Research on the characteristics of the growth risk sources of new ventures based on Immune Theory

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Abstract. Under the background of the national strategy of "mass innovation and entrepreneurship" and the information age, it is very important to use the artificial immune theory to characterize the growth risk sources of new ventures and make them become the quantitative index features available for the model. It can lay the foundation for the construction of risk identification model of new ventures. First of all, through the in-depth analysis of the characteristics of the growth risk of the new venture, the source of the growth risk is defined according to the classification of the growth risk of the new venture; then, through combing and summarizing the relevant research at home and abroad, this paper analyzes the influencing factors of R & D risk source, product risk source, management risk source and social network risk source, verifies and selects through empirical research, and constructs the identification index system on this basis; finally, the growth risk characteristic structure of new ventures based on artificial immunity is constructed, and risk identification indicators are engineered to transform qualitative indicators into quantitative indicators for model experiments. It provides a basic reference for the establishment of the new enterprise growth risk identification model, so as to effectively meet the in-depth decision support, information mining and discovery in the growth process of the new enterprise, thereby promoting the stable and healthy growth of the new enterprise.

1. Introduction
At present, my country has clearly defined "mass innovation and entrepreneurship" as a national strategy under new business conditions, and new ventures are the main force in my country's social and economic development and innovation. With the advent of the "Internet +" era, the continuous development of information technology, and the deepening of economic globalization, the internal and external uncertainties of enterprises are increasing. Therefore, in the face of the uncertainty and high failure rate of the growth process of startups, how to effectively identify the growth risks of startups has important practical significance and academic value.

However, most of the existing researches focus on the risk indicators from a single dimension, such as determining the risk factors from the organizational level or the entrepreneur's personal level, and lack of comprehensive, multi-dimensional and systematic research on the growth risk index system of new ventures. According to the theory of Organizational Immunity, the enterprise organization has its own immune system, which is a complex and evolutionary self-organization system. In order to maintain the normal operation of the organization and ensure the sustainable development of the enterprise, the
organization immune system draws lessons from the biological immune mechanism, eliminates the internal and external risk factors of the organization and produces memory.

Therefore, this article combines the existing results of the research on the growth risk identification of new ventures, analyzes the connotation, characteristics and classification of the growth risks of new ventures, uses empirical methods to study the main risk factors that affect the growth of new ventures, and builds a growth risk identification index system. Then we build a new venture's growth risk characteristic structure based on artificial immunity, and use characteristic engineering ideas to transform the index system, transforming it from a qualitative index system into a characteristic system structure that can be used directly by the identification model. This will lay a foundation for the research and construction of risk identification model for new ventures, so as to meet the urgent needs of new ventures in deep decision support, information mining and discovery by using information technology, reduce the bankruptcy rate of Chinese enterprises, enhance the international competitiveness of new ventures, and promote the healthy growth of knowledge-based new ventures.

2. Analysis on the growth risk characteristics of new ventures and the construction of risk index system

2.1. Analysis of enterprise growth risk characteristics

On the basis of drawing lessons from the existing research, combined with the actual background, the main characteristics of the growth risk of the new ventures are analyzed in four aspects: diversity, dynamics, prominence, and instantaneity.

Combining the definition of my country's new ventures and their development reality, this article divides the first-level indicators of the growth risks of new ventures into: R&D risk, product risk, management risk and social network risk. Combining the definition of growth risk and the analysis of the characteristics of growth risk of my country's new ventures, this paper proposes a new venture growth risk derivative model. The derived model is shown in figure 1.

![Figure 1. A growth risk derivative model for startups](image)

From the formation process of the growth risk of new ventures, we find that there is a certain relationship between the essential characteristics of growth risk and its evolution process, that is, some characteristics of risk factors gradually evolve into risks, and the formation of growth risk mainly depends on the evolution of risk factors. The process that the growth risk of new ventures evolves and forms through internal and external environmental effects is just like that immune genes, through continuous variation and inheritance, eventually form immune cells (antigens) that are harmful to the body. The biological phenotype is determined by different gene combinations, and the growth risk of new ventures is also determined by different combinations of risk factors. Using this operating mechanism for reference, this paper studies the characteristics of the growth risk sources of new ventures based on Feature Engineering, so as to meet the construction of enterprise risk identification model.

2.2. Construction of enterprise risk index system

Based on the analysis and research on the growth risk characteristics of new ventures, this article defines the growth risk sources of new ventures as four types: R&D risk sources, product risk sources, management risk sources, and social network risk sources.
According to the above risk factor assumptions, this article uses questionnaire surveys to conduct empirical analysis and verification, and basically clarifies the main growth risks faced by startups under the background of "Internet +". On this basis, this paper selects the calculated factor scores to obtain the weight value of each risk factor, and selects the risk factors with higher weight and greater influence on the growth of the enterprise to form an identification index system. Existing research has shown that, compared with the weight calculation methods such as expert estimation and expert survey method, the use of factor analysis to calculate the weight vector can reduce the interference of human subjective factors as much as possible. The specific calculation formula is as in equation (1) and equation (2).

\[
\bar{w}_i = \frac{\sum_{j=1}^{k} \sqrt{\lambda_j} \times a_{ij} \times h_j^2}{h_i^2} \quad i = 1, 2, 3, ...m. \quad j = 1, 2, ...k \quad k \leq m
\]  

(1)

\[
w_i = \frac{\bar{w}_i}{\sum_{i=1}^{m} \bar{w}_i} \quad i = 1, 2, 3, ...m
\]  

(2)

Among them, \( \bar{w}_i \) is the calculated factor score of each initial variable \( x_i \), and \( w_i \) is the standardized factor score, that is, the final variable weight. \( \lambda_j \) is the extracted characteristic value of the \( j \) main factor, \( h_j^2 \) is its corresponding cumulative variance contribution rate, \( a_{ij} \) is the load factor of the \( i \) variable on the \( j \) main factor, \( h_i^2 \) is the cumulative contribution rate of all the main factors. Use the above formula to calculate, and select factors with a weight greater than 0.1 as the main influencing factors based on the coefficient calculation results. According to the above experimental steps, the risk factors under all risk sources are calculated, and the risk factors with a relatively large weight among various risk sources are obtained. Based on the results of the main factor analysis of the growth risk factors of new ventures, a new venture The three-level indicator system of the source of enterprise growth risk to comprehensively evaluate its growth risk, as shown in table 1.

| Risk source (first level indicator) | Risk factors (secondary indicators) | Risk factors (three-level indicators) |
|------------------------------------|-----------------------------------|------------------------------------|
| R&D risk sources                   | R&D technology risk factors       | Degree of technical protection      |
|                                    | R&D personnel risk factors        | Internet technology maturity        |
|                                    | R&D environment risk factors      | R&D investment level                |
| Product risk sources               | Product performance risk factors  | Product design defects              |
|                                    | Product operation risk factors    | Product manufacturing defects       |
| Manage risk sources                | Manager risk factors              | Personal competence of managers     |
|                                    | Management system risk factors    | Management experience of managers   |
| Sources of Social Network Risk     | Government risk factors           | Scientific degree of management system |
|                                    | Competitive risk factors          | Completeness of management system information platform |
|                                    |                                   | National economic fluctuations      |
|                                    |                                   | Government policies and laws and regulations |
|                                    |                                   | Industry potential                  |
|                                    |                                   | Enterprise's own competitive advantage |
3. The characteristic project of risk sources for the growth of new ventures

Feature Engineering, also known as variable elimination, is a process of transforming original irregular data into effective and operable features. Feature engineering covers feature construction, feature extraction, and feature selection. Among them, feature construction can be regarded as the "brainstorming" stage, which is mainly a process of subjectively forming a data feature set from the original data based on the research problem; feature extraction and feature selection are the combination of the initial data feature set and the data itself, taking into account the principles of feasibility, and selecting effective features from them to form feature vectors, and performing dimensionality reduction through methods such as expert evaluation and factor analysis. At the same time, the influence of noise and irrelevant variables is reduced while ground feature data, so as to ensure an efficient feature set.

Therefore, the use of feature engineering ideas can effectively extract the characteristics of new ventures' growth risk sources. The quantification of each indicator element through feature engineering can transform qualitative indicators into quantitative indicator features that can be used in model experiments, and lay the foundation for the future construction of new venture enterprise risk identification models.

Combining the previous analysis of the growth risks of new ventures under the background of "Internet +" and the proposed risk indicator system, in order to better reflect and quantify the growth risks of enterprises through characteristic indicators, and under the premise of to comprehensively consider the feasibility of data and calculations, finally, we build feature engineering based on the four dimensions of R&D risk sources, product risk sources, management risk sources, and social network risk sources.

3.1. The characteristic structure of the growth risk of new ventures

The construction of new ventures' growth risk characteristic project is based on the principle of artificial immunity. The biological immune system is a huge system composed of immune organs, immune cells and immune molecules. Its main physiological function is to recognize "self" and "non-self" antigens. It forms immune tolerance to "self" antigens and produces immune rejection to "non-self" antigens. Analyzing the biological immune recognition mechanism, we propose the characteristic structure of the growth risk of new ventures based on artificial immunity, and divide the growth risk of new ventures and the immune gene library in the artificial immune system into three layers: data layer, logic layer and presentation layer. The three-tier structure mapping relationship between the two is shown in table 2.

| System          | Immune gene bank | Growth risks of new ventures |
|-----------------|------------------|-----------------------------|
| Presentation layer | Immunoglobulin gene | Source of risk |
| Logic layer     | Immune mechanism | Risk evolution mechanism |
| Data layer      | Gene fragment    | Risk factors               |

Table 2: New ventures growth risk and artificial immune system gene bank mapping table

The diversity of the immune gene pool depends on the recombination and mutation of different gene fragments through different immune mechanisms, and ultimately the formation of different immunoglobulin genes. Similarly, the growth risk of new ventures can also be divided into three layers, in which the data layer is the risk factors; the logic layer is the evolution mechanism of growth risk, which represents the combination and evolution process of different risk factors with time and environment; the presentation layer is the risk source, which is the identified risk source output by the
risk evolution mechanism. Therefore, based on the previous analysis and research on the growth risk index system of new ventures, the growth risk of new ventures based on the principle of artificial immunity can be expressed by Equation (3).

\[
GR_t = \{\mu_1 DR_t, \mu_2 PR_t, \mu_3 MR_t, \mu_4 NR_t\}
\]  

(3)

Among them, \(GR_t\) represents the growth risk faced by the enterprise at \(t\) moment, \(DR_t\), \(PR_t\), \(MR_t\) and \(NR_t\) respectively represent the R & D risk source, product risk source, management risk source and social network risk source respectively, and \(\mu_i (i = 1, 2, 3, 4)\) represents the risk weight corresponding to the above risk sources.

3.2. Feature extraction of growth risk sources of new ventures

Based on the concept of risk source proposed above, the internal and external risks under each level of risk sources in the index system are analyzed in depth. Combined with expert opinions and existing research results, the characteristic attributes of risk indicators are proposed, and the feature engineering based on risk sources is constructed.

According to the previous analysis of R&D risks in the growth of new ventures, factors such as the maturity of R&D technology, the degree of protection of technology, the comprehensive capabilities of R&D personnel, and the R&D environment in the R&D process will all affect the growth of the company. Among them, R&D technology and personnel-related characteristics describe the internal attributes of enterprise R&D, while R&D environment characteristics describe the external attributes of enterprise R&D. Therefore, a feature vector reflecting the enterprise's R&D risk is constructed, the internal and external attributes under the source of R&D risk are deeply excavated, and the above features are analyzed. The technical protection degree of feature attributes is described as follows:

Degree of technical protection. Under the background of "Internet +", the main competitive advantage of a new startup is its own unique advanced technology. If its own technology is leaked or lost during the research and development process, it will directly cause the company to face the possibility of losing its main competitive advantage, affecting the progress of research and development or even Lead to R&D failure. The attributes used to describe the characteristics of the degree of technological protection are: whether the company’s system clearly includes the technological protection system, whether the R&D personnel has signed a confidentiality agreement, and the degree of punishment when a technology leaks occurs. The calculation formula for feature \(v_{11}(DRT)\) is shown in Equation (4).

\[
v_{11}(DRT) = (v - (x_1 + x_2)) + x_3
\]  

(4)

Among them, \(v\) is the adjustment coefficient, which is set according to the risk preference of different enterprises. \(x_i (i = 1, 2, 3)\) represents the value of each characteristic attribute mentioned above. The greater the characteristic value \(v_{11}(DRT)\), the greater the risk. The reference value of each attribute is shown in table 3.

| Index | Description                         | Value     | Remarks                                      |
|-------|-------------------------------------|-----------|----------------------------------------------|
| \(x_1\) | Whether the technology protection system | \{0, 1\} | The company includes a technology protection system with a value of 1; otherwise, it is 0 |
| \(x_2\) | Whether to sign a confidentiality agreement | \{0, 1\} | The value of the confidentiality agreement signed by the R&D personnel is 1; otherwise, it is 0 |
| \(x_3\) | Punishment                          | \{1, 2, 3, 4, 5\} | The smaller the punishment, the greater the value, the greater the risk |

According to the specific description of this attribute of the degree of technological protection, the same applies to other characteristic attributes of R&D risk sources and characteristic attributes of
product risk sources, management risk sources, and social network risk sources to obtain calculation formulas and reference risk values for each characteristic.

4. Conclusion
Facing the uncertainty and high failure rate of the growth process of new ventures, how to effectively identify the growth risks of new ventures has important practical significance and academic value. The prerequisite for constructing an effective new ventures growth risks identification model is to characterize the growth risk sources of new ventures and make them a quantitative indicator feature available for the model. Based on this, this research uses artificial immune theory to study the characterization of new ventures' growth risk sources. By constructing the characteristic structure of the growth risk of new ventures based on artificial immune, the risk identification indicators are engineered, and the qualitative indicators are transformed into quantitative index features that can be used in model experiments. It provides a basic reference for the establishment of the new enterprise growth risk identification model. In a practical sense, it meets the urgent needs of new startups using information technology for in-depth decision support, information mining and discovery, reduces the bankruptcy rate of Chinese enterprises, improves the international competitiveness of new startups, and provides important help for the healthy growth of knowledge-based start-ups. In terms of academic value, this research aims at the shortcomings of existing research, starting from the perspective of biological immunity, and constructing an index system for risk identification based on in-depth analysis of the formation and evolution mechanism of growth risks of new ventures. Then we use feature engineering ideas to transform it from a qualitative index system into a feature system structure that can be used directly by the identification model, which is of great significance to the construction of a new venture's growth risk identification model, and lays a theoretical foundation for the later dynamic risk identification research.

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