

# Application of Boston matrix combined with SWOT analysis on operational development and evaluations of hospital development

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**Abstract.** – The aim of this study is to explore the application of Boston matrix combined with SWOT analysis on operational development and evaluations of hospital departments. We selected 73 clinical and medical technology departments of our hospital from 2011 to 2013, and evaluated our hospital by Boston matrix combined with SWOT analysis according to the volume of services, medical quality, work efficiency, patients' evaluations, development capacity, operational capability, economic benefits, comprehensive evaluation of hospital achievement, innovation ability of hospital, influence of hospital, human resources of hospital, health insurance costs, etc. It was found that among clinical departments, there were 11 in Stars (22.4%), 17 in cash cow (34.7%), 15 in question marks (31.2%), 6 Dogs (12.2%), 16 in the youth stage of life cycle assessment (27.6%), 14 in the prime stage (24.1%), 12 in the stationary stage (20.7%), 9 in the aristocracy stage (15.5%) and 7 in the recession stage (12.1%). Among medical technology departments, there were 5 in Stars (20.8%), 1 in Cash cow (4.2%), 10 in question marks (41.6%), 8 Dogs (29.1%), 9 in the youth stage of life cycle assessment (37.5%), 4 in the prime stage (16.7%), 4 in the stable stage (16.7%), 1 in the aristocracy stage (4.2%) and 6 in the recession stage (25%).

In conclusion, Boston matrix combined with SWOT analysis is suitable for operational development and comprehensive evaluations of hospital development, and it plays an important role in providing hospitals with development strategies.

*Key Words:*

Boston matrix, SWOT analysis, Hospital, Development and evaluations.

## Introduction

Boston matrix analysis method and SWOT analysis method are widely applied in the enterprise management and provide strategic planning for the enterprise development<sup>1</sup>. Although the

hospitals in China belong to non-profit-making institutions, the adaptation to competitive market under the situation of wide-ranging market reforms has become the focus and challenge for hospital managers<sup>2</sup>. There were some successful precedents<sup>3</sup> about the application of Boston matrix analysis method and SWOT analysis method in hospital management, but their application scope is still narrow<sup>4</sup>, let alone the combination of Boston matrix analysis method and SWOT analysis method. The comprehensive evaluation was implemented by our hospital based on the conclusion of total 12 indicators concerning clinical department and medical technical department from 2011 to 2013. We also compared our hospital with other hospitals of the same class. Thus, the combination of Boston matrix analysis method and SWOT analysis method has provided strategic decisions for the operation and development of our hospital.

## Materials and Methods

### *Clinical Specimens*

73 clinical and medical laboratory departments were selected among our hospital from 2011 to 2013, which includes 49 clinical departments and 24 medical laboratories as shown in Table I. All data were automatically generated by the hospital's background management system, which was accurate and detailed, and the missing items were deleted.

### *Statistical Index*

Our hospital was comprehensively evaluated from twelve indexes, such as service volume, medical quality, work efficiency, patients' evaluation, development capacity, operating capacity, economic benefits, hospital's comprehensive performance, hospital's innovation ability, hospi-

**Table I.** List of the clinical departments and medical laboratories involved in the study.

Clinical departments		Medical laboratories
1.	ICU	Department of traditional Chinese medicine
2.	Department of radiotherapy	Catheter room
3.	Department of digestive system	Ultrasonic department
4.	Department of urology surgery	CT department
5.	Department of endocrinology	Department of western medicine
6.	Department of spinal orthopaedics	Department of hyperbaric oxygen, ECT room
7.	Department of osteoarthropathy surgery	Outpatient operating room
8.	Rehabilitation department	Department of isotope
9.	Invasive technology department	Endoscopy room
10.	Department of breast surgery	Electrocardiographic room
11.	Department of pediatrics	Ultrasound department
12.	Department of gastrointestinal surgery	Transfusion room
13.	The first department of bone trauma	Department of lung function
14.	The first department of oncological surgery	Pathology department
15.	The second department of cardiology	Department of electroencephalogram
16.	The first department of cardiology	x-ray department
17.	The third department of cardiology	Department of physiotherapy
18.	Obstetrical department	Room of cerebral blood flow
19.	Department of outpatient service	
20.	Department of gynaecology	PET-CT,
21.	The first department of chest surgery	room for clinic anesthesia
22.	The first department of medical oncology	blood sampling room,
23.	Department of otolaryngology	blood band
24.	Department of emergency	plastic surgery room
25.	The first department of respiratory medicine	
26.	The third department of neurology	
27.	The second department of brain surgery	
28.	Department of traditional Chinese medicine	
29.	Department for minimally invasive surgery of blood	
30.	Department of nail and hernia	
31.	Department of cardiac surgery	
32.	Department of stomatology	
33.	Department of rheumatism	
34.	Nephrology department	
35.	Dialysis chamber	
36.	Reproductive center	
37.	Dermatological department,	
38.	Department of pediatric surgery	
39.	Department of pancreatic and splenic surgery	
40.	Department of hematology	
41.	The fourth department of neurology	
42.	The first department of neurology	
43.	The second department of neurology	
44.	The first department of brain surgery	
45.	Department of ophthalmology	
46.	Department of anorectal section	
47.	Department of infection	
48.	RICU	
49.	CCU	

tal's influence, hospital's human resources and health care costs, and it is compared with equivalent hospitals. The index of service volume included the number of outpatient visits, the number of emergent patients, the number of discharged patients, the number of critically ill patients, the number of surgeries (including inter-

vention, outpatient, eye surgery), the number of beds, the actual number of days the beds were occupied. The medical quality index included cure rate, improvement rate, fatality rate, diagnose accordance rate before and after the diagnosis, clinical and pathological diagnose accordance rate, average length of stay, average length

of stay before surgery, first healing rate of septic operation and success rate in rescuing critically ill patients. The work efficiency index included utilization rate of hospital beds, bed rotation rate, average length of stay, number of surgeries performed by each doctor, outpatients number of each doctor, complete bed days of each doctor, discharged patients of each doctor, daily admitted patients, number of admitted patients from every 100 outpatients. The patients' evaluation index included degree of patients' satisfaction towards comprehensive service, per capita outpatient expense, average hospitalization expense, drug proportion, annual per capital income of staffs. The development capacity index included total revenue, operating income, total assets, net assets, annual surplus, per capita surplus. The operating capacity index included number of total asset turnover, number of current asset turnover, receivable turnover in days, accounts receivable turnover, inventory turnover days and medicine turnover days. The economic benefits index includes return on equity, return on total assets, surplus rate of operating income, self-financing rate, per capita fund expenditure, one hundred yuan fixed assets; hospital's comprehensive performance index includes per capita revenues, per capita surplus, number of surgeries of each doctor, number of patients discharged from hospital of each doctor, number of outpatient of each doctor and average length of stay of patients discharged from hospital. The hospital's innovation ability index included technological advancement award above provincial level, technology introduction award in provincial level, national research projects, research projects above provincial level, city-level and technological advancement and achievement award, city-level technology introduction award, city-level research projects, SCI (all year round), Zhonghua thesis, provincial key specialist departments. The hospital's influence index included number of doctors that participate in medical outreach to countryside, number of patients discharged from hospital, city's number of discharged patients, discharged patients in counties under City Administration and patients in other places. The hospital human resources index included the total number of staff, personnel on payroll, number of introduced experts, number of doctors, number of nurses, number of health technicians. The health care costs index included total costs of health care, overspend limit, number of patients received and average medical charge.

### **Research Method**

The market share of whole hospital was set as 100%,  $1/\text{total number of departments} = \text{average market share of hospital departments}$ , that is the reference value of abscissa of BCG matrix compared with market share. The higher reference value indicated a high market share and lower reference value indicated a low market value

Relative market share of departments = business income of departments/total hospital income, clearly aware of department with highest relative market share and department with lowest relative market share, clearly set maximums and minimums of abscissa as dividing value;

The average growth rate of hospital departments in recent three years = (income growth rate of hospital's business from the year of 2011 to 2013)/3, that is the reference value of growth rate of ordinate in BCG matrix. The higher reference value indicated a high growth rate of departments and lower reference value indicated a low growth rate of departments, clearly aware of department with highest growth rate and department with lowest growth rate, clearly set maximums and minimums of ordinate as dividing value; clearly awareness of the specific position of every department in four quadrant and the percentage of start department, cash cow department, problem department and thin horses department. The SWOT analysis was combined to analyze for adjusting the strategy, ensuring a sound development of department and hospital. The departments were divided into the clinical department and medical department, and were counted respectively.

## **Results**

### ***Clinical Department Type and the Life Circle Assessment Results***

The average growth rate of the clinical department from 2011 to 2013 was 26.6%, accounting for 1.6% of the market share. Therefore, clinical departments were defined according to a certain classification: Stars (growth rate > 26.6%, market share > 1.6%), cash cow (growth rate < 26.6%, market share > 1.6%), Question marks (growth rate > 26.6%, market share < 1.6%), Dogs (growth rate < 26.6%, market share < 1.6%). Among the 49 clinical departments, there were 11 stars (22.4%), 17 cash cow (34.7%), 15 question marks (31.2%), and 6 Dogs (12.2%). The distribution of clinical departments types as shown in Table II and Figure 1.

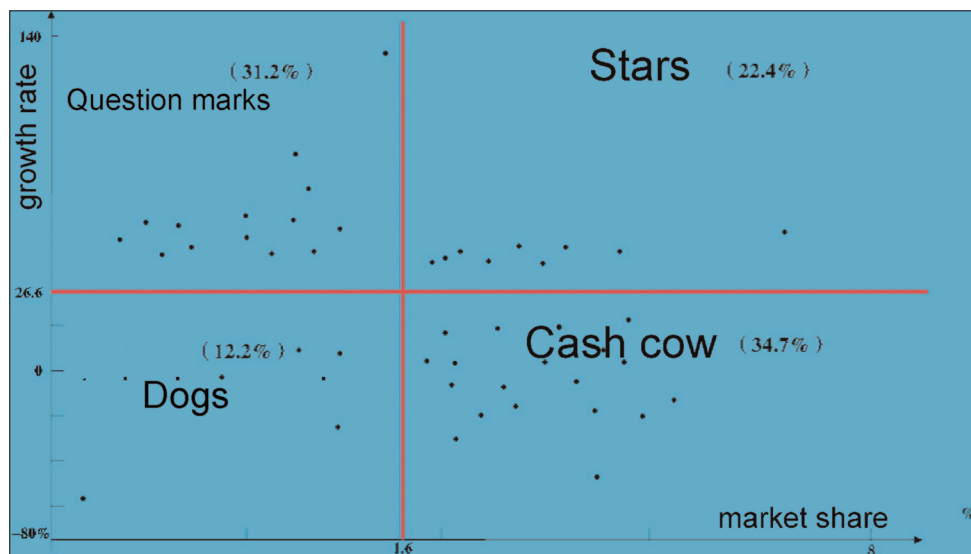
**Table II.** Classification of clinical department types.

Types	Quantities (%)	Departments	Features
Star	11 (22.4)	ICU, department of radiotherapy, digestive system department, department of urology, CCU, department of endocrinology, department of spinal orthopaedics, department of osteoarthropathy surgery, rehabilitation department, invasive technology department, breast surgery	High growth rate, high market share
Cash cows	17 (34.7)	Department of pediatrics, gastrointestinal surgery, the first department of bone fracture, the first department of oncological surgery, the second department of cardiology, the third department of cardiology, obstetrics, convenient outpatient service, department of gynecology, the first department of thoracic surgery, the first department of medical oncology, department of otolaryngology, EICU, emergency treatment, first department of respiratory medicine, the third department of neurology	High market share, growth rate lower than that of the wards' average
Question marks	15 (31.2)	The second department of cerebral surgery, Traditional Chinese medicine department, department for minimally invasive surgery of blood, nail and hernia, department of cardiac surgery, department of stomatology, department of rheumatism, urology department, dialysis chamber, reproductive center, dermatological department, pediatric surgery, department of pancreatic and splenic surgery, department of hematology, the fourth department of neurology, the first department of neurology	Growth is higher than that of the wards' average; low market share
Dogs	6 (12.2)	The second department of neurology, the first department of brain surgery, ophthalmology, anorectal section, department of infection disease, RICU	High growth rate, the market share is lower than that of the wards' average

**Evaluation Criterion for Life Circle**

It was defined with the combination of the life circle theory of Mike Dean and the actual of our hospital, which classified departments of life circle into youth stage, prime stage, stable stage,

aristocracy and the recession stage. The details of classification were as follows young stage (market share < 1.6%), prime stage (0.8% < market share < 1.6%), stable stage (market share > 1.6%, growth rate > 26.6%), aristocracy (market share



**Figure 1.** Distribution of Clinical Department Types.

> 1.6%, 13.3% > the growth rate > 26.6%), the recession stage (market share > 1.6%, growth rate < 13.3%). According to this classification, there were 16 cases of youth stage (27.6%), 14 cases of prime stage (24.1%), 12 cases of stable stage (20.7%), 9 cases of aristocracy stage (15.5%), and 7 cases of recession stage (12.1%) as shown in Table III.

**Medical Laboratory Types and the Life Circle Assessment Results**

The average growth rate of the annual revenue of medical laboratories was 21.57%, accounting for 4.0% of the marker share. Therefore, the classification criteria of the assessment of medical laboratory types were Stars (growth rate > 21.57%, market share > 4.0%), cash cow (growth rate < 21.57%, market share > 4.0%), Question marks (growth rate > 20%, market share < 4.0%), Dogs (growth rate < 20%, market share < 4.0%). According to this classification, there were 5 cases of Stars, accounting for 20.8%, one case of Cash cow, accounting for

4.2%, 10 cases of question marks, accounting for 41.6%, 8 cases of Dogs, accounting for 29.1% (Table IV, Figure 2).

**Evaluation Criterion for Life Circle**

There were young stage (marker share < 2%), prime stage (2% < market share < 4%), stable stage (market share > 4%, growth rate > 21.57%), aristocracy (market share > 4%, 21.57% > the growth rate > 10.8%), the recession stage (market share <10.8%). According to this classification, there were 9 cases of youth stage (37.5%), 4 cases of prime stage (16.7%), 4 cases of stable stage (16.7%), 1 case of aristocracy stage (4.2%), and 6 cases of recession stage (25%) (Table V).

**Discussion**

It is considered that the strategy can create sustainable and real value, and the real value should be equipped with enduring competitive-

**Table III.** Life circle classification of clinical departments..

Types	Quantities (%)	Departments
Youth stage	16 (27.6)	The second department of neurology, reproductive center, dermatology, the second department of respiration, anorectal section, department of infection, the second department of oncology, pediatric surgery, the fourth department of neurology, the second department of chest surgery, department of minimal invasive surgery for hand and foot disease, department of bone tumour, RICU, the sixth department of neurology, the third department of neurosurgery
Prime stage	14 (24.1)	Traditional Chinese medicine department, department of stomatology, hematology department, urology department, dialysis chamber, the second department of oncological surgery, The second department of cerebral surgery, department of pancreatic and splenic surgery, the first department of neurology, department for minimally invasive surgery of blood, nail and hernia, the first department of brain surgery, department of ophthalmology, department of cardiac surgery, department of rheumatism
Stable stage	12 (20.7)	ICU, digestive system department, department of gastrointestinal surgery, department of urinary surgery, department of radiotherapy, CCU, department of endocrinology, department of spinal orthopaedics, department of osteoarthopathy surgery, rehabilitation department, convenient outpatient service, department of otolaryngology
Aristocracy stage	9 (15.5)	Department of pediatrics, the first department of bone trauma, department of gynecology, the first department of respiration, invasive technology department, department of breast surgery, the second department of cardiology, EICU, department of emergency
recession stage	7 (12.1)	The first department of cardiology, the third department of cardiology, department of obstetrical, the first department of oncological surgery, the first department of chest surgery, the first department of medical oncology, the third department of neurology

**Table IV.** Classification of medical department types.

Types	Quantities (%)	Departments	Features
Star	5 (20.8)	Test, Department of traditional Chinese medicine, conduit room, department of ultrasound, CT room	High growth rate, high market share
Cash cows	1 (4.2)	Department of western medicine	High market share, growth rate lower than that of the wards' hospital
Question marks	10 (41.6)	High pressure oxygen, ECT room, minor operation room, isotope, endoscopy room, electrocardiogram, department of ultrasound, transfusion room, department of lung function, department of pathology, electroencephalogram	The growth is higher than that of the wards' average; low market share
Dogs	8 (29.1)	Radiation, department of physiotherapy, cerebral blood flow room, PET-CT, outpatient anesthesia, blood collection room, blood bank, department of plastic surgery	Growth rate and market share are lower that of the wards' average

ness. In the case of lack of strategy, the enterprise would not grasp strategy to make success although it has found an opportunity<sup>5</sup>. The Boston matrix analysis method was just put forward through enterprise strategy research based on the said idea. Boston matrix analysis method has been widely spread and utilized for its simplicity and utility. SWOT analysis method was originated from strategic planning in enterprise management theory, which was put forward by professor Weihric H in USA's University of San Francisco. The method considered various factors including the enterprise's internal conditions and external environment so as to conduct systematic evaluation and choose the best business strategy. The combination of Boston matrix

analysis method and SWTO analysis method was used for evaluating the management and development of hospital departments is a kind of research on competitive intelligence in essence<sup>7</sup>. Just as The Art of War said "To know the enemy and know yourself, and you can fight a hundred battles with no danger of defeat". The competitive intelligence was a process to collect, collate and analyze the competitor, competitive environment, competitive strategy and other integrated information. We can acquire valuable information from this process to make an analysis on hospital, the internal market competition of hospital departments and comparative advantages for industry development, based on which we can determine the business development direc-



**Figure 2.** Distribution of medical laboratory types.

**Table V.** Life circle classification of clinical departments.

Types	Quantities (%)	Departments
Youth stage	9 (37.5)	High pressure oxygen, electrocardiogram room, infusion room, lung function room, department of physiotherapy, electroencephalogram room, blood collection room, radiology department, endoscopy room
Prime stage	4 (16.7)	Outpatient operating room, ECT room, isotope room, department of ultrasound
Stable stage	4 (16.7)	Test, department of traditional Chinese medicine, conduit room, CT room
Aristocracy stage	1 (4.2)	Department of western medicine
Recession stage	6 (25.0)	Blood bank, department of physiotherapy, cerebral blood flow room, PET-CT, outpatient anesthesia, department of plastic surgery

tion and investment proportion of hospital and hospital departments so as to make the best of medical resources and meet the people's increasing demands for health.

The Stars departments set a good example for the whole hospital, so we should keep strengthening the management of them, strengthen the connotation construction, and make the most of the brand and technical advantages to improve the service quality and maintain the dominant position. Due to the rapid growth of business and occupancy of the said business in the expanding market, huge money needed to be invested. It is recommended that to maintain and expand the market share of medical services should be put in the first place followed by the profit. We should strengthen the investment of capital and medical technology, which should be above the average market level. We should strengthen research and development and take the high-quality and high-price strategy of super medical services. Also, we should increase businesses in medical service market and equipment for developing specialty staff.

Each department of Cash cow takes advantage of the existing talents to actively explore new markets and create high-quality brands so as to inject new vigor and motive force for the development of hospital departments. The high market share would produce better revenue which becomes the main source of hospital's profit. However, more investment shall not be put in the industry in low growth. It is recommended to control the investment in medical equipment and prolong the life cycle of existing medical equipment and technology so as to maximize the profit. We should also conduct medical service market segmentation and try to implement the differential operation.

The growth rate of young question marks was above the average level of the whole hospital and their occupancy rate was low. Thus, we should maintain the existing growth rate to improve the occupancy rate and become the star department. We can also do a lot in small departments. Each department should actively introduce technology and talents to improve core competitiveness and become the star department earlier. More capital is necessary to be invested to catch the precursor in the industry and to meet the increasing market demands; thus, the competitive risk is greater. The departments which need improvement should carefully sum up experience and lessons and find out failure reasons to accelerate its growth. At present, our primary task is to improve our own growth rate.

Through the said research, we have come up with some strategies for the construction of clinical departments as below:

1. We should adapt to the market demands and focus on the development of relevant departments, for example, cardiovascular department, cerebrovascular department, tumor, diabetes and metabolic disease, geriatric-related prostatic disorders, osteoarthritis, osteoporosis, hazy weather-related respiratory system disease, lung cancer, asthma, second pregnancy-related maternity, reproductive medicine and pediatric department.
2. We should give full play to our superiority and highlight our features. We are more confident than general hospitals of the same class, and the secondary hospital is an example, and our technical advantage is that our hospital concentrates on clinical work, because the medical science is a kind of empirical science and the promotion of our own technology is our

emphasis. As for the surgery, one of the advantages is that the surgery quantity of our hospital ranked the first place in 2013; thus, we do not have any teaching task pressure, and our physicians have strong practice ability. As for the acute and severe diseases, one of our advantages is that the number of patients with acute and severe disease who are admitted to our hospital is more than those who are admitted to the secondary hospital, thus the number of patients with acute and severe disease who are admitted to our hospital ranks the first or the second place in the whole province.

Our special advantages include vascular surgery, micro neurosurgery, angiography and cerebral vascular intervention, rheumatism Immunity, functional neurosurgery, endoscopic therapy, lymphoma therapy in hematology department and epilepsy diagnosis and treatment center. The comprehensive diagnosis and treatment ability of our hospital are stronger than that of the special hospital. The obstetrics and gynecology hospital has Varian radiotherapy instruments for gynecological oncology, the children's hospital has neonatal treatment rooms, the traditional Chinese medicine hospital combines the traditional Chinese medicine and Western medicine, the tumor hospital has comprehensive diagnosis and treatment ability and the stomatological hospital has a head-neck and maxillofacial surgery department.

3. We should follow the frontiers of medical science and actively develop three-new business. We should develop minimally invasive medicine, for instance, endoscope, abdomen microscope, radioactive intervention, ultrasound intervention, microsurgery and biotherapy including tumor DIK therapy, blood and bone marrow transplantation and femoral head necrosis stem cell therapy; medical science for severe and acute diseases, including intensive care and organs support; precision medicine, including the application of navigation in each department; the diagnosis and treatment of complicated ascites diseases.
4. Integration of disciplines and segmentation of special disciplines. Different disciplines shall be integrated and centralized, for example, the establishment of multiple centers (lung cancer diagnosis and treatment center, hemangioma diagnosis and treatment center, hyperthyroidism diagnosis and treatment center, prosopalgia diagnosis and treatment center, sleep-related breathing disorders diagno-

sis and treatment center, chest pain center) and cerebral vascular disease diagnosis and treatment center, metabolic disease hospital and rehabilitation hospital. As for the segmentation of special disciplines, the clinical department is divided into four branches for specialized diseases, and the medical technical department is divided into three branches, in which the special out-patient department is established for specialized diseases and for the development of sub-specialty so that the junior physicians would be generalized, the mid-level physicians would be specialized, the senior physicians would be responsible for specialized diseases and the department chief in specialized hospital would be promoted to the hospital director.

5. We should strengthen professional study and establish a learning department, and each department should find a model department in the whole country and then learn from the said model department according to the plan. The professional study and academic exchange meeting should be held in the department once a week so as for the physicians to discuss severe and acute diseases with each and for young physicians to give an academic report.
6. We should strengthen scientific research and teaching work to strive for the key specialized department in the whole province and city. Each department of our hospital can basically meet the requirements raised by the key provincial specialized department in terms of provincial topics, achievements, awards and clinic projects, and the main disadvantages for our hospital to strive for the key provincial specialized department is scientific research, so each department of our hospital should concentrate of scientific research. The next we will do is to develop 5-10 provincial specialized departments.
7. We should actively promote charity clinic and continuously expand the new market, and each department should pay their attention to carry out charity clinic activities in the countryside, should concentrate on self-promotion and the website construction of department.

## Conclusions

The combination of Boston matrix analysis method and SWOT analysis method plays an extremely important role in the operation, develop-



ment and evaluation of hospital departments, thus it can provide valuable strategic decisions for the improvement of the hospital's competitiveness.

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#### Conflict of Interest

The Authors declare that there are no conflicts of interest.

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