the contrary, particularly in such companies, qualitative and dimensional growth depends on the extent to which the entrepreneur is able to discern relationships between current decisions (short-term objectives) and long-term wider business goals.

Understanding dynamic relationships between current and future events is an important outcome of a deep *learning process*, which ought to be continuously fostered. However, this is not an easy task. In fact, focusing on managing day to day can obscure the longer-term implications of decision making. This amplifies the complexity of strategic entrepreneurial learning in SMEs.

Detecting weak signals of strategic change hidden in current activities in which the entrepreneur is fully involved implies a different level of complexity from long-term decisions (e.g., capital investments). Although, in the first case, the structure of the system to be managed can more easily be framed than in the second case, monitoring strategic relevance of current events implies a major difficulty in detecting in advance *weak signals of change*.

Conceiving SMEs' P&C systems in a learning-oriented perspective is likely support the entrepreneur in foreseeing the future stages of business growth and in understanding the proper time and policies to build strategic assets that will foster future expansion.

On this concern, two main issues are particularly critical, i.e.:

- available learning-oriented methodologies and software tools, providing the context for the *modelling framework* and *validation*;
- ''actors'' who can facilitate the introduction of a learning-oriented perspective into SMEs' P&C systems, providing the context for the *model building* process.

In the remaining sections of the paper the above two topics will be explored.

The modelling framework

Matching SD and accounting models into interactive learning environments to support planning and control systems in SMEs' growth management

Popular approaches to P&C in SMEs involve spreadsheet models and/or accounting packages. Spreadsheet simulation modelling, based on periodical balance-sheet analysis, can provide decision makers with limited support in understanding business growth dynamics. In fact, spreadsheet models generally lack flexibility (Shrage 1991): they are based on a linear, static and narrow approach, often extrapolating balance-sheet data, lack feedback analysis, and excessively focus on internal and financial variables.

Drawing up a plan on the basis of only single and static pieces of financial data may lead entrepreneurs to design policies that are, perhaps, effective in the short run, but may produce unintended negative effects which seriously prejudice business survival and growth, on a longer time horizon.

Simplifying systems analysis only apparently allows the reduction of complexity. Instead, complexity and unpredictability ought to be understood and properly handled through the modelling of:

- interdependencies between variables;
- relationships (including non-linear) between policy levers and affected variables;
- delays between causes and effects.

In order to frame SMEs' peculiar complexity and to support decision makers' learning processes, standard accounting packages may prove useful, but they are of no help in addressing strategic information requirements, which relate to different control variables (Espejo and Schwaninger 1993; Schwaninger 2000). Being based on analytical and hierarchical databases, which give rise to a detailed reporting, they frequently do not fit into SMEs for three main related reasons (Bianchi *et al*. 1999):

- They are founded on the assumption that a controller should be in charge of reporting analysis. However, many SMEs cannot rely on such an organisation unit.
- Reporting that is delivered by industrial accounting is usually related to responsibility centres in order to allow managers to support performance evaluation and budgeting procedures. However, SMEs are often lacking in a techno-structure and necessary formal procedures.
- The SME entrepreneur and collaborators usually do not have enough technical competence nor enough time for detailed analysis, diagnosis and formulation of corrective action.

The higher system complexity and unpredictability is, the bigger is the risk that current decisions are taken without questioning the consistency of key actors' mental models. In order to overcome such weaknesses, a so-called *double loop learning* approach is advocated, which allows decision makers to evaluate consistencies in their mind-sets.

SD modelling can foster key actors' tacit knowledge elicitation, thereby mobilising and sharing what is, perhaps, the most important strategic asset in SMEs.

The use of Interactive Learning Environments (ILEs) embodying both SD and accounting models is likely to improve the quality of P&C processes, as it allows SME decision makers to observe through the feedback perspective the same financial variables that they are accustomed to analyse in the accounting perspective alone.[5]

Building SD models to support a learning-oriented approach in SMEs' planning

As in larger firms, SD models developed for SMEs can be either *customised* or *generic*. In the first case they are built from scratch in order to analyse the specific processes, issues, behaviours, policies and constraints related to a given company. In the second case, they are developed to reflect the broad processes (e.g., financial, production, distribution) of any firm, often related to a specific industry (Lane and Smart 1996; Winch *et al.* 1997).

The decision on whether to prefer a customised or a generic SD model to support an SME's P&C mainly depends on:

- consulting costs the firm is willing to sustain for the development of the ILE and decision makers' facilitation in the modelling, simulation and planning sessions;
- human resources the firm is able to afford for the modelling project, e.g., concerning roles they cover in decision-making processes, time they are expected to devote to the modelling activity, number of people involved, as well as the knowledge base and scope they are able to provide;
- quality and scope of data that can be gathered from company records;
- the extent to which the firm is familiar with SD modelling and simulation;
- the learning goal(s) triggering the modelling effort. For instance, SD modelling could be required to understand the financial consequences of commercial strategies (for which a customised model could be a proper option), or to figure out the drivers of business strategic performance against competitors. In this last case, a generic model embodying the processes of any firm in the industry could allow decision makers to gain more insights about the problems to frame.

Customised modelling is, in general, the most suitable option when the specific processes of an SME are to be analysed and enough resources are available. However, the use of generic structures that can be easily and quickly tailored to an individual firm (Arthur and Winch 1998) has also proved to be successful in enhancing a learning-oriented approach to planning in those SMEs that are not able to afford considerable investment.

The use of generic models can also be appropriate in order to develop simulators to be used as a teaching aid in entrepreneurs' education. Furthermore, generic models could be a proper choice during the early stages of a project, especially when SME entrepreneurs are novices in the SD field or if the knowledge base of business processes to be modelled does not provide enough reliable material to build a customised model.

Figure 2 depicts a typical P&C process facilitated by an ILE, embodying both an accounting and an SD model (Bianchi *et al*, 2000; Bianchi and Bivona 2000).

An input window allows decision makers to insert their own budget assumptions and policies, e.g., concerning sale prices, terms of payment allowed to customers, expected demand. A spreadsheet model based on linear and static hypotheses, as well as on financial and accounting variables only, automatically calculates expected results associated with the above decision

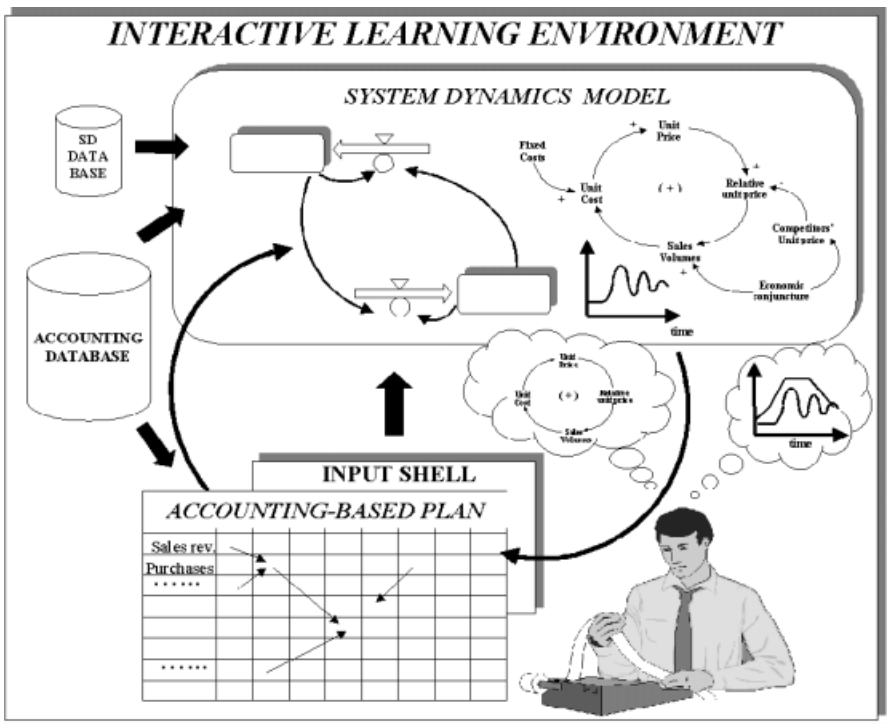


Fig. 2. The structure of ILEs embodying the feedback and accounting views of business systems

makers' assumptions and policies, and shows them in different budget reports (Financial, Income, Flow of Funds and Cash flow statements).

On the basis of spreadsheet results, decision makers are able to adjust their policies in order to achieve desired goals, e.g., in terms of sales revenues, market share, current income, cash flow, debts-to-equity ratio, etc. Then, they are ready to simulate their budget decisions through an SD model.

Although both the spreadsheet and the SD model share a same database, the latter follows a different approach. It takes into account feedback loops, delays, non-linearities and soft variables (e.g., the business-owning family satisfaction level, perceived business solvency, company image). These are very difficult to represent in a spreadsheet model.

Another spreadsheet window dynamically linked with the SD model allows decision makers to analyse variances between the original budget and related results generated by the dynamic simulation model.

The analysis of such variances has a fundamental importance in the learning process supported by the ILE. In fact, during the planning session, each decision maker will be helped by a *learning* facilitator. The facilitator suggests hypotheses, to debate with others, attempting to explain the causes underlying different patterns of the behaviour of key variables that the accounting and SD model often portray.[6] This process helps them to learn how to:

- discern the hidden feedback structure of a system from its observed behaviour, and
- change the existing system structure in order to affect its behaviour, according to desired goals.

From the above analysis it is possible to emphasise that the major justification for building ILEs embodying both the SD and accounting views of business phenomena is related to three main reasons:

- To provide learners with a friendly environment: in fact, decision makers in SMEs are more accustomed to a spreadsheet accounting-oriented, rather than SD, model.
- To give empirical evidence of how results that a given decision set is likely to produce can be differently conceptualised. If one adopts a feedback, rather than a linear and static view of the business system, financial and non-financial variables can be observed.
- To show SD simulation results, not only through time graphs or tables, but also through accounting reports commonly used in budgeting and control. This is likely to concretely improve the quality of P&C in SMEs.

On the validation of SD models embodying the accounting view of business phenomena

Initialising stock variables

An important part of model building to support SMEs' planning process is related to the *financial consistency test.* It implies that the SD model must include for the same financial variable (e.g., cash flow or net working capital) different modes of calculation. Lacking or superficial validation of financial equations can be a primary cause of misunderstanding and refusal of SD models by those SME key actors who are used to framing problems only according to the accounting view.

In relation to this concern, a proper initialisation of the SD model stock variables is an important issue. According to SD modelling practice, in order to assess the robustness of decision makers' policies, such variables are initialised so that the simulation shows an equilibrium state, until learners change the input set. Both the shock generated by this change in key factors' initial steady state and further oscillations in their behaviour over time are likely to help decision makers to visualise, detect and better understand system sensitivity to adjustments made in their policies and assumptions (Sterman 2000, pp. 716–717).

In principle, if the primary learning goal in an SME is to assess through a generic model the robustness of decision makers' policies, this consolidated practice can be successfully pursued (Lyneis 1980, p. 260). However, an initial state of non-equilibrium condition could be a proper approach if one intends to:

- show a problematic growth or decline reference mode of behaviour;
- understand causes associated with discrepancies between budgeted and actual results in a given time span;
- support the drawing up of a business plan.

The first case can be associated with the use of learning environments in the context of entrepreneurs' education, where the SD model is a vehicle to better frame in a feedback perspective those issues and problems illustrated in a case study.

In the second case, since the modeller has to match a historical situation (Richardson and Pugh 1981, p. 240), the actual starting financial statement values must initialise the SD model stock variables. Then, policies and assumptions adopted by decision makers in the observed time horizon are taken as inputs to the SD model. Simulation results will help learners to make sound hypotheses about the reasons for experienced variances, and understand results that a different set of policies and external constraints could have alternatively produced.

In the third case, the SD model simulated results are automatically transferred to an accounting model, e.g., to draw up a monthly plan, whose initial assets and liabilities are the actual ones, included in the last financial statement.

Particularly in the last two cases, a correspondence between accounting and SD models on the initial values of assets, liabilities and equity is critical for getting reliable insights from modelling and simulation.

As a matter of fact, setting financial stocks to an initial equilibrium state condition may lead to significantly divergent values from the actual ones depicted in accounting records.[7]

Displaying the balance sheet through an SD financial model

Another important issue related to the validation of an SD model embodying the accounting view of business phenomena concerns the formats through which variables are displayed in the causal loop and stock and flow diagrams, and in the accounting reports showing simulation results. In order to establish sufficient confidence in the SD model by those SME decision makers who are mostly accustomed to accounting reports, the format of the three maps ought to be the same.

In order to show this concept, a simple example of a generic SD model embodying the accounting perspective of current operations will be shown in this section. The model was applied by the author to provide an initial basis for analysis and discussion with the two owners and the professional accountant of Licari & Sons Co.,[8] an SME operating as a regional wholesaler in the pharmaceutical industry. The two brothers owning the company were simultaneously involved in strategic and current decision making. One of them was responsible for commercial activities; the other managed relationships with banks. The market was characterised by the strong bargaining power of large producers and a fragmented, standardised wholesale supply, involving strong competition on price, terms of payment allowed to customers and delivery time.

The industry had been recently affected by unexpected structural changes, related to the reduction of funds granted by the State to pharmaceutical companies and the drastic reduction of State financial contributions to citizens for the purchase of medicines.

Over a few years, such events led to a decrease in demand and were a primary cause of crisis in many firms operating both in the production and distribution stages. In the regional market where Licari & Sons operated, an increasing number of pharmacies started to shift their financial difficulties onto wholesalers. They did this by postponing payments of purchased goods beyond negotiated terms. On the other hand, the fear of market-share loss exacerbated competition between wholesalers, while, at the same time, terms of payment negotiated with producers were decreasing.

Like its competitors, Licari & Sons started to pursue a commercial strategy aimed at keeping (and, possibly, increasing) its customer base and market share. This was accomplished through a progressive rise in price discounts and terms of payment on sales. Very often, when a new order was submitted, terms of payment were re-negotiated with clients by phone. One of the arguments used by clients to persuade the firm to grant longer terms of payment was the availability of other wholesalers that allowed them higher payment delays. Clients also made emotional pleas, pressuring Mr Licari, asking him to postpone the collection of their accounts payable, in the name of their old commercial relationships.

The above policy gave rise to a sharp increase in both sales revenues and income. It also generated a sharp financial crisis, which was detected by the firm only after banks started to increase their pressure on Mr Licari. This was done by asking him to reduce the firm's negative balances and to submit a business plan to prove company solvency.

No formal planning was done by the firm. The only tools used were transaction systems (e.g., inventorying, invoicing, etc.) and financial accounting.

In order to help the business owners to frame dynamic relationships, the author was asked by the firm's professional accountant to calibrate a generic SD model (see Figure 3) on the basis of past balance sheets.[9] Relationships were framed between terms of payment policies, income, commercial net working capital (NWC),[10] cash flows in order to understand limits to growth associated with the company financial structure and demand elasticity. The generic model's calibration process gradually also involved the two business owners, as they started to be questioned on issues such as retailers' and competitors' reactions to changes in terms of payment on goods sold, perception delays in available bank credit, etc.

The model assumed that, at the beginning of the simulation, the firm was able to finance sales growth through available bank credit and the terms of payment allowed by producers and granted to retailers.

Facilitated simulation sessions supported analysis and reflection by the two brothers and their adviser on the feedback structure driving key variables' behaviour. When more feedback loops were gradually discerned by decision makers after a number of simulation sessions, they started to be aware of the perils associated with their bounded perception of the relevant system.

Figure 4 shows that, in order to increase sales revenues, the company gradually raises terms of payment allowed to clients. As customers are sensitive to payment delays and the unit contribution margin on goods sold is positive, it can successfully increase the income rate. A higher income also raises bank balances, provided that cash flows are positive. The increase in bank balances raises perceived bank credit, thereby encouraging the firm to gradually boost again terms of payment allowed to customers (reinforcing loop ''a'').

There are, however, two main limits to growth to the sales revenues and income rates, i.e.:

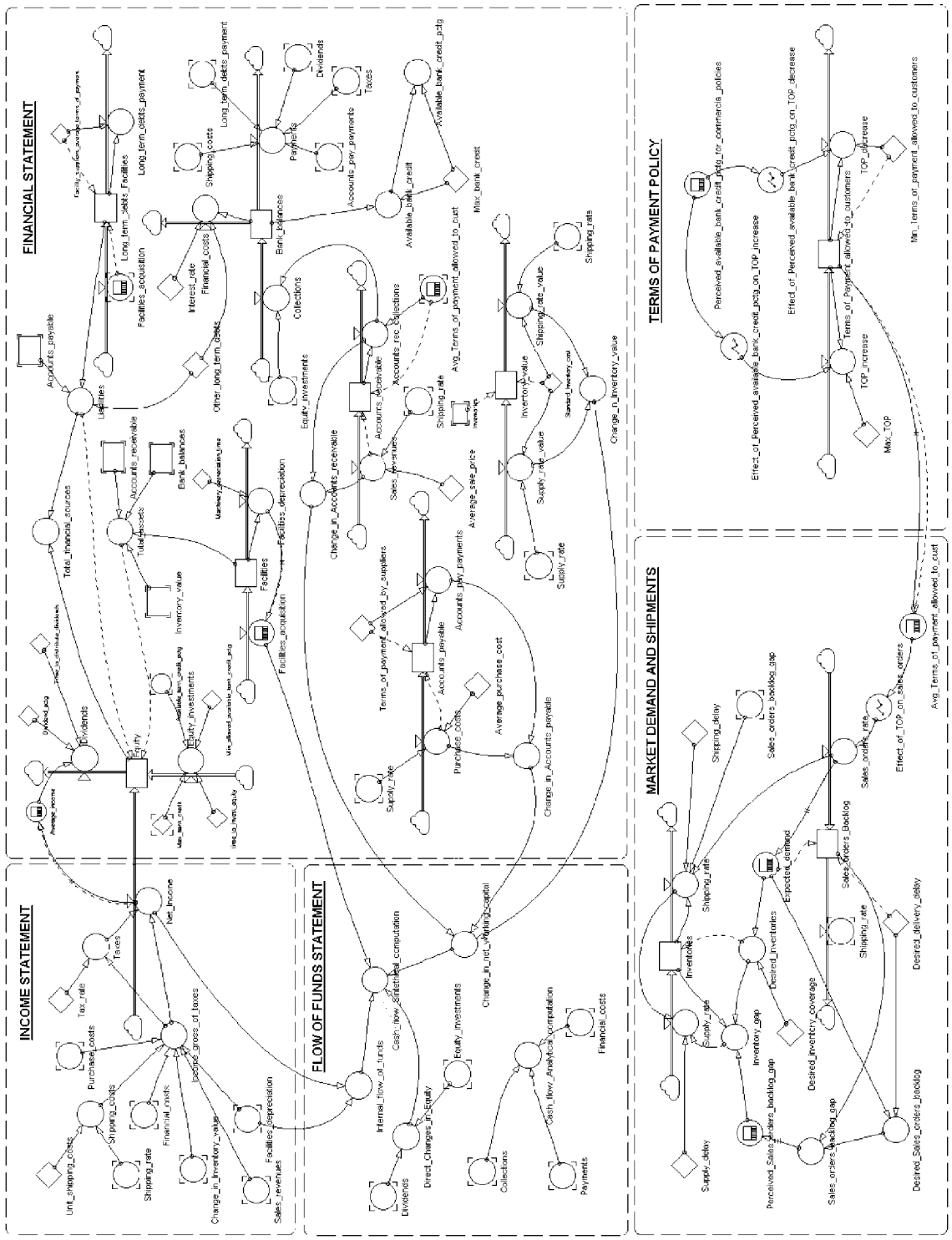


Fig. 3. A generic SD model embodying the accounting perspective

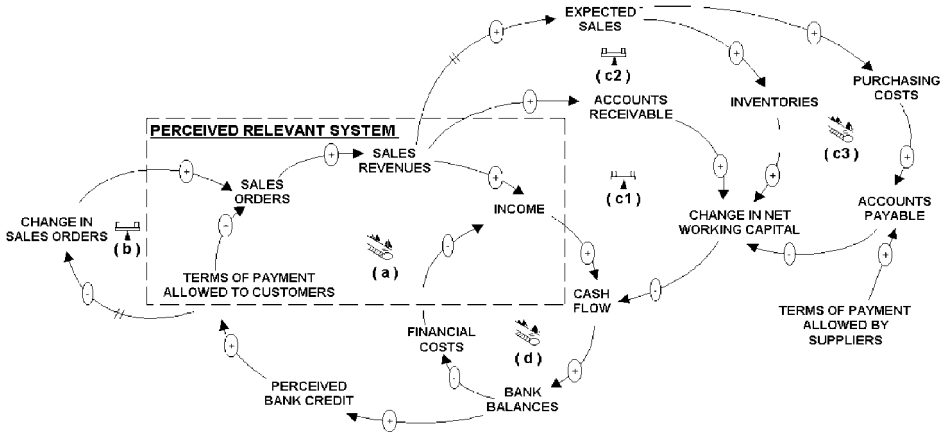


Fig. 4. Feedback structure underlying income, commercial net working capital and current cash flow behaviour associated with terms of payment policies

- demand elasticity to terms of payment;
- changes in the company financial structure caused by higher sales revenues.

Concerning the first limit, the model implies that effects generated on sales orders by further increases in terms of payment allowed to customers can be depicted by an S-shaped curve. As shown in Figure 5, this means that, when the commercial policy lever is increased beyond a threshold level (in this case, about 13 weeks), the change in sales orders will decrease (balancing loop ''b'').

Concerning the second limit, higher sales revenues will increase financial needs for both inventories and accounts receivable (the last effect is also amplified by higher terms of payment allowed to customers). This raises the NWC, thereby causing lower cash flows. If the change in the NWC is higher than income gross of depreciation, cash flows are negative. This leads to a reduction in bank balances, perceived bank credit and terms of payment allowed to customers (balancing loops ''c1'' and ''c2''). Such a limit to growth could be counterbalanced by higher terms of payment allowed by suppliers on purchased goods, giving rise to higher accounts payable and—other conditions being equal—lower NWC, higher cash flows and bank balances (reinforcing loop ''c3'').[11]

The above balancing loops prevail over the reinforcing loop ''a'' after about the 20th week, when bank balances start to drop. However, such a limit to growth is not immediately perceived by the company, which continues to raise terms of payments allowed to customers until about the 40th week. This policy determines both a lower increase in sales revenues (caused by demand elasticity) and decreasing cash flows and bank balances (see Figure 5). An unintended side effect of this policy is also associated with higher financial costs on negative bank balances, leading to lower income and cash flows that reduce bank balances again (vicious reinforcing loop ''d'').

When the firm realises the above limits to growth and the risks they imply for profitability and solvency, it starts to reduce terms of payment allowed to customers. If this happens before business profitability has been prejudiced as a result of the effects produced by loop ''d'' and if the market permits, such a policy allows the business to attain a NWC reduction and an increase in cash flows and bank balances, although both sales revenues and income decrease.

After about the 60th week the above policy has allowed the firm to improve its financial structure, so that it can rely on a positive available bank credit, which fosters a new gradual increase in terms of payment allowed to customers, which makes loop ''a'' dominant again, until the balancing loop ''b'' stabilises the system.

The above generic model provided the basis for a wider SD model (also including decisions on price, equity investment and the customer base), which was customised to the company to support its planning process, according to the framework described in the previous section.

Although the above relationships may appear to be commonplace, if only observed through a *post facto* perspective, the dynamics they are likely to generate are often counterintuitive and puzzling for many small business entrepreneurs. Among the main factors explaining such perception difficulties are:

- a counterintuitive behaviour of key variables such as income, cash flows and change in the NWC;
- inertial effects generated by decision makers' policies, due to delays embodied in the relevant system;
- SME entrepreneurs' high emotional involvement in current operations, which makes it difficult to perceive how continuous small changes in the short run are likely to generate structural modifications in the relevant system's structure;
- a static and discrete view of business phenomena often provided by accounting reports to SME entrepreneurs;
- a weak relative weight of the firm in its market, especially towards suppliers and distributors.

Figure 6 portrays accounting reports whose values are generated by the SD model simulations discussed above. Embodying accounting variables in an SD model allows one to open the entrepreneur's mind on the processes generating forecast and actual values depicted in a balance sheet. For instance, rather than focusing only on income, internal flow of funds, change in the NWC and cash flows, decision makers can be supported by SD models in understanding policy levers on which to act in order to affect the behaviour of key variables over time, according to a desired direction.

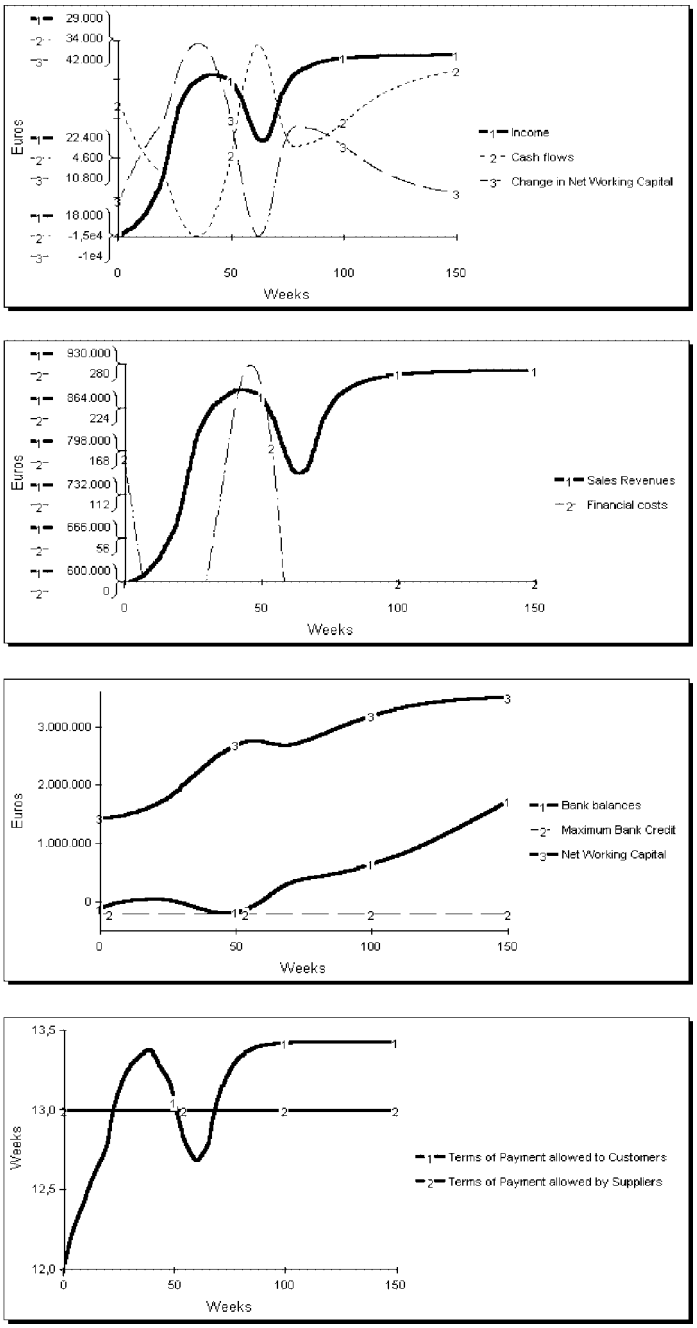
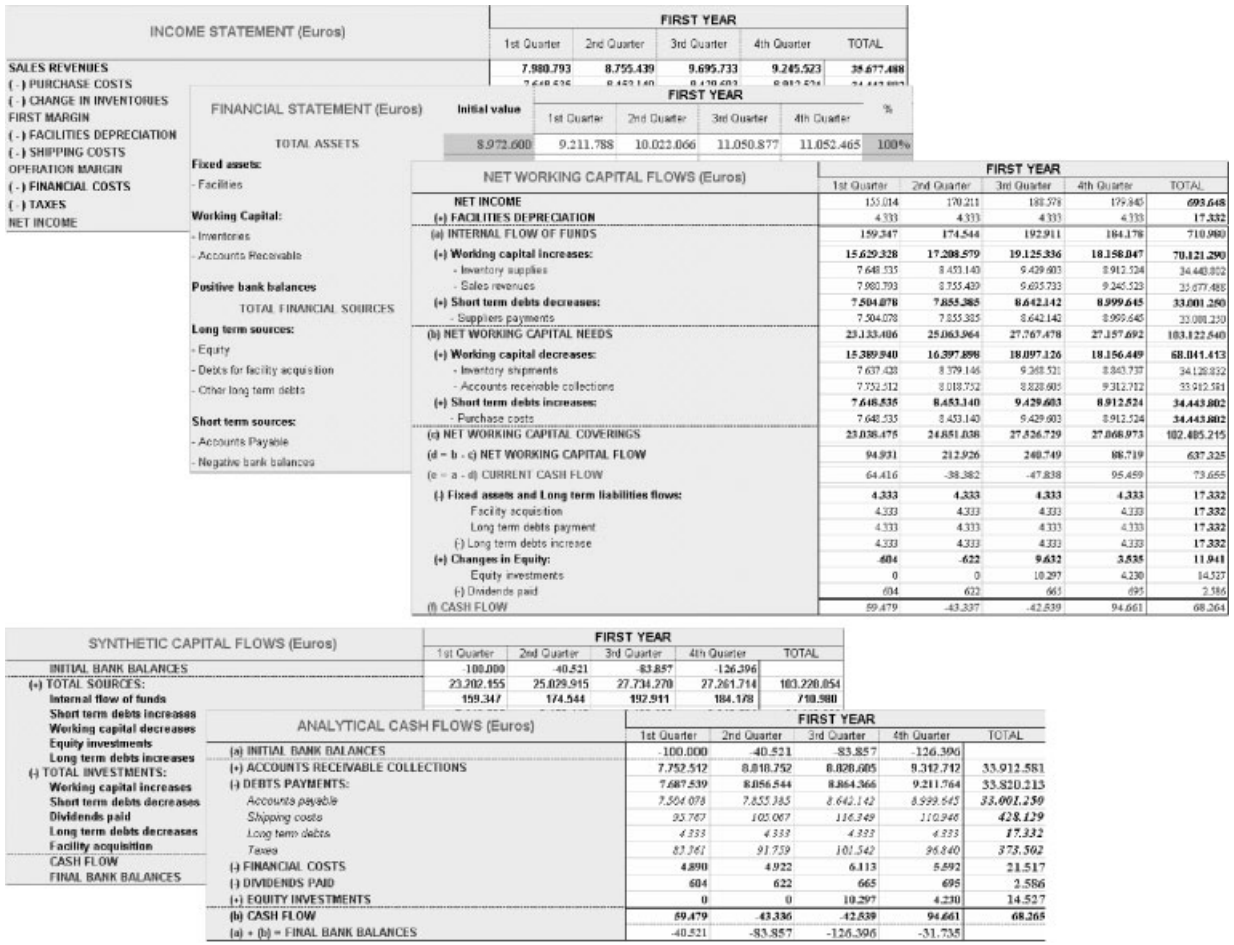


Fig. 5. Behaviour of key variables generated by changes in terms of payment allowed to customers



INCOME STATEMENT (Euros)

	FIRST YEAR				
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	TOTAL
SALES REVENUES	7.980.793	8.755.439	9.695.733	9.245.523	35.677.488
(-) PURCHASE COSTS					
(-) CHANGE IN INVENTORIES					
FIRST MARGIN					
(-) FACILITIES DEPRECIATION					
(-) SHIPPING COSTS					
OPERATION MARGIN					
(-) FINANCIAL COSTS					
(-) TAXES					
NET INCOME					

FINANCIAL STATEMENT (Euros)

	Initial value	FIRST YEAR				%
		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	
TOTAL ASSETS	8.972.600	9.211.788	10.022.066	11.050.877	11.052.465	100%
Fixed assets:						
- Facilities						
Working Capital:						
- Inventories						
- Accounts Receivable						
Positive bank balances						
TOTAL FINANCIAL SOURCES						
Long term sources:						
- Equity						
- Debts for facility acquisition						
- Other long term debts						
Short term sources:						
- Accounts Payable						
- Negative bank balances						

NET WORKING CAPITAL FLOWS (Euros)

	FIRST YEAR				
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	TOTAL
NET INCOME	155.014	170.211	188.378	179.845	**693.648**
(+) FACILITIES DEPRECIATION	4.333	4.333	4.333	4.333	**17.332**
(a) INTERNAL FLOW OF FUNDS	159.347	174.544	192.911	184.178	710.980
(+) Working capital increases:	**15.629.328**	**17.208.579**	**19.125.336**	**18.158.047**	**70.121.290**
- Inventory supplies	7.648.535	8.453.140	9.429.603	8.912.524	34.443.802
- Sales revenues	7.980.793	8.755.439	9.695.733	9.245.523	35.677.488
(+) Short term debts decreases:	**7.504.078**	**7.855.385**	**8.642.142**	**8.999.645**	**33.001.250**
- Suppliers payments	7.504.078	7.855.385	8.642.142	8.999.645	33.001.250
(b) NET WORKING CAPITAL NEEDS	23.133.406	25.063.964	27.767.478	27.157.692	103.122.540
(+) Working capital decreases:	**15.389.940**	**16.397.898**	**18.097.126**	**18.156.449**	**68.041.413**
- Inventory shipments	7.637.408	8.379.146	9.368.521	8.843.737	34.128.832
- Accounts receivable collections	7.752.512	8.018.752	8.828.605	9.312.712	33.912.581
(+) Short term debts increases:	**7.648.535**	**8.453.140**	**9.429.603**	**8.912.524**	**34.443.802**
- Purchase costs	7.648.535	8.453.140	9.429.603	8.912.524	34.443.802
(c) NET WORKING CAPITAL COVERINGS	23.038.475	24.851.038	27.526.729	27.068.973	102.485.215
(d = b - c) NET WORKING CAPITAL FLOW	94.931	212.926	240.749	88.719	637.325
(e = a - d) CURRENT CASH FLOW	64.416	-38.382	-47.838	95.459	73.655
(-) Fixed assets and Long term liabilities flows:	**4.333**	**4.333**	**4.333**	**4.333**	**17.332**
Facility acquisition	4.333	4.333	4.333	4.333	**17.332**
Long term debts payment	4.333	4.333	4.333	4.333	**17.332**
(-) Long term debts increase	4.333	4.333	4.333	4.333	**17.332**
(+) Changes in Equity:	**-604**	**-622**	**9.632**	**3.535**	**11.941**
Equity investments	0	0	10.297	4.230	14.527
(-) Dividends paid	604	622	665	695	2.586
(f) CASH FLOW	59.479	-43.337	-42.839	94.661	68.264

SYNTHETIC CAPITAL FLOWS (Euros)

	FIRST YEAR				
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	TOTAL
INITIAL BANK BALANCES	100.000	-40.521	-83.857	-126.396	
(+) TOTAL SOURCES:	23.202.155	25.029.915	27.734.270	27.261.714	103.228.054
Internal flow of funds	**159.347**	**174.544**	**192.911**	**184.178**	**710.980**
Short term debts increases					
Working capital decreases					
Equity investments					
Long term debts increases					
(-) TOTAL INVESTMENTS:					
Working capital increases					
Short term debts decreases					
Dividends paid					
Long term debts decreases					
Facility acquisition					
CASH FLOW					
FINAL BANK BALANCES					

ANALYTICAL CASH FLOWS (Euros)

	FIRST YEAR				
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	TOTAL
(a) INITIAL BANK BALANCES	-100.000	-40.521	-83.857	-126.396	
(+) ACCOUNTS RECEIVABLE COLLECTIONS	7.752.512	8.018.752	8.828.605	9.312.712	33.912.581
(-) DEBTS PAYMENTS:	7.687.539	8.056.544	8.864.366	9.211.764	33.820.213
Accounts payable	*7.504.078*	*7.855.385*	*8.642.142*	*8.999.645*	***33.001.250***
Shipping costs	*93.767*	*103.067*	*116.349*	*110.946*	***428.129***
Long term debts	*4.333*	*4.333*	*4.333*	*4.333*	***17.332***
Taxes	*83.361*	*91.759*	*101.542*	*96.840*	***373.502***
(-) FINANCIAL COSTS	4.890	4.922	6.113	5.592	21.517
(-) DIVIDENDS PAID	604	622	665	695	2.586
(+) EQUITY INVESTMENTS	0	0	10.297	4.230	14.527
(b) CASH FLOW	**59.479**	**-43.336**	**-42.839**	**94.661**	**68.265**
(a) + (b) = FINAL BANK BALANCES	-40.521	-83.857	-126.396	-31.735	

Fig. 6. Accounting reports generated by SD model simulation results

The model building process: main ''actors'' involved in the introduction of SD models to support a learning-oriented view of SME growth planning

From the above analysis a very controversial issue emerges: a lack of managerial culture, human, financial, information and time resources are evident obstacles to the use of sophisticated tools supporting SME planning. On the other hand, entrepreneurial creativity and company key actors' mental databases may provide a very fertile context for the introduction of SD modelling as a visioning tool to support SME growth planning.

In order to deal with this ''dilemma'', a significant role can be played in the model building process by those ''actors'' who can be involved from outside the firm in an SME's planning.

Professional accountants and other business advisers are one of the few categories of ''actors'' whose advice is taken into account by SME entrepreneurs, particularly when their decisions concern financial or fiscal issues (Bianchi *et al*. 1999; Downing 1998). For instance, during start-up and expansion stages, they are often asked by entrepreneurs to draw up formal business plans, typically to support applications for financial grants or to obtain credit from banks. Such actors can be very helpful to SD consultants in the tailoring of generic models to a specific company and building preliminary models (Vennix 1996, p. 113) to open the entrepreneur's mind towards a feedback view of business planning.

Other key actors could substantially help SMEs in achieving a more learning-oriented view of their P&C processes. For instance, banks and public trusts financing business start-up could embody the feedback approach as a necessary prerequisite in defining standard requirements to accept a business plan as eligible for a grant. Likewise, more research-oriented institutions, such as universities and science parks, could provide a high-quality modelling support at a reasonable cost, particularly when the project is financed by public bodies.

The above categories of external stakeholders could significantly help entrepreneurs to utilise business planning as a fundamental step in determining future growth, rather than as a bureaucratic constraint to be undertaken by accountants or advisers using standard formulae and simple extrapolation. In such cases, a pre-requisite for such a ''shift of mind'' is that the above ''actors'' also include among their roles the promotion of a new business culture oriented towards learning.

Conclusions and implications for further research

The need for a *learning-oriented* perspective has been emphasised in this paper, as a pre-requisite to fostering SMEs' survival and growth.

It has been shown how such a view can be effectively pursued through the development of interactive learning environments linking SD and accounting models, which provide two complementary views of business phenomena. In order to support drawing up of business plans and the evaluation of results related to their implementation, the use of financial SD models embodying the accounting perspective has been recommended.

The author's experience in working with SME entrepreneurs through workshops and applied research projects has suggested that this approach is likely to enhance a shift in their minds, as they will be able to analyse under the feedback view financial variables they are only used to seeing through the accounting ''lens''.

The article has also shown how the specific factors that sharply characterise management complexity in SMEs discourage a systematic replication of approaches commonly adopted in bigger company practice in introducing SD. An implication of this is the opportunity to use, at least in the early stages of model building, preliminary and generic SD models, in order to reduce time and capital investment, which are usually the most scarce resources in SMEs.

These factors have been focused with regard to the modelling object and framework, model building and the validation processes.

Further research and experimentation will be necessary to understand how the above issues may be differently shaped according to various factors, such as, for instance, the entrepreneur's personal attitudes or the nature of the decision making processes.

Therefore, the above analysis can be considered as an intermediate step in the understanding of relationships between SD, P&C and growth in the characteristics and multifaceted universe provided by SMEs.

Notes

1. By business planning & control, we mean an activity oriented to support decision makers in: (a) setting goals and objectives; (b) planning actions (i.e., strategies, policies and operational activities) to achieve them; (c) assessing efficiency and effectiveness in the use of available resources; (d) evaluating performance, through reporting, in order to compare planned and achieved results; (e) adjusting goals/objectives and/or actions according to reported information. Such a process can be conceived as a *system*, as it consists of three main inter-related components: (1) an *organisation structure of responsibility centres*; (2) an *information structure*, which is based on management/strategic accounting and other non-accounting tools; (3) a *process* connecting information to the organisation structure through the feedback and feed-forward mechanisms (Maciariello 1984).

2. A considerable percentage of smaller companies—from 66 percent in Europe to 80 percent in the USA (Ward 1990)—is made up of family-owned businesses.
3. It is worth remarking that such a schema does not pretend to completely separate three aspects of this issue, as they are inter-related. It only tries to show a systematic picture of the investigated phenomena.
4. In such contexts, lack of professional management external to the property is often a primary factor giving rise to a blurred definition of:
   - bargaining relationships between the firm and equity owners. Particularly when operational business growth rate is high, this phenomenon can imply a bias in profit and cash flow expectations, leading to uncontrolled liquidity withdrawals from company bank accounts to satisfy the equity-owning family needs. Such a phenomenon is particularly frequent in unlimited liability companies, where owner–entrepreneurs more often misperceive the difference between business and personal assets. Another possible implication of this phenomenon is related to purchasing processes and costs, when co-operative partners are also the main company suppliers;
   - roles played in the business by family members or partners in co-operative firms.
5. According to the taxonomy proposed by Maier and Grossler (2000), such tools could also be defined as *gaming oriented* single-user and multi-user applications.
6. Also direct access to the underlying stock and flow model and equations can significantly help learners in making a shift from a static and linear approach to a feedback approach.
7. For instance, this often happens for those items included in the commercial net working capital (i.e., inventories + accounts receivable−accounts payable), whose initial book value could also be different from the one that is compatible with a system equilibrium state. Consequently, because of the financial statement equation (assets = liabilities + equity), in order to counterbalance the under or overestimation of some variables, the value of at least another asset or liability, or even equity, would have to be different from the one portrayed in the balance sheet. Also prospective cash flows and bank accounts could be overestimated if, for instance, the equilibrium value of initial account receivables' were higher than the book value. This could imply an estimation of lower financial costs, which would inflate the higher income rate and equity portrayed by the model.
8. For confidentiality reasons, both the company name and balance sheet values have been disguised.
9. The model depicts cash flow as the net change in bank balances in a given time step. Current cash flows result from the difference between internal flow of funds (i.e., income gross of depreciation) and the change in commercial net working capital. A higher income increases current

cash flows if the change in net working capital (corresponding to an extra current financial need) is lower than the increase in internal flow of funds. Furthermore, current cash flow becomes negative if the change in net working capital is higher than the internal flow of funds. The total cash flow portrayed in the model is calculated by adding to the current cash flow the direct change in equity (i.e., investments *minus* profit withdrawals) and deducting monetary needs associated with payments for machinery replacement. Total cash flow can be also analytically calculated, i.e. from the algebraic sum of different flows impacting on bank accounts (Accounts receivable collections−Financial costs−Payments referred to accounts payable on purchased goods, shipping costs, long-term debts for machinery acquisition and dividends). The reader will also notice how Figures 3 and 6 show the isomorphism between the SD and the accounting model of the flow of funds sector. Model equations are available on request from the author.

10. On the concept of commercial net working capital, see Note 7.
11. Another possible way to finance sales growth could be associated with new liquidity investments as equity, made by business owners.

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