Research on Performance Evaluation System of Innovative Pharmaceutical Enterprises Based on Balanced Scorecard ——Taking CCS¹ WuXi AppTec as an Example²

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Abstract. With the reform of medical system, China's pharmaceutical industry has entered a period of adjustment and transformation with steady development. The comprehensive performance evaluation of pharmaceutical companies is conducive to understanding the overall operation and development potential of the pharmaceutical industry in China, and has reference significance for the decision-making of all stakeholders. Based on the balanced scorecard, this paper designs a comprehensive performance evaluation system at the financial and non-financial levels, using scientific and effective evaluation methods to analyse the performance of pharmaceutical industry companies, which will play an important role in improving the comprehensive performance evaluation of pharmaceutical industry companies.

1. Introduction
Since the reform and opening up, with the improvement of people's living standards and the increasing emphasis on their own health, as well as the increase of medical and health expenditure year by year, the scale of China's pharmaceutical market has maintained a rapid growth, accounting for 11% of the global pharmaceutical market, becoming the second largest pharmaceutical market after the United States[6]. However, research on performance evaluation of pharmaceutical enterprises has not developed rapidly. At present, when the domestic academic circles study the performance of the listed companies in the pharmaceutical industry, the comprehensive performance evaluation is less. And there are still some outstanding problems, such as neglecting the characteristics of the industry, neglecting the innovative characteristics of the enterprise, overemphasizing the financial performance and so on. Therefore, combining with the development status and characteristics of Listed Companies in the pharmaceutical industry, it is an urgent and significant problem to use scientific and effective evaluation methods to compare and analyse the performance of Listed Companies in the pharmaceutical industry.

¹ CCS: China Concept Stock refers to a company registered and listed overseas, but the largest controlling (usually more than 30%) or the actual controller is directly or indirectly subordinate to a private enterprise or individual in mainland China.
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As a representative of technological innovation and high-tech enterprises supported by pharmaceutical research and development, WuXi AppTec is a unicorn in China's CRO industry. It takes innovation and R & D as the starting point of the company, has different characteristics from other traditional pharmaceutical enterprises, and is more suitable to construct a comprehensive performance evaluation system as a representative enterprise. For innovative enterprises such as WuXi AppTec, there are many parts that are difficult to be measured directly by financial indicators. The commonly used evaluation method of manufacturing performance is not applicable to WuXi AppTec. Therefore, this study chooses the balanced scorecard which can balance the non-financial part to measure the enterprise performance of WuXi AppTec. Such an evaluation system increases indicators such as research and development, transformation of scientific and technological achievements, more suitable for the characteristics of innovative enterprises, and the evaluation results are more objective and comprehensive.

2. Literature references
Performance evaluation refers to the comprehensive evaluation of the output benefits formed by the use of resources in a certain period of time by combining quantitative and qualitative methods on the premise of determining the evaluation criteria. Generally speaking, the development of performance evaluation has experienced three stages: early cost performance evaluation, Mid-term Financial Performance Evaluation and comprehensive performance evaluation.

The initial performance evaluation is the simplest cost accounting, including direct cost accounting and indirect cost accounting. The purpose of calculation is simple profit, and the purpose of evaluation is statistics. However, with the continuous development of the economy and the continuous expansion of the scale of the enterprise, the mode of operation and the mode of profit are becoming more and more diversified. A single cost control can no longer meet the requirements of the maximization of interests. At the same time, for the joint-stock enterprise, its goal orientation also changes from the maximization of interests to the maximization of shareholder value. Therefore, the performance evaluation is extended from the original cost index to the repayment index and profit index to meet the needs of investors, shareholders and creditors. In this period, the most representative performance evaluation method is DuPont analysis. DuPont analysis is a hierarchical financial performance evaluation method with return on equity as the core. It is simple and clear, which can not only clearly reflect the financial situation of the enterprise, but also help to optimize the allocation of enterprise resources and meet the needs of investors and creditors. Since the third scientific and technological revolution, with the rapid development of productivity and the rapid change of the macro environment of enterprise management, the development of enterprises is facing more threats and opportunities. It is of great significance to formulate long-term development strategies and seek sustainable development. Under this premise, the performance evaluation system with financial indicators as the main and non-financial indicators as the auxiliary is gradually formed, and more and more non-financial indicators are added to the index system. In 1992, Robert Kaplan and David Norton first proposed the concept of balanced scorecard (BSC) in Harvard Business Review[4]. They pointed out that the balanced scorecard can surpass the traditional performance evaluation model based on financial data, construct the enterprise performance evaluation system with four dimensions of finance, customer, internal process, learning and growth, and promote the transformation of the organization's macro strategy to specific action through performance evaluation, so that the enterprise can win a longer-term development.

Once BSC came out, it aroused the strong interest and strong repercussions of the theoretical and practical circles, and quickly swept the American business and theoretical circles. A large number of scholars poured into the research field of BSC. Based on the continuous deepening and improvement of

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3 CRO industry: Contract Research Organizations refers to the companies or institutions that provide specialized outsourcing services for pharmaceutical enterprises in the process of drug research and development through contracts. Its business model is mainly to accept the entrustment of customers (mainly pharmaceutical enterprises), and provide the whole process or part of the process services in the process of drug research and development to the market according to industry regulations and customer requirements.
BSC, a theoretical model beyond BSC was proposed. Andy Neely (1997) proposed "performance indicator record scale" based on the research of Kaplan and Norton according to the application cases, this paper summarizes the experience, points out the advantages and disadvantages of the performance index recording scale, and provides a relatively fixed and functional theoretical framework for the design of enterprise performance evaluation[1]. Paul Niven (2002) published a monograph "Practical Guide to balanced scorecard", which filled in the gap between BSC theory and practice[5]. Cheng and Humphreys (2012) tested the strategic role of BSC through experimental methods[2]. Goswami Propa (2018) believes that BSC can be used as a strategic tool for sustainable operation and management of enterprises[3].

3. Research design

3.1. Selection of evaluation indexes

3.1.1. Financial dimension
Due to the characteristics of innovative enterprises, the traditional DuPont analysis and other financial indicators are not very suitable. Therefore, in order to reflect the value creation ability of innovative enterprises, according to the innovative enterprise characteristics of WuXi AppTec, the financial indicators are selected from three aspects:

1. Value creation: Economic added value (EVA for short)
   EVA is the most suitable index to express the value creation ability of innovative enterprises. R & D is a long-term behaviour of enterprises. Due to the impact of tax or industrial policies, the profit results of innovative enterprises will be inaccurate. After adjusting these factors and deducting the cost of capital and debt, the remaining value can reflect the real "economic" profit.

2. Profitability: Return on net assets
   Return on net assets is an index to measure the efficiency of capital use of a company. As the investors of innovative enterprises, it is very important to know whether the invested capital can have good innovation output and get good return. As an innovative enterprise, it is one of the key issues whether it can respond to the interest demands of capital. Therefore, from the perspective of profitability, this paper chooses the return on net assets to measure.

3. From the perspective of business growth: Capital maintenance and appreciation rate
   Capital maintenance and appreciation rate refers to the ratio between the owner's equity at the end of this year and the owner's equity at the beginning of this year after deducting objective increase and decrease factors. It reflects the preservation and growth of the capital invested by investors, whether the economic benefits realized in the current period are good, and what is the development potential of the enterprise.

3.1.2. Customer dimension
Customer is the most important resource of an enterprise, which determines the quality of its social relationship, the number of businesses and whether it can further expand and develop better. For innovative enterprises, customers are particularly important. Most of them are growth enterprises, and customers are a very important part of their stakeholders. Therefore, this paper considers the customer indicators of WuXi AppTec from three perspectives:

1. Customer retention rate
   Customer retention rate refers to the change proportion of the number of existing old customers in the current period compared with the previous period. Generally speaking, the higher the customer retention rate is, the better. Because of the large volume and many customers of WuXi AppTec, this paper chooses the top ten customer retention rate of WuXi AppTec to measure.

2. New customer acquisition rate
New customer acquisition rate refers to the proportion of change in the number of new customers increased in the current period compared with the previous period. As with customer retention rate, generally speaking, the higher the new customer acquisition rate, the better.

3. Market ranking
This index reflects the position of enterprises in the same kind of enterprises. As WuXi AppTec has gone through delisting and re-listing after listing abroad, and its volume is "unicorn level", and its business has been facing the international market, this paper selects its international market ranking as the scoring index.

3.1.3. Internal process
WuXi AppTec is a new drug R & D enterprise with R & D innovation capability as its core competitiveness, so this part of the internal process focuses on the process from innovation input to innovation output, in order to consider the internal process dimension of WuXi AppTec:

1. Innovation investment
Due to the characteristics of innovation enterprises, this paper chooses the proportion of R & D funds in the main business income to measure the level of innovation investment, which reflects the investment of innovation activities.

2. R & D cost profit margin
R & D cost profit margin refers to the share of R & D cost in profit, that is, the contribution level of R & D expenditure to the development of enterprises. We can see the contribution of R & D activities to the future of the enterprise.

3. Proportion of intangible assets in total assets
As a research and development-oriented pharmaceutical enterprise, WuXi AppTec's innovation achievements are the representative factors to measure the internal process achievements. In this paper, the proportion of intangible assets to total assets is selected for evaluation.

3.1.4. Learning and growth dimension
Good strategy is based on the important foundation of the future, especially for innovative enterprises, in order to maintain the competitive advantage in the future, we must attach importance to talents as the internal key driving force of enterprises. Therefore, the evaluation of learning and growth mainly uses the proportion of highly educated personnel, the income level of R & D personnel and the level of human capital investment.

1. Proportion of highly educated personnel
The proportion of highly educated personnel is the proportion of all employees engaged in innovation and R & D, which can clearly reflect the educational level of employees. In this paper, talents with master's degree or above are divided into highly educated personnel.

2. Income level of R & D personnel
Income level is a measure of whether an enterprise attaches importance to talents and is willing to spend higher salaries than those of the same type and same volume companies in the same industry to treat talents. In this paper, the income of R & D personnel in the same industry and the same type of companies with the same volume is selected as the measurement index.

3. Investment level of human capital
At present, the development of pharmaceutical industry in China is very rapid, and the demand for technology is very large. Therefore, as an innovative enterprise, WuXi AppTec should invest more cost in talent training. This paper measures the investment level of human capital of WuXi AppTec by measuring the investment of its staff education funds.
3.2. Determination of the weight of performance indexes

A complete performance system, not only performance indicators, but also specific needs, to determine the status of each element in the performance evaluation, that is, the confirmation of the weight of performance indicators. In this paper, MATLAB software is used to quantitatively express the relative importance of each factor in the above four dimensions according to the judgment of objective display, and then the weight of relative importance order of all factors in each level is determined by mathematical method, which is used as the evaluation and selection party The basis of the case.

1. Determine the weight of financial indexes system

| Financial indexes | EVA | Return on equity | Rate of capital accumulation | Weight |
|-------------------|-----|------------------|-----------------------------|--------|
| EVA               | 1   | 2                | 3                           | 50.00% |
| Return on equity  | 1/2 | 1                | 2                           | 33.33% |
| Rate of capital accumulation | 1/3 | 1/2             | 1                           | 16.67% |

2. Determine the weight of customer indexes system

| Customer indexes | Customer retention rate | New customer acquisition rate | Market ranking | Weight |
|------------------|-------------------------|-------------------------------|----------------|--------|
| Customer retention rate | 1 | 1 | 3 | 42.86% |
| New customer acquisition rate | 1 | 1 | 3 | 42.86% |
| Market ranking | 1/3 | 1/3 | 1 | 14.28% |

3. Determine the weight of internal process indexes system

| Internal process | Innovation investment | R & D cost profit margin | Proportion of intangible | Weight |
|------------------|-----------------------|-------------------------|-------------------------|--------|
| Innovation investment | | | | |
Innovation investment 1 1 1/2 25.00%
R & D cost profit margin 1 1 1/2 25.00%
Proportion of intangible assets in total assets 2 2 1 50.00%

4. Determine the weight of learning and growth indexes system

Table 4. Study and growth dimension indexes weight table (consistency test: 0.0088)

| Study and growth indexes | Proportion of high-level R & D personnel | Income level of R & D personnel | Investment level of human capital | Weight |
|--------------------------|----------------------------------------|--------------------------------|----------------------------------|--------|
| Proportion of high-level R & D personnel | 1 | 1/2 | 1/3 | 16.67% |
| Income level of R & D personnel | 2 | 1 | 1/2 | 33.33% |
| Investment level of human capital | 3 | 2 | 1 | 50.00% |

Table 5 Weight of four dimensions (consistency test: 0)

|                       | Financial dimension | Customer dimension | Internal process | Study and growth dimension | Weight |
|-----------------------|---------------------|--------------------|------------------|-----------------------------|--------|
| Financial dimension   | 1                   | 1                  | 2                | 2                           | 16.67% |
| Customer dimension    | 1                   | 1                  | 2                | 2                           | 16.67% |
| Internal process      | 1/2                 | 1/2                | 1                | 2                           | 33.33% |
| Study and growth dimension | 1/2           | 1/2                | 1                | 2                           | 33.33% |

3.3. Determination of scoring standards for each index

The weights of the first level indicators of the four dimensions to the second level indicators and the weights of the second level indicators to the enterprise value have been calculated. Next, we need to determine the scoring standards for each indicator of each dimension. Among them, we divide the pros and cons of each index of WuXi AppTec into five grades: 0-1 for extreme poor, 1-2 for poor, 2-3 for general, 3-4 for good, and 4-5 for excellent.

1. Financial dimension

For the scoring standard of financial indicators, we refer to the evaluation standard setting of pharmaceutical industry (large enterprises) in the 2018 enterprise performance evaluation standard issued by SASAC.

Table 6. Financial indexes scoring standard table

| Financial indexes          | 100~90 | 90~80 | 80~70 | 70~60 | Below 60 |
|---------------------------|--------|-------|-------|-------|---------|
| EVA (%)                   | 12.30  | 7.70  | 1.40  | -3.60 | -7.30   |
| Return on equity (%)      | 19.00  | 14.40 | 9.10  | 3.60  | -7.30   |
| Rate of capital accumulation (%) | 117.30 | 113.10| 107.30| 102.70| 95.90   |

2. Non-financial dimensions
Table 7. Non-financial indexes scoring standard table

| Non-financial indexes | 100~90 | 90~80 | 80~70 | 70~60 | Below 60 |
|------------------------|--------|-------|-------|-------|----------|
| Customer retention rate | 100%~90% | 90%~80% | 80%~70% | 70%~60% | Below 60% |
| New customer acquisition rate | 100%~90% | 90%~80% | 80%~70% | 70%~60% | Below 60% |
| Market ranking | Top 10 in the industry | Top 20 in the industry | Top 30 in the industry | Top 50 in the industry | After 50 in the industry |
| Innovation investment | 3%~5% | 2%~3% | 1.5%~2% | 0.7%~1.5% | <0.7% |
| R & D cost profit margin | At the upstream level of the industry | In the middle and upper reaches of the industry | In the middle of the industry | In the middle and lower reaches of the industry | At the downstream level of the industry |
| Proportion of intangible assets in total assets | 3%~5% | 2%~3% | 1.5%~2% | 0.7%~1.5% | <0.7% |
| Proportion of high-level R & D personnel | At the upstream level of the industry | In the middle and upper reaches of the industry | In the middle of the industry | In the middle and lower reaches of the industry | At the downstream level of the industry |
| Income level of R & D personnel | At the upstream level of the industry | In the middle and upper reaches of the industry | In the middle of the industry | In the middle and lower reaches of the industry | At the downstream level of the industry |
| Investment level of human capital | At the upstream level of the industry | In the middle and upper reaches of the industry | In the middle of the industry | In the middle and lower reaches of the industry | At the downstream level of the industry |

3.4. Calculate the performance index scores of WuXi AppTec
1. Financial index score

According to the 2018 enterprise performance evaluation standard[7], we have obtained the criteria for scoring financial factors, and the scoring results are shown in the table below:

Table 8. Scoring table of financial indexes

| Financial index | 2018 | Weight | Scoring |
|-----------------|------|--------|--------|
| EVA (%)         | 12.69 | 50.00% | 50.00  |
| Return on equity (%) | 18.81 | 33.33% | 32.33  |
| Rate of capital accumulation (%) | 270.00 | 16.67% | 16.67  |

2. Non-financial index score

Table 9. Scoring table of non-financial indexes

| Non-financial index | 2018 | Weight | Scoring |
|---------------------|------|--------|--------|
| Customer retention rate (%) | 100.00% | 42.86% | 42.86  |
| New customer acquisition rate (%) | 160.67% | 42.86% | 42.86  |
| Market ranking | 9 | 14.28% | 14.28 |
| Innovation investment (%) | 4.55% | 25.00% | 23.75 |
| R & D cost profit margin | In the middle and upper reaches of the industry | 25.00% | 21.25 |
| Proportion of intangible assets in total assets | 2.76% | 50.00% | 43.00 |
| Proportion of high-level R & D personnel | At the upstream level of the industry | 16.67% | 15.84 |
| Income level of R & D personnel | In the middle and upper reaches of the industry | 33.33% | 27.66 |
| Investment level of human capital | In the middle and upper reaches of the industry | 50.00% | 41.00 |
3.5. Comprehensive evaluation results

| Dimension               | Weight  | Scoring |
|-------------------------|---------|---------|
| Financial dimension     | 16.67%  | 16.50   |
| Customer dimension      | 16.67%  | 16.67   |
| Internal process        | 33.33%  | 29.33   |
| Study and growth dimension | 33.33% | 28.16  |

According to the above comprehensive evaluation method, the final comprehensive performance evaluation index of WuXi AppTec is 90.66. According to the standard table, the evaluation result is good. The specific analysis is as follows:

Both the business growth and profitability of the enterprise of WuXi AppTec are relatively good, and at the same time, it also has outstanding performance in value creation, and its financial level is generally excellent.

In 2018, WuXi AppTec did not lose its old customers, with a maintenance rate of 100%. At the same time, with the increase of investment in science and technology, it not only used the old customer relationship to obtain new customers, but also used the new software developed to attract new resources. Of course, the new products also better serve the old customers and get a good market response.

At the same time, the increased R & D investment, income and transformation of innovation achievements of WuXi AppTec are all in the upstream or middle upstream level of the industry, which also has a positive impact on the financial indicators.

Finally, at the level of learning and growth, what WuXi AppTec has done is also in place, with large investment in employee training and income level in the upper reaches of the industry, which to a certain extent ensures the stability of employees. At the same time, the proportion of highly educated employees is nearly 40%, which shows that WuXi AppTec pays attention to the layout of enterprise talent development and the continuous improvement of its core technical talents.

4. Conclusion

At present, China's performance evaluation system is still dominated by financial performance, supplemented by operational performance index, and does not fully consider the non-financial part of enterprises, especially the innovative enterprises. There are many parts that are difficult to be measured directly by financial indicators. The commonly used evaluation method of manufacturing performance is not applicable to these enterprises. Considering the particularity of the pharmaceutical industry, we should include the non-financial performance into the performance evaluation standard of the pharmaceutical industry according to the characteristics of R&D and innovation, and emphasize the importance of the pharmaceutical enterprises to constantly innovate. Relevant performance evaluation and evaluation standards can be piloted from pharmaceutical enterprises, revised after practice, and promoted to the whole innovative industry.

5. Appendices

Performance evaluation weight questionnaire of WuXi AppTec

Hello, I'm a student of Accounting School of Guangdong University of Finance and Economics. Now I'm working on the thesis design of "WuXi AppTec performance evaluation". Please make a corresponding evaluation according to your understanding of the operation of WuXi AppTec. This survey is conducted anonymously, only for thesis research, not for other purposes. Please fill in it with confidence and truthfulness. Thank you for your cooperation.

Please complete this survey under my guidance, thank you very much for your strong support, and wish you all the best!

1. Questionnaire description and examples
   1.1 questionnaire description
The purpose of this questionnaire is to investigate the impact of different factors on the financial risk of WuXi AppTec. The evaluation index system is as follows:

| First level                  | Second level                      |
|------------------------------|-----------------------------------|
| Financial dimension          | EVA                               |
|                              | Return on equity                  |
|                              | Rate of capital accumulation      |
| Customer dimension           | Customer retention rate           |
|                              | New customer acquisition rate     |
| Internal process             | Market ranking                    |
| Study and growth dimension   | Innovation investment             |
|                              | R & D cost profit margin          |
|                              | Proportion of intangible assets in total assets |
|                              | Proportion of high-level R & D personnel |
|                              | Income level of R & D personnel   |
|                              | Investment level of human capital |

Please compare the indicators in the table in pairs according to the comparison importance criteria given.

| Scale | Meaning                                                                 |
|-------|-------------------------------------------------------------------------|
| 1     | Indicates that the two factors are equally important                   |
| 3     | Indicates that one factor is slightly more important than the other    |
| 5     | Indicates that one factor is significantly more important than the other|
| 7     | Indicates that one factor is more important than the other              |
| 9     | Indicates that one factor is extremely important compared with the other|
| 2, 4, 6, 8 | The median value of the above two adjacent judgments                   |

Reciprocal: If $a_{ij}$ is judged by comparing factor $i$ with $j$, then $a_{ji} = 1 / a_{ij}$ is judged by comparing factor $j$ with $i$.

1.2. Example (this example is only for demonstration, please do not be disturbed by this)

Please compare the importance of the factors that affect the financial dimension.

| Financial indexes | EVA | Return on equity | Rate of capital accumulation |
|-------------------|-----|------------------|-------------------------------|
| EVA               | 1   | 2                | 3                             |
| Return on equity  |     | 1                | 2                             |
| Rate of capital accumulation |   |                 | 1                             |

(1) Just fill in the upper right corner of the form above the diagonal.
(2) You need to write the judgment value in the corresponding space, for example, the first indicator on the left "EVA" is compared with the second indicator "return on net assets" above, and the result is filled in the space where EVA and return on net assets intersect. "2" indicates that when measuring "EVA" and "return on net assets", the influence of "EVA" is slightly stronger, and so on.

2. Grade the first level indexes

| Financial dimension | Customer dimension | Internal process | Study and growth dimension |
|---------------------|--------------------|------------------|---------------------------|
|                     | 1                  | 1                |                           |
| Customer dimension  |                     | 1                |                           |
| Internal process    |                     |                 | 1                         |
| Study and growth dimension |           |                |                           | 1                         |
3. Grade the first level indexes

(1) Score and compare the indexes of "financial dimension"

| Financial dimension | EVA | Return on equity | Rate of capital accumulation |
|---------------------|-----|------------------|-------------------------------|
| EVA                 | 1   | 1                |                               |
| Return on equity    | 1   | 1                |                               |
| Rate of capital accumulation | 1 | | |

(2) Score and compare the indexes of "customer dimension"

| Customer dimension | Customer retention rate | New customer acquisition rate | Market ranking |
|--------------------|-------------------------|------------------------------|----------------|
| Customer retention rate | 1                       |                              |                |
| New customer acquisition rate | 1                  |                              | 1              |
| Market ranking |                         |                              |                |

(3) Score and compare the indexes of "internal process"

| Internal process | Innovation investment | R & D cost | Profit margin | Proportion of intangible assets in total assets |
|------------------|-----------------------|------------|---------------|-----------------------------------------------|
| Innovation investment | 1                     |             |               |                                               |
| R & D cost |           | 1 |                        | 1 |
| Profit margin |                       | 1 |                        |    |
| Proportion of intangible assets in total assets | 1 | | | |

(4) Score and compare the indexes of "learning and growth dimension"

| Study and growth dimension | Proportion of high-level R & D personnel | Income level of R & D personnel | Investment level of human capital |
|----------------------------|-----------------------------------------|--------------------------------|----------------------------------|
| Proportion of high-level R & D personnel | 1                                      |                              |                                  |
| Income level of R & D personnel |                                       |                              | 1                                |
| Investment level of human capital |                                   |                              |                                  |

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