Business Simulation Environment:
A Case Study for Business Schools and Startup Accelerators

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Abstract

The aim of this study was to develop business simulation environment to help evaluate future businesses performance using system dynamics approach. The business dynamics simulator for entrepreneurship helps in: (a) designing 5-years pro-forma financial statements for the creation of business plans, (b) simulating strategic decisions to improve survival rate and support growth, (c) producing analysis of performance and business valuation, (D) fostering entrepreneurial education, training & research, in risk-free, enjoyable, realistic and interactive simulation environment. The functionality and usability of business dynamics simulator was tested and evaluated on 40 business school students and 20 students of Founder Institute - world's largest entrepreneur training and startup acceleration program. We found both students see the simulation of their future businesses useful to check if the business will be profitable and cash breakeven but they can see many uncertainties, such as market prices, in the simulation and they still prefer excel spreadsheets to make simple financial evaluations.

Keywords: business dynamics, business simulation, startup, SME, entrepreneurship, scenario analysis

Introduction

Entrepreneurial cognitions can be defined as the knowledge structures that people use to make assessments, judgments or decisions involving opportunity evaluation and venture creation and growth [1]. In this definition, the key elements are knowledge structures (whether heuristical or scripted) and decision making (including assessment and judgment) are set within the context of entrepreneurship's opportunity evaluation, venture creation, and growth. To be an entrepreneur is to act on the possibility that one has identified an opportunity worth pursuing [2]. Theories of entrepreneurship that embrace this perspective traditionally have considered a system level approach concerned primarily with how the economic system functions [2]. Moreover, entrepreneurs develop unique knowledge structures and process information differently (they transform, store, recover, and use information differently than non-entrepreneurs [3], entrepreneurs prevail in the face of bounded rationality due to their "entrepreneurial expertise" [3]. Therefore, one of the key questions in entrepreneurship

research is how are the development of knowledge structures and information processing activities, which are sustained by the development of systemic perspectives of economic functions?

The aim of the project was to understand the business dynamics of technology startups and to develop an interactive learning environment to support entrepreneurs and SMEs managers. Managing successfully startups is a formidable challenge for people who do not have experience running businesses and well-developed management skills determining that only 1 in 5 firms survive after 5 years [4]. Our overall objective and vision is to improve the survival rate of technology startups by allowing entrepreneurs and SMEs managers to simulate various future business performance scenarios and growth strategies (e.g. cost optimization, capital raising, human resources management, part-time staffing, marketing and pricing strategies) in a safe environment prior making their strategic decisions. Using SD modelling approach the business dynamics simulator provides a generic template in the field of entrepreneurial education, training, research and decision support for new companies, allowing them to simulate future 5-years pro-forma financial statements and business performance indicators, helping them to learn to cope with business dynamics complexity, evaluate diverse managerial strategies, make smarter future strategic decisions in risk-free, enjoyable, realistic and interactive learning environment.

Literature Review

Entrepreneurial cognition is defined here as the extensive use of individual heuristics and beliefs that impact decision-making [5]. Recent research on cognition indicates that entrepreneurs use heuristics in their decision-making more than their managerial counterparts in large organizations [6]. Consequently, they often make significant leaps in their thinking leading to innovative ideas that are not always very linear and factually based. Information is an important part of the new venture process, and as noted above, information that entrepreneurs use in the discovery process and in starting new ventures is often nonlinear in nature [5]. In the bundling of resources, entrepreneurs use their available information to make decisions to produce a product that utilizes the available resources in a superior and more efficient manner [7]. The information and its application and know- how are available to the entrepreneur through previous learning [5]. The information owned by the entrepreneur is deeply embedded, socially complex know-how of how to recombine resources and this know-

how combined with entrepreneurial decision-making is a source of firm heterogeneity [5]. Consequently, the management of a start-up involves the bundling of multiple resources in a systemic way with limited information, which is influenced by the existing mental models and heuristics.

Using models to bundling resources and managing startups.

Managing startups require integrated, holistic model for realistic startup opportunity evaluation. State-of-the-art is that unfortunately entrepreneurs generally do not use the tools of business modelling and simulation. Nevertheless, some attempts of the business modelling and simulation are mainly performed using vast number of Excel spreadsheets (often more than 50 of them) and frequently with numerous mandatory manual and exogenous inputs [8]. However, these models have important limitations, e.g. endogenous feedback mechanisms are commonly omitted (due to limitation of spreadsheets approach) [7] and models are static, sensitivity analyses and shock tests are usually missing. Therefore, the our main long-term project objective is to fill a gap in the entrepreneurship research field by researching & improving above mentioned fragmented sub-models, researching & developing uncovered models into a new, generic startup business dynamics model/simulator, and evaluating its functionality.

The System Dynamics (SD) has proven in long history evaluating dynamics theories of firm performance and how people make sense of the dynamic performance of firms [9-17]. Few attempts towards generic startup business models using SD approach (methodology which allows complex systems modelling) are pioneered by colleagues from Warwick Business School (WBS) [18] and MIT Sloan School of Management [19] and their work can be further extended to achieve real world applications. Other SD business models are project-specific, targeting only specific aspects of businesses: (1) profitability & pricing, (2) marketing diffusion, (3) competitive dynamics, (4) product launches, (5) project development, (6) supply chains & inventory dynamics, (7) accounting. While modelling other business areas are not or only partially, covered, like (8) staffing/hiring dynamics, (9) employee chain & experience, (10) financial compensation & job satisfaction, (11) work effort & productivity [19, 20]. Kunc and Huang (2012) proposed a generic star-up model based on the resource-based view of the firm [5]. A general startup business includes eight main resources: potential customers, customer base, staff, service in process, product in process, assets, cash available and

company brand. Apart from these resources, financial information is considered to be the most important elements of a startup business due to its impact on survival of the startup. The common resources and key financial variables will be integrated in a system dynamic model (see Figure 1).

Basically, there are six feedback loops. Starting with funding from debt (if the company raise funding through this way), potential customers can be targeted with an increase in the marketing budget to perform different activities, such as advertising and promotional exercises. Depending on the customer requirements, services and products are sold depending on the staff availability, which increases the costs reducing cash (B1). Together with the service/product price determines the revenue increasing the profit. An increase in profit leads to more cash available and more development activities can be implemented to enable the growth of the business (R1). Apart from the company-driven growth in customers, new customers can be attracted indirectly through recommendations from customers (R2). The continuous provision of services/products together with the perceived value of services/products determine the reputation of the company. New customers can be reached when the reputation of the company increases (R3).

As the number of staff increases, it is necessary to invest in additional assets to provide the services required which lead to asset depreciation decreasing the profit (B2). Depending on the number of services and products, the services completed increase the operating costs whereas the completed orders increase the production costs, both reduce profits (B3).

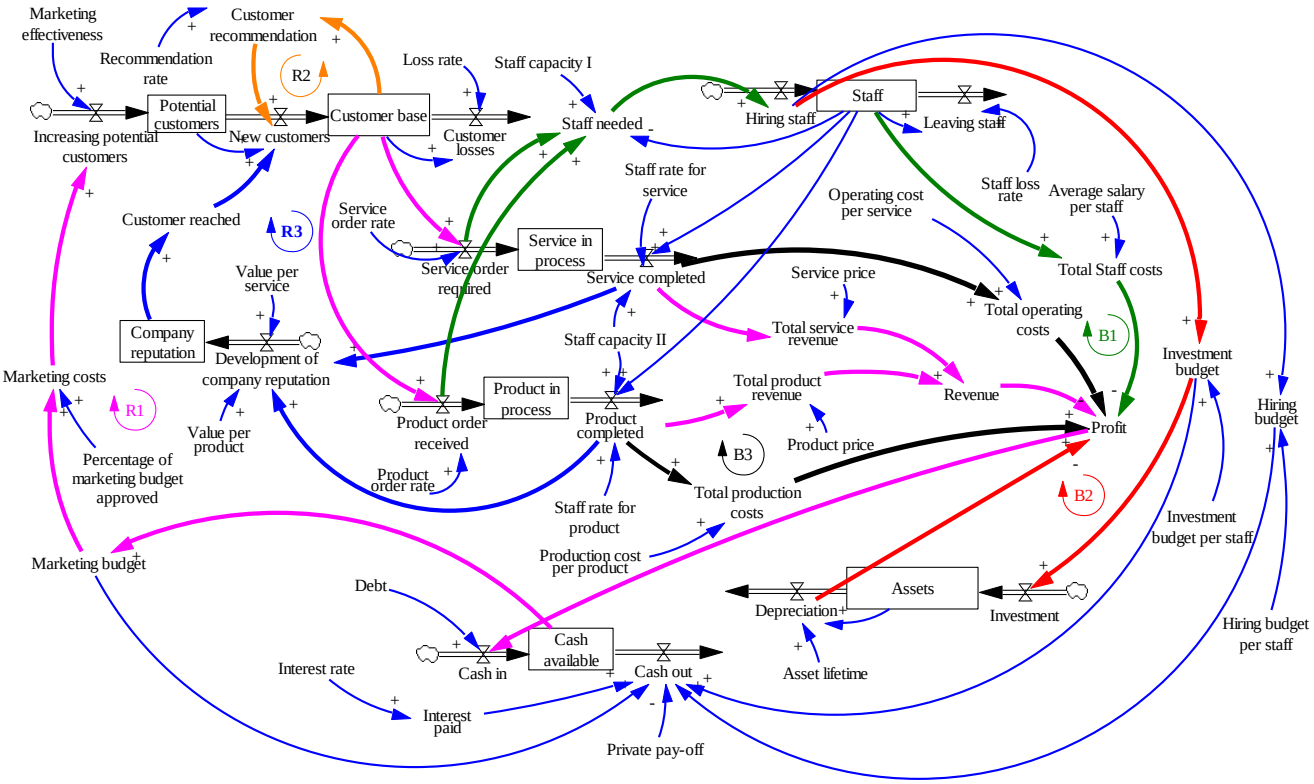


Figure 1. Base model for Start-ups (Kunc and Huang, 2012)

Methodology

Using System Dynamics (SD) modelling approach we have developed business simulation environment for technology-based startups, SMEs and new projects within existing firms allowing entrepreneurs to forecast future 5-years pro-forma financial statements and learn the business dynamics responsible for growth and development of their technology-based companies. Up to present, the business dynamics model based on accounting SD double-entry bookkeeping principle [22] have so far been tested with various stakeholders, in particular technology-based startups entrepreneurs and business school students.

The business dynamics model is shown in Figure 2 and business dynamics simulator (downloadable desktop version) is shown in Figure 3.

Business simulator consists of multiple modules sorted in two main categories: (A) financial modules (e.g. balance sheet, profit & loss, cash flow statements) and (B) operating modules

(e.g. staffing, marketing & sales, branding, orders, product development). The business simulator mainly support business planning & strategic decisions making:

- it covers 6 functional capabilities: financial, marketing, production, learning, supply-chain, staffing,
- it allows pro-forma financial statement forecasting of: (using separate modules)
    - Balance sheet, Profit & Loss, Cash Flow statement (FIN module),
    - Financial Reporting & Ratio Analysis (REP module),
- it allows forecasting/projection & modelling/simulation of business operations & market dynamics:
    - Staffing / Hiring (STAFF), Market growth dynamics and Competition strategies (M&C), Product Development & Inventory (DEV), Production Planning & Costing (COGS), Pricing & Revenue (REV), Operating Processes & Expense (OPEX), Capital Expansion (CAPEX),
    - it allows company valuation & investment optimization (INV) by answering e.g. How much cash do entrepreneur needs and when? What will be cash burn rate, when entrepreneur can expect cash breakeven point and positive cash flow? How does entrepreneur make money with it? What does entrepreneur or investor think the company is worth?
    - it helps in entrepreneurship Education/Training/Research, e.g. How to help entrepreneurs avoiding stagnation? How to prepare successors in family startups? How to prepare managers to continue the initial growth of the startup?

The business model allows simulation in two modes: (a) simulation mode and (b) gaming mode. (a) Simulation mode allows setting the model initial parameters and initial conditions and one-time running of the simulation for whole 5-years numeric integration period, while (b) Gaming mode is more interactive and allows moving forward and backward in time: month-by-month, quarter-by-quarter or year-by-year and interacting with model parameters in these time steps.

The business model is validated and initial model parameters are calibrated based on the real financial and operating data for startup called “Green Devil Control Systems Ltd.” which are available in [8].

Figure 2. Business dynamics model.

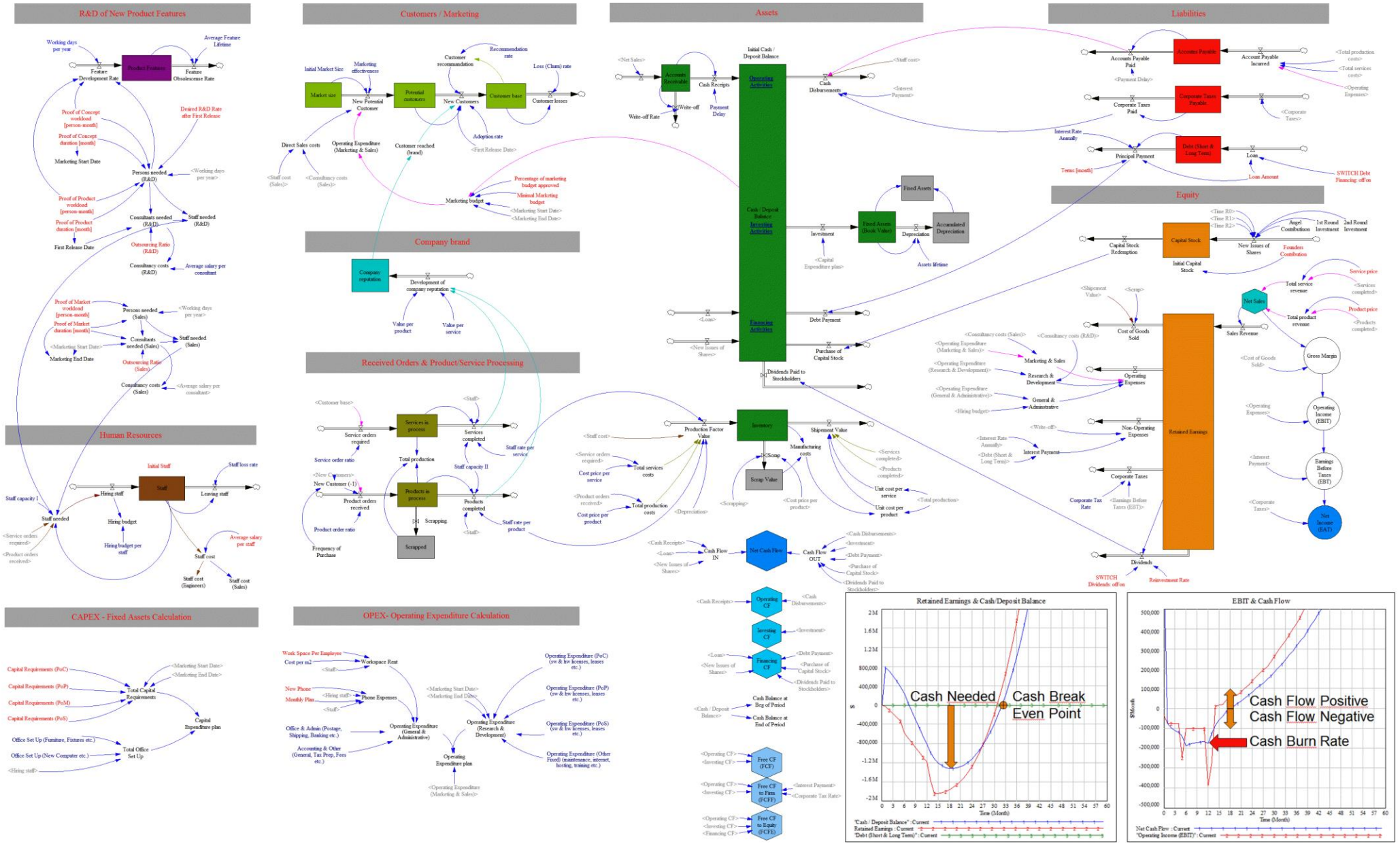
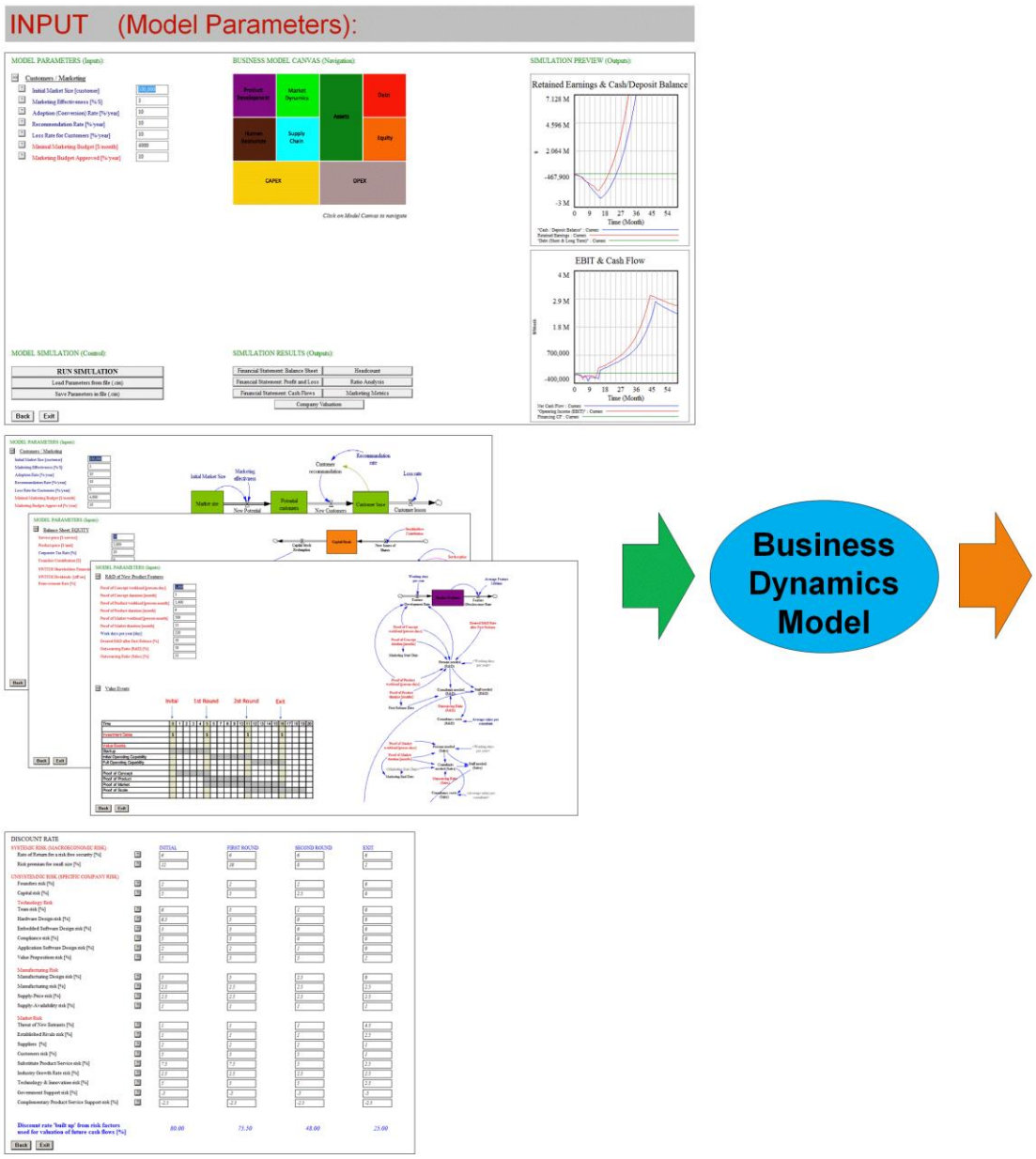


Figure 3. Business dynamics simulator. Downloadable through the following link: http://hr.linkedin.com/in/ssovilj



To test the experience we have designed an online Business Simulator Questionnaire for 20 students of Founder Institute accelerator program and 40 students of Vern' University of Applied Sciences business school in Zagreb. We have offered the business simulator to students for the purpose of testing the functionality and usefulness in entrepreneurial training, education and research and then we have provided an online questionnaire. Additionally, the students were also informed that the software, with a bit of additional mastery, can also be helpful to them as the startup/SME founders to simulate their future businesses, before they enter in this very risky endeavor in which only 1 of 10 startups/SMEs survive. The survey was also used to collect information on what people's concerns are and what design specifications are the most important to them.

The following questions were asked:

1. What do you see as the biggest problem regarding a success of your future business?
2. Do you know of any ways to resolve these problems?
3. Have you tried to contact any business consultants (for business planning or market research) and how much their service will cost (or you expect will cost) for your project?
4. How would other business simulation approaches help to solve your problem?
5. Does the idea of financial performance analysis & valuation of your own company/idea appeal significantly to you?
6. Have you looked into business simulation software so far?
7. Would you prefer a use of business simulation in your entrepreneurial education/training?
8. Would you prefer a simulation of your future business?

After the problem statement test, we have proposed a problem solution (business simulator that they have tested previously):

9. What features would you require the business simulator to have?
10. How much you expect such a business simulator has to improve your own financial projection to consider using it?
11. What would be your most important considerations in deciding whether to use it?
12. How much the business simulation solution (that you have tested) seems attractive to you?
13. What do you think how functional it is?

Results

As previously stated the business model was validated and initial model parameters were successfully calibrated based on the real financial and operating data for the startup called "Green Devil Control Systems Ltd." which are available in [8].

The most important graphical outputs of the model simulation are: Retained Earnings and Accumulated Cash Balance (stocks of equity and assets) shown in Figure 4A and Earnings before Interest and Taxes – EBIT and Total Cash Flow (flows around equity and assets) shown in Figure 4B. From these graphs it is possible quickly to read Cash Needed for investment, Cash Break Even point, Cash Burn Rate and points when negative Cash Flow becomes positive.

For more detailed analysis, complete financial statements are generated (Balance Sheet, Profit & Loss statement and Cash Flow statement) which can be represented monthly, quarterly or annually as shown in Figure 5.

Figure 4. Output example: (A) Retained Earnings & Accumulated Cash Flow and (B) EBIT & Total Cash Flow

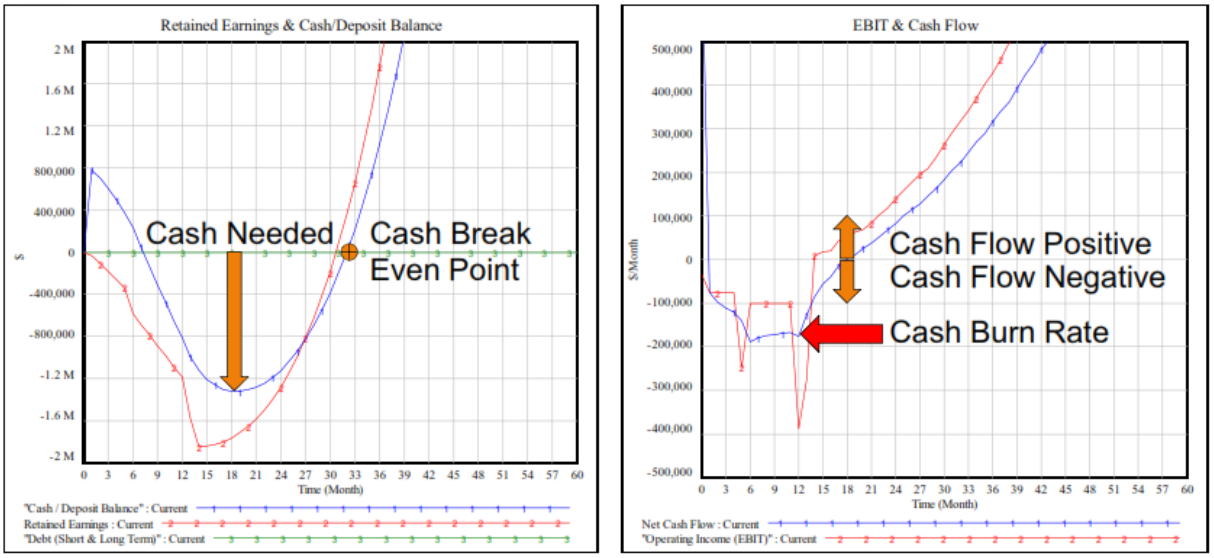


Figure 5. Financial report outputs example.

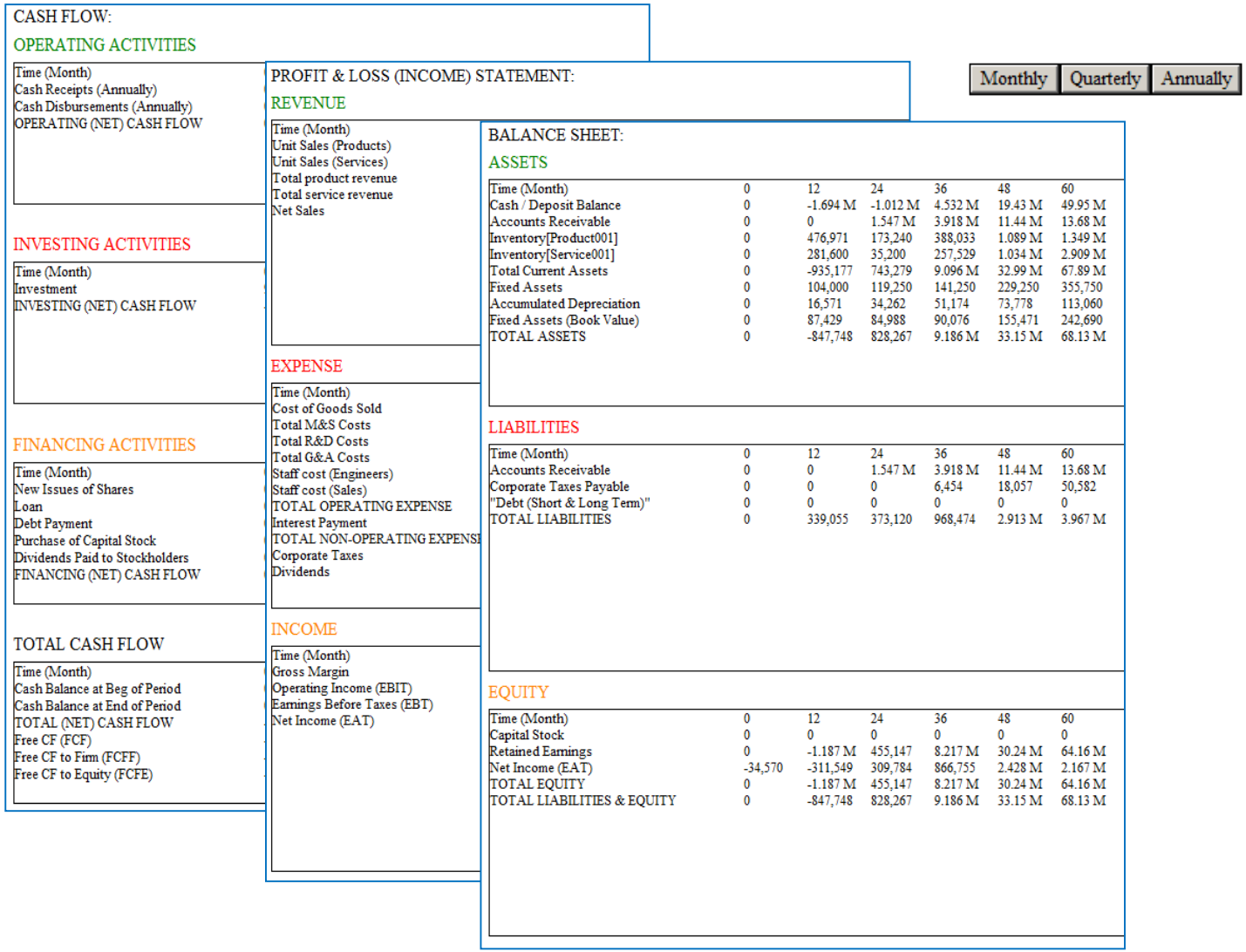
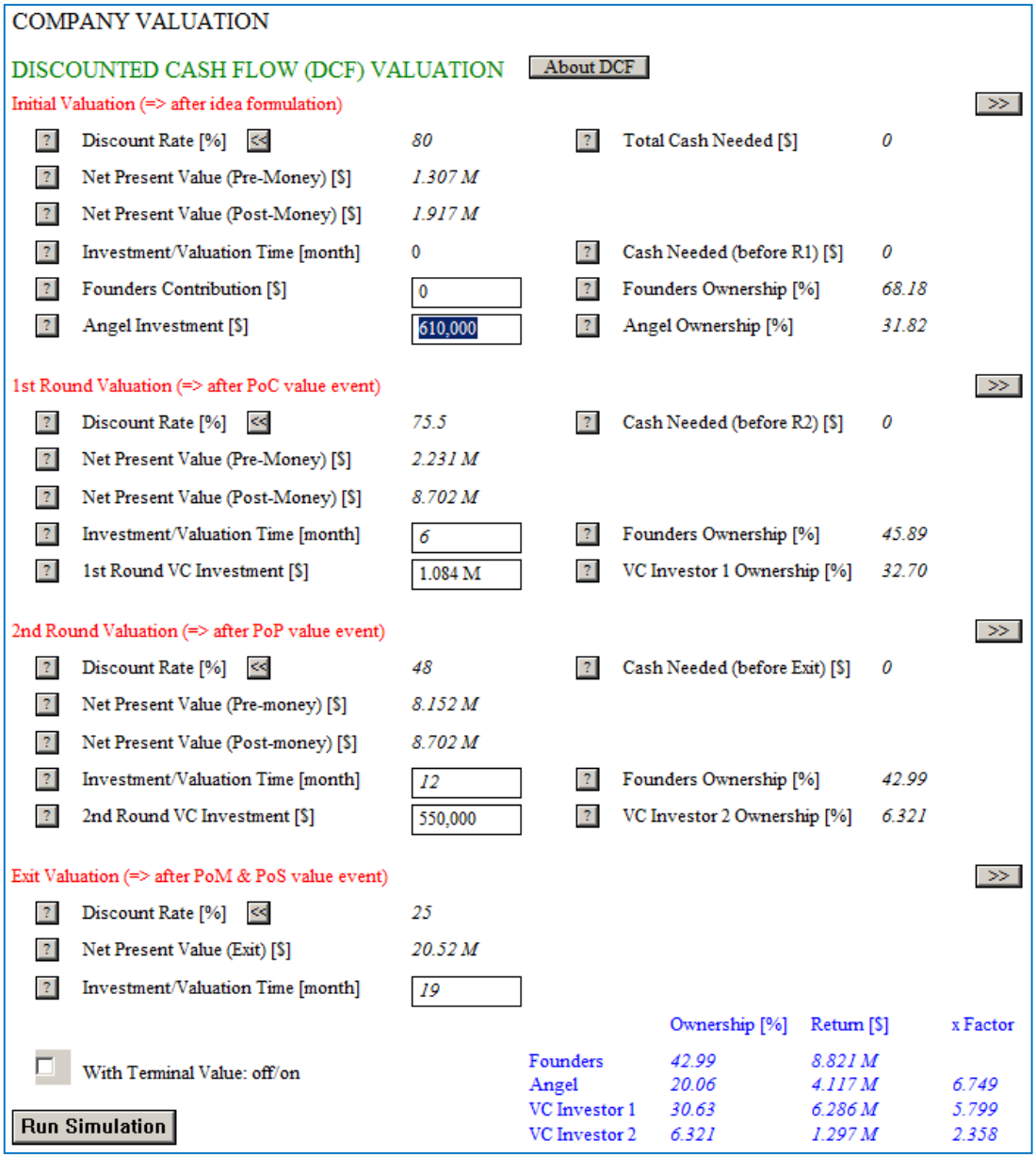


Figure 6. Company valuation based on DCF valuation method.



Since the projections of future cash flows are inherently available from business simulation for the company/idea valuation it is necessary to discount future cash flows using Discounted Cash Flow (DCF) method as shown in Figure 6. Default discount rates are determined using build-up method, based on riskiness of the company development stages: Initial Valuation (after idea formulation; 80%), 1st Round Valuation (after Proof of Concept – PoC; 75.5%), 2nd Round Valuation (after Proof of Product – PoP; 48%) and Exit Valuation (after Proof of Market – PoM and Proof of Scale – PoS; 25%).

The survey shows the following results:

- 89% of future startup entrepreneurs and business school students would prefer a simulation of their future businesses.
- the biggest problem the future entrepreneurs see regarding a success of their future business are:

  1. They don't know will this be profitable business or not and if yes, when they will be cash breakeven.

  2. They don't know how much to price their product/service that the market will accept.

  3. They don't know how to make financial projections for good business plan.

  4. They don't know how much they have to invest and how much of ownership they have to give to potential investors.
- Most of them value consider the current solution is sufficient to resolve these problems.
- Most of them (67%) do not plan to contact any business consultants (for business planning or market research)
- regarding the question how would other business simulation approaches help to solve their problem:
    - Own Excel calculations: for most of them do not help solving the problem.
    - Excel models developed by others: for most of them is partial solution, but still unsolved.
    - Business Simulation as a web-cloud service: for 40% of them would represent perfect solution and for 40% would represent also partial solution. The largest concert for them is estimation of model parameters for their future business.
- Most of them consider the idea of financial performance analysis & valuation of their own company/idea significantly appealing.
- 50% do not consider using business simulation software since it is too expensive or complex, while 50% of them are considering using business simulation in the future.
- 100% of participants would prefer using business simulation software in entrepreneurial education and training.
- The most important features of a business simulator are:
    - Market dynamics (Market Metrics: Customer Aquisition Cost (CAC), Lifetime Value of Customer (LTC) etc.),
    - Profitability estimation (Net Income: Monthly, Quarterly, Annually),
    - Company/Idea valuation (How much your idea worth at current stage),

    - Gaming control (so that you can simulate your future decisions month-by-month, quarter-by-quarter or year-by-year),
    - Pricing strategy simulation (based on demand-supply curves),
    - A business plan Wizard (e.g. 10 steps for building a business plan).
- The desktop version of the business simulator is perceived as very functional but not attractive regarding user experience.

Conclusion

This is research is still in progress. We have tested the business simulator on following users/stakeholders: (a) 20 startup entrepreneurs, students of Founder Institute accelerator program (most of them without financial background) and (b) 40 students from Vern' University of Applied Sciences business school in Zagreb (with financial background).

Based on our survey we can conclude that there is a potential significant demand for the business dynamics simulator for entrepreneurship in particular in the domain of entrepreneurial education, training and research. Startup community is a bit skeptical regarding the parameters estimation and therefore a new benchmarking for the model parameters has to be offered. We will employ the Startup Genome Report that annually offers referential business metrics for startups (e.g. churn rates, conversion rates, customer lifetime value – CLV, customer acquisition cost – CAC etc.) to calibrate the model in our next round of testing. Finally the user experience of the ideal business dynamics simulator has to be improved by making it - easy to learn, but hard to master.

The use of business simulators can improve entrepreneurial cognition by identifying the impact of resource bundling [7] and the management of information to realize the opportunities that have been identified in the process of entrepreneurship [21].

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