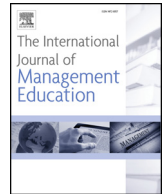


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Fostering entrepreneurial learning processes through Dynamic Start-up business model simulators

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ABSTRACT

Entrepreneurial learning is a critical process in realizing the success or failure of a new business venture, as it implies that would-be entrepreneurs acquire those strategic management competencies required to start and manage a new business. Actually, statistics on start-up survival/failure rate reveal that the main reasons for failure are related to a lack of entrepreneurial competencies of start-uppers.

This paper argues that combining Business Model representation schemas with System Dynamics modelling may support potential start-up entrepreneurs in learning and experimenting how to turn a business idea into a real firm. System Dynamics modelling is a methodology that allows us to elicit would-be entrepreneurs' mental models underlying the ways to start and set up the strategic architecture of a nascent business, as well as to learn essential strategic management principles by exploring – through the use of simulation – alternative strategic choices and associated scenarios within a protected interactive learning environment. As such, a 'Dynamic Business Modelling' approach may offer useful insights to start-up entrepreneurs by capturing, explaining and simulating how critical business model elements interact to produce enduring competitive advantages over time.

1. Introduction

According to the US Bureau of Labour Statistics,¹ about 40% of start-up firms fail in the first four years of their life. Cressy (1999) supports that this dynamic, which is surprisingly stable over time, can be mainly explained by the characteristics of human capital (see also Bates, 1990; Peña, 2002; Dickson, Solomon, & Weaver, 2008). A recent study from the University of Tennessee² outlines that the leading causes of business failures are “incompetence” (in the 46% of cases) – i.e., lack of strategic planning, emotional approach to pricing, non-payment of taxes, no knowledge of industry pricing conventions, no knowledge of financing requirements and conventions, no experience in record-keeping, living beyond the means of the business – and a “lack of managerial experience” (in the 30% of cases) – i.e., a too rapid expansion, stunted growth, inadequate borrowing practices, poor credit granting practices.

In this perspective, some authors identify the role of learning in the process of business evolution as one of the main driver determining business failure (Jovanovic, 1982; Peña, 2002). According to Peña (2002), from the moment the firm is created,

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¹ https://www.bls.gov/bdm/entrepreneurship/bdm_chart3.htm accessed on 26/02/2018.

² Entrepreneur Weekly, Small Business Development Center, Bradley Univ, University of Tennessee Research. Data available at <http://www.statisticbrain.com/startup-failure-by-industry/> accessed on 10/06/2017.

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entrepreneurs are exposed to a learning process whose knowledge and matured experience constitute a fundamental intangible asset which will influence the survival and growth of the start-up. Thus, starting a new business venture requires would-be entrepreneurs to understand and explore how to create an organized business structure around such an idea, as well to investigate how it may become profitable and sustainable over time. Brilliant ideas often emerge from the perception of uncovered market needs or new market opportunities by people unfamiliar with basic strategic management principles and concepts. As a result, they frequently miss the opportunity to fully exploit their ideas and launch the related products/services to satisfy the novel human needs identified.

With the intent to learn how to formalize and develop a new business idea and its strategic architecture, nascent entrepreneurs may find support in the use of strategy-tools. As recommended by academic incubators and venture capital associations worldwide, the key-tool to formalizing and developing business ideas is the Business Model (BM), i.e. a framework that designs the strategic and organizational architecture of a nascent business and the way through which value creation processes lead to revenues (Fiet & Patel, 2008; Massa, Tucci, & Afuah, 2016; Morris, Schindehutte, & Allen, 2005; Zott, Amit, & Massa, 2011). In this study, BMs are intended as formal conceptual representations of how an organization functions and creates value. These representations aim at simplifying the entrepreneurial cognition of a business system.

In this perspective, BMs are viewed as explicit cognitive artifacts formalized in graphical, mathematical, or symbolic frameworks (Massa et al., 2016). The adoption of formal conceptual representations is particularly valuable for understanding and framing the complexity of BMs by making explicit the entrepreneur's mental model - i.e. the assumptions, generalizations, and representations that influence how people understand the world and take action (Senge, 1990). These representations can be used to articulate, challenge, transfer, and recombine the tacit knowledge at the background of implicitly understood cognitive schemas, heuristics, narratives and other organizationally embedded manifestations of BMs (Chesbrough, 2010; Massa et al., 2016). As such, BMs are designed as structured frameworks aimed at organizing managerial understandings about the design of firms' value creation processes (Martins, Rindova, & Greenbaum, 2015), as well as exploring their implications in terms of organizational performance and sustainability (Amit & Zott, 2012; Bocken, Short, Rana, & Evans, 2014; Boons & Lüdeke-Freund, 2013; Casadesus-Masanell & Ricart, 2010; Demil & Lecocq, 2010; Osterwalder & Pigneur, 2010; Zott & Amit, 2008). A business can be considered well-performing and sustainable if the products/services it offers better satisfy customer needs through the development and refinement of its distinctive competencies. These competencies must be related to the critical success factors of its market (or niche), and aim to provide the business with an enduring competitive advantage.

The search and identification of sustainable sources for competitive advantages is a complex task, particularly for new business ventures. In fact, while incumbent firms with a well-defined BM are mostly called to innovate it through a fine-tuning process oriented to benefit from new market opportunities and/or strategy re-formulation, start-up firms – often lacking of an appropriate entrepreneurial experience – need to design and implement their core business logic from the outset, under a deeper uncertainty related to the entrepreneurial risk they are engaging in (Alvarez & Barney, 2005; McMullen & Shepherd, 2006; Reymen et al., 2015; Sarasvathy, 2001). Actually, critical issues – such as the entity of funding, product pricing, making decisions about acquiring and coordinating resources, and so on – increase the level of uncertainty and complexity underlying entrepreneurial venturing. This uncertainty also refers to the fast speed of technological innovation that, together with a global-scale competition, makes the achievement of competitive advantages harder (Pisano, Pironti, & Rieple, 2015).

As Wrigley and Straker (2016) assert, in uncertain, complex and fast-moving environments, both product and process development essential for designing new BMs increasingly benefits from a combination of novel insights, rapid experimentation, and evolutionary entrepreneurial learning. Therefore, as well Andries, Debackere, and Van Looy (2013) argue, new firms need to be more adaptive and responsive to organizational and contextual changes by engaging in BM experimentation as a core competency for gaining sustainable competitive advantages.

Though drawn up with attractive insights, conventional BM representation frameworks (e.g., the Business Model Canvas) basically list and organize into specific sectors the main business elements (e.g., strategic resources, customer segment, cost structure, revenue streams, and so on). As such, they are designed to provide a *static* perspective of how the firm operates and creates value (Shepherd, 2015). Although it allows potential entrepreneurs to frame the core business elements according to their mental model, this prevents them from exploring the dynamic complexity of business sectors, experimenting and learning how the business reacts to strategic changes.

In this paper, we argue that combining conventional BM representation schemas with System Dynamics (SD) modelling may result in a strategy simulation-based tool able to feed up the strategic learning processes of would-be entrepreneurs (Cope, 2003, 2005; Minniti & Bygrave, 2001). The methodological support provided by simulation-based techniques – such as SD – is particularly recommended to model and analyse social systems characterized by dynamic complexity and uncertainty, as well as experiment with the models to design strategies for management and change (Forrester, 1961; Bianchi, 2016; Cosenz & Noto, 2016; Warren, 2008; Sterman, 1994, 2014).

Such an approach allows business modellers to coherently integrating strategic, economic, organizational, and social concerns into a holistic view of a start-up BM. In addition, the possibility to experiment with different scenarios and strategic initiatives by using simulation techniques has the potential to contribute in speeding up entrepreneurial learning processes by identifying those strategic levers and business key-elements on which to act in order to understand how the business reacts in terms of both profitability and sustainability. The main motivation for building start-up BM simulators is to bring a deeper understanding of how to create and develop new business ventures into university and professional education.

For this purpose, we initially provide an overview of SD modelling and its applications to entrepreneurship and strategic management with a focus on its relevance to BM research advances. Then, an analysis oriented to explain how to combine BM and SD modelling is conducted. This leads to the introduction of start-up BM simulators as entrepreneurial learning tools (Martins, 2017). To

understand the practical effectiveness of this approach to entrepreneurial learning and business modelling, we provide an example of a start-up BM simulator based on a simplified theory of the firm (i.e., one-product firm with limited financial resources, where labour and capital assets are the main production factors, focused on a profitable and sustainable growth with the intent to maximize its profit in the long-term). Alternative strategies and associated simulation results are also illustrated and discussed. Eventually, the paper concludes with behavioural implications, closing remarks and research perspectives.

2. Designing start-up business models through System Dynamics modelling

SD methodology is an approach for modelling and simulating complex physical and social systems and experimenting with the models to design strategies for management and change (Forrester, 1961). Following SD principles, models are based on a feedback view of business systems, seen as a closed boundary, i.e. embodying all the main variables related to the phenomenon being investigated (Sterman, 2000).

In particular, SD modelling is adopted to map system structure to capture and communicate both an understanding of behaviour driving processes and the quantification of the relationships so as to produce a set of equations that form the basis for simulating possible system behaviours over time. SD models are powerful tools to help understand and leverage the feedback interrelationships of complex management systems. The models also offer an operational methodology to support both business planning and decision-making (Bianchi, 2016).

As such, SD modelling can be used to help people understanding how strategies will work over time, how things may go wrong and interventions that could be applied to mitigate such situations (Kunc & Morecroft, 2007; Pidd, 2009). For instance, SD modelling can be used to create a set of distinct strategies to challenge the collective intuition of a management team (Probert, 1982), as well as to explain why some managers adopt strategies that are associated with competitive success (Gary & Wood, 2011; Langley & Morecroft, 2004; Torres, Kunc, & O'Brien, 2017). As Torres et al. (2017) remark, the use of SD modelling in the strategy research field can be divided into three categories: (1) models for testing strategy theories, (2) models for teaching strategic thinking and capacity development, and (3) models for supporting strategy development within organizations. In this paper, SD is meant as a methodology aimed at teaching strategic thinking and capacity development. Under this perspective, the use of SD focuses on analysing ways to teach strategy and strategic thinking via SD modelling. Recently, Sterman (2014) demonstrated the benefits of using simulations in an open course at MIT, the purpose of which was to explore the consequences of different strategies by simulating them so that students, executives, and policy-makers could learn about the complexities of business dynamics.

A BM representation schema may be regarded as a tool for supporting the structural analysis of a business (Chesbrough, 2010; Sosna, Treviño-Rodríguez, & Velamuri, 2010), while a simulation-based methodology, such as SD, provides appropriate information and evaluation for strategy development according to a flexible perspective on both internal and external changes (Morecroft, 2007). Based on a set of strategic assumptions, designing and experimenting BMs through SD models aim to predict dynamic implications of strategies to determine whether they will result in a future that will be better or worse than it would have been without the intervention (Cosenz & Noto, 2018; Cosenz, 2017). In practical terms, potential entrepreneurs can use these models to simulate alternative scenarios – based, for instance, on alternative investment policies – and explore what could happen under a variety of different assumptions and across alternative decision choices (Sterman, 2000). To this end, combining SD and BM representation schemas (e.g., the Business Model Canvas) can be used as strategy simulation tool to explore how strategies, decisions, and external phenomena interact to generate long-term behaviours of key performance variables, as well as to explain why and how outcomes change, and potential unintended consequences. This combined approach to design BMs has been named Dynamic Business Modelling (DBM) (Cosenz & Noto, 2018; Cosenz, 2017). The DBM is interpreted as a strategy design tool aimed at outlining formal conceptual representations of how an organization operates and creates value. Here, the term *dynamic* is used to highlight the adoption of SD as a methodological support to overcome a too static perspective of conventional BM representations (e.g., the Business Model Canvas).

The emerging framework includes seven building blocks corresponding to the core BM elements able to describe how a firm operates in achieving its goals. They are: (1) Key Partners; (2) Strategic Resources, (3) Value Proposition and Key Performance Indicators, (4) Key Processes, (5) Customer Segments, (6) Cost Structure, and (7) Revenue Streams. The use of SD modelling highlights the main causal relationships between the BM elements respectively identified in the building blocks providing the readers with a holistic perspective on business strategy and operation. These causal relationships form closed feedback loops (reinforcing or balancing) which determine the business system behaviour over time (Sterman, 2000).

Fig. 1 displays a general DBM structure which needs to be tailored, gauged and remodelled according to the specific strategic and organizational characteristics of a given business. While the building blocks included in this interface are pre-set sections so as to serve as a basis on which to conduct a comparative analysis on BMs, the SD model outlined inside this interface is calibrated according to the specific firm's organizational and strategic features (Cosenz, 2017). The elements are modelled in terms of SD variables. In particular, stock variables identify Key Resources, Key Processes, and Customer Segments. As such, for instance, equity, as well as other assets, is defined as a stock variable which accumulates/depletes its value according to the economic results achieved throughout time (i.e., the net-income that represents a net-flow to equity). Key Processes are defined by those stock variables eliciting the production process including, for instance, placed orders and shipped products. The Customer Segment section is characterized by the stock of customers or potential customers whose need could be fulfilled by the firm. Value Proposition, Cost Structure and Revenue Streams sections include flow variables as they correspond to the results the business management activity produces over time. Input variables define the different decisions the entrepreneur may make to improve business performance and, therefore, allow modellers to change the business strategy (e.g., setting different product prices). The arrows identify the causal connections between

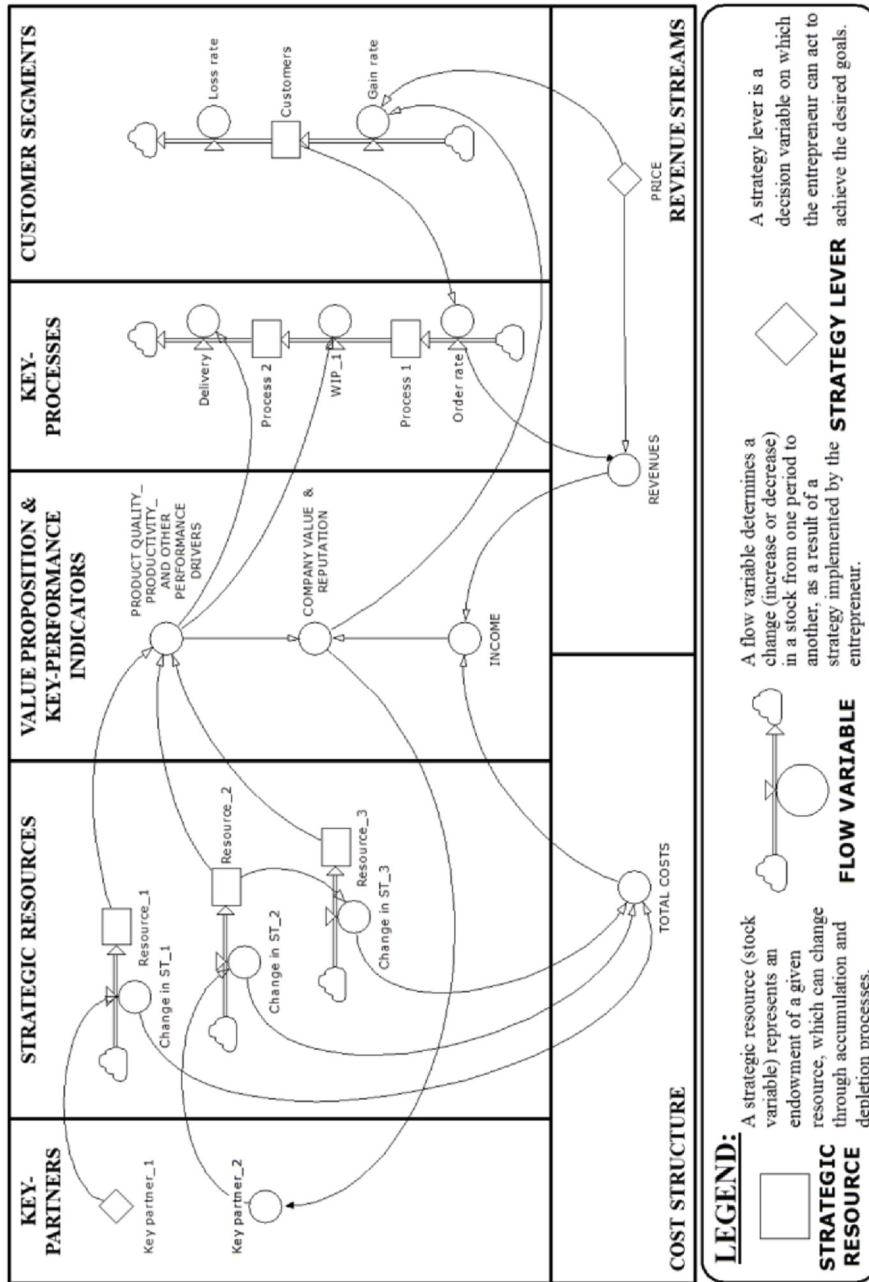


Fig. 1. Designing BMs through SD modelling (Cosenz & Noto, 2018).

the critical BM elements encompassed in all the building blocks. For instance, both price and order rate positively influence revenues which, together with the costs associated with strategic resources acquisition, determine the income. In the medium-long-term, income affects the company value and reputation that produce an effect on key partners (e.g., investors, providers). Then, strategic alliances with key partners may imply a change in the strategic resources (e.g., equity funding, discounts in raw material supply) whose allocation influences performance drivers (or indicators), such as product quality, productivity, and so on. The drivers produce an effect on business processes (e.g., production, shipments), as well as on company reputation and value (e.g., customer satisfaction), that eventually impact on the acquisition of new customers.

In the above example, two main strategy levers have been identified: price (which positively influences revenues and negatively customer acquisition), and key partners (resulting, for instance, in an agreement for reducing the delivery delay of raw material provision or for increasing the time to pay back debts). The value proposition is positioned in the middle of the framework including a set of indicators (or value drivers) to measure the firm's performance over time. These indicators may relate to competitiveness, profitability and social satisfaction, and are expressed in relative terms, i.e. by comparing an actual result with a benchmark often associated with competitors' results.

Each variable included in the framework can be simulated in order to verify the corresponding behaviour over a given time interval. Namely, the possibility to simulate the behaviour of the business system over time enables entrepreneurs to experiment alternative strategic choices, i.e. to assess the effectiveness of a given business strategy and to manage the potential trade-offs in terms of performance between short- and long-term. Therefore, after the start-up phase, the DBM can be also used as a lean managerial support to measure and manage performance, as well as to innovate the current BM. As a result, both a holistic perspective and simulation may foster entrepreneurs' strategic learning processes.

3. A Dynamic start-up business model simulator for entrepreneurial learning

In order to show how DBM may support entrepreneurial learning processes, we built a DBM simulator based on a simplified theory of the firm (Cyert & March 1963; Jensen & Meckling, 1976; Penrose, 1995). In our explanatory case, labour (i.e., workforce) and capital assets (e.g., financial resources, assets) are the main production factors and their combination creates – as in the production function – an output of a single type of product (one-product firm). The firm competes in a market where productivity and product delivery delay are the critical success factors. Its strategy focuses on a profitable growth in the medium-long term.

As portrayed in Fig. 2, the DBM structure presents two main reinforcing feedback-loops and five main balancing feedback-loops.

R1 loop shows the dynamic according to which an investment in marketing drives the business system toward the acquisition of new customers and, consequently, new orders and revenues. These variables positively affect the net-income generating an increase in equity, as well as in the stock of available financial resources that allow decision-makers to increase the marketing budget.

B1 loop frames the production process. As previously mentioned, an increase in customers determines an increase in new orders. If the firm does not adapt its production capacity to the changing market demand, this may generate an increase in the product delivery delay which slows down the acquisition of new customers, e.g. through a word-of-mouth (WOM) effect.

R2 loop focuses on the dynamics related to the productivity adjustment process. With the intent to counterbalance the rise in the product delivery delay, an investment in workforce may increase the overall company productivity which in turn speeds up the production process and, thus, reduces the delivery delay. This influences the acquisition of new customers and, consequently, revenues and financial resources that may be used to hire new workforce units.

B2 and B3 loops show that a growth of sales orders is likely to generate an increase in the inventory, as well as in assets. Such an increase in both inventory and assets implies new costs and, consequently, the financial resources decrease. Less financial resources determine a reduction in the marketing budget which negatively affects the acquisition of new customers.

B4 and B5 loops are related to expenditures. Particularly, an increase in workforce or marketing initiatives determines higher costs (i.e., salaries and promotion costs) which, other conditions being equal, decrease the net-income. This also generates a decrease in equity, as well as in the financial resources to pay salaries or marketing expenses.

The causal loop representation of the DBM portrayed in Fig. 2 helps us to frame and highlight the causal relationships that characterize the firm's BM. The value generated by the firm is expressed through a number of performance drivers and other conventional economic measures, namely the Net Present Value (NPV) of the firm, Return On Investments (ROI), Return On Equity (ROE), and dividends. All of these depend on the yearly net-income calculated as revenues minus costs.

Revenues are calculated as the number of products ordered by customers multiplied by their price. The orders act as an input to fuel the production process that, in our model, has been divided into three steps (see Key process section): new orders, product assembly, and shipments. The time that occurs to complete the production process – from when the orders are placed up to the moment in which these are shipped – measures the delivery delay. This variable could be represented as a performance driver since it influences the acquisition of new customers through the WOM effect. The delivery delay is then defined as the critical success factor through which managers may measure the ability of the company to gain new customers.

The managerial levers that influence the delivery delay are related to the company's productivity. This depends on the endowment of key resources employed in the production process. Particularly, the number of human resources working in the firm should be adapted to the number of received order and by considering the average individual productivity (i.e., avg. number of made products/worker/time). In addition, the production process depends on how the raw materials are managed so as to complete the ordered products. The inventory is adjusted according to the order rate, as well as the reliability of the suppliers in terms of raw material delivery delay.

Another relevant strategic resource for the company is represented by its assets. These should be periodically replaced so as to

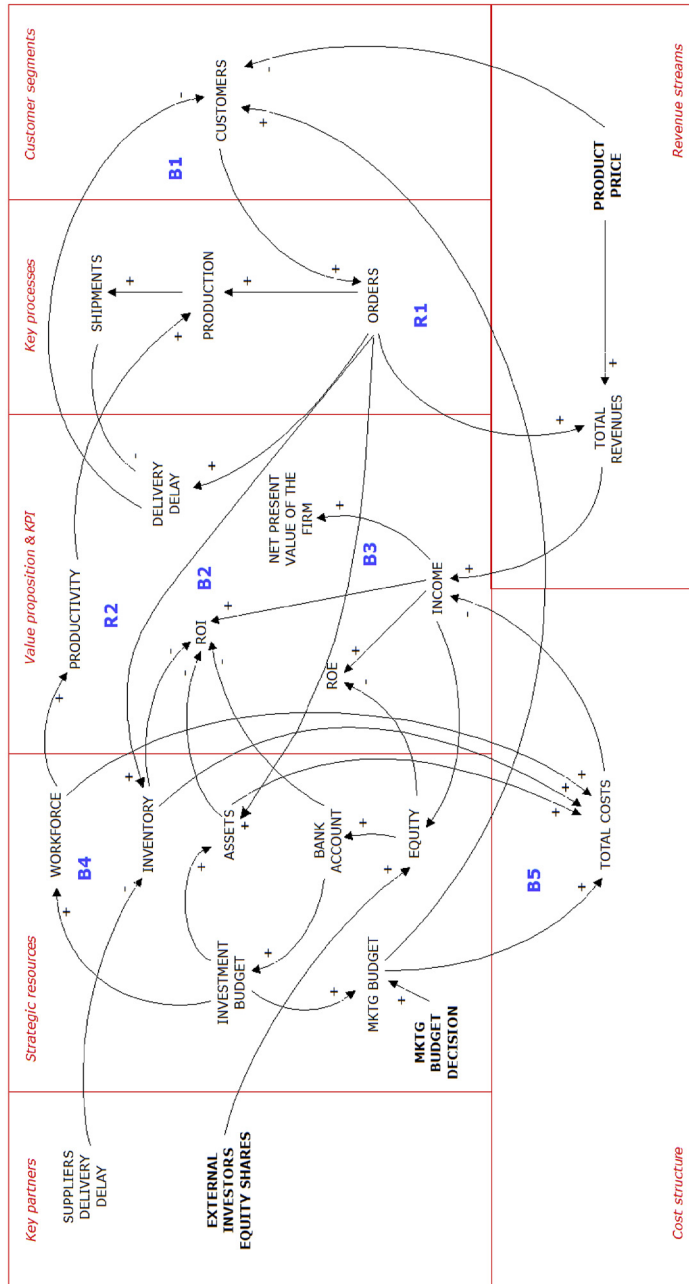


Fig. 2. A causal loop diagram of DBM.

Table 1
Value proposition and key performance indicators.

Variable	Criteria	Unit of measurement
ROI	Income/(Assets + Bank account + Inventory value)	%
ROE	Income/Equity	%
Dividends	Income* Dividend rate	Euro per time
Net Present Value	Income/Interest rate	Euro
Delivery Delay	Orders in place/shipments	Time
Total productivity	Standard individual productivity/Workforce	Products per time

compensate for their obsolescence rate. In order to pursue a positive economic result, the actions aimed to invest financial resources in new assets should take into account the other expenses, such as the salaries of new human resources, the costs of raw materials and marketing activities. The costs related to the acquisition of these elements, including the asset depreciation, form the company's total costs.

Both revenues and costs influence the stock of financial resources - i.e., the bank account – that, together with the other assets, enables to calculate the ROI index. The bank account was initially formed by the equity funded by shareholders and other external investors (see key partner section). Correlating income with equity enables to calculate the ROE index.

The NPV is calculated as the net-income divided by an interest rate representing the cost of capital (average sector WACC).

In [Table 1](#), value proposition variables and performance indicators are listed, and their calculation is made explicit.

[Fig. 3](#) displays the stock and flow structure of the DBM simulator.

4. Using and experimenting dynamic business model simulators

In order to better explore the business value creation process, the DBM was structured in the form of a flight-simulator game of the type used by [Sterman \(2014\)](#). This modelling process increases the understanding of the environment ([Andersen, Chung, Richardson, & Stewart, 1990](#)) as it allows players to experiment and explore different strategic solutions.

The model and the flight-simulator control panel was built through Powersim[®] Studio 10 software. [Fig. 4](#) shows the control panel interface where players may set different strategic choices year by year.

In particular, this simulator includes a set of strategic alternatives which are explored to show the potential benefits – in term of learning and training – of DBM. These are:

- *Marketing strategy*: when starting a new business venture, entrepreneurs are called to set an appropriate marketing mix. This variable enables to set the budget to invest in promoting the product in order to capture the market share that would make the business sustainable over time. Particularly, three options have been provided for testing: aggressive (85% of the available budget); medium (50% of the available budget); and weak (10% of the available budget).
- *Product price*: another component of the marketing mix is related to the product price. In this case, the control panel provides three options: low (€ 650); medium (€ 750); high (€ 850) price.
- *Investor equity shares*: this variable refers to the possibility to involve external investors (e.g., business angels, venture capitalists, etc.) in the business equity. As such, players may test how the business reacts when, at the beginning of the simulation, external investors have no shares, or invest € 100.000, or € 350.000.
- *Entrepreneur equity investment*: this variable allows players to determine the initial amount of money the entrepreneur should invest when starting the business: € 5.000, € 25.000, or € 50.000.
- *Dividend rate*: the slide bar above the bottom graph in the control panel enables to simulate the business behaviour in case of different dividend policies.

The combination of these strategic alternatives allows players – i.e., would-be entrepreneurs – to explore how the business operates and reacts according to different strategies in order to identify profitable and sustainable patterns of behaviour. For example, players may test and simulate whether a 'cost leadership strategy' ([Porter, 1980](#)) – i.e., low product price and weak marketing strategy - is profitable in the case of an equity investment of € 25.000 from the entrepreneur and additional €100.000 collected from external investors (see [Fig. 5](#)). In this simulation dividend share rate is equal to 10% of the net-income.

The graphs portrayed in [Fig. 5](#) shows that the tested conditions make the business profitable over time. This is demonstrated by a growing market share and a financial structure producing an expected constant net-income of about € 60.000 per month. The positive results achieved by the company support the build-up of the key resources that show linear growth patterns (see [Fig. 6](#)).

In this example, players may notice that in the first three years the company performance improves until it reaches a net-income of about € 80.000 per month and an NPV of € 8 million. Then, since 2019 the company's profit slightly decreases and finds an equilibrium level of about € 60.000 per month. ROI and ROE reach their maximum value while experiencing the exponential growth phase of income (2015–2016), and then decrease during both linear growth and decrease phase of the same variable. Productivity shows a linear growth trend, while the delivery delay, after an initial shock given by the production system adjustment time, stabilizes at the value of two months. [Fig. 7](#) displays the simulation results related to the value proposition and key performance indicators.

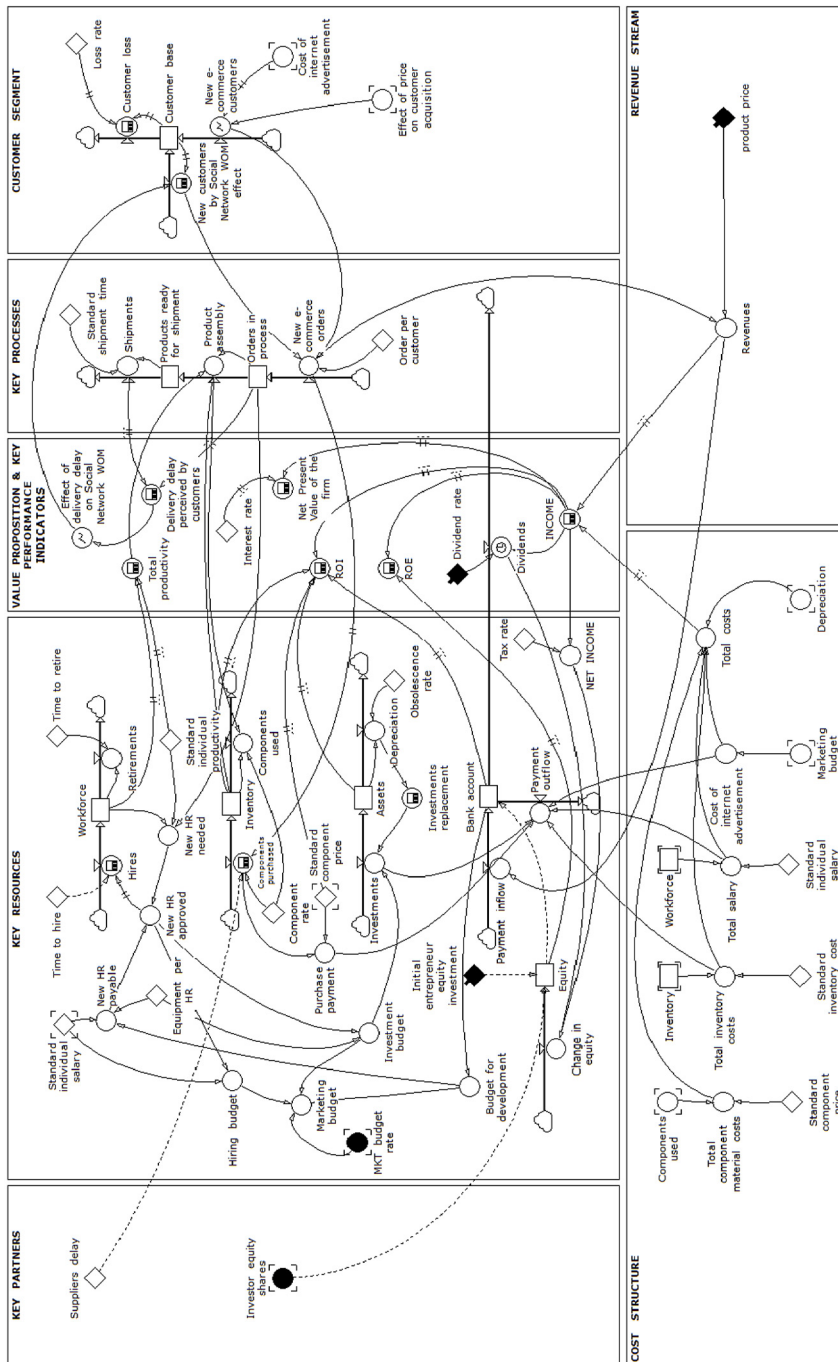


Fig. 3. A stock-and-flow map of the Dynamic Start-up Business Model simulator.

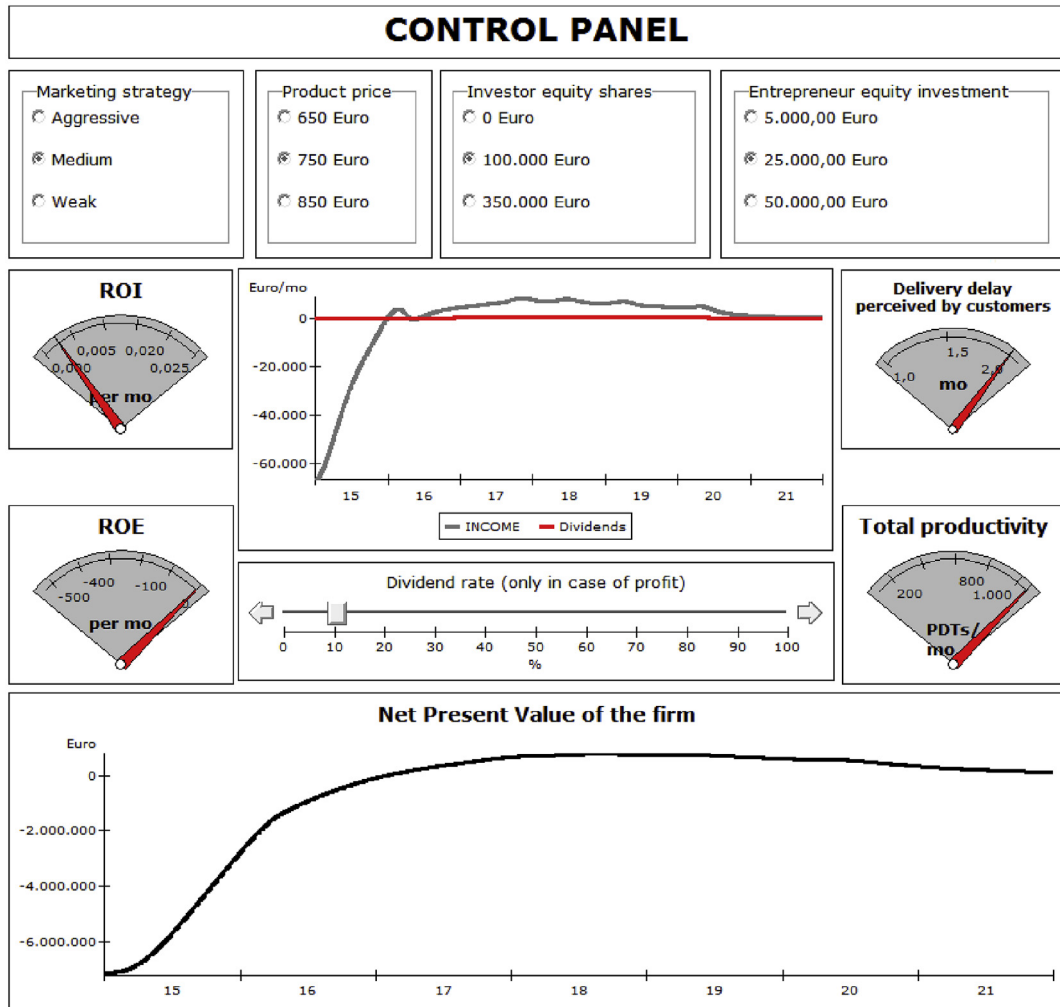


Fig. 4. The Dynamic Start-up Business Model simulator control panel.

Simulation results show that the chosen set of parameters allows the business to create value for its stakeholders and to foster its growth.

An alternative strategy that could be tested relates to ‘differentiation’ (Porter, 1980), i.e. setting a high product price and an aggressive marketing strategy. Fig. 9 shows the simulation results obtained by testing the differentiation strategy.

By comparing Fig. 8 with Fig. 6, we may notice that results are significantly different. In this case, the high cost of advertisement and the limited market share determined by the high product price result in a net-income equal to € 0. Thus, a differentiation strategy appears sustainable but unable to ensure an appropriate remuneration to shareholders, particularly if compared with the cost-leadership one. All the main variables display a goal-seeking trajectory that reveals how, by adopting this strategy, the business may grow up to a certain level (150 customers).

Key resources, as well as the other variables, show a constant behaviour starting from 2018. According to this trend, the initial investment in equity is far from being restored during the time frame considered.

The value proposition variables and the key performance indicators also show an overall poor performance when compared with the cost-leadership strategy previously simulated (Fig. 10).

This simple example, based on an experimentation comparing ‘cost-leadership’ with ‘differentiation’ strategies (Porter, 1980), shows that, through the use of DBM, would-be entrepreneurs may be enabled to understand whether in a given market a low product price is more effective than an aggressive promotion strategy in gaining new customers and make the business grow.

The DBM is designed to simulate performance year by year. As such, players may change the set of strategic alternatives while simulating in order to experiment potential reactions to unintended behaviours or to seek for a better performance. This possibility increases the understanding of the overall business system and associated performance trajectories.

The example focuses on two parameters, i.e. marketing strategy and product price. Users may also test other scenarios and parameter sensitivity by simulating changes in other variables (e.g., dividend rate, initial equity, etc.).

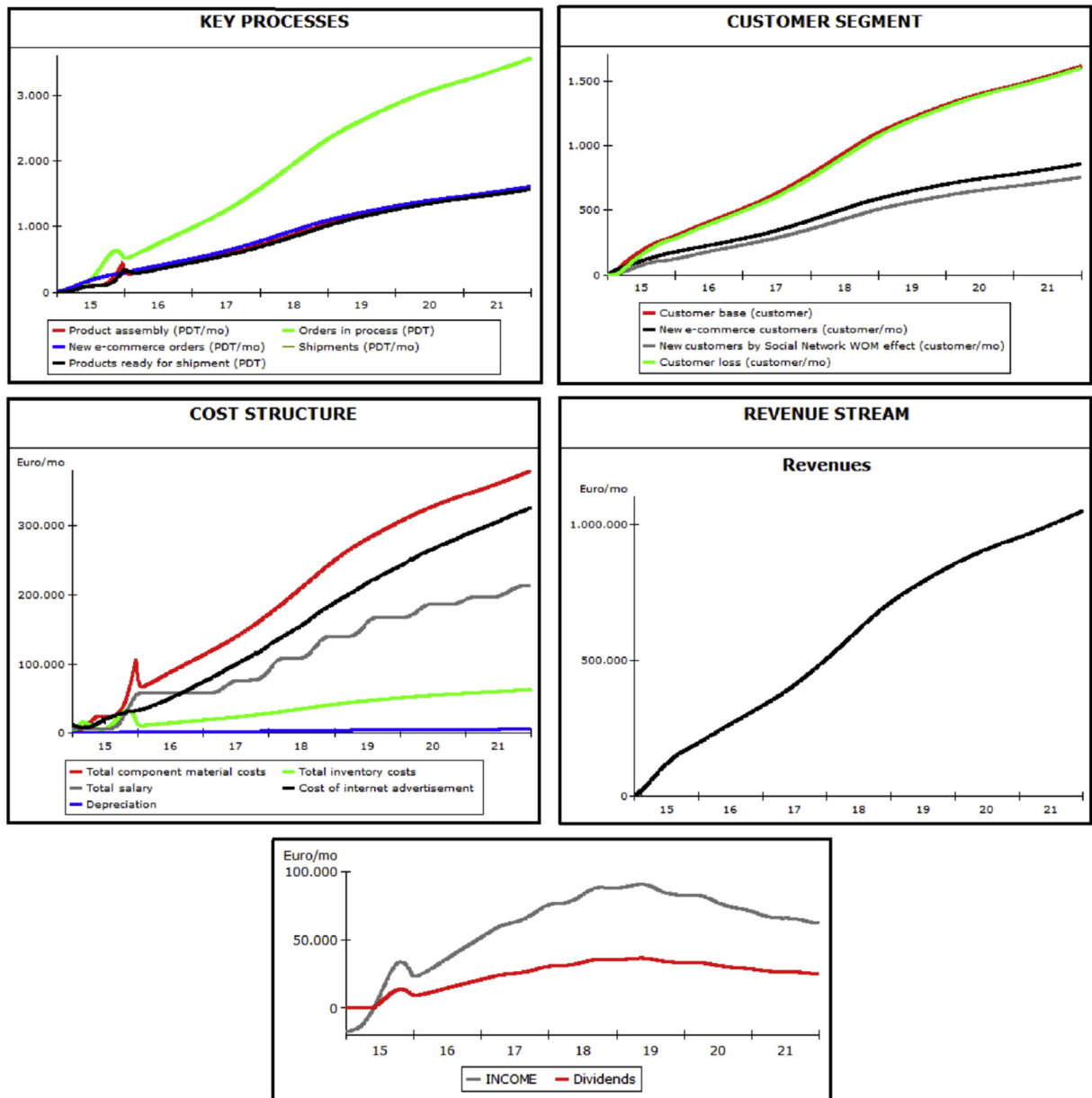


Fig. 5. Income, costs, revenues, processes and customer segment simulation results.

5. Discussion

Strategic management and entrepreneurship are challenging fields in which people are usually trained by studying handbooks and making internships to learn how things are usually done by experienced managers. The start-up world does not allow young entrepreneurs to assist experienced strategists and entrepreneurs to understand how to start new businesses and make them successful. Moreover, each business venture presents its own organizational characteristics that prevent one to set and apply general rules for managing them. As a result, 40% of new ventures fail within 5 years.³

This phenomenon is mainly determined by a lack of competences and managerial experience that, during the start-up phase of a business, may lead to wrong decisions which can be fatal for the survival of the young venture in the medium-long term. Entrepreneurial experience and competencies cannot be obtained through traditional models of instruction (King, 1993; Mintzberg, 2005; Pfeffer & Fong, 2002), but can be gained mainly through a strategic learning process based on experimentation (Aldrich, 2009;

³ https://www.bls.gov/bdm/entrepreneurship/bdm_chart3.htm accessed on 26/02/2018.

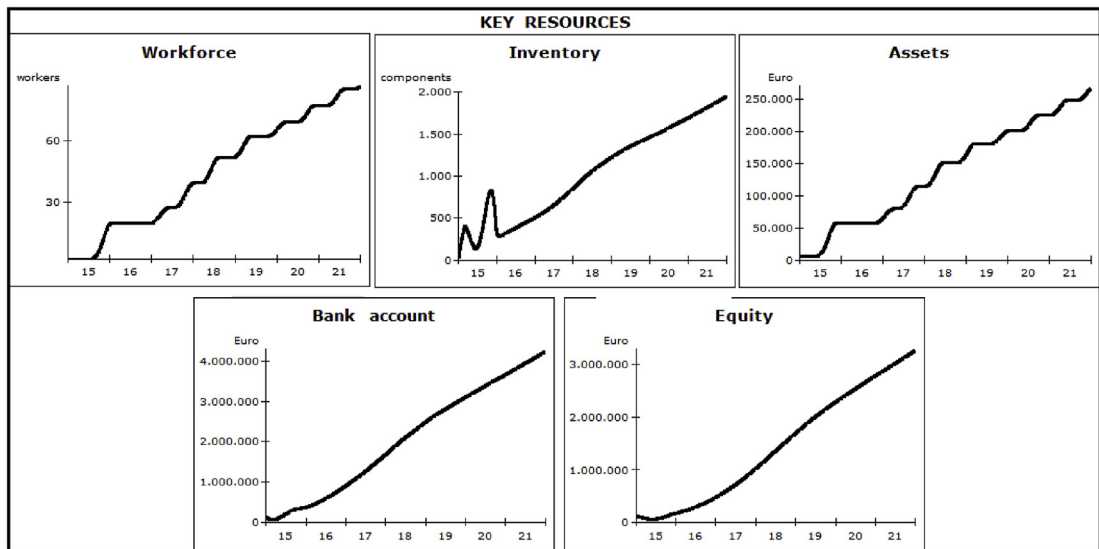


Fig. 6. Key resources simulation results.

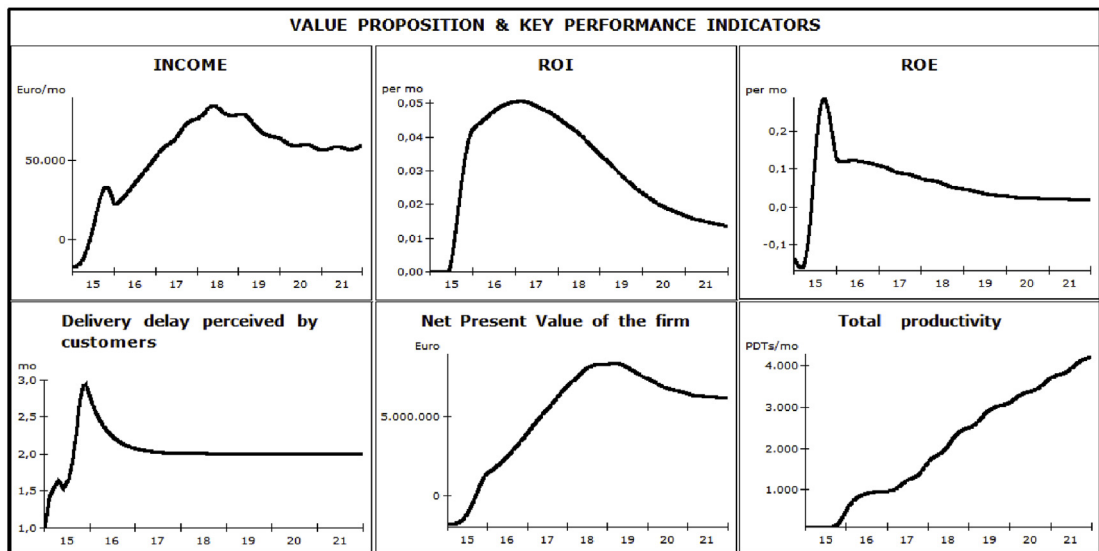


Fig. 7. Value proposition and KPI simulation results.

Pfeffer & Sutton, 2000; Schrage, 2000; Thomke, 2003). In this context, simulation may represent a valuable tool to experiment with business strategies and BMs in a protected and non-harmful environment for the firm (Davies et al., 2007; Sterman, 2014). Simulation also supports a trial-and-error learning that would be unfeasible in the real world.

Designing BMs through SD modelling may enable start-up entrepreneurs to test and refine their strategic decisions through simulation exercises.

There are other business simulation tools suggested by both literature and practice that make use of simulation for learning and training purposes (e.g., SimVenture, MIT Sloan Learning Edge, Forio simulations, etc.). What distinguishes the DBM from these tools relates to the possibility to build, develop and test the business model proposed by the would-be entrepreneur. In fact, although detailed and reliable, the above tools only allow users to simulate with pre-existent model structures of specific market sectors (e.g. clean energy start-up) and a set of pre-defined actions that may be tested. The advantages of using DBM instead of other simulation tools or methods (e.g., agent-based modelling, or even a simple excel spreadsheet) is mainly related to the possibility to build, map and make explicit the original entrepreneur's mental model, as well as the underlying causal relationships characterizing the structure driving the business performance (Cosenz & Noto, 2018). This empowers the two steps process which, according to Kim, MacDonald, and Andersen (2013), characterizes learning through simulation models; namely: i) learning from causal maps, which implies building and exploring mental models; ii) learning from the simulation model that follows, that results in an enhancement of the

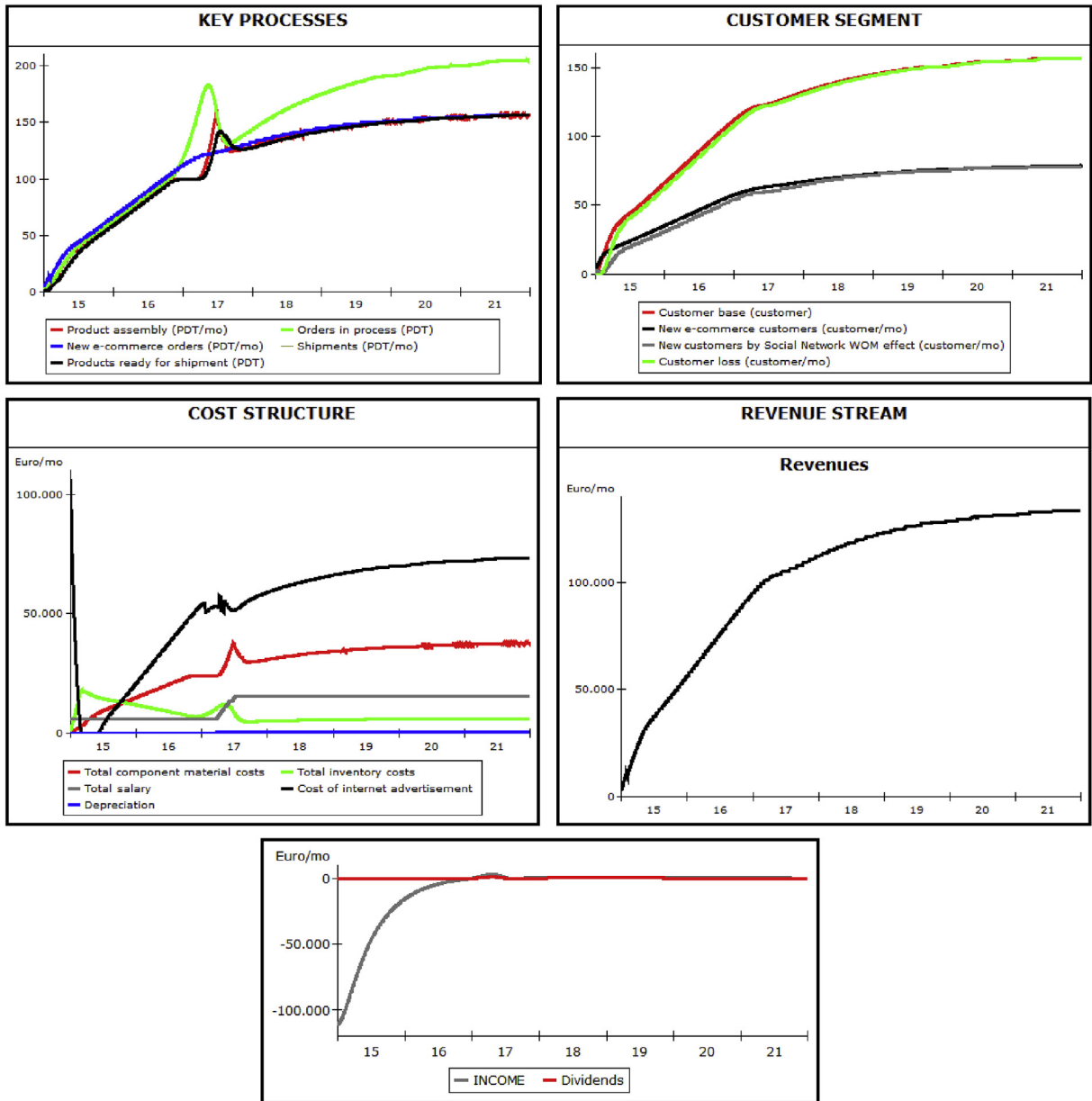


Fig. 8. Income, costs, revenues, processes and customer segment simulation results.

mental models' accuracy. Other simulation tools available in practice rely exclusively on this last lever.

The use of SD modelling thus helps start-up entrepreneurs theorizing on the potential impacts of scenarios that emerge from testing and challenging their mental models and business decisions. It is through this form of learning that start-up entrepreneurs may reflect on how resources are perceived and deployed to improve profitable and sustainable strategies. By learning through virtual performance, they can improve their entrepreneurial skills experimenting and enhancing their analyses of ways to implement strategic initiatives designed to improve performance (Dyson, Bryant, Morecroft, & O'Brien, 2007).

As such, DBM allows one to reflect on potentially appropriate changes in the business structure. The possibility to question how a business works and whether solutions may imply the change in its governing values forms the basis on which to ground a 'double-loop learning' process, as characterized by Argyris (2002). Double-loop learning involves the modification of goals or decision-making rules in the light of experiences that one can gain by simulating and testing BMs, as well as the strategic directions within the same BM. Such a process may lead to a continuous refinement of the entrepreneur's mental model (Argyris, 1991; Argyris & Schon, 1978). Fig. 11 portrays the difference between single- and double-loop learning.

Since strategic decisions are generated from mental models, these are intended as the main leverage points for enhancing decision-making processes. In complex and dynamic environments, the observation of strategic actions and related results (i.e., the

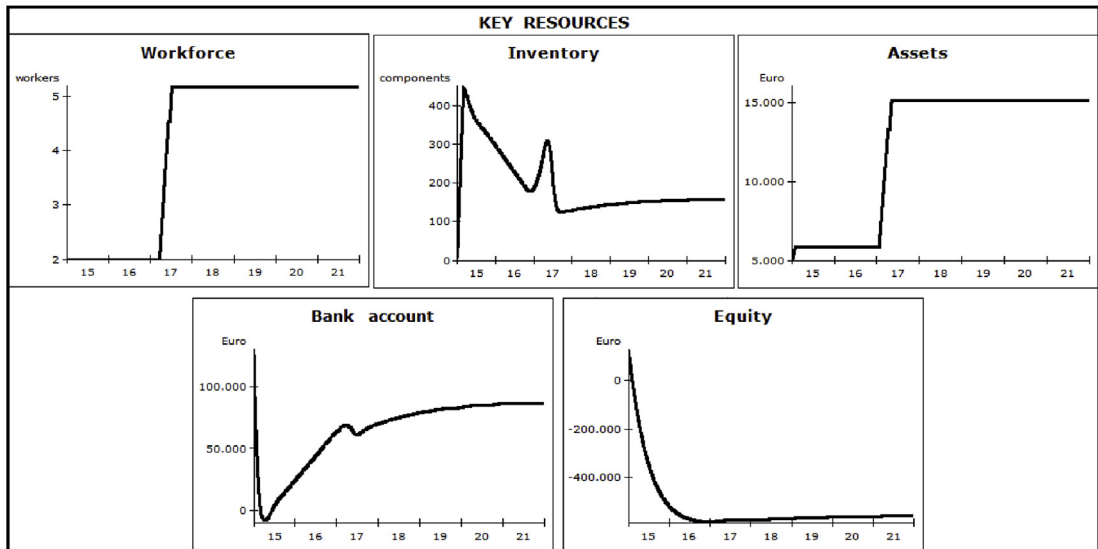


Fig. 9. Key resources simulation results.

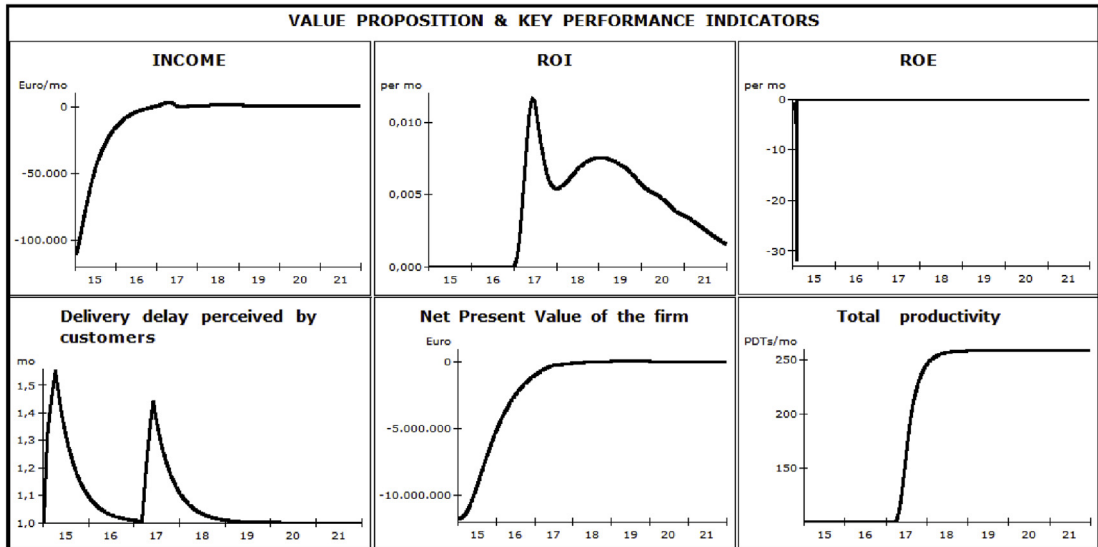


Fig. 10. Value proposition and KPI simulation results.

firm's performance) is interpreted by the mental models which – based on the entrepreneurial experience – formulate corrective actions. Single-loop learning occurs when such observations of the business system, especially the outcomes of previous strategic actions, lead to changes in decision-making. When double-loop learning occurs, these observations produce a deeper effect, leading to a modification of entrepreneurs' mental models (Kim et al., 2013).

Through the process of using, testing, and experimenting the computer simulation model (i.e., the DBM), start-up entrepreneurs may challenge and re-construct their mental models to include new strategic insights and more entrepreneurial experience through an active engagement with the business system (Sterman, 1994, 2014). This may support them in turning a business idea into a real business.

6. Concluding remarks and research perspectives

This paper has built on the existing recent literature on BM design to introduce SD simulation modelling as a tool to foster the entrepreneurial learning of potential entrepreneurs and, as a result, to exploit the acquired knowledge to turn a business idea into a real business. Based on this background, this paper has outlined an analysis of the DBM, seen as a strategy design tool emerging from the combination of conventional BM representations and SD modelling. This approach may allow start-up entrepreneurs to address

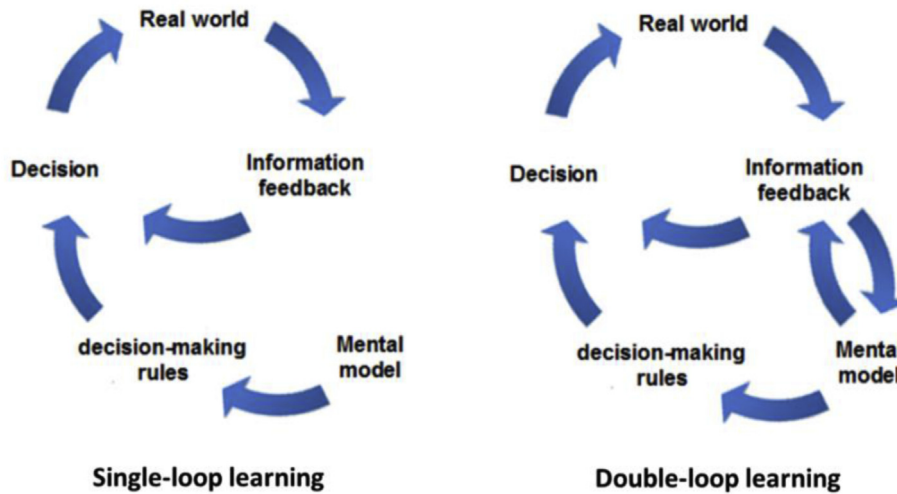


Fig. 11. Single-vs. Double-loop learning (source: Argyris, 2002).

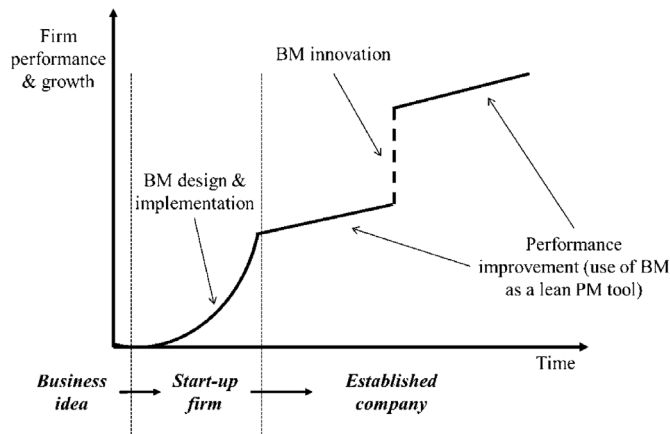


Fig. 12. Multiple potential uses of DBM in the firm's lifetime.

the main causes of business failure (i.e., incompetence and lack of managerial experience) through experimenting and learning how the business reacts to strategic and organizational changes in terms of performance, innovation and value creation. In fact, the DBM approach adopts a systemic perspective that enables one to identify and analyse the main cause-and-effect relationships between the core elements of the BM. Moreover, applying a simulation technique – such as SD modelling – contributes to providing a better understanding of how a firm operates both internally and externally, and its prospective performance over time.

The possibility to include in the value proposition a number of performance indicators (e.g., ROI, ROE, productivity, NPV, etc.) makes this approach a valuable tool to support the firm during its lifetime. In fact, after the start-up phase, experimenting with simulation alternative BMs or strategic choices may enable entrepreneurs to innovate the current business formula. In addition, as displayed in Fig. 12, a set of key performance indicators may also serve as a lean performance management tool.

Due to its characteristics, the DBM approach contributes to the academic discussion by highlighting the fundamental aspects, contents and elements related to entrepreneurial and managerial learning and training.

Further research will be necessary to develop more applied knowledge on the DBM approach and its effectiveness in supporting entrepreneurial learning processes. In particular, this approach should be introduced and tested in University education (e.g., professional courses) in order to understand how learners use and explore the simulator, and what are the related learning outcomes. In addition, learners should also learn how to directly modify a DBM with the intent to add and test more strategic options.

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