The Application of Intelligent Human Resources Cockpit in Human Resources Management

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Abstract. In the era of big data, it has become hot research topic about how to utilize and analyse human resource data in hospital. At present, the existing human resource management system lacks an intuitive reflection of the operation status of hospital human resources. Therefore, the research team firstly established a set of the human resources management statistics with 20 departmental/hospital-level indicators. Secondly, the human resources cockpit is built on the basis of the domestic platform called Sky-Cloud-Star Analysis and Visualisation Platform which offer functionality to enable data exploration and gain insights. The human resource cockpit serves as analytical and detailed dashboard, and holds both operational and strategic data. The cockpit includes seven web pages to display human resources data in real time and provides the platform for monitoring and tracking key workforce metrics. The human resource data can be presented to department-level and hospital-level management to view, analyse, manage and decision making.

Keywords: human resources management; management cockpit; data visualization;data analysis

1 Introduction

With the rapid development of information technology, how to use big data to create value has gradually become a hot research topic for many scholars. Human resource(HR) is an important assets in hospital that can help the organization achieve hospital's goals. Hospital should conduct appropriate and and effective human resource management(HRM) to maximize the performance of employee.

At present, Peking University Shenzhen Hospital (hereinafter called our hospital) has over 3,500 employees. The human resource management in our hospital mainly relies on the human resourcemanagement system. The existing system can implement the functions of displaying personal basic information,etc. However, the existing human resource management system lacks an intuitive reflection of the operation status of hospital human resources. Our hospital is turning to more effective way by relying on data and analytics to manage human resource. The management cockpit has the characteristics of being intuitive, configurable, convenient, comprehensive, and multi-dimensional. A good management cockpit should be simple to master

and easy to understand. The management cockpit is technically implemented to achieve multi-user, multi-access management, multi-graphic and multi-indicator functions.With an open system structure, it is easy to configure functions flexibly and customize basing on different needs. It can aggregate and present department and employee data in a meaningful way. As a real-time display of key metrics, the human resource cockpit can simplify information gathering and present well-sorted data. The human resource cockpit provide the platform for monitoring and tracking key workforce metrics. The human resource data can be presented to department-level and hospital-level leadership to view, analyse, manage and decision making. The contributions of this paper are as follow:

(1) The research team has established a set of the human resources management statistics covering a total of 20 departmental/hospital-level indicators.The indicators includes the total number of staff, doctor-nurse ratios, talent quality education index, professional title holding ratio, and staff age distribution.

(2) The HR cockpit is built on based on the Sky-Cloud-Star analysis and visualisation platform. The cockpit contains seven pages to visualise personnel indicators for department-level and hospital-level managements.

2 Related Works

The Management Cockpit[1], as known as dashboard, Patrick M. Georges proposed in 1989 that the basic idea of integrating information science, management science and human brain science is a high-level decision support system based on ERP[3]. The management cockpit can visually display various key indicators through various charts, such as bar chart, sector chart, histogram, line chart, radar chart, indicator card, etc., monitor the operation in real time, and conduct early warning and mining analysis on abnormal key indicators.

At present, the management cockpit is widely used in the medical field[2][3]. radiology[4]、 pharmacology[5], emergency[6], outpatient[7], nursing, finance[8] and other field. The top-level cockpit for human resource management in public hospitals has not yet been established. A private hospital has proposed a hospital human resource management data application framework to build a functional integrated human resource management system[8]. This model can display the existing evaluation results and predictions of employee abilities, and can also compare visual abilities among employees[9], possessing the characteristics of managing the cockpit. Competency-based HR management digital dashboard models are built so that every employee will be assessed more optimal.[10]

3 The Proposed System Construction

It is the domestic platform called The Sky-Cloud-Star Analysis and Visualization platform is an home-made platform for data extraction, visualization and analysis. The research team built the human resources cockpit based on the Sky-Cloud-Star platform which offer functionality to enable data exploration and gain insights. The human resource cockpit serves as analytical and detailed dashboard, and holds both operational and strategic data.

3.1 Overall architecture of human resource cockpit
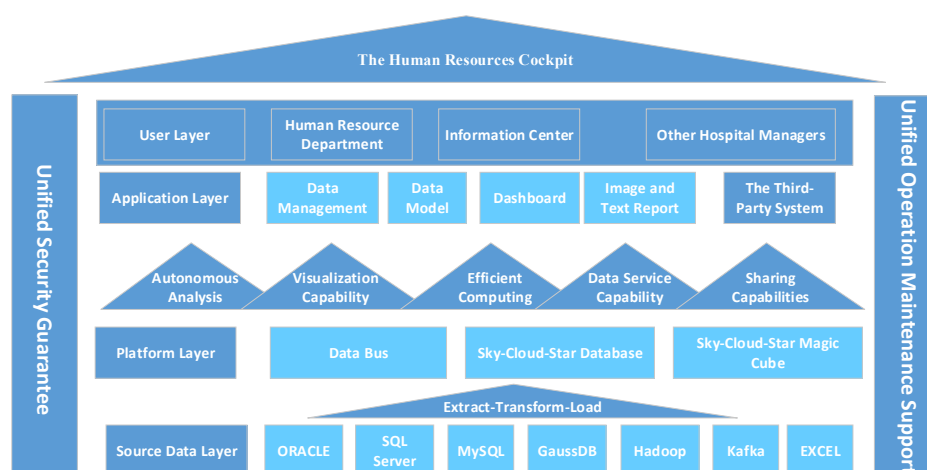
Fig. 1. Overall architecture of the human resource cockpit

As shown in **Figure 1,** the overall architecture of our human resources cockpit. The platform consists of four layers: source data layer, platform layer, application layer and user layer.

(1)   **Source Data Layer:** The source data layer directly interfaces with the relevant business information data integrated by the existing human resources system data support platform, providing the platform with multi source heterogeneous data resources.

(2)   **Platform Layer:** the platform layer is composed of domestic distributed database, visual big data modeling analysis software and data intelligent extraction tool software, which are uniformly deployed in the intranet server of the hospital information room to provide the platform with the ability of independent analysis, visualization, efficient computing, data service and mass innovation sharing.

(3)   **Application Layer:** the application layer provides data management, data modeling, dashboard, and graphic report applications based on the platform layer's ability to visualize big data modeling analysis software, and provides data modeling agility for human resource management.

(4)   **User Layer:** The user layer is aimed at human resources departments or other hospital managers, and through precise authorization of data and the sinking of data analysis capabilities, all users can easily and quickly carry out data practical applications, with points becoming gold.

3.2 Indicator setting

This system adopts the Delphi method to set up HRM statistics indicators of the human resources cockpit. The specific steps are as follows:

(1)   Collect the needs of personnel, hospital leaders, department leaders, and some employees, and establish an expert group based on the scope of knowledge for predicting problems.

(2)   Propose predicted questions and related needs to all experts, and attach materials such as the background of the experts' required questions. Each expert independently provides predictive opinions through written responses based on the received materials.

(3)   Summarize the first judgment opinions of each expert, form a chart, compare them, and redistribute them to each expert, allowing them to compare their different opinions with others, and modify their own opinions and judgments.

(4)   Collect and summarize the modification opinions of all experts, and distribute them again to all experts for the second modification. This process is repeated until each expert no longer changes their opinion.

(5)   Comprehensively handle the opinions of experts.

Finally, based on the principles of comprehensiveness, typicality, independence, and rationality in the HRM statistics indicators. The research team aim to meet the needs of our hospital. From the five dimensions of age, professional title, degree, personnel employment category, and job category, the research team will horizontally evaluate the support of human resource management indicators for professional management indicators such as talent indicators for the entire hospital and the soft power of hospital development. The research team will vertically divide the three statistical levels of the entire hospital, department, and middle level management to assist in decision making on hospital talent cultivation Employee management and other strategies to comprehensively enhance the hospital's soft power.

4 The Emperical Result and Analysis

### 4.1 Human resource system interface

At present, the HR Cockpit has achieved a full range of statistics and displays of HR operational data in hospital. The cockpit achieves full coverage of employee data. The Sky-Cloud-Star platform provides common visualization types such as line chart, histogram, pie chart, histogram, radar chart, indicator card, and combination chart.

The cockpit system contains seven data visualisation pages: the homepage, middle level management page, personnel employment category page, job category page, personnel age statistics page, distribution of professional title page, educational background/degree page.

Take home page as an example. The home page provides an overview of the operational and strategic data throughout the entire hospital. The indicator settings and display style of the home page of the cockpit are shown in Table 1, containing a total of 16 indicators such as organizational structure, the number of people in the whole hospital, the distribution of high-level talents, beds and other statistical quantities.

Table 1. Indicator setting for homepage

Indicator Name	Display Style
Hospital Organization Structure	graphic
High-level talent distribution	list
Distribution of age in the entire hospital/clinical department	histogram
Distribution of professional titles in the entire hospital/clinical departments	histogram
Degree distribution across the entire hospital/clinical departments	doughnut diagram
Distribution of high-level talents	tabulation
Proportion of medical personnel and beds	digit
Proportion of doctor and nurse	digit
Proportion of senior professional titles of physicians	digit
Total number of employees in the hospital	digit
Total number of beds	digit
Distribution of job category	pie
Distribution of personnel employment category	pie
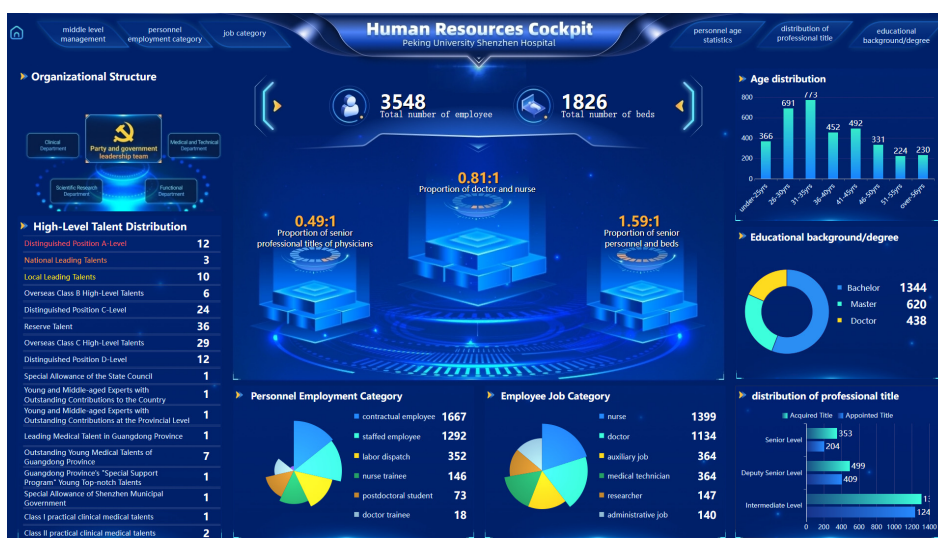
Fig. 2. Homepage of human resources cockpit

Homepage of human resources cockpit are shown in Fig 2. The top of the homepage is the title of the Human Resources Cockpit and the name of the hospital. The homepage display section is divided into three parts: left, middle, and right. The Organizational Structure, High-Level Talent Distribution are displayed on the left, Key Index and Pesonnel Employment Category and Employee Job Category are displayed in the middle, and Age Distribution, Educational Background/Degree, and Distribution of Professional Title are displayed on the right.

4.2 Experimental resuslt

Table 2. Basic indicator in hospital

Indicator Name	Indicator Value
Total number of people in the hospital	3548
Total number of beds in the entire hospital	1826
Proportion of senior professional titles of physicians	0.49:1
Proportion of doctor and nurse	0.81:1
Proportion of medical personnel and beds	1.59:1

As is shown in Table 2, the basic information of our hospital can be overviewed that the hospital has 3548 employees and 1826 beds. There is roughly one senior and associate senior employee in every three employee. The ratio of health technicians to actual open beds is 1.59:1, which is in line with standard ratio ≥ 1.2:1 in the "Guideline of Medical Service Capacity of Tertiary General Hospitals (2016 version)" (in Chinese). The ratio of doctors and nurses is 0.81:1, which is lower than standard ratio ≥ 1.6:1 in the "Guidelines for Medical Service Capacity of Tertiary General Hospitals (2016 Edition)"(in Chinese).

As is depicted in Table 3, contractual employees account for nearly half of the total number of employees in the hospital and staffed employees account for 1/3. The composition of personnel employment is relatively stable.

Table 3. Distribution of personnel employment category

Personnel Employment Category	Number of Employee
contractual employee	1667
staffed employee	1292
labor dispatch	352
nurse trainee	146
postdoctoral student	73
Doctor trainee	18

As is depicted in Table 4, nurse, doctor and medical technician account for 81.7% of the total number of employees in the hospital. This reflects the fact that the majority of hospital employees are still predominantly in medical related jobs, with other supporting or back-up positions.

Table 4. Distribution of employee job category

Personnel Job Category	Number of Employee
nurse	1399
doctor	1134
auxiliary job	364
medical technician	364
researcher	147
administrative job	140

As shown in Table 5, the age composition of the staff on home page is relatively young, with staff under the age of 45 being the mainstay of the workforce, accounting for over 3/4.

Table 5. Distribution of employee age

Personnel Age	Number of Employee
under 25yrs	366
26-30yrs	691
31-35yrs	773
36-40yrs	452
41-45yrs	492
46-50 yrs	331
51-55yrs	224
above 56yrs	230

As shown in Table 6, our hospital has the largest number of employee with appointed Intermediate title, accounting for 1/3 of the hospital workforce. Due to the hospital's restrictions on the number of appointed titles, our hospital implements the policy of "higher acquired title for lower appointed title". Therefore, the total number of people who acquired the title is more than the total number of people who were appointed to the title.

Table 6. Distribution of personnel professional title

Title Name	Acquired Title	Appointed Title
Senior Level	358	209
Deputy Senior Level	501	410
Intermediate Level	1312	1046
Assistant Level	568	768
Others	809	-
Total	3548	2433

5 Conclusions

This paper focuses on the design and application of HR cockpit. The research team firstly established a human resource management indicator system, covering a total of 20 indicators such as the total number of staff, doctor-nurse ratio, talent quality education index, professional title holding ratio and staff age distribution. Secondly, the research team built the HR cockpit based on the Sky-Cloud-Star analysis and visualisation platform. The cockpit contains seven data visualisation pages to realise the visual display of personnel indicators and monitoring of indicator data for department-level and hospital-level managers. The HR Cockpit system not only visualises the rich HR business data, making it possible to display talent information not only on paper files, but also in a digital graphical visualisation. The HR Cockpit provides partial decision support for hospital HR policies, enabling departmental and hospital-level managers to support HR decisions at both macro and micro levels, improving hospital management and efficiency.

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