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THE APPLICATION OF SD FOR MARKET STRATEGY

- The Local Government Server Market of Korea -

Sang-Hyun Park[1], Seung-jun Yeon[2], Sang-wook Kim[3], Won-Gyu Ha[4]

Electronics and Telecommunications Research Institute (ETRI)
161 GajongDong, Yusung-Gu, Daejon, 305-350 Republic of Korea
ubiquitous@etri.re.kr[1], sjyeon@etri.re.kr[2], wgha@etri.re.kr[4]

Department of MIS, Chungbuk National University
#48 GaeshinDong, Cheongju City, Chungbuk, 361-763 Republic of Korea
sierra@chungbuk.ac.kr[3]

Abstract *: Continual building and reviewing business strategies are indispensable for the profit organizations to gain or maintain competitive advantage in the market. But such strategies sometimes mislead the companies to hazardous conditions. This is mainly because symptomatic reaction in short-term perspective overrules holistic response in longer term. Quite often the importance of investigating the dynamics and the delayed feedback effects of structural mechanism underlying the environmental changes is overlooked in the process of building strategies. Systems thinking may be the best alternative in analyzing structural features of the target market as a whole. By introducing a case of the local government server market of Korea, this paper attempts to depict how systems thinking and system dynamics simulation approach can be effectively applied to exploring alternative proposals and finding a best strategic option.*

1. INTRODUCTION

'Building a market strategy' is important enough to be regarded as a keynote taken to succeed in the present or in the future market. Continual building and reviewing business strategies are indispensable for the profit organizations to gain or maintain competitive advantage in the market. But such strategies sometimes mislead the companies to hazardous conditions and end up with disappointing consequences. This is mainly because symptomatic reaction in short-term perspective overrules holistic response in longer term. Quite often the importance of investigating the dynamics and the delayed feedback effects of structural mechanism underlying the environmental changes is overlooked in the process of building strategies. Assumptions about the future demand and the performance are essential for many business decisions. For example, how much to produce; how much capacity and other resources to acquire; what products to develop; and how much financing to be needed by the business, etc. Sometimes managers tend to make the naive forecast, assuming that the future will be like the past or the past trend (Lyneis, 2000). Needless to say, companies devote significant efforts, using the traditional methodologies like statistics or accounts models, to estimating the future demand for their products and determining the consequences of the demand on business performance. Number-crunching approach to grabbing the future trends, however, is no longer workable in the complex system like business environment with high uncertainty of late. Complex systems behave differently from simple systems where number-crunching methods are appropriately working. A complex system appears to have many variables, many factors at play, and many semi-independent but interlocking components. In a complex system, thus, the dominance of the different feedback loops shifts and the timing and length of delays vary. For this matter, number-oriented forecasting techniques may mislead decision-makers to take wrong actions. For example, actions taken by forecasts that misestimate demand create adverse consequences. Underestimates of demand can lead to self-fulfilling prophecies as feedbacks, often through product or service availability, drive sales to equal the capacity provided to meet the forecast(Lyneis 1980). Also, decisions taken by overestimates of demand can lead to over-capacity and financial difficulties. These instances are easily found from the electric utility industry in the 1970s, the petroleum industry in the 1980s, and the personal computer industry in the late 1980s(Barnett 1988).

As a result of forecast inaccuracies and potential misuse in decisions many system dynamics practitioners desire to shift managerial emphasis away from forecasting and towards understanding and policy design. Sterman(2000) and Hyun & Kim(1998) contend that the purpose of modeling is not to anticipate and react to problems in the environment but to eliminate the problems by changing the underlying structure of the system. In the same context, Lyneis(2000) suggests that the proper use of system dynamics models for market "forecasting" and structural analysis can therefore add value to clients in several ways:

- System dynamics models can provide more reliable forecasts of short to mid term trends than statistical models, and thus lead to better decisions.
- System dynamics models provide a means of understanding the causes of industry behavior and thereby changes in industry structure.
- System dynamics models allow the determination of reasonable scenarios as input to decisions and policies.

With beliefs aforementioned, this paper attempts to show how nicely system dynamics methodology (Forrester 1961; Goodman 1989; Richardson and Pugh 1981; Sterman 2000) can be applied for market analysis and strategy establishment. By introducing a case problem of a domestic server supplier's setting strategies coping with the computer server market of local governments in Korea, this paper aims at three objectives as follows: First, analyzing the dynamics and the delayed feedback of structural mechanism underlying the server market of local governments in Korea. Second, identifying the problems with basic assumptions or perspectives toward the market a domestic server supplier (hereinafter, company "ALPHA") has. Third, presenting a set of assumptions and market strategy are workable for the computer server market, with casual loop diagrams and stock-flow diagrams based on system dynamics.

2. CASE STUDY

2.1. The Local Government Server Market in Korea

The computer server market of local governments in Korea started forming in full-scale as information systems(IS) project for the public administration was launched in nation-wide in 1992. Since that time on, the local government server market (hereinafter, LGS market) has grown rapidly up to year 2000, reaching 450 servers in use

Will the LGS market continue to grow as in the past? The answer to this question would not be very positive, taking into account the Nolan(1979)'s DP(data processing) Growth Stage Model(Figure 1) which is widely referred to by not only practitioners but academicians as a bench-marking framework for information systems planning that matches various features of information systems to the stages of growth. It should be noted that management responses to growth in computing are reflected in different levels of control or slack at each stage.

The LGS market appears to have gone through initiation and contagion stages so far, and thus enjoyed rapid growth, where experimentation with and adoption of computers by many users and proliferation of applications are typical phenomena. However, entering into control stage beyond contagion stage, organizations begin to perceive the problems with rapid growth in computer use – for example, applications incompatibility and data duplications, etc., and begin to impose high level of controls usually based on cost effectiveness criteria. A task of information systems planning is given increased emphasis at this stage. The Korean government recently took measures similar to those taken by organizations at control stage. Prohibiting duplicate investment in IS projects and demanding every local government to set up ISP (information strategy plan) beforehand have been enforced. In line with this, as a means of preventing duplicate investment and resolving the problem of applications and data incompatibility among the local governments, the central government launched a project of developing a comprehensive information system covering twenty-three functional areas (such as Land Registry, Welfare, Rural Affairs, Residence, Vehicle, Public Finance & Tax, Architecture, Water Supply & Drainage, etc.), all of which two hundreds thirty two primary administration bodies throughout the nation have in common to deal with civil petitions. Distribution of this system as a national standard for the public administration ended in 2002. It appears that this type of regulatory trend will go on at least for the time being.

This environmental change may be critical to the case company (hereinafter referred to 'ALPHA') whose major business is selling computer servers to the public sector including local government bodies, and force it to review the market assumption from the zero-base: how the future server-market will change and what would be the appropriate strategic options to meet the change in order to remain a leader in the market. Nonetheless, quite a few key members of the company are found to take it easy in negligence of its impending potential danger. After several meetings with them, we have come to a conclusion that this is mainly because they have a wrong mental model on the actualities of the target market.

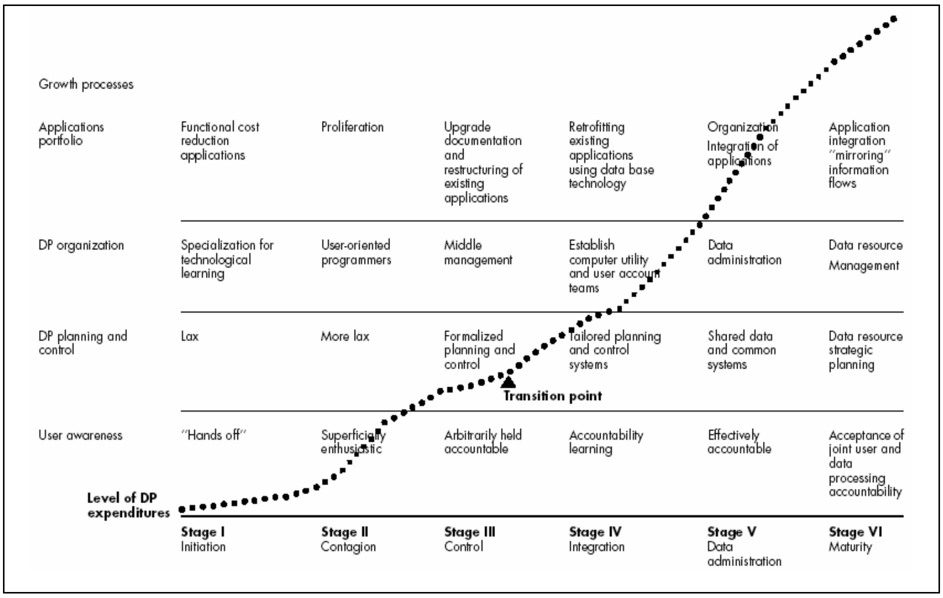

Figure 1. Six Stages of Data Processing Growth(Nolan, 1979)

2.2. Casual loop diagrams

The mental model the ALPHA crew has, in the systems thinking point of view, can be depicted as a casual-model with only positive feedback loops as in figure 2. High percentage of market share ALPHA retains at present would be enough to lock-in customers by increasing externalities like compatibility, stability, technical after-services, etc. This is what they believe: As the installed base of customers grows, more and more new customers will find adoption worthwhile. Therefore, now that ALPHA has gone beyond the critical mass of customers, the present market share will maintain and the revenue will be generated as in the past. In the system dynamics notions, this is a typical example of consolidating loops generating positive feedback and reinforcing one another.

It should be noted that the source of positive feedback in the this case mainly comes from the demand-side of the market (so-called '*demand-side economies of scale*,' instead of the supply-side. Thus, seemingly the ALPHA's standpoint makes a sense in this aspect. However, this highly optimistic mental model clearly fails to fit the real world situation, as self-reinforcing behaviors generated by positive feedback loops, if possible, can't exist long in reality. It is simply like a puzzle with some critical pieces missing unless some balancing loops are included in the model to be more realistic. There may exist quite a few balancing loops in the case. For simplicity, however, two major balancing feedback loops are added to the model, representing the limit of quality maintenance service capacity and the limit of business performance as the market expands. Figure 3 shows a modified casual loop diagram by incorporating the balancing factors.

According to a prior survey, overall satisfaction of the local governments with ALPHA and its services turns out below expectation, and it is primarily due to dissatisfaction with the responsiveness of after-services and technical assistance. The quality of maintenance service in particular is found below average. There are a lot of complaints on the salesmen's performance in terms of the responsiveness to customer's demands. For the past several years, the local governments at all levels have introduced computer servers for their uses and the server market of the public sector has rapidly grown. During that period, ALPHA has been successful in gaining critical mass and entering into the position where the large get lager. This leads ALPHA to staying with optimism towards the market and overlooking the fact that the deterioration of the customer satisfaction level is mainly caused by its market share in size outgrowing its service capacity.

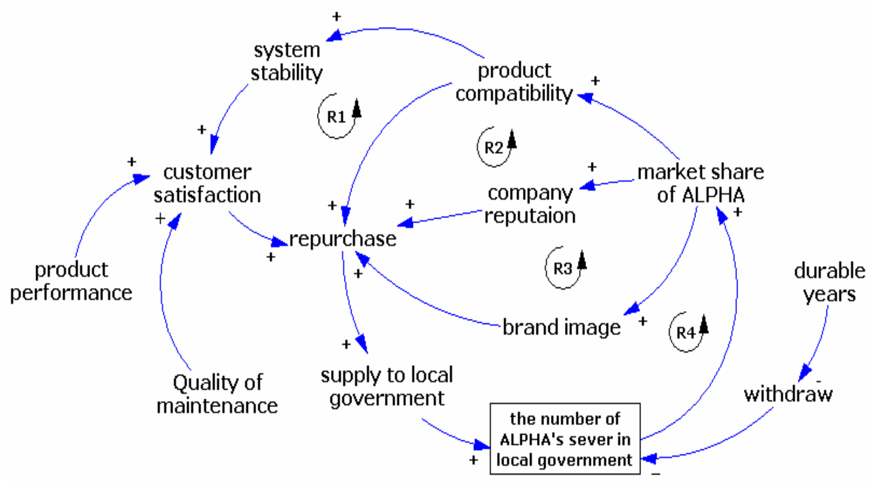

Figure 2. Casual loop presentation of ALPHA's mental model on the LGS Market

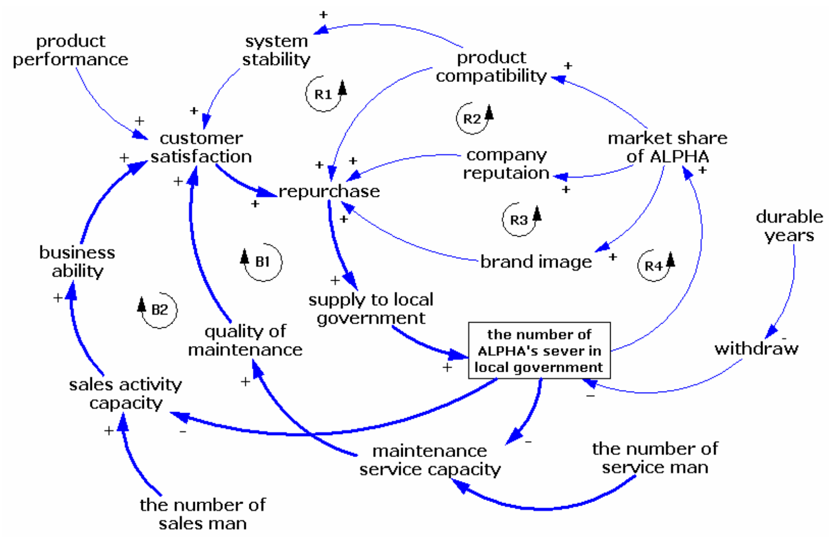

Figure 3. Modified casual loop diagram with negative feedback loops incorporated

The lower quality of maintenance service leads to the lower customer satisfaction and thus the repurchase rate, which will in the long run result in lowering the market share and hampering replenishment of the sales force. This sequence forms a negative feedback loop and makes the limits of growth in the system. Customer satisfaction is determined by not only product-inherent factors but service factors as well. In case of industrial goods, as Finkelman(1990) pointed out, the factors like maintenance, business support, installation, education, etc., play a decisive role on the customer satisfaction. Maintenance services in particular, occupying 40%, is dominant. Another point not to be overlooked is that the LGS market has almost saturated and a substitute demand for new servers periodically turns around about every five years. The cyclical ups and downs of new server demands would make the revenue structure unstable. This perhaps implies that ALPHA has to put its strategic focus from now on improving the quality of system maintenance rather than attempting to create new demands. Increasing system maintenance contracts via escalating customer satisfaction with services would be a lot more effective in securing the source of stable revenue than creating new demands. Besides, it would also affect repurchases positively in the long term. This presumption is baked up clearly through computer simulation runs.

3. SIMULATION AND POLICY LEVERAGES

3.1. Stock-Flow Diagram for Simulation

Based on the causal map in Figure 3, a stock-flow diagram in Figure 4 is developed for computer runs with system dynamics simulation package, ‘STELLA.’ Constants are calculated with raw data ALPHA retains and some external variables and variables hard to be quantified are given default values or ratios. Decision-making related factors are treated as external variables to experiment diverse scenarios. Time span for simulation is set from 1998 to 2018. A graph function is devised for the change of market trend in terms of size (in the number of units), using actual data up thru 2001 and fictitious data beyond 2001 with an assumption of 3% annual growth generated from the data and traffic increases.

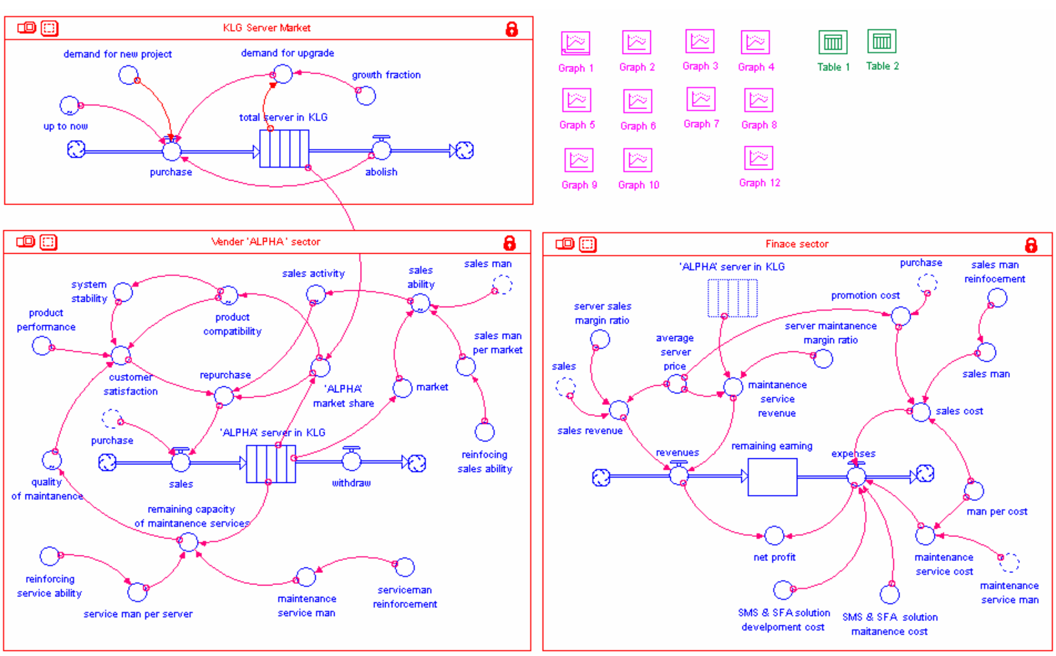

Figure 4. Stock-Flow Diagram for Simulation Runs

3.2. Simulation Runs and Policy Leverages

In the above simulation model key policy variables are the size of service personnel and sales staff, server maintenance capacity per service person without hurting customer satisfaction, order-receiving performance per salesman, new demand from the new IS projects and so on. Satisfying solutions can be obtained by adjusting these situation variables whose initial values are given. Figure 5 to Figure 7 are the results from the first simulation run with an assumption that current situation remains unchanged for the time span. The sale drops constantly while annual sale volume repeats ups and downs(Figure 5), and so does the financial status (Figure 6). What's worse is that repurchase rate, market share will drops sharply, while sales activity and maintenance service quality go downward gradually (Figure 7).

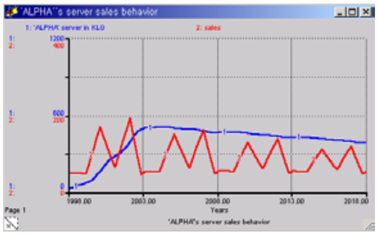

Figure 5. ALPHA's server sales
1.ALPHA's servers in KLG 2.sales

Figure 6. Financial Status
1.expenses 2.revenues 3.net profits

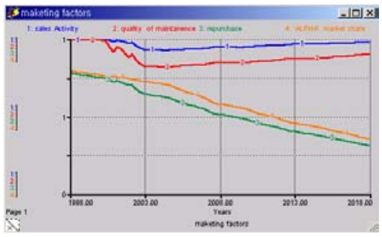

Figure 7. Marketing factors
1.sales activities 2.quality of maintenance
3. repurchases 4.ALPHA's market share

The rationale behind these behavioral patterns is that a slight decrease in the performance of sales and maintenance services will bring about a sharp down-slope of market share and repurchase rate. The first run indicates that increase in customer satisfaction level is the utmost task for ALPHA to take. Another policy implication is that whereas sever demand shows a periodic surge the server purchase (actual installation) rate is increasing constantly, even without considering natural increments caused by the increase in data and traffic volume. The stable rate of holding servers implies to the policy makers of ALPHA that maintenance service reinforcement and thus increase in service quality from it is very critical for the stability of revenue.

Figure 8 thru Figure 10 show the results of the second simulation by stepping up the technical assistance and the sale forces with ten workers supplemented each in 2003. Server sale volume turns out slightly higher (Figure 8) and the market share and the repurchase rate are a lot improved and maintained at reasonable levels throughout the period (Figure 8 & Figure 10). On the other hand, the maintenance quality and the sales activities show notable improvement in the beginning and then gradually lowered down to the first run's levels (Figure 8 & Figure 10). This means simple increment of manpower may not be the fundamental solution in the long term. Stepping up the sale force in particular turns out ineffective. Rather, it causes deterioration of financial status due to drastic increase in personnel expenditure although net profit recovers gradually after a sharp drop (Figure 9).

Overall picture of the second run indicates that a simple increase in manpower of maintenance and sales does not work very well. There exist, however, three implications to the policy-makers of ALPHA. First, technical staff for the quality maintenance services has to be supplemented as soon as possible. Second, the increment of sale forces has to be determined in line with financial status. Third, together with the increase of manpower, some complementary measures like computer solutions for SM (Systems Management) and SFA (Sales Force Automation) have to be taken for productivity gains.

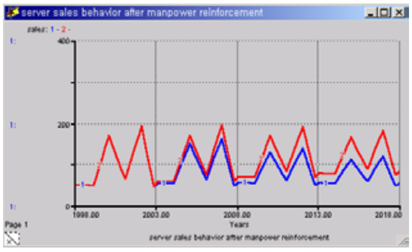

Figure 8. Server sales
1.before 2.after

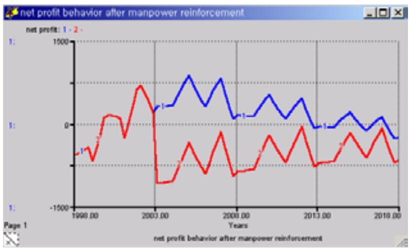

Figure 9. Net profits
1.before 2.after

Figure 10. ALPHA's market share
1.before 2.after

For the third run, the following assumptions are made: Stepping up the manpower to the same level as in the second run, together with introducing computer solutions for SM and SFA with 50% productivity gain each. Costs incurred from developing and maintaining the solutions are also reflected in the model. As shown in Figure 11 to Figure 13, the overall picture of business projections turns out a lot better, and the implications derived from the second run are testified.

ALPHA at present fails to notice customer's defecting signal mainly because of their wrong mental model on the target market. It should be noted that ALPHA's case is a typical example of so-called "Growth and Under-investment," a special case of the "Limits to Success" archetype. ALPHA has experienced a growth in demand, which in turn begins to outstrip the firm's capacity. As the simulation runs indicate, the best possible course of action ALPHA has to take would be to expand the service capacity, together with supportive solutions for SM, SFA, and the like

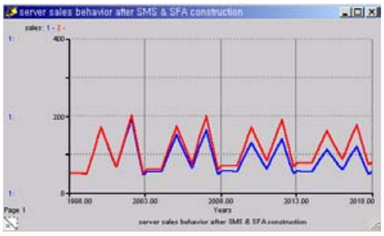

Figure 11. Server sales-1
1.before 2.after

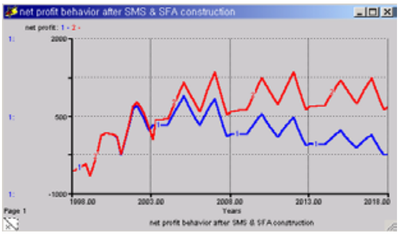

Figure 12. Net profits-1
1.before 2.after

Figure 13. ALPHA's market share-1
1.before 2.after

4. CONCLUSIONS

This paper attempts to show how effectively the system dynamics simulation could be applied for the market strategy by introducing a typical case of so-called "Growth and Under-investment," a special case of the "Limits to Success" archetype. Admitting that the simulation model presented needs a lot further improvement to be more realistic, we hope that this paper would provide some general ideas and guidelines for the market strategy planning with simulation techniques – system dynamics in particular. As a closure of discussion, a set of step process for finding a solution to such problems as ALPHA faces is presented below:

Step 1. Start with a single reinforcing loop by identifying a key growth engine. Once one loop is successfully drawn, then identify additional reinforcing loops that are relevant. In this process it is important to focus on dynamic behavior by identifying growth loops, not just growth factors. This helps emphasize the process that is feeding back and regenerating itself.

Step 2. Determine the point in time when the company's growth doubles if marketing efforts continues (at a certain percentage of sales, for example). It is very important because doubling time is the starting point where the growth would outstrip current capacity.

Step 3. Identify potential limits and balancing loops. It may help to categorize the limits in order to explore the many possible side-effects of success. Figure 1 may give some ideas to work out this job.

Step 4. Make an assessment of what changes are required to deal effectively with the limit(s) identified and how much time needed to change. In terms of personnel, for example, technical assistance needs could be assessed by exploring questions such as: If sales double, will we get more sophisticated users, or less? How reliable services could be maintained?

Step 5. Consider how to balance the two processes of the growth engines and the potential limits. Looking for links between the reinforcing and balancing loops will make it possible to manage the balance between the two, rather than just react to changes. For example, if a company discovers they cannot hire technical assistance for quality services, perhaps it would be better to choose to balance sales growth with their capacity to service that growth properly.

Step 6. Always be open to questioning on and reevaluating the growth strategy even if it is highly successful. Getting what you wish for may not give you exactly what you want over the long term.

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