The Dynamics of A Software House's One-Shot Growth

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Abstract

The pattern of one-shot growth is most seen in software industry. The purpose of this paper is to understand the growth dynamics of a software house and to facilitate the software house to manage its growth. This paper models a major domestic ERP software house in Taiwan that is experiencing the one-shot growth process. Business type-level packages and high quality service is the company's secrets for its success. With a good reputation for high quality systems and services, the company's growth strategy is to expand the market it serves by developing new kinds of packages for more business types. However, how to balance the human resources requirements of R&D sector and ERP project service for customers is rather difficult when long delays exist everywhere in a software house. With the system dynamics model built, this paper illustrates how the one-shot growth pattern is generated by the misallocation of human resources in the process of quick expansions.

Introduction

Software industry is getting more and more attentions for its important role in facilitating the development of knowledge economics. The market for various kinds of software has been dramatically growing in recent years. Intuitively, it seems that the high market growth rate of software requirements represents a high profit for software houses. However, the fact is the survivals of most software houses are so difficult that only 19% of them can survive for more than one year. And most of those software houses that survive are diminished in a few years later (Giarratana, 2004). The pattern of one-shot growth is most seen in software industry. Some researches even claimed that only one or two software houses are to stay in the market (Nambisan, 2002; Giarratana, 2004; Bernroider, 2002).

Some difficulties challenging the management of a software house is essential in the software industry. Low entry costs and increasing marginal returns of software as information goods consistently attract new comers into the software industry. New comers can often earn a lot of revenues easily and quickly because of the high market demands. But the growth of a software house's revenue is hard to be sustained, for global competitions, high knowledge-intensive, and rapid innovations and short life cycle of software are contributing to the managerial complexity. In other words, for a software house, entering the software market is just only the first step. How to deal with the managerial complexity accompanying its growth is a more serious agenda.

Rather than discussing the formulation and implementation of growth strategies that is general to all types of software houses or even to all kinds of industries, this paper chooses to answer the question of how to manage a software house's growth by modeling the specific process that a software company has been experiencing. The purpose of this paper is to understand the growth dynamics of a software house and to facilitate the software house to overcome the one-shot growth problem. This paper models a major domestic ERP (Enterprise Resources Planning) software house, Company HAN in Taiwan. Like ERP software houses in other countries, Company HAN faces severe competitions with world famous software companies as SAP and Oracle. Rather than targeting on big business customers to sell expensive packages with minor customizations, Company HAN is focus on SMEs market. Company HAN penetrates into different industries by designing ERP systems that take into account the industrial differences and develops specific ERP packages for different types of business in the selected industry market. For example, one of the most successful industry market Company HAN has is the textile industry. Company HAN develops a series of ERP packages for each type of businesses at each stage in the textile supply chain, including yarn spinning, weaving, finishing and dyeing, and cutting and sewing. Because of Company HAN's attitude in serving its customer with high quality software packages and services, 50% to 60% customers keep good relationships with Company HAN. While global software houses as SAP and Oracle are competing for the big electronic and computer industry or other high technology industry customers in Taiwan, Company HAN successfully earns its reputations for high quality packages and good services in several traditional industries (ex. textile industry, steel industry, and mechanical industry).

Company HAN started to operation at year 1996 and was indeed successful and maintained high net income in the first three year. However, Company HAN is now experiencing the so-called "one-shot growth" process. The growth of its net income is

stagnated and even started to fall from year 2003. With the system dynamics model built in this paper, it is found that the growth dynamics of Company HAN is mainly influenced by the interactions among marketing strategy, the R&D policy, and the human resource management policy. Business type-specific packages and high quality service is Company HAN's secret of its success. With a good reputation it earns, Company HAN's growth strategy is to expand the market it can serve by developing new kinds of packages for more business types. However, how to balance the human resources requirements of R&D projects for developing new packages and the ERP projects to offer customer timely and high quality services is rather difficult when long delays exists everywhere in a software house. The following section details the model structure built in this paper to explore the on-shot growth phenomenon. Some simulations are experimented and suggestions for the company to overcome the one-shot growth are proposed in later sections.

The Model structure

With more than ten interviews with the CEO, marketing manager, several staffs including programmers, system designers, and system analysts in Company HAN individually in six months, a model describing what Company HAN has been experiencing is built. All the variables and relationships are extracted from the three interviewees' verbal descriptions and have been accepted. The complete model structure has been communicated major with CEO using both qualitative and quantitative diagrams during the modeling process and after the model is completed. The CEO is surprised to see a model precisely capturing their experiences. For the firs time, the CEO clearly gets the whole picture of how the company operates and realizes how the emphasis on R&D policy in human resources allocation leads to downturn of the company's profitability. In this paper, we first explain the model structure and then discuss the simulation results to demonstrate the dynamics of one-shot growth experienced by the company.

Figure 1 is the model's overview. The model contains three major sectors. Customer Projects Sector describes Company HAN's attitude towards its target market and those various kinds of projects it serves to customers. Package Development Sector is about planning process to penetrate into new markets and research and development process to develop new software packages to serve those planned markets. Human Resource Sector abstracts the most critical human resources in a software house. That is, consultants, programmers, and system analysts. Figure 1 illustrates the three major sectors and corresponding level variables. There are interlocked relationships among the three sectors. For example, the target number of

business types to penetrate in Package Development Sector calls for the initiation of specialized design projects in the Customer Projects Sector to investigate business knowledge and accumulate related software experiences. With enough experiences about specific new business types, new R&D projects are initiated to develop new software packages for more business types. Besides, human resources required to complete tasks in Customer Projects Sector and Package Development Sector are reflected in the hiring policy modeled in Human Resources Sector. Further, through the critical human resource allocation policy separated from Human Resource Sector, customer projects and R&D projects acquire human resources with different priorities set by Company HAN. Besides, revenues generated from Customer Projects Sector also impact the company's market expansion plan and its hiring policy. The three sectors and human resources allocation policy are interlocked to generate positive and negative loops. Following, the model structure is detailed.

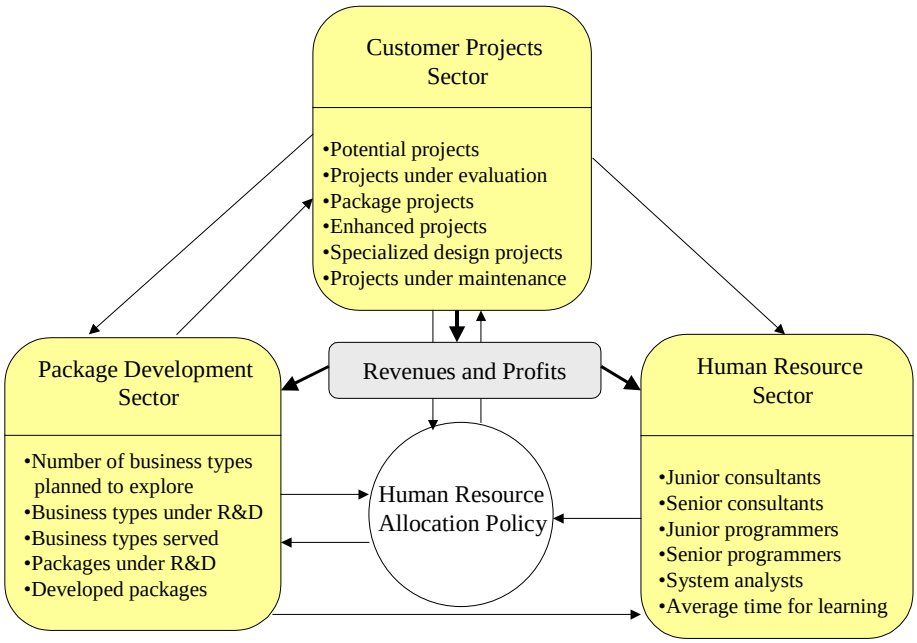

Figure 1 the model's overview

The customer projects sector

Figure 2 demonstrates the relationships between Company HAN and its customers. Company HAN offers three kinds of ERP projects to customers. Package projects are standard packages with minimal customizations. If customization is needed for specific operational requirements after proper evaluations, an enhanced project based on standard packages would be proposed to customers. Unlike package projects and enhanced projects that contribute to Company HAN's major revenues, specialized-design projects are expected to accumulate required experiences and

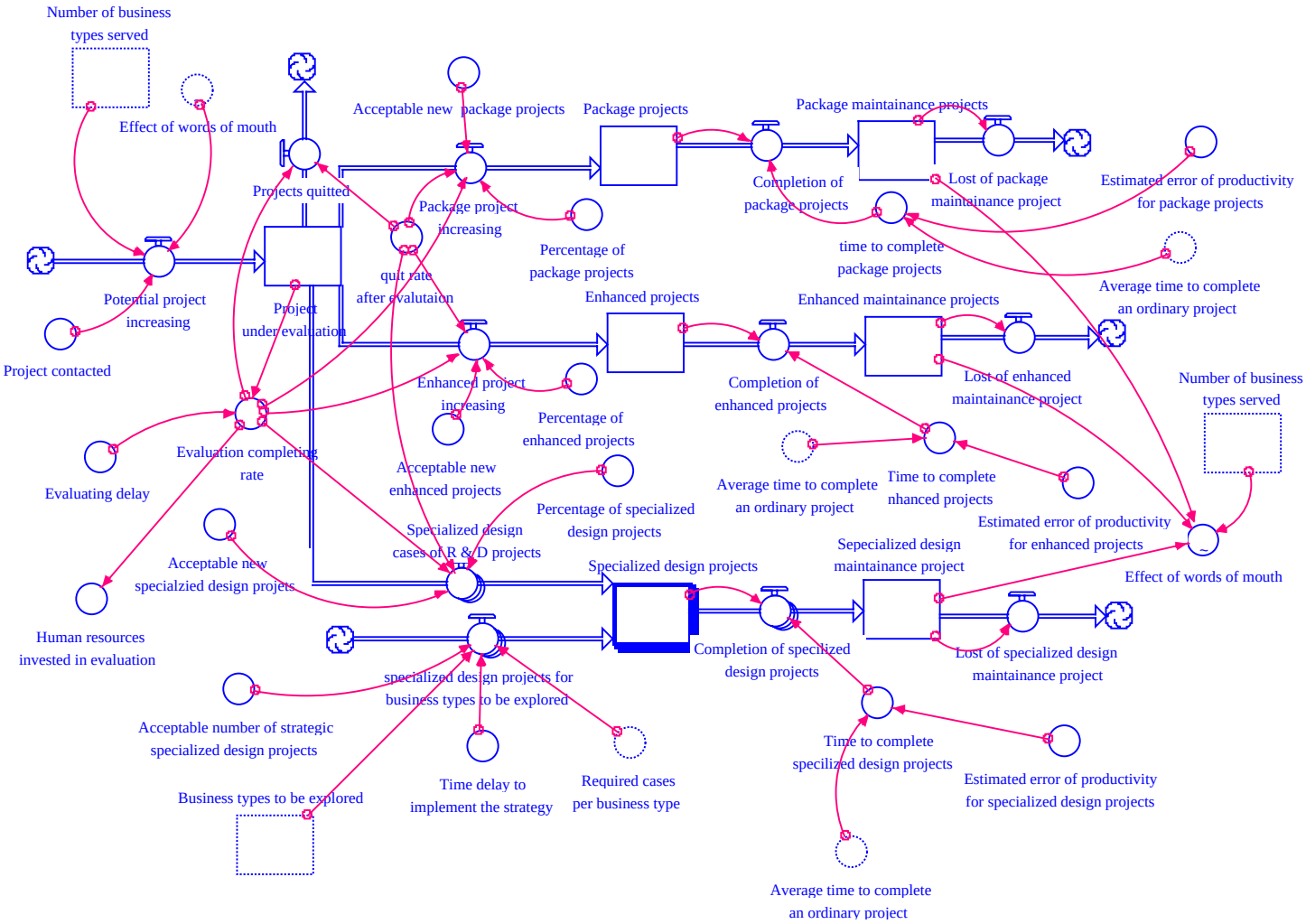

Figure 2 the customer projects sector

industrial knowledge about the new business types that Company HAN wants to step into. In evaluating specialized-design projects, only those customers whose business types or industrial characteristics are consistent with the new types of businesses that the company attempts to penetrate will be accepted as specialized design projects. If a specialized-design project is about business type that Company HAN has some experiences before, then, the projects is most possibly requested and initiated by interested customers. If Company HAN attempts to explore the knowledge of a specific new business type with no prior experiences, then, few customers belonging to that business type are interested and Company HAN searches for collaborative businesses to initiate experimental specialized design projects.

With an overall understanding of Company HAN's products, let's turn to trace the complete process from contacting a interested customer to the maintenance of a customer's ERP system. It is found that customers become interested in Company HAN for two major reasons. One is the strong effect of word-of-mouth and the other is the number of business types Company HAN serves. As mentioned before, Company HAN offers customers differentiated packages for specific business types and high quality services, most customers are satisfied with it services and keeps maintenance relationships with Company HAN. It is illustrated in Figure 2 as the three level variables of *Package projects with maintenance*, *Enhanced projects with maintenance, and Specialized design projects with maintenance*. The more projects under maintenances, the stronger the effect of word-of-mouth, in turn, the more customers are interested in Company HAN. Besides, the number of business types served by Company HAN determines the size of Company HAN's target market and thus affects the number of customers may be interested. The variety of business types served also impacts the effect of the word-of-mouth, for the more the company can serve, the more reputation it earns in the software industry.

When an interested customer proposes a request of ERP projects, Company HAN starts to evaluate if the company is able to meet the customer's requirements. Company HAN deliberately considers the operational characteristics, requirements of ERP systems, and the possible difficulties during collaboration process to arrive at a decision. The evaluation delay is about six months. Averagely, only ten percents of evaluation projects continue to the next stage. Among these projects, 40% of them are classified as package projects, 50% of them are enhanced projects, and 10% of them belong to specialized design projects. Company HAN expects to complete a project in twelve months regardless the project type. To satisfy the expectation, Company HAN allocates human resources according to the difficulties a project may face. Normally,

specialized design projects are the most difficult projects, then enhanced projects, and the least difficult projects are standard ERP package projects. Besides, the initiation of new customer projects may be postponed if the human resources required to complete those projects in time are excess of the human resources allocated in customer projects and related services. Details about human resources allocation policy are discussed in a later section.

The package development sector

As other software houses, Company HAN's major income is from the sale of packages and related services, including package projects and enhanced projects. Software packages have the advantage of low variable cost thus to distribute the high development cost over large volume of sales. Hence, the development of new packages implies not only the increase of the business types served but also the enlargement of the company's marginal profits. Figure 3 illustrates how Company HAN develops new packages and enlarges the business types it can serve.

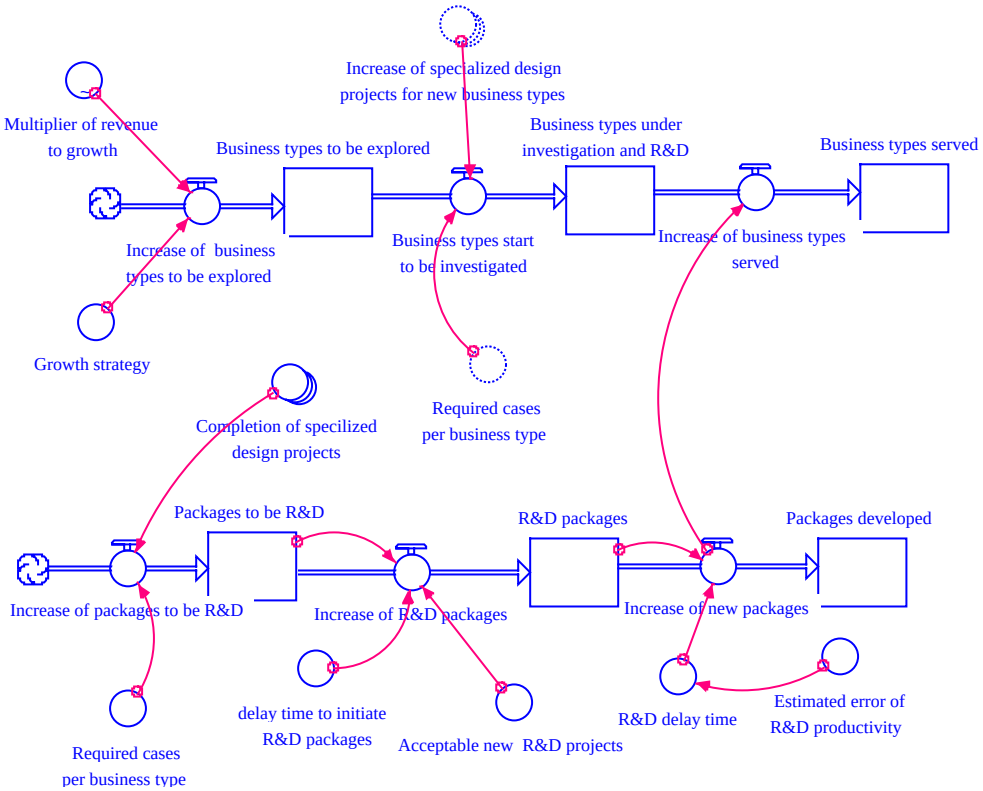

Figure 3 the package development sector.

To develop new software packages, Company HAN first sets the target number of business types to be extended to by taking into account the revenues it may earn in the future and the expectation of future economics. The more revenue the company gets, the more optimistic and confident HAN's managers are and the more financial

support can be allocated to develop new packages. Company HAN's expectation of future economics is based on the number of interested projects it may attract. Because the company offers high service quality and has a good reputation, managers believe that the changes of interested projects are strongly impacted by the overall economics of those clients' industrial environments.

As denoted in Figure 3, two different flows are initiated to implement the expansion plan toward new markets. One denotes the number of business types the company serves and the other denotes the number of packages it develops. Research and development department investigates which business type is more proper to penetrate in and triggers specialized-design projects to accumulate related experiences and knowledge. At least three specialized design projects have to be completed in advance. Afterwards, a research project is initiated to study how to general those accumulated experiences to develop standardized software package for a specific business type. An R&D package is the package that requires further examination of the information system's architecture, the program code, related documents, the implementation process, etc. to develop a standardized package for a specific business type. Averagely, an R&D package requires 24 months to be completely developed into a standard ERP package that is ready to be sold. Due to the constraints of human resources, not all research projects can be investigated right away when accumulating enough specialized-design projects experiences. Some packages may be waiting to be studied and developed.

The human resource sector

Figure 4 demonstrates the two flows of consultants and programmers. Consultants, including junior consultants and senior consultants, are responsible to implement software packages into client companies. With enough experiences, a junior consultant becomes a senior consultant. In the company, senior consultants take the responsibility to train junior ones. But under the situation of high workloads, learning from senior consultants is less possible and thus increases the delays for a junior consultant to be well trained. Both senior and junior consultants may quit their jobs when the work stress is too high.

As consultants, programmers in the company include junior programmers, senior programmers, and system analysts. Programmers and system analysts are mainly responsible system designs, system developments and system standardization to develop packages. To be promoted to be a system analyst, a programmer has to accumulate lots of programming and project management experiences. Usually, the

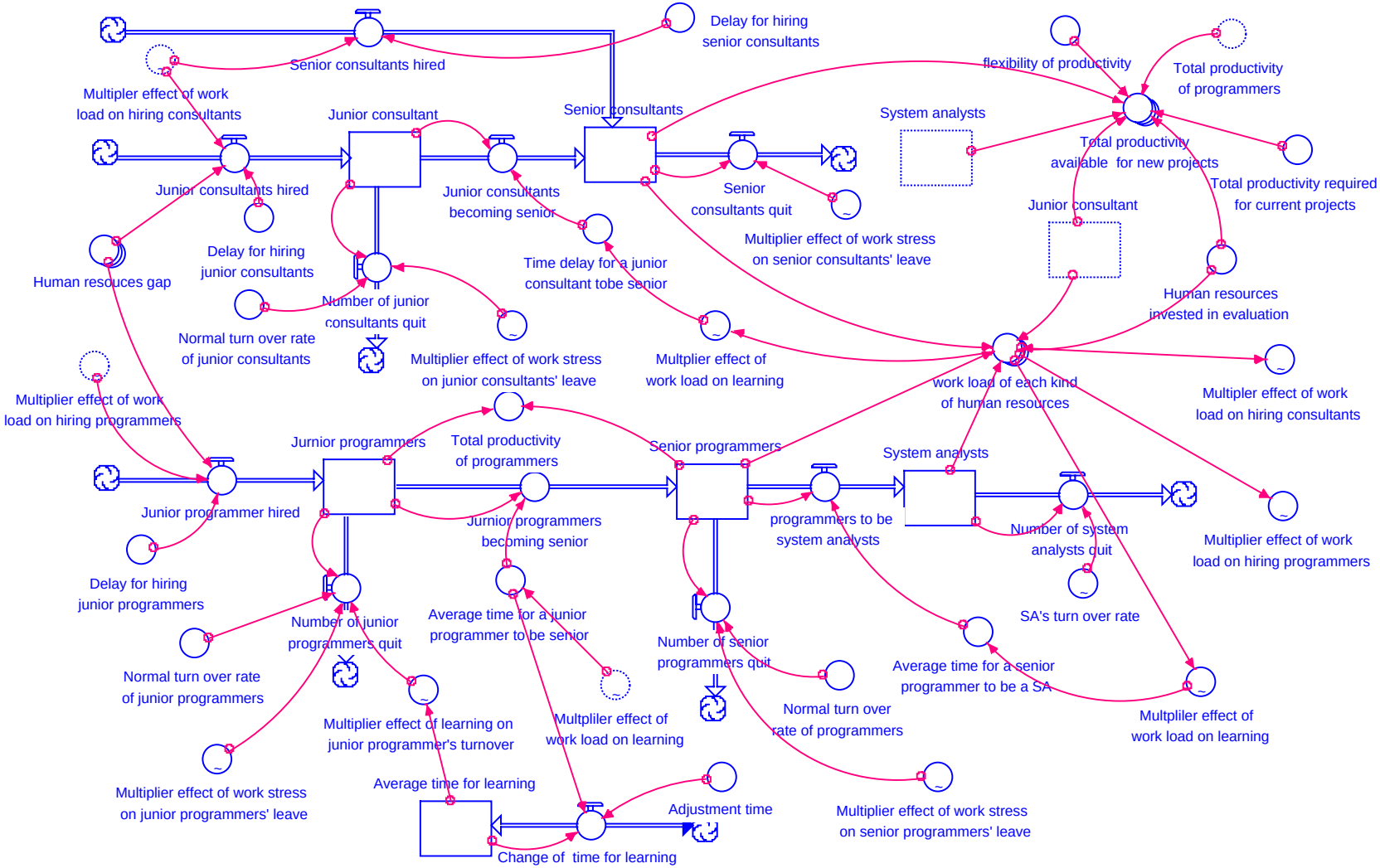

Figure 4 the human resource secto

productivity of a junior programmer is quite low and the work assigned to him or her is not so heavy as to senior programmers. To be an experienced, a junior programmer relies heavily on learning from experienced colleagues. Thus, when experienced colleagues are under the status of high workload, the opportunities to learn from each other decrease delays the time for a junior programmer to become senior and the time for a senior programmer to be a system analyst. Furthermore, to junior programmers eager to learn programming skills, recognizing the time available for learning is scarce will make them choose to quit.

The human resource allocation policy

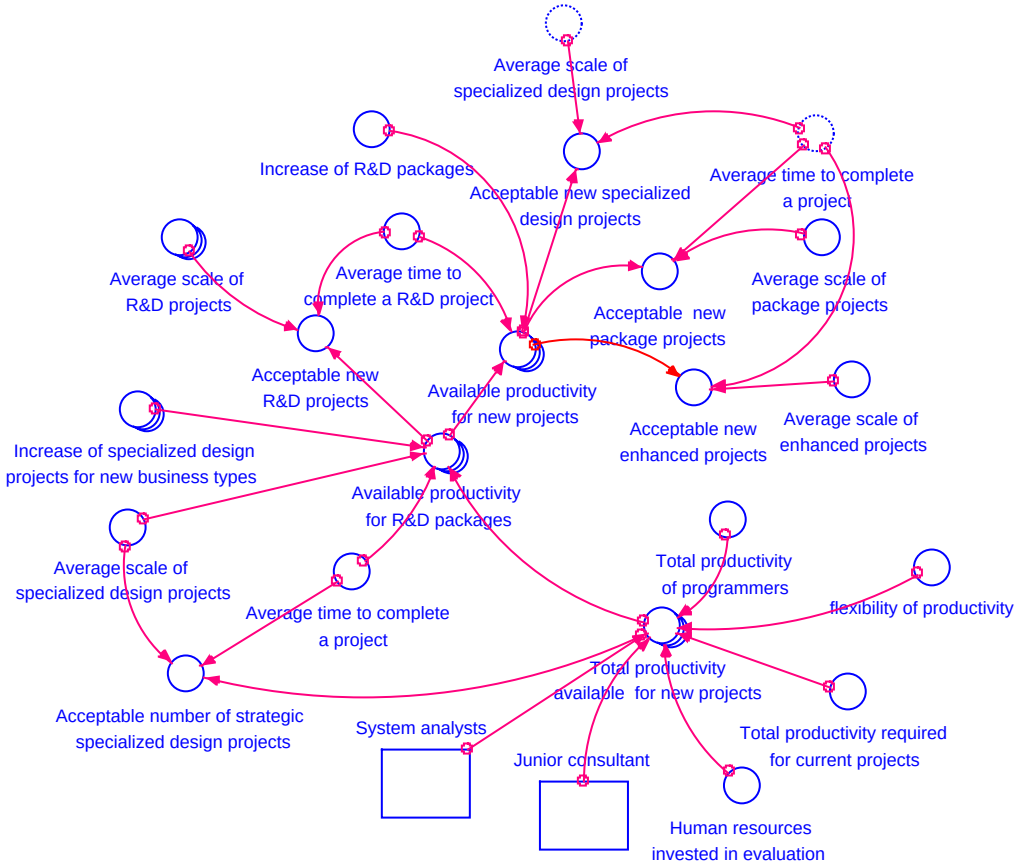

Figure 5 the human resource allocation policy

As common software houses, Company HAN measures its productivity by man-month that can be calculated directly by summing up all human resources (a junior programmer's productivity is only 1/4 of a senior programmer). According to the company's policy, the allocation of human resources to customer projects and R&D projects has to in advance reserve the required productivity for evaluating potential customer projects and for completing currently running customer projects. Afterwards, human resources are allocated to R&D packages. Customer projects, like package projects, enhanced projects, and the specialized projects are the last priority

to get human resources. The priority to allocate human resources is demonstrated in the Figure 5.

The dynamics of Company HAN's one shot growth

Figure 6 is the simulated time patterns of *package projects, enhanced projects, two kinds of specialized projects, and net income.* Though we have no actual data to demonstrate how the simulation result is close to the reality, the examination and acceptance of those simulated time patterns from the CEO and the other two managers convinced us the model's credibility to demonstrate Company HAN's experience. In Figure 6, the behavior pattern of *Net income* illustrates the one-shot growth the company confronts. Based on a qualitative causal loop diagram that is simplified from the quantitative model, we explore the dynamics of the one-shot growth. We first examine the basic growth engine that drives the company to earn its income at the initial stage (from month 1 to month 45). Then, we illustrate how the company's growth strategy and R&D policy lead to the stagnation of the company's (from month 46 to month 60). Later, how the company is trapped into the situation of losing its market and being incompetent to change the situation (from month 61 to month 120) is further discussed. Feedback loops corresponding to the three stages are plotted to facilitate readers' understanding.

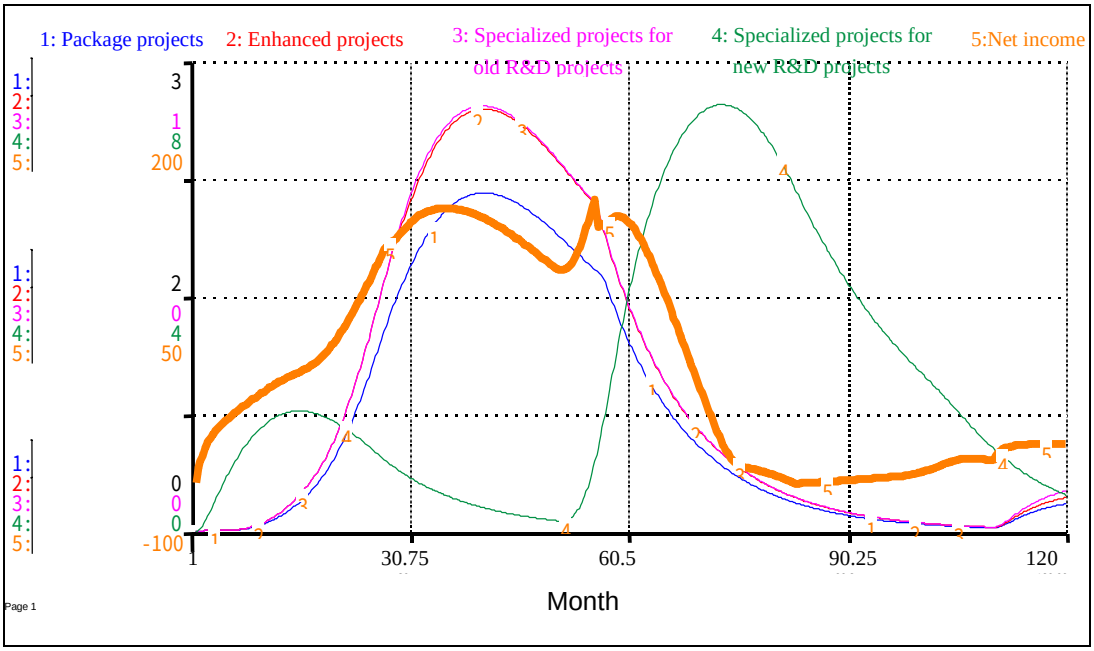

Figure 6 Simulated one-shot growth

The growth engine for flight

In software industry, the start of an ERP software house is often accompanied with

standardized ERP packages for selected industries. The standardized packages may be offered by big international software companies, such as SAP or Oracle, or be developed by the software house alone. Company HAN is the latter case. The company is set up by a group of senior programmers and senior system analysts who are very knowledgeable about textile industry. The company decided to target at textile industry and initialized several specialized-design projects to develop ERP packages and accumulate necessary experiences and knowledge *via* customer projects. As specialized-design projects for the development of ERP packages are completed, Company HAN-owned brand ERP software is developed. Because the packages developed are specific to the level of business type, the company takes into account more details about various kinds of customers and thus offers higher service quality to customers. Company HAN attracts its customers mainly through the effect of words-of-mouth. The more customers are interested in Company HAN's services, the more project evaluations requests are proposed. Both the number of package projects and enhanced projects increase. Due to the company's high service quality and skillful personnel, most customers continue their maintenance relationship with Company HAN and thus strengthen the effect of word-of-mouth. This is the major growth engine underlying the growth pattern of the company's net income from month 1 to month 32. (shown in Figure 6).

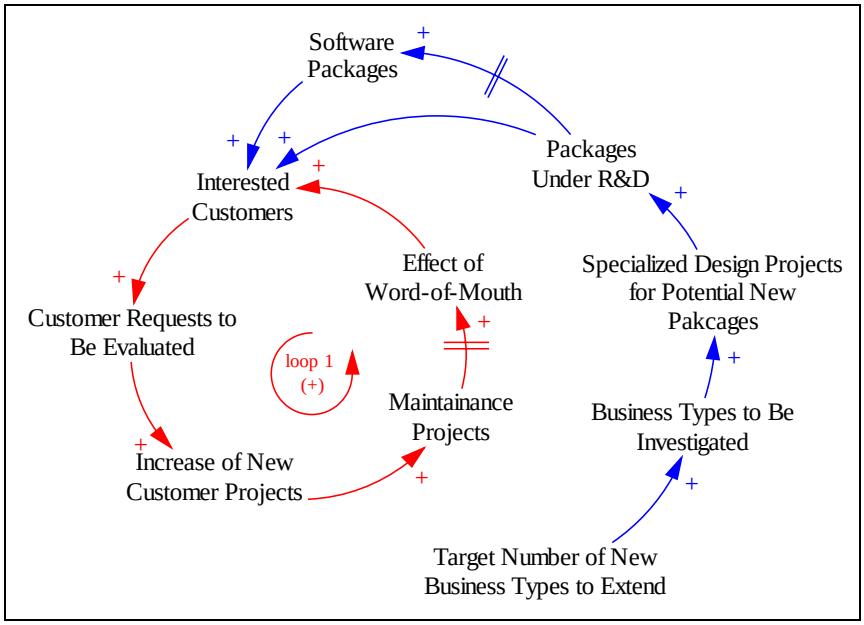

Figure 7 the growth engine for flight

The expansion strategy resulting in stagnation

To Company HAN, the success just discussed encouraged it to develop more high quality packages. The company believed that the development of software

carefully designed for specific business types is a correct decision. Loop 2 and loop 3 in Figure 8 illustrate that the impacts of the increase of Company HAN's confidence. When the company was such confident of its positioning strategy, it was aggressive to expand the number of business types to expand market size. The company thought that as long as enough specialized-design projects were completed, they could start to attract more customers, including earlier adopters of packages under R&D and common customers with developed software. In addition, the initial success brought the company lots of money that not only strengthen the company's aggressiveness but also offered financial supported to both R&D activities and customer projects. In Figure 8, loop 4, loop 5a and loop 5b illustrate these financial reinforcing effects to the company's expansion strategy.

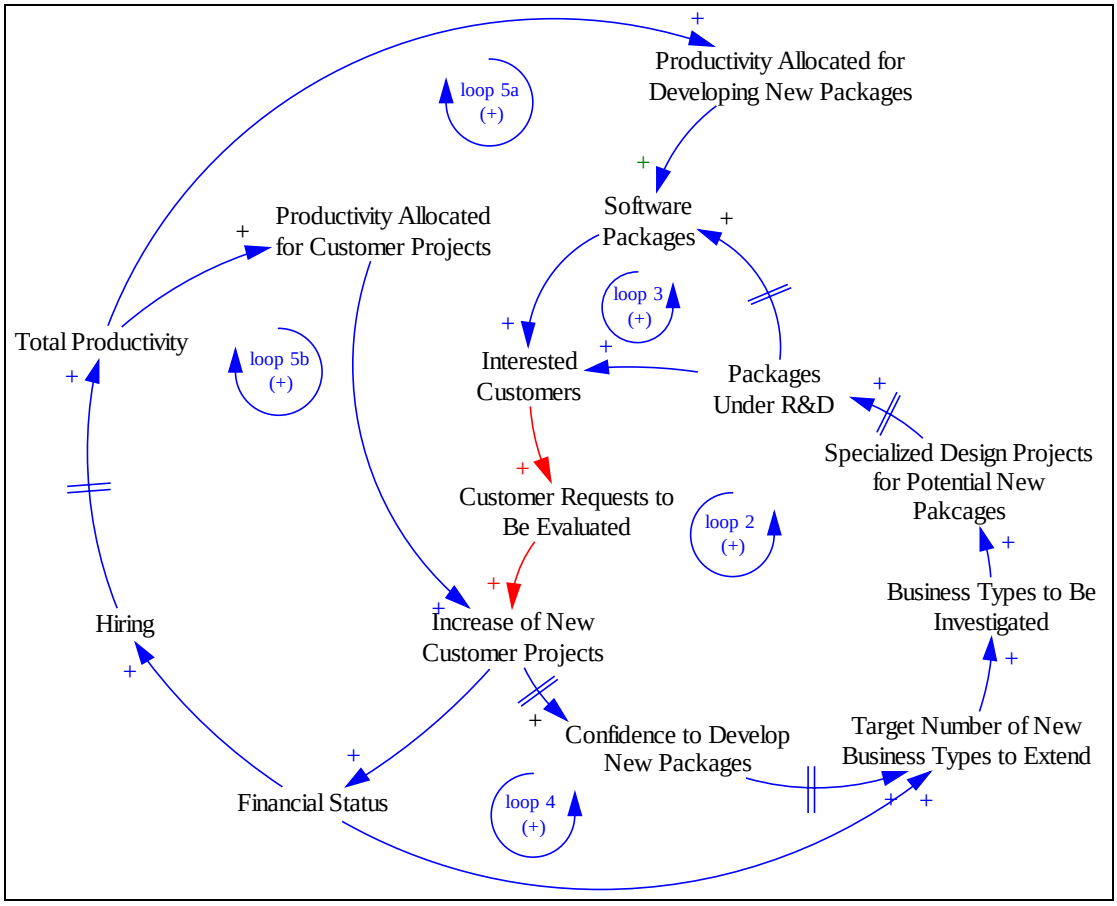

Figure 8 the expansion strategy resulting in stagnation

The five positive loops shown in Figure 8 together compose the company's expansion strategy. At the first glance, it seems to be a good strategy to take the company to a higher growth. However, things were not so smooth in the company. Due to the delays in assuring the properness of product strategy and planning desired number of business types to penetrate into, required specialized-design projects for

packages of new business types did not start immediately when prior R&D projects were completed. Furthermore, because of the antecedent condition of market expansion was enough customer projects, the human resources required to complete those customer projects shrank available productivities for new R&D projects. Time delays for the initiation of new R&D projects are lengthened! The combined result of positive loops and time delays in market expansion was the postponed but exacerbating number of new R&D projects and corresponding specialized-design projects. Time pattern of specialized-design projects for new R&D projects depicted in Figure 8 demonstrates such an effect. Because of the postponement of new R&D projects and related specialized-design projects, Company HAN did not have new software packages to serve new customers while the market of specific business types in textile industry had been saturated. Package projects and enhanced projects started to decrease and net income was stagnated during the period from month 33 to month 60. The company was hard to sustain the growth!

Vicious loops worsening the problem

Because Company HAN's ambitious to expand the variety of business types was not only strengthened by its confidence and rich financial support but also exacerbated by the time delays, the company was quite aggressive to invest in developing new software to expand its market. As shown in Figure 6, the peak of the time pattern of the expansion was much higher than the previous wave. The company's speed of expansion was much faster than the speed of hiring new employees. Due to the higher priority for R&D projects than customer projects in allocating human resources, the human resources allocated to customer projects were insufficient to complete those projects on hand. Workloads to complete present projects arose and acceptable number of new customer projects decrease. Two vicious loops, loop 5 and loop 6 depicted in Figure 9, demonstrate the impacts of arising workloads on attrition rate. Loop 5 states the increase of attrition rate inducing from high workloads and work stress, while loop 6 demonstrates the increasing attrition due to less opportunity for junior employees to get training from seniors under the situation of high workloads, especially for junior programmers who were eager to learn. Arising attrition further led to result in the decrease of total productivity and thus the available productivity allocated to customer projects. The problem of human resource shortages was worsened! In Figure 10, it shows the high workloads of each kinds of human resources and attrition rate. Note that the senior programmers' workload was much higher than other kinds of human resources, which was caused by high turnover rate of junior programmers!

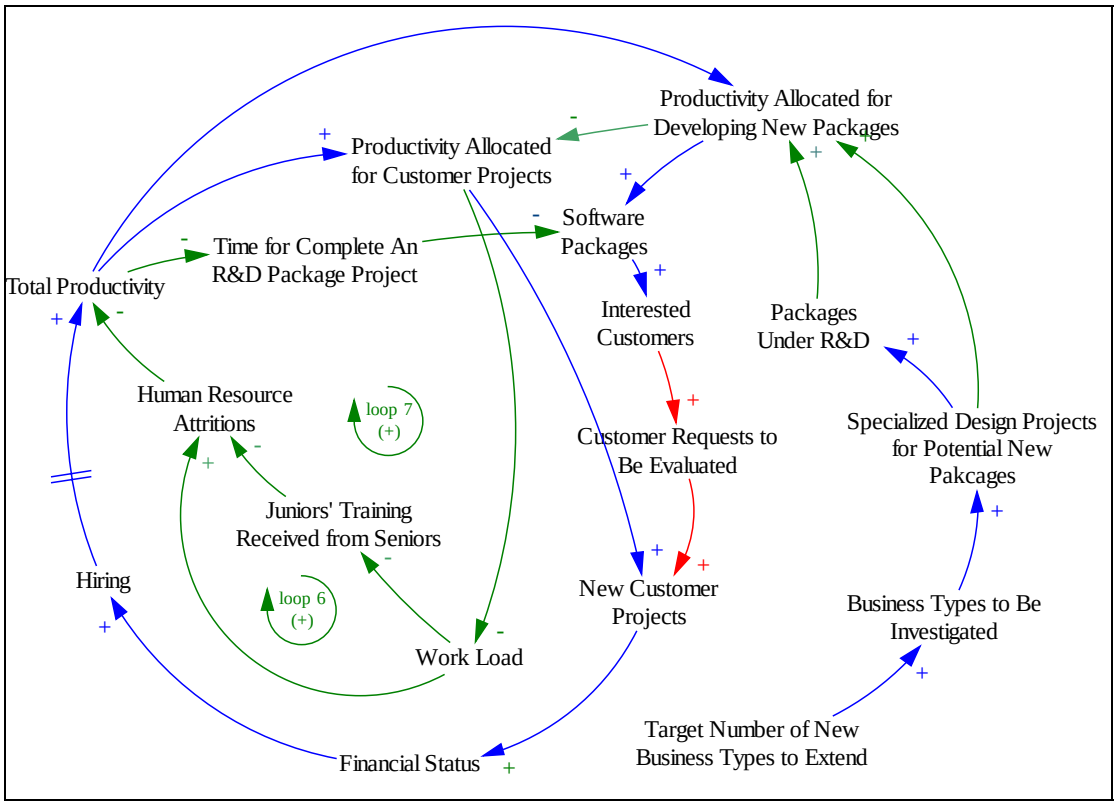

Figure 9 feedback loops limiting the growth

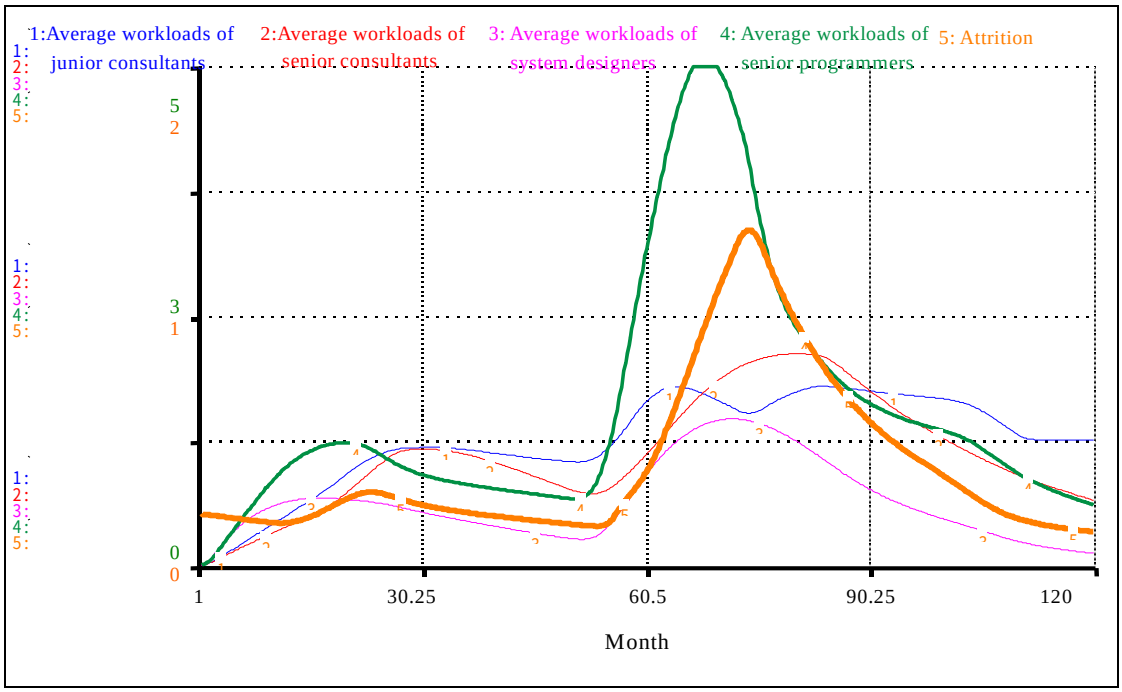

Figure 10 simulated workloads and attritions

In confrontation of such a circumstance, Company HAN kept allocating human resources to R&D instead of customer projects because of the high sunk costs of R&D

packages once abandoned (Shapiro and Varian, 1999) and the long R&D lead times (Hilmola et al., 2003). All company HAN did to solve the labor shortage problem was to hire more personnel. However, delays existed in hiring appropriate persons and total productivity did not return to required level immediately. To the company, the human resources shortage problem propagated to marketing sector. The number of acceptable new customer projects based on the available human resources decreased. Financial status began to fall. Fewer and fewer financial support was available for hiring personnel! The road to solve the human resource shortage problem seemed to be longer. The shortage problem finally propagated to the R&D sector, for the insufficient human resources also restricted the amount of productivity available for R&D projects and the delay time to complete R&D was lengthened! The lengthened R&D time implied that human resources were occupied in R&D projects for longer time. Less customer projects result in less money that the company could earn!

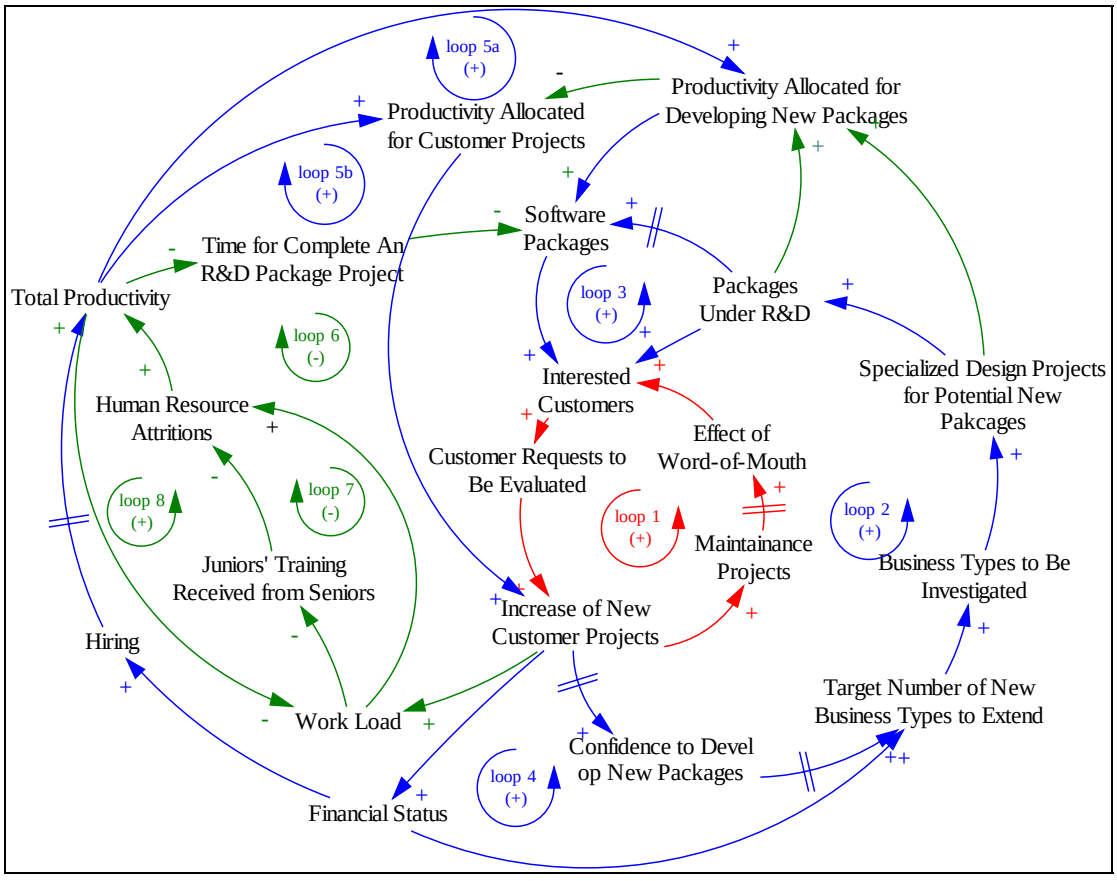

Figure 11 casual loop diagram of the one-shot growth

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