Modeling Start-ups using System Dynamics: Towards a generic model[1]

Xiaojun Huang
Warwick Business School
Coventry, UK
CV4 7AL

Martin Kunc
Warwick Business School
Coventry, UK
CV4 7AL

Paper to be presented at the The 30th International Conference of
the System Dynamics Society, St. Gallen, Switzerland
July 22 – July 26, 2012

Abstract

In system dynamics, different scholars have proposed templates to analyze similar problems, e.g. Peter Senge's archetypes. This paper attempts to develop a generic model for managing start-ups with the aim to provide a template for entrepreneurs to develop a system dynamics model of their own firm. The different experiments with the generic model suggest that long term management of key staff and cost optimizing are the right strategies to overcome the high rate of failure during the first 5 years of operation of start-ups.

[1] This paper is developed from Xiaojun Huang's dissertation for the degree in MSc in Business Analytics and Consulting.

Introduction

Managing a successful start-up is a formidable challenge for people who don't have experience running businesses and well-developed management skills (Reuvid and Miller, 2003; Woods, 2008). System dynamic modeling approach is widely used to understand growth engines, for example Market Growth Model (Forrester, 1968) and People Express (Morecroft, 2007). However, there are not system dynamics models that cover most aspects of driving growth in start-ups. The methodology employed in the paper comprises the following stages:

I. Understand the fundamental factors of running start-ups successfully and identify the critical resources which determine the fundamental characteristics of start-ups through case studies of various industries such as consulting, internet services.

II. Develop sets of resource maps (Kunc and Morecroft, 2009) of different industries to facilitate the system dynamic modeling process. Resource map is a map of the system that represents a unique set of strategic resources believed to be most important for driving business performance.

III. Develop a basic system dynamic model

IV. Employ the proposed system dynamic model to evaluate diverse strategies to ensure that those strategies are satisfactory to make start-ups sustainable

In this paper we present steps three and four.

Developing a generic system dynamics model for start-ups and growth strategies

Based on the insights obtained from analyzing different case studies (see appendix for the list of case studies), a generic system dynamics model for start-ups was developed to test diverse strategies and understand potential reasons for failures.

A general start-up 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 a very important element of a start-up business due to its impact on survival of the start-up. The following tables summarize the information:

Common Resources			
Potential customers	Customer base	Service in process	Order/Product in process
Staff	Cash available	Assets	Company brand

Common resources of a start-up business

Financing Variables			
Revenue	Profit	Cash in	Cash out
Service account for revenue	Product account for revenue	Total operating costs	Total production costs
Total staff costs	Hiring budget	Marketing budget	Investment budget

Key financing variables of a start-up business

The common resources and key financial variables are 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 using a marketing budget to perform different activities, such as advertising and promotional exercises. Following customer requirements, services and products are sold depending on the staff availability, which increases the costs reducing cash

(B1). The amount of products/services sold together with the service/product price determines the revenue increasing the profit. An increase in profit leads to more cash available and more marketing 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 existing 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). The equations of the model are in the appendix.

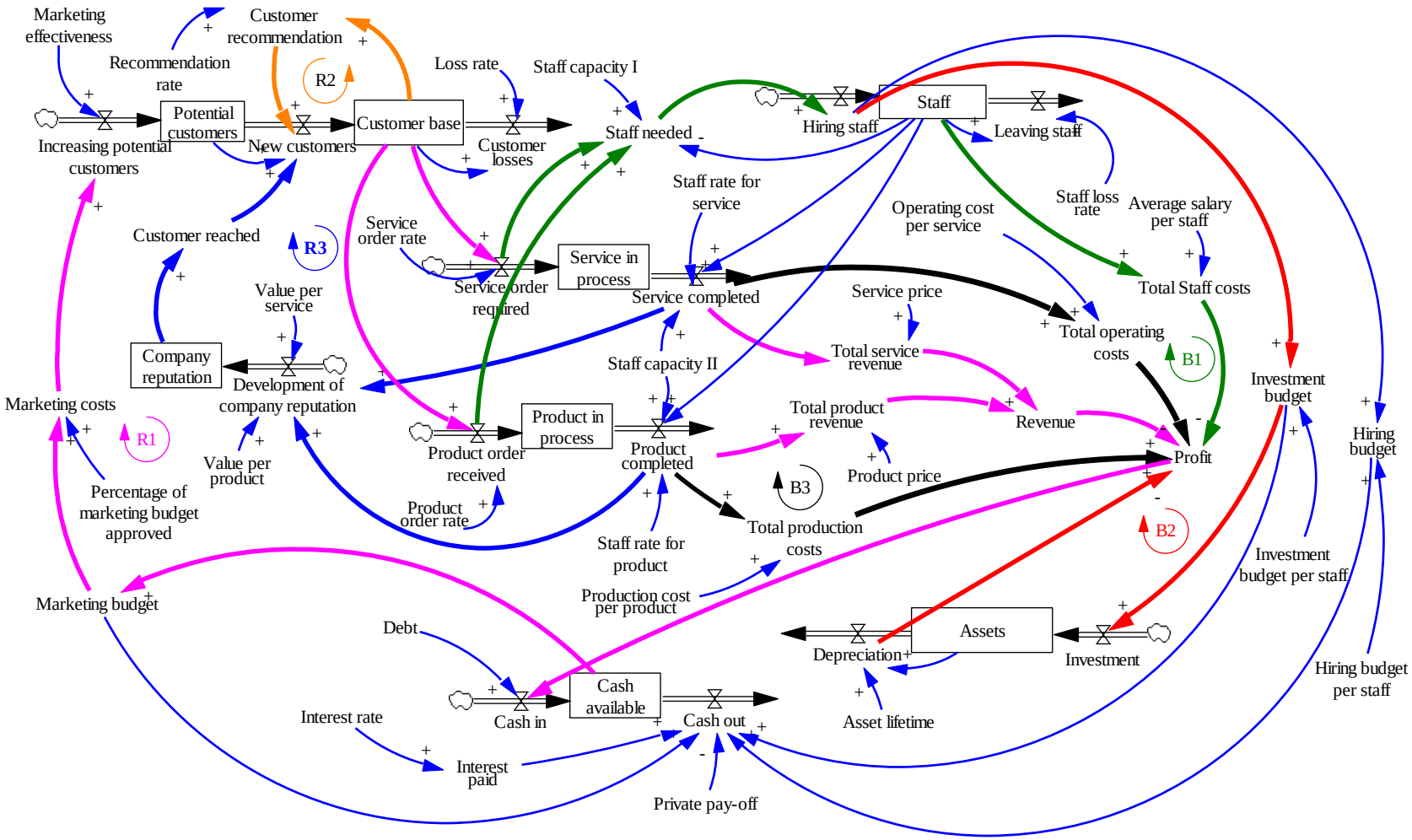


Figure 3. Generic model for Start-ups

Evaluate diverse strategies to ensure that those strategies are satisfactory to make start-ups sustainable

Using the generic model with initial parameters (see appendix 2 for the equations and key assumptions), we analyzed the long-term financial performance of the start-ups. Eight key decision variables are considered for experimenting with growth strategies and are presented in table 1.

1. Percentage of marketing budget approved	This variable means the percentage of the marketing budget used for marketing activities to attract potential customers
2. Marketing effectiveness	This variable is used to define the effect of market strategy. If the marketing effectiveness is too low, the start-up company will go bankrupt
3. Staff capacity	This variable indicates the number of customer orders that the staff can handle each quarter. In the basic model, it is assumed that each staff of the company is able to deal with 250 pieces of services/products for each quarter
4. Average salary per staff	This variable is used to define the average salary per staff of the company. If the cost is too high, the profit will decrease and the company will go bankrupt
5. Service/product price	These variables are used to define the price of service and product. If the price is too high, customers will leave. Or if the price is too low, the company cannot make profit and will go bankrupt
6. Operating/Production costs per service/product	These variables are used to define the production costs and operating costs of the outputs. These variables are directly influencing the profit of the company because if these costs are too high, the company should pay lots of money for the expenditure, in which cases the company may go bankrupt
7. Recommendation rate	This variable indicates the percentage of the prior customers who will make a recommendation to others to buy service or product from the company
8. Value per service/product	These variables indicate the percentage of customers attracted by the company's reputation after buying the product or using the service
9. Hiring/investment budget per staff	These variables are used to define the budget for hiring extra staffs. Specifically, hiring budget per staff means the company should pay the money for each extra staff hired, and this budget is used for training courses or recruitment. Invest budget per staff means the company should pay the money for each extra staff hired, and this budget is used for buying necessary equipments or facilities for the extra staff. If these budgets are high enough, the company might go bankrupt
10. Private pay-off	This variable is used to define the cash that the entrepreneur will take from the company for private used. For a start-up business, entrepreneur will only take money after the company becoming profitable

Table 1. Key variables

The worst-case scenario assumes heavy expenses (costs) of operating, production and human resource. The best-case scenario considers relatively low expenses of operating, production and human resource. The results are in figure 2.

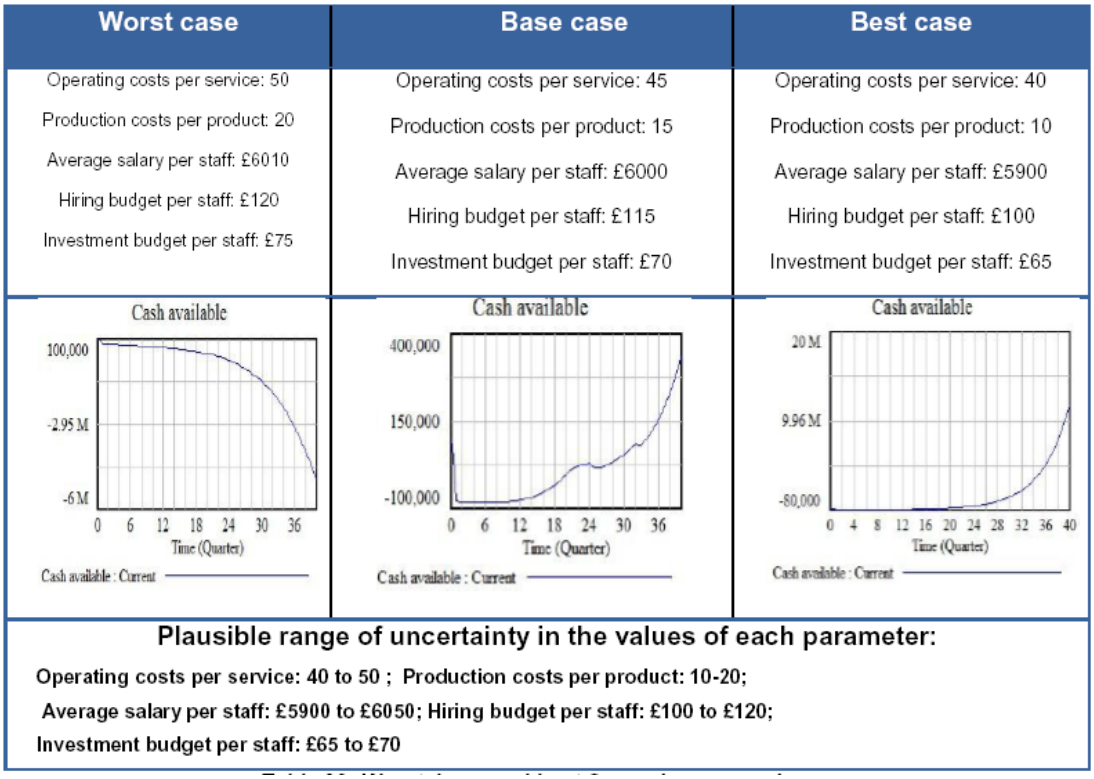
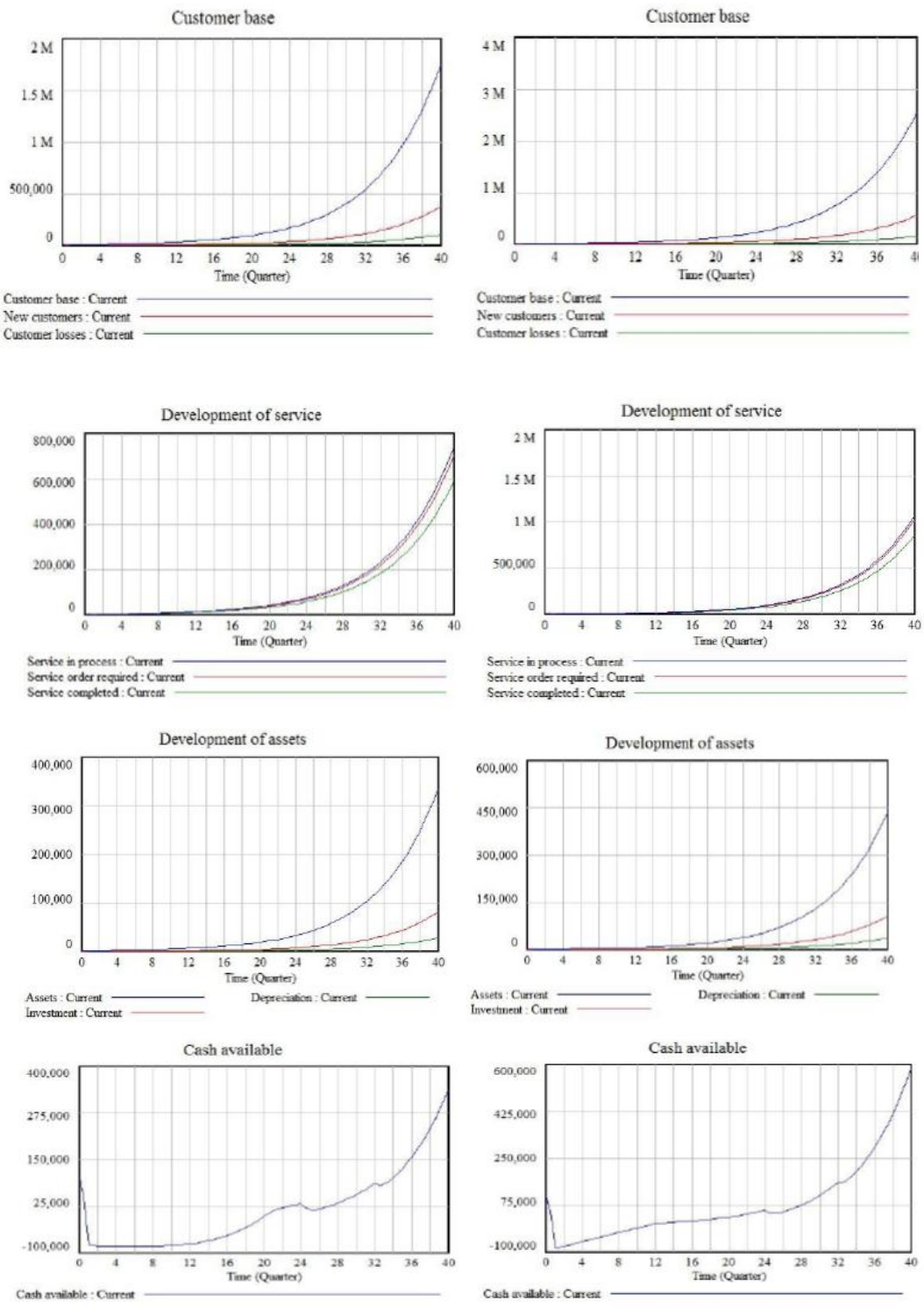


Figure 2. Scenarios using base model

Cost Optimizing Strategy[2]

Most start-ups fail in the first several years, the only way to avoid failure is to develop a growth strategy to help the company become profitable as soon as possible. A combination of capital raising, which involve an initial commitment to fund the venture, and HR management, where people retention and productivity increases are at the core of the decisions, is tested under this strategy. The simulation results are presented in figure 3.

[2] This is the only strategy where graphs are presented due to the similarities with the behaviour over time observed in the five strategies experimented.



Base Case Cost Optimizing Strategy

Figure 3. Strategy Cost Optimising

Compared with the base case, the number of customers will increase from 1,762,780 to 2,560,660 ten years later. The cash available will increase from £339,338 to

£586,805. It is clear that the company is sustainable after employing this very optimistic strategy. Particularly, the company is able to make profit at 11th quarter, compared with the base case which the company can only make profit at 20th quarter. The company can earn all the initial start-up capital at 30th quarter. This strategy can be successful to make the start-up sustainable.

Additional Strategies

Capital Raising strategy. According to the basic model in chapter 4, the initial start-up capital is set as £100,000 and subject to 5% interest payment for each quarter. Now, the company decides to raise capital in the form of equity, therefore there is a dividend payment instead of interest payment. It is assumed the company should pay 24% of the available cash to the investors every year (6% per quarter). And the initial start-up capital is set as £110,000. The owners will take some money for "private pay-off" (director's payments) as the base case. The number of customers in customer base will increase from 1,762,780 to 2,387,670 after ten years compared to the base case. Finally, the cash available will increase from £339,338 to £468,552. If the company raises fund in the form of equity, the company will start to make profit at the 11th Quarter.

Strategy Human resources management strategy. Therefore, it is suggested the human resources management (HRM) strategy is employed for the development of the startup company. After applying this strategy, the company can hire more "experienced" staffs to deal with the service. In this way the staff productivity (represented as "staff capacity" in the model) can be improved. Furthermore, the expenditures related to the recruitment can be reduced (represented as "hiring budget per staff") since "experienced" staffs does not need to have a "training process" to

improve their production capacity, they are able to manage the production process since they have lots of experiences. Nevertheless, there is no doubt that retaining experienced staffs lead to an increase in the staff costs because salary is the basic point to retain the experienced staffs. Therefore, an increase in the average salary for staffs is unavoidable. Hence, the staff capacity will increase from 250 to 280 per quarter, the average salary per staff will increase from £6000to £6700 compared to the base case. Moreover, hiring budget per staff will decrease to £100. The number of customers will increase to 1,876,750 ten years later, a slightly increase while compared to the base case. Finally, the cash available will increase to £423,731. The company will start to earn money 19 quarters after starting, only one quarter ahead the base case.

Staffing strategy. We will introduce an important resource (part-time staff) to deal with the service and product of the company. Even though employing part-time staff can lead to an extra part-time staff costs and hiring and investment budgets. However, the costs of those spending are lower than the costs for the full-time staffs. Many start-ups employ part-time workers to achieve flexibility during the beginning of their business. Since the costs of part-time staffs are lower than the full-time staffs, therefore it is assumed that the salary per part-time staff is £2300. Meanwhile, the staff capacity of part-time staffs will be set as approximately half of the full-time staffs. The number of customers will be 1,542,220, a slightly decrease while compared with the base case. The number of full-time staffs will decrease to 4101, a reduced amount of 1800 staffs compared with the base case. The cash available of the company will increase from £339,338 to £369,867 after ten years. The company will start to earn money 19 quarters after starting, only one quarter ahead the base case.

Operating Optimisation Strategy. It is noticed that one of the decision policies of the model states that extra staffs are hired once customers require services or products from the company. This policy maybe weak because of customers should wait until the company hiring enough staffs to deal with the services and products. And this might lead to an increase in the losses rate of customers. However, a start-up might not able to hire a large amount of staffs because of the limited capital. This strategy aims to hire extra staffs before operating on services and producing on products. In the base case, the initial value of staffs is zero, now the initial value of staffs is set as fifteen. The customers will increase to 2,186,490 after ten years. The cash available will increase to £440,339 ten years later. The company will start to earn money 19 quarters after starting, only one quarter ahead the base case

Summary of the Strategies

Table 2 displays the results obtained from each strategy in terms of resources accumulated, profitability and timeline to start making out money. The results confirm that the most difficult stage for start-ups is the first 36 months to recover its capital and different strategies may delay being profitable.

Comparisons of the growth strategies						
Strategy	**Base case**	***Capital raising strategy***	***HRM strategy***	***Staffing strategy***	**Cost Optimisation Strategy**	**Operating Optimisation Strategy**
Customer base	1,762,780	2,387,670	1,876,750	1,542,220	2,560,660	2,186,490
Potential customers	56,416	88,651	71,935	64,249	110,266	76,520
Service	590,050	798,300	626,584	466,337	854,056	731,100
Product	885,075	1,197,450	939,876	699,506	1,281,080	1,096,650
Staff	5,900	7,983	5,594	Full-time: 4101 Part-time: 1081	7,625	7,311
Assets	£336,861	£457,118	£320,313	£262,805	£437,789	£418,043
Profit	£4,397,310	£5,949,150	£4,784,580	£4,362,440	£6,521,450	£5,448,410
Cash available	£339,338	£468,552	£423,731	£369,867	£586,805	£440,339
Time to earn money	At 20 quarter	At 11 quarter	At 19 quarter	At 19 quarter	At 11 quarter	At 19 quarter
Time to earn back initial capital	At 34 quarter	At 31 quarter	At 32 quarter	At 33 quarter	At 30 quarter	At 31 quarter

Comparisons of the growth strategies

Table 3 presents an analysis of the strengths and weaknesses of each strategy considering its feasibility. Our analysis clearly suggests that generic templates are good starting point to discuss the strategy to manage a start-up. However, this should not be considered the only tool or the final model to rehearse your strategies (Kunc and Morecroft, 2007).

Strategy	Strengths	Weaknesses
1. Capital raising strategy	• Customers, completed services and products, profit and cash available increase immediately • The company can make more profit than the base case • The company can become profitable at 11 quarters and can earn back all the initial start-up capital at 31 quarters • The initial start-up capital for equity investment is higher than the debt investment • No interest payment • The company do not need to pay dividend to shareholder every year so that company can retain money for further development	• An increase in the number of staffs resulting in extra staff costs and asset investment costs • It is not easy to make profit during the first several quarters of the start-up business • The price of dividend payment is subjected by the market • It is hard to control the running process because of the company is controlled by several shareowners • It is hard to implement decision policy because different shareholders might have different opinions • It is not easy to fund capital from investors because of it is a new business • The investors may leave because the slow development during the first several years so that the company is easy to collapse
2. HRM strategy	• An increase in customers, completed services and products, profit and cash available compared to the base case • A decrease in the number of staffs and assets • The company can become profitable at 19 quarters and it can earn back all the initial start-up capital at 32 quarters • It is easy for entrepreneur to make any decision policies because of the company is controlled by the owner (entrepreneur)	• It is difficult to implement the processes of retention, recruitment and succession • It is not easy to improve the staff capacity • The salary pay for the skilled staffs is higher than the normal staffs • The company will collapse if some of the skilled staffs suddenly leave • It is not easy to make profit during the first several years of the start-up business
3. Staffing strategy	• An increase in potential customers and cash available • A decrease in the number of staffs and the amount of assets • The company can make more profit than the base case • The company can become profitable at 19 quarters can earn back all the initial start-up capital at 33 quarters • It is easy for entrepreneur to make any decision policies because of the company is controlled by the owner(entrepreneur) entirely	• A higher losses rate of the part-time staffs • It is difficult to hire part-time staffs • The royalty of part-time staffs is low which may have a negative effect on the reputation of the company • The training process for part-time staff is difficult • It is not easy to make profit during the first several quarters of the business
4. Cost Optimisation Strategy	• Customers, completed services and products, profit and cash available immediately increase • A decrease in the number of staffs and assets • The company can make more money than the base case • The company can become profitable at 11 quarters can earn back all the initial start-up capital at 30 quarters • The initial start-up capital for equity investment is higher than the debt investment • No interest payment • The company do not need to pay dividend to shareholder every year so that company can retain money for further development	• The price of dividend payment is subjected by the market • It is hard to control the running process because of the company is controlled by several shareowners • It is hard to implement decision policy because different shareholders have different opinions • It is not easy to fund capital from investors because of it is a new business • The investors may leave because of the slow development during the first several year • It is difficult to implement the processes of retention, recruitment and succession • It is not easy to improve the staff capacity because it should take long time to train the staffs • The salary pay for the skilled staffs is higher than the normal staffs • The company will collapse if some of the skilled staffs suddenly leave
5. Operating Optimisation Strategy	• Customers, completed services and products, profit and cash available increase immediately • A decrease in the number of staffs and amount of assets • The company can make more money than the base case • The company can become profitable at 19 quarters and can earn back all the initial start-up capital at 31 quarters • It is easy for entrepreneur to make any decision policies because of the company is controlled by the owner	• The company is easy to go bankrupt during the first several quarters for the reason that the staff costs must be paid before the company making profit

Table 2. Strengths and Weaknesses of the Strategies Analysed

Conclusions

Our paper attempts to lay out the foundation stone for more research on system dynamics model archetypes similar to Senge's archetypes (1999) to help managers to cope with dynamic complexity. However, there are limitations to this approach. For example, since different industries have different specific characteristics, entrepreneurs should conduct further research on the market of the industry before starting a new business, particular on the customer's aspects and competitor's aspects. Since all of these strategies have weaknesses, we suggest further analysis on start-ups growth strategies, such as the market strategy and pricing strategy based on the particular characteristics of the business that the entrepreneur wants to start.

The simulation results generated by the model measured the KPI's of a business in four dimensions:

- Market/marketing management
- Operation (service and product) management
- Human resources management
- Financing management

Apart from these, the simulation results of the model indicated that a start-up company is sustainable but only can make profit after 20 quarters similar to the fact that lots of new companies fail particular on the first several years (Beaver, 2003).

References

Beaver, G. (2003). " Small Business: Success and Failure". Strategic Change, 12(3): 115-122

Kunc, M and Morecroft, J (2007). System Dynamics Modelling for Strategic Development in Dyson, R and O'Brien, F. (eds.) Supporting Strategy: Frameworks, Methods and Models, Wiley & Sons.

Kunc, M (2008). Achieving a balanced organizational structure in professional services firms: some lessons from a modeling project. System Dynamics Review Vol. 24, No. 2, (Summer 2008): 119–143

Kunc, M. and Morecroft J. (2009). Resource-based strategies and Problem Structuring: Using resource maps to manage resource systems. Journal of the Operational Research Society, 58: 191-199.

Morecroft, J (2007).Strategic Modelling and Business Dynamics, Wiley & Sons.

Reuvid J and Miller. R (2003), Start Up & Run Your Own Business. London: Kogan Page.

Senge, P (1999). The Fifth Discipline. Random House.

Steiman J (2005). Top ten industries to start and grow business. [Online]. (URL: http://www.inc.com/articles/2005/04/top10.html)

Woods, C (2008). Brilliant start-up: how to set up and run a brilliant business. Harlow, England; New York: Pearson Prentice Hall.

APPENDIX 1

Steiman (2005) suggest top ten industries in the USA which are considered to be the most valuable for entrepreneurs to start and grow a business:

Top Ten Industries	
1. Internet/information services	2. Computer systems and related services
3. Software	4. Employment services
5.Management, sciences and consulting services	6. Home Health Care
7. Personal Financial Advisory	8. Childcare Services
9. Art, Entertainment and Recreation	10. Motion Picture/Video

To build a comprehensive resource map for the start-up company, it is suggested the following steps should be included:

Key Steps for Building the Resource Map	
Step One	Capture the kinds of information that concerns the basic characteristics of the company
Step Two	Identify the essential variables which are perceived to be the source of competitive advantage
Step Three	Display the growth behavior of the company
Step Four	Describe the interactions of the variables/resources

Table ˆ: Key Steps for Building the Resource Map

The following tables display the analysis performed with the different businesses.

Key Factors		
Falling PC prices	Increased connection speed	Increased number of computers
Development of Business plan	Financing(Debt)	Marketing activities

Table : Key Factors of an Internet business

Strategic Resources		
Website page	Customer base	Cash available
Staff	Potential customers	Order in service
Assets	Product brand	Website Reputation

Table : Strategic resources of an Internet business

Source: (adapted from) Julie (2007)

Key Factors		
Increasing reliance on information technology	Falling prices of computer	Computer security
Internet	Automated manufacturing	Financing (Equity)

Table : Key factors of a computer system business

Strategic Resources		
IT assets	Staff	Customer base
Service in process	Software in process	Potential customers
Store	Company brand	Cash available

Table : Strategic resources of a computer system business

Source: (adapted from) Newberry Group (2010)

Key Factors		
Changing of environment	Quality of consultant	Specialized expertise
Financing(Debt)	Marketing activities	Service price

Table : Key Factors of a consulting business

Strategic resources		
Staff(Consultant)	Service in process	Experience with consulting process
Company brand	Cash available	
Potential customers	Customer base	Assets

Table : Strategic resources of a consulting business

Source: (adapted from) Milestone Group (2009)

APPENDIX 2

Variables	Assumptions
1. marketing effectiveness	Potential customers are increased depending the marketing costs according to the marketing effectiveness, and the marketing effectiveness rate is set as "4%", if the marketing effectiveness rate is zero, there will be no potential customers and the company will go bankrupt
2. Percentage of marketing budget approved	The percentage of marketing budget approved is set as " 80%" of the available cash, if the marketing budget approved rate is zero, there will be no potential customers enter to the company so the company will go bankrupt
3. Staff capacity	Staff capacity is constant (250 services or products /staff/quarter). If the staff capacity decline, more extra staff should be hired but which will lead to extra staff costs thereby decreasing the profit and the company will go bankrupt
4. Value per service/product	New customers can be addressed by the reputation of the company. The "value per service" refers to the value generated by the completed services. Every "100" completed services attract 4 customers, therefore "value per service" is set as "4%"; Besides, the "value per product" is set as "2%". If the value per product is zero, the company reputation will not increase. Hence, an increase in company reputation depends on these values. However, the company' reputation does not play an important roles on the development of the company since most of the new customers can be reached by potential customers and customer recommendations
5. Average salary per staff	The average salary per staff is constant(£6000/staff/quarter), the profit and cash available must fall and the company must go bankrupt if this value rises high enough
6. Interest rate	The bank has £100,000 for the start-up company. We assume that the firm obtains money in the form of "debt", therefore there is an additional cost of interest (chapter 2, section 2.2.3, table 4), and the interest rate is set as "5%". If the interest rate is zero, it means that the company does not need to pay any interest to the bank and the available cash of the company will increase immediately. However, this is not acceptable because as a general rule that

	capital rising in the form of "debt" must pay interest to the bank. But if the interest rate is too high, the available cash will decrease and the company will go bankrupt
7. Service price	The price of service is constant (£90/service), if the service price rises high enough, the profit of the company will grow unexpectedly, which does not behave in a realistic fashion because it is well-known that most of the start-up companies will fail particular on the first several years. However, if the service price is too low, the profit will decrease and the company will go bankrupt
8. Product price	The price of product is constant (£30/product), if the price of product rises high enough, the profit of the company will grow unexpectedly , which does not behave in a realistic fashion because it is well-known that most of the start-up companies will fail particular on the first several years
9. Operating cost per service	The operating cost per service is constant (£45/service). If the operating cost per service is higher than the service price, there will be no profit and the company will go bankrupt. Or if it is too low, the company cannot make enough profit to sustain its development and will go bankrupt as well
10. Production cost per product	The production cost per product is constant (£15/product). If this cost raises high enough, the profit will decrease and the company will go bankrupt. Or if it is too low, the company cannot make profit and will go bankrupt as well
11. Private pay-off	The entrepreneur will take £30,000 of the available cash for private pay-off from year 6 to year 7, and then will take £60,000 from year 8 to year 10. This an important decision rule, the entrepreneur only takes money from the company after the company making profit, if the entrepreneur takes money from the company during the first five years, the company will go bankrupt. Or if the company takes too much from the company, the start-up cannot grow and will go bankrupt as well
12. Investment budget per staff	The investment in assets is necessary for each staff hired, and the amount to invest is £70 per extra staff. If the investment budget per staff raises high enough, the "cash available" will decline and the company will go bankrupt. But having no investment budget for extra staff is not a realistic behavior
13. Hiring budget per staff	The hiring budget is necessary for each supported staff hired, and the amount of hiring budget for each staff is £115. If the hiring budget per staff raises high enough, the "cash available" will decline and the company will go bankrupt. But having no budget for extra staff is not a realistic behavior for a company
14. Loss rate	Customer base increased by new customers and decreased by 6% because the customers have not recommended the services/products to others and the

	effect from competitors. If the loss rate of the customer base is higher than the number of customers enter to the company, which means that the customer base will not increase and the "service in process" or "product in process" must immediately go down
15. Recommendation rate	An increase in new customers is based on the recommendations of prior customers. 3% of the prior customers will give a recommendation to others per quarter. Besides, new customers can be addressed by potential customers
16. Staff loss rate	The number of staffs will decreased 4% per year because of retirement and accidents, which behaves in a realistic manner
17. Staff needed	Extra staffs are hired once customers require services or products from the company
18. Service/product order rate **Staff rate for service**	There are 40% of the customers will require the services and 60% of the customers will order the products and these represented as the "service order rate" and "product order rate" in the model separately. Besides, there are 40% staffs are responsible for the "service completed" and 60% staffs are responsible for the "product completed" and they are represented as the "staff rate for service" and "staff rate for product" respectively
19. assets	The assets include all the related equipments and facilities, and the initial value of assets are set as £1,000 for a start-up
20. Asset lifetime	The depreciation period (asset lifetime) is 12 quarters(3 three years) and it is accepted by the market

Vensim - List

Cash available= Cash in-Cash out
Cash in= Debt+Profit
"Private pay-off"= STEP(30000,24) + STEP(30000,32)
Profit= Revenue-Total Staff costs-Total operating costs-Total production costs-Depreciation
Marketing budget= IF THEN ELSE(Cash available>0, Cash available, 0)
Cash out= INTEG (Interest paid+Investment budget+Hiring budget+Marketing budget+"Private pay-off", 0)
Interest rate=0.05
Marketing costs= Marketing budget*Percentage of marketing budget approved
Debt= STEP(100000,0)-STEP(100000,1)
Interest paid=100000*Interest rate
Increasing potential customers= INTEGER(Marketing costs *Marketing effectiveness)
Asset lifetime=12
Assets= INTEG (Investment-Depreciation,1000)
Product completed= INTEGER((Staff*Staff rate for product)*Staff capacity II)
Product in process= INTEG (INTEGER(Product order received-Product completed),0)
Product order received=INTEGER(Customer base*Product order rate)
Company reputation= INTEG (Development of company reputation,0)

Customer base= INTEG (INTEGER(New customers-Customer losses),0)
Investment budget per staff=70
Customer reached=Company reputation
Total product revenue=Product completed*Product price
Total production costs=Product completed*Production cost per product
Depreciation=Assets/Asset lifetime
Hiring budget=Hiring staff*Hiring budget per staff
Hiring budget per staff=115
Hiring staff=INTEGER(Staff needed)
Development of company reputation= INTEGER(Service completed*Value per service+Product completed*Value per product)
Investment=Investment budget
Investment budget= Hiring staff*Investment budget per staff
Value per service=0.04
Staff needed=INTEGER((Product order received+Service order required)/Staff capacity I-Staff)
New customers= INTEGER(Customer recommendation+Potential customers +Customer reached)
Value per product= 0.02
Total Staff costs= Staff*Average salary per staff
Percentage of marketing budget approved= 0.8
Potential customers= INTEG (INTEGER(Increasing potential customers),0)
Average salary per staff= 6000
Product price= 30
Customer losses= INTEGER(Customer base*Loss rate)
Customer recommendation=Customer base*Recommendation rate
Service in process= INTEG (INTEGER(Service order required-Service completed), 0)
Service order rate= 0.4
Service order required= INTEGER(Customer base*Service order rate)
Service price= 90
Staff= INTEG (INTEGER(Hiring staff-Leaving staff),0)
Staff capacity II=250
Staff rate for product= 0.6
Staff rate for service= 0.4
Leaving staff= INTEGER(Staff*Staff loss rate)
Loss rate= 0.06
Marketing effectiveness= 0.04
Operating cost per service= 45
Production cost per product= 15
Staff capacity I= 250
Product order rate= 0.6
Recommendation rate= 0.03
Revenue= Total product revenue + Total service revenue

Service completed= INTEGER((Staff*Staff rate for service)*Staff capacity II)
Total service revenue= Service completed*Service price
Total operating costs= Service completed*Operating cost per service
Staff loss rate= 0.04