A Collaborative Management Design Model for Career Planning

Weibao Chang
Academy of Mathematics and systems science
Chinese Academy of Sciences
Beijing, P.R. China
cwb@amss.ac.cn

Liqiang Wang
Department of Enterprise Platform Services
Microsoft (China) Co., Ltd
Beijing, P.R. China
bewang@microsoft.com

***Abstract* — This paper proposes the collaborative management design for career planning, which is an advanced management function in the modern human resource management system. Its implementation is quite complicated. Especially for a large enterprise, its huge size, complicated positions and diversified staffs make HR with career planning even more difficult and face two main challenges: one is coordination with other human resource modules (e.g., recruitment, training, performance appraisal, etc.), another is collaboration in the career planning process. It is needed to address issues such as: the problem of evolution of appraisal standards, the problem of satisfying corporation and employees in appraisal, the problem to involve every employee in career path planning. This article proposes a "data-driven, function-coordination" concept, and provides a collaborative design framework, based on its applications in Sinopec.**

Keywords – HR; position; career planning; Collaboration; CBR

I. INTRODUCTION

The intense competition among companies ultimately is the competition for talents, therefore a first-rate enterprise must have first-class human resource management (HR) [6], and furthermore it must have the first-class HR management software system. HR software includes many functional modules: recruitment management, staff training management, salary management, performance management, human resource planning, career planning, employee self-service, and so on. Issue that career planning [1] must resolve is how to make the promoted plan of next several positions and ultimate objective based the current position, certainly it does not exclude the possibility of being transferred to another position at the same level. The career planning process generally includes: self-assessment, present status examination, career path planning, and procedure management.

Career path planning covers the whole lifecycle of HR management and has interoperability requirements with almost all other modules. In a traditional career path planning software system, if the appraisal standards changed, the data for the old standards becomes obsolete and cannot be used anymore. Upstream systems and downstream systems, which are based on the old standards, must be modified before working with the new standards. In this article, a mapping model for the evolution appraisal standards is introduced to address the problem of change of standards. The article also describes how to improve the interoperability through providing Web Services and messaging mechanism.

In a modern enterprise, talents are the most valuable asset. A traditional appraisal is driven by the organization and managers. The employees are not actively involved and their ideas and opinions are not well considered. As a result, the employees do not have their career paths well aligned with the organization's goals. The organization must provide a way to enable every employee to be actively involved and to align their personal goals with the organization's goals [2]. The article describes collaboration solutions in the appraisal process and self-service career path planning, which will improve the satisfaction and loyalty of the employees. The growth of employee users supports the prosperity of the corporation.

The core function of career planning is to give the different career planning according to the different person. A large company's HR is more complex. It contains numerous subsidiaries, complex positions, and a huge number of employees. In Sinopec (China Petrochemical Corporation), for example, the number of employees is measured by millions and there are almost 50,000 branches. The positions in a large enterprise are complicated and so is the personnel career path planning. On the side, it has a large historical data as its advantage. CBR (case-based reasoning) technique in artificial intelligence is used to plan career paths of employees [4] [5]. By searching same or similar cases in the existing system, the next career paths can be designed. At the same time, the self-learning mechanism is used to adopt expert's advices and to add new cases to optimize, and improve the system.

In the following, the fundamental model of career planning is introduced in Section 2. Section 3 studies the coordination issue between the HR modules. Section 4 addresses the network coordination issue. Section 5 applies CBR to plan the career paths. Section 6 summarizes with the conclusion and future work.

II. GENERAL MODEL FOR CAREER PLANNING

The career planning serves each employee of whole companies. Our goal is to give different career paths (position paths) for each employee. A large enterprise contains giant subsidiaries, complex positions and a huge number of employees. In Sinopec, for example, the number of employees is measured in millions and there are hundreds of thousands of positions, which have a series of indexes to evaluate [9].

 ISBN: 978-1-61208-287-5

Suppose there are ℓ employees and m positions in the enterprise, and set n indexes for evaluation.

The employee set is:

$$E = \{ E_1, E_2, \dots, E_\ell \}. \quad (1)$$

The position set is:

$$P = \{ P_1, P_2, \dots, P_m \}. \quad (2)$$

Each position includes two important attributes at least: *parent position* and *salary level*. The *parent position* means the superior position being report to. If the *parent position* is NULL, the position is at the top-level. A position tree based on the *parent position* attributes can be drawn as below.

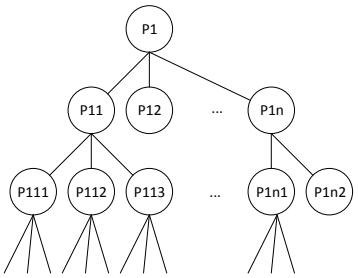

Figure 1. Example of a position tree.

The *salary level* is a measurement of the position's value. In general, if a position reports to another position, the latter has a higher *salary level*. $SL(P_i)$ is used to describe the *salary level* of the position P_i.

There are some specific indexes to evaluate a position. All the indexes make up the full index set to evaluate all the positions:

$$X = \{ X_1, X_2, \dots, X_m \}. \quad (3)$$

In the set, X_i can be the appraisal, professional interest, professional value or personality standard. One index can be applied to multiple positions.

Every index can have a serial scores and $\max(X_i)$ means the maximum score of the index X_i.

There is the essential attribute of index: *parent index*. Same as positions, an index tree based on the *parent index* attributes can be drawn as below.

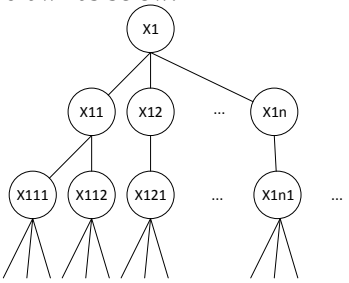

Figure 2. Example of an index tree.

In Sinopec, for example, the index tree is set up with 5 levels.

Some indexes in the index set can be used to evaluate a specific position, and the related thresholds and weights can be specified at same time.

For a specific position P_j, the index subset X^j, related threshold set T^j and weight set W^j can be defined as follows.

$$X^j = \{X_1^j, X_2^j, \dots, X_{nj}^j\} \subset \{ X_1, X_2, \dots, X_n \} \mid nj \le n; \quad (4)$$

$$T^j = \{T_1^j, T_2^j, \dots, T_{nj}^j\} \mid nj \le n; \quad (5)$$

$$W^j = \{W_1^j, W_2^j, \dots, W_{nj}^j\} \mid nj \le n. \quad (6)$$

After completing the definitions, all the employees with the positions can be evaluated. For the employee E^i at the position P_j, the evaluation result set V^{ij} can be calculated.

$$V^{ij} = \left\{V_1^{ij}, V_2^{ij}, \dots, V_{nj}^{ij}\right\} \mid i = 1,2,\dots,\ell;\ j = 1,2,\dots m; \quad (7)$$

$$nj \le n.$$

Theoretically, the employee E^i qualifies for the position P_j, if:

$$V_k^{ij} \ge T_k^j \mid k = 1,2,\dots,nj. \quad (8)$$

As a result, the entire position path chain for the employee E^i may be gotten.

$$P^i = \{P_1^i, P_2^i, \dots, P_{mi}^i\} \subset \{ P_1, P_2, \dots, P_m \} \mid mi \le m. \quad (9)$$

In general, the *salary level* of the position is monotone rise:

$$SL(P_k^i) \le SL(P_{k+1}^i) \mid k = 1,2,\dots,mi+1. \quad (10)$$

The goal of the career planning is to make the different position path chains for all the employees.

III. COLLABORATION WITH OTHER MODULES IN HR

In a modern corporation, there are many information systems to support daily operations and business growth. Career path planning system has close collaboration with other systems in recruiting, training, performance appraisal and promotion process [1]. The interoperability among these supporting systems is the key to make functional groups to coordinate smoothly together.

In order to support the collaboration of different modules in HR, the "data-driven, function-coordination" concept is proposed, which uses a generic data model for the appraisal process and a unified way to coordinate with other functions. To implement this concept, it needed to address two basic

 ISBN: 978-1-61208-287-5

problems: 1. the evolution of index standards; 2. the collaboration with other modules in HR.

A. Evolution of Standards

The lifecycle of appraisal is usually aligned with physical or fiscal year. At the beginning of the new cycle, the organization will define the standards based on the strategies and priorities. No matter if the change of standards is minor or significant, it will affect historical records and any upstream/downstream systems, which reference the changed indexes. The change can be categorized as adding, removing, updating an index or changing the calculation formulas.

The evolution mapping model is used to address the above problems. Given a sub-tree of index tree as example, it can be changed twice since the first year. The changes are illustrated in below diagram:

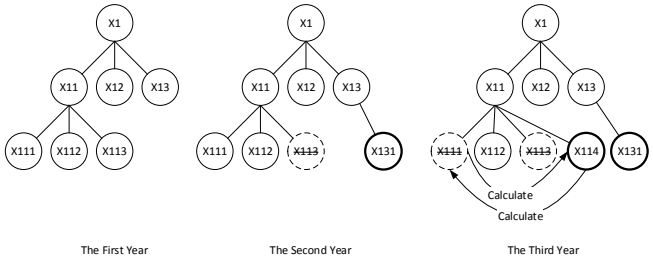

Figure 3. Illustration of the evolution mapping model.

In the first round changes, the index "X113" is removed and the index "X131" is added. In the second round changes, the definition of index "X111" is changed.

For deleting an index (e.g., "X113"), the index is marked as obsolete but will not be dropped physically. A user cannot set value for an obsolete index, but other systems can still use the value of this index as before. This will not break upstream or downstream systems. The data for obsolete indexes will be kept as historical data and can be used as fact data for business intelligence.

For adding an index (e.g., "X131"), it will change the calculation rule for the *parent index*. If the parent one was a leaf before, it may have inputting values before but will only have calculated value after the change.

For updating an index (e.g., "X111"), it will add a new index and mark the old index as obsolete. At the same time, it will allow the user to define the function from old to new index:

$$V_{X114} = f(V_{X111}). \quad (11)$$

The value of "F114" can be calculated based on this function f( ).

In order to be compatible with other systems, a reverse function can be defined as:

$$V_{X111} = g(V_{X114}). \quad (12)$$

With this function, it can calculate the value of "X111" when the value of "X114" is inputted or changed. Any system that reference "X111" can work as before and use the scores after the index changed.

Table 1 shows the example of the inputted and calculated values for an employee:

TABLE 1. EXAMPLE OF INPUTTED AND CALCULATED VALUES

Cycle	X1	X11	X111	X112	X113	X12	X13	X131	X114
1	C	C	F	F	F	F	F		C
2	C	C	F	F		F	C	F	C
3	C	C	C	F		F	C	F	F

In above table, "F" means inputted fact value and "C" means calculated value.

From the table, it can tell that values of the index "X113" are kept. When index "X111" was changed to "X114" on the third year, index "X114" has calculated values for first and second year by calling f(). On the third year, "X111" has calculated value by calling g(). This makes it possible to compare all the indexes over the three years.

To sum up, the mapping model of changed indexes makes it possible to change standards while keeping the history data and the interoperability with other systems.

For a large enterprise, the value of the history data will increase year by year. In Sinopec, it will turn into a huge data repository. A distributed database system can be built for long term data storage.

B. Collaboration with Mudules in HR

The key model for career path planning is appraisal standard of the indexes. Some values of the indexes are from other modules in HR, e.g., the degree data result from training module and attendance rate in check-in module. The appraisal module also provides information to other modules, such as open positions and position requirements for recruiting module, training requirements to training management module and projected employee growth for strategy analysis.

In order to provide data to downstream system and allow upstream systems to update information in career planning system, it provides Web Services around appraisal standards [7] [8]. The Web Services provide operations to query definitions of appraisal standards, query requirements of positions, update scores for indexes, make calculation and query appraisal results. All branches of Sinopec across all the regions can integrate with the central Web Services.

The systems for a corporation are loose coupled. In order to orchestrate them to work together, it provides a messaging mechanism. The messaging system provides ways to send message to other modules or persons. For example, when the appraisal cycle starts, it sends calendar items to all participants. The events will show up in calendar on a PC or a mobile. The receivers can access system by clicking the link in the event.

Based on the projected changes for next year, it can send out projected open positions to recruiting module. This makes it possible to start the talent recruiting work in advance.

 ISBN: 978-1-61208-287-5

IV. COLLABORATION IN CAREER PLANNING PROCESS

Career planning is an employee driven process. In the context of the corporation and society, with the help of the corporation, experts, mentors and friends, the employee improves himself/herself in one or several appraisal index and moves from one position to another. The corporation establishes the index appraisal standards, which set the expectation for an employee's career development. At the same time, the corporation needs to provide a collaboration platform for self-serviced career planning [2].

A. *Appraisal with Collaboration*

A traditional appraisal process is mainly driven by a manager. The manager defines expectations based on the appraisal standards, and then communicates the expectations to the employee. The manager measures the actual performance, compares with expectations and provides feedbacks to the employee. The employee takes actions based on feedbacks and the manager will measure and compare again. This is an on-going measure and feedback process. At the end of a cycle, the manager records the results. Figure 4 shows the whole process of a traditional appraisal.

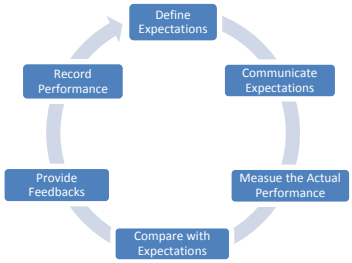

Figure 4. The appraisal process.

A limitation of the process is that employees are not actively involved. 360-degree performance appraisal was introduced to address the problems of the traditional appraisal [3].

Figure 5. The 360-degree performance appraisal.

The 360-degree performance appraisal is a process to get feedbacks from members of an employee's immediate work circle. The challenge is how to make the process efficient as it involves much collaboration across the teams. With the career planning system, all steps can be done online.

When the appraisal starts, it will send reminders to employees. An employee will see events on his/her calendar on a PC or a mobile. Following the guide in the reminders, the employee can nominate other employees to provide feedbacks. The nomination will be sent to the manager who then can choose from the list, add other employees if necessary and send out the invitations. The employees who are invited will receive reminders in their calendars. Opening the events, they can follow the guide to provide feedbacks. The feedbacks are for indexes defined by the organization.

The manager will grade an employee based on the feedbacks and other defined indexes, and then the manager can communicate the results to the employee. As the feedbacks are collected from a wide audience, the manager can grade more subjectively and the employee can get more helpful advices. The collaboration process improves the precision of the appraisal and the satisfaction of the employee.

B. *Self-Serviced Career Planning*

In additional to the appraisal, an organization can provide a self-serviced career planning system to support the growth of employees. Figure 6 shows four steps in self-serviced career planning.

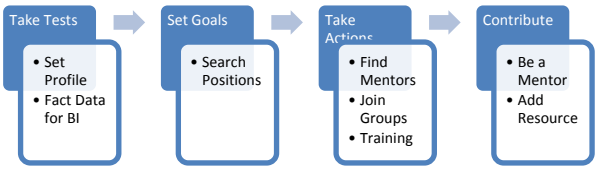

Figure 6. The Self-Serviced Career Planning Process.

Step 1: take tests. The system provides a career interest test, a career value test and a personality test. When an employee finishes those tests, he/she will have a profile in the system. The profile can be fact data for business intelligence analysis. The employee can search other employees based on his/her test results. Other employees can find theirs based on their profiles. It will build up a social system from the career perspective.

Step 2: set goals. Career planning is to set goals for career growth. The employee can search positions based on his/her test and appraisal results. The system can also recommend open positions based on an analysis of the employee and positions' requirements.

Step 3: take actions. The employee may find mentors for some fields, join in some groups and attend some training.

Step 4: contribute. As an employee grows up, he/she can provide help to other employees. He can be a mentor and add some resources. The system can also provide ranking or endorsement to mentors or experts. This will encourage volunteers to contribute to the system.

The four steps are iterative growth steps for all employees. They enable every employee to create a high-quality career path plan. With this information, the

 ISBN: 978-1-61208-287-5

organization can have the dynamic information of talents and win in competitions.

V. CAREER PATH PLANNING

Career path is a series of positions in the corporation. Section 4 describes how to get evaluation result from the collaboration process. This section will describe how to get the career path that fits an employee. In other words, how can an employee find a positive higher-level position? This section will solve the problem. Based on "Suitable is the best", the "*Qualifying Rate*" concept is proposed at first.

A. Defining *Qualifying Rate*

The position requirements and the evaluation are described in Section 2. For a specific position P_j, the index subset X^j, related threshold set T^j and weight set W^j can be specified. For the employee E^i at the position P_j, the evaluation result set V^{ij} can be calculated in Section 4.

Theoretically, the employee E^i qualifies for the position P_j, if $V_k^{ij} \geq T_k^j \mid k = 1,2,\dots,nj$. In general, that is impossible for the next higher-level position, because he has not worked at the position yet.

The *Qualifying Rate* Q^{ij} of the employee E^i for the position P_j is defined as follows.

$$Q^{ij} = \frac{\sum_{k=1}^{nj}\{\left(V_k^{ij} - T_k^j\right) * \frac{W_k^j}{\max\left(X_k^j\right)}\}}{nj}; \quad (13)$$

$$i = 1,2,\dots,\ell;\ j = 1,2,\dots m.$$

Here, $\max(X_k^j)$ is the maximum value of the index X_k^j

It is obvious that:

$$-1 \leq Q^{ij} \leq 1 \mid i = 1,2,\dots,\ell;\ j = 1,2,\dots m. \quad (14)$$

In general, positive Q^{ij} means that employee E^i qualifies for the position P_j, and negative Q^{ij} means the opposite. For example, in the following diagram, employee 1 qualifies for the position, and employee 2 does not qualify for the position.

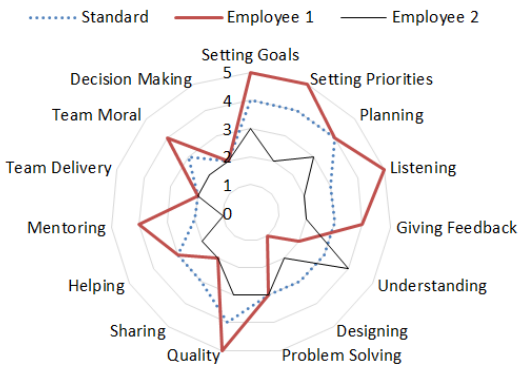

Figure 7. The capability model.

B. Finding the next higher-level position

From the above definition of *Qualifying Rate*, all the Q^{ij}s for an employee E^i to a position P_j can be calculated, which may be different from the current position. The next problem is how to select the next suitable higher-level position for the employee.

Actually, the maximum Q^{ij} is just the decision. The position P_k is the most suitable higher-level position where:

$$Q^{ik} = \max(Q^{ij}) \mid j = 1,2,\dots m, \quad (15)$$

and the *salary level* (defined in Section 2) of P_j is higher than the one of the current position.

C. Finding the career path

The way to find the next higher-level position is proposed as above, but it is impossible to use the way to get the entire position path for the significant distance in position hierarchy. Career planning is to give the different career planning way according to the different person. This is complicated in a large enterprise, which normally has multiple levels and numerous regions. For instance, Sinopec Group has five levels of branches, three types of companies along the industry chain, millions of employees and almost 50,000 branches. Rich historical career path data may be used to find similar career path cases.

CBR technique in an artificial intelligence may be applied to career path planning.

 ISBN: 978-1-61208-287-5

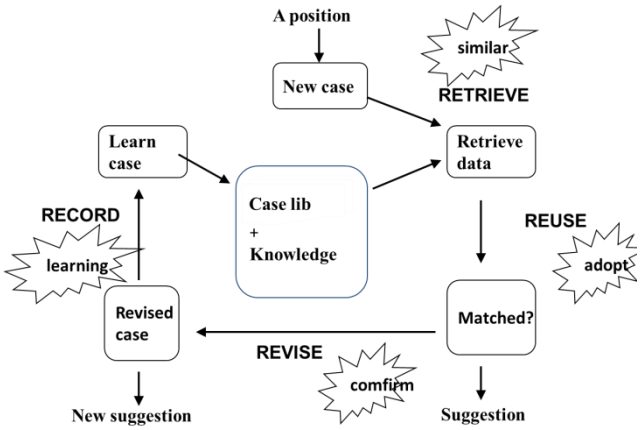

Figure 8. CBR proess diagram.

From the above diagram, the following "4-R" steps support the career path planning.

Step 1: Retrieving. For an employee with an existing position, it looks for the same cases in the case library.

Step 2: Reusing. If the same case is found, it recalls the historical data to plan the employee's position path.

Step 3: Revising. If no such case, the computer finds the most similar case, and saves it to a new case for the employee and HR manager to revise

Step 4: Returning. Add the new case to the case library, if there is not any problem.

The core technology is the matching algorithm. Based on current position, it can find the matching case, which has the minimum difference between the two persons. The distance definition of two persons E_1 and E_2 at position P_j may be given by:

$$D^{12} = \frac{\sum_{k=1}^{nj}\{abs\left(V_k^{1j} - V_k^{2j}\right) * \frac{w_k^j}{max\left(x_k^j\right)}\}}{nj}. \quad (16)$$

By constantly learning, the case library gradually becomes bigger and bigger. This model was considered effective when tested in Sinopec.

VI. Conclusion and Future Work

Career planning is a collaborative effort of the employees, their teammates, managers and the corporation. This paper described a framework of information system to support the collaborations in career planning process. It defined a model for appraisal standards, and then it elaborated how to manage the evolution of standards and interactions with other modules in HR system. After that, it proposed the appraisal process and collaborations in the process. Based on the analysis of the rich and well organized historical data, career path planning supporting information system can be a valuable assistant to the employees and the corporation.

The traditional career path selection is a manual process. The paper introduced an innovative solution to make automatic decision of the career path planning, which is based on the proposed *Qualifying Rate* to find the next-higher level positions and to get the whole career path by CBR.

As this is a general framework to provide support of collaborations in career planning, only skeleton was defined. The future work will elaborate the data model and define more details of CBR. The model will be adjusted and improved based its applications in the corporations.

Acknowledgment

This paper is supported by the National Center for Mathematics and Interdisciplinary Sciences, CAS。Thank Prof. Changshui Zhang from Tsinghua University for his instructions to this paper.

References

[1] Gary W. Carter, Kevin W. Cook, and David W. Dorsey, "Career paths: charting courses to success for organizations and their employees", Chichester, U.K., Wiley-Blackwell, 2009, pp. 69-90.

[2] Jessica Keyes, "Enterprise 2.0: Social Networking Tools to Transform Your Organization", Boca Raton, Fla. CRC Press, c2013

[3] Richard Lepsinger and Anntoinette D. Lucia, "The Art and Science of 360-degree Feedback, Second Edition", San Francisco, c2009.

[4] Qijun Xia and Ming Rao, Dynamic case-based reasonin for process operation support systems, Engineering Applications of Artifacial Intelligence, Vol. 12, Issue 3, June 1999, pp. 343-361.

[5] Agnar Aamodt and Enric Plaza, Case-based resoning: foundational issues, methodological variations, and system approaches, Artifical Intelligence Communications, Vol. 7, Number 1 / 1994, pp. 39-59.

[6] H. John Bernardin and Joyce E. A. Russell, Human Resource Management: An Experiential Approach, New York, McGraw Hill, 1998.

[7] Mohammad Mehedi Hassan and Eui-Nam Huh, Dynamic cloud collaboration platform: a market-oriented approach, New York, NY, Springer, 2013.

[8] Manlio Del Giudice, Elias G. Carayannis, and Maria Rosaria Della Peruta, Cross-Cultural Knowledge Management: Fostering Innovation and Collaboration Inside the Multicultural Enterprise, New York, NY, Springer, 2012, pp. 49-62.

[9] Weibao Chang and Changshui Zhang, Model for Evaluation and Optimal Distribution of the Service Branches of Large Business Enterprises, Proceedings of the 2012 International Conference on e-Learning, e-Business, Enterprise Information Systems, and e-Government, WORLDCOMP'12, July16-19, 2012, Las Vegas Nevada, USA, pp. 273-279.

 ISBN: 978-1-61208-287-5