

# Efficient Web-Based Planning Support for Training

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## Abstract

Collecting and analyzing training needs data using traditional survey method is extremely tedious and time consuming. Adopting a competence-based approach, this paper summarizes a conceptual model for effective training needs assessment, and presents an efficient web-based tool for assisting training specialists in conducting the needed analysis. Time saving benefit of the web-based tool was demonstrated. A sensitivity test was devised and found that the time saving benefit increases with employee size. A prototype system was implemented using MS IIS 5.0 web server, ASP web programming language and MS Access 2000 database. The complete process was demonstrated to a class of human resource managers and received favorable ratings on several measures of effectiveness and efficiencies.

## 1. Introduction

E-business is in. Company processes are being automated to increase efficiencies; business activities are linked by the newest web-technologies to add value to customers and users. In the midst of this e-frenzy, an important business process seems to be left behind. We found very few applications in support of the planning processes for the training and development of a company's most valued human capital.

The notion of a new knowledge economy reinforces the idea of employees being the most important asset. Human resource departments in many companies were compelled to look for ways to increase human capital [6]. From the perspective of long-term management, one viable way to increase a company's human capital is through carefully implemented HR practices such as training and development, performance evaluation and planned manpower changes [5]. Training, especially, is an important strategic practice in the development of internal competence.

Training activities preceded any knowledge management practices as the primary means to transfer organizational knowledge and "know-how's" to employees. However, unlike knowledge management practices, there seems to be a lack of efficient use of or coordination in modern technologies in training related processes. Though we have seen an increase in the utilization of a human resource management information system, from a humble 7% in the seventies, to 68% in the

eighties, and to a whopping 88% in the nineties, the applications are still limited to the more traditional aspects of personnel management, such as compensation and hiring [7]. Also, although e-learning is a sizzling topic for both the academia and the practitioners, the application deals primarily with the delivery of learning contents. The process of deciding who should get training on what, i.e., the planning process, is still done manually today. Blanchard and Thacker [1] highlighted the importance of structure and technology as the two internal factors which strongly affect an organization's competitive position. To improve an organization's competitive stand, we call attention to the use of the latest information technologies to support this strategic planning process called training needs analysis.

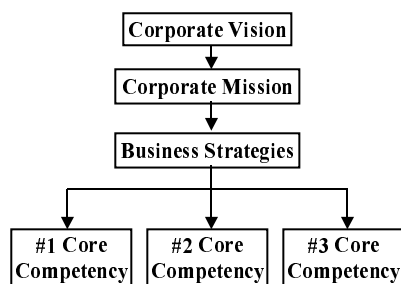
Swanson [9] proposed a technical training system model, including steps of analysis, design, development, implementation and evaluation. Needs analysis, the initial planning and analysis of a training program, is the most vigorous yet important stage in the training and development process. The accuracy of the analysis determines the legitimacy and effectiveness of training program design and subsequent deliveries in the latter stages of the training process. There are various ways to determine employees' training needs. The most commonly used method is survey questionnaires to the employees and their managers measuring the employees' skill level. However, as with any survey research, this method in its traditional manner is extremely tedious and time consuming.

This paper summarizes a conceptual model for effective training needs analysis, and presents an efficient web-based tool for assisting training specialists in conducting the needed analysis.

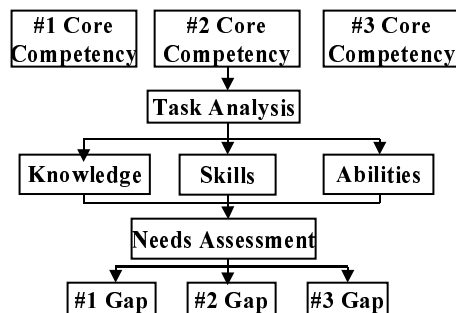
## 2. Competence-based Training Needs Assessment

Yeh [11] indicated that in the practical world, a training curriculum in a company is planned based on the following methods: 1) what available organizational resources are there, 2) by departmental functions, 3) what current management trends are, 4) in accordance with the labor law, 5) what corporate strategy calls for, and 6) how to fulfill corporate core competency. Since enhancing corporate core competencies has been a critical element for many companies to gain competitive advantage in their business [6], the competency-based training approach is

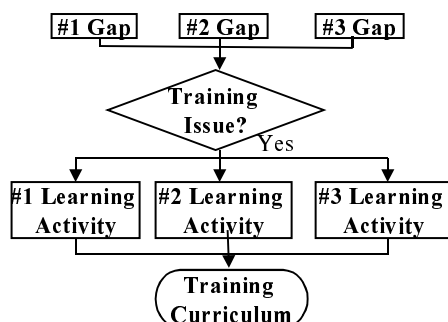
used to build the skeleton of the proposed conceptual model. As seen in Figure 1, the first stage of the model starts with identifying the company's vision, its mission statement, and business strategies, in order to flush out the company's core competencies. Deploying from the identified competencies, in Figure 2, a task analysis is conducted to further identify required knowledge, skills and abilities of a corresponding competency. Then needs assessment is conducted to measure the gaps of the required knowledge, skills and abilities between the "what-ought-to-be" in a company and the "what-is" in the employees. Finally, as shown in Figure 3, after ruling out non-trainable gaps, the training specialist plots the training curriculum for each employee by filling each individual gap with a learning activity.



**Figure 1. Identify company core competencies**



**Figure 2. Perform task analysis and needs assessment**

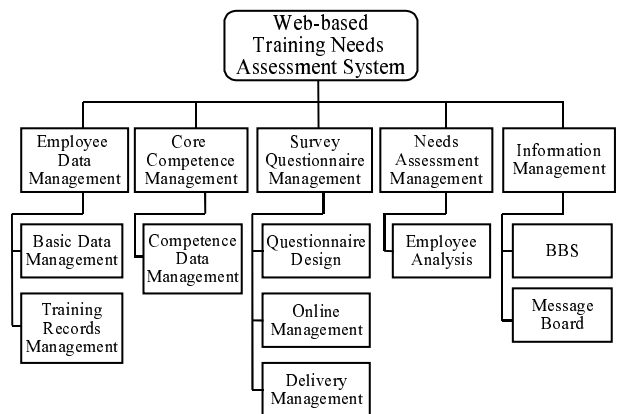


**Figure 3. Design training curriculum**

### 3. A Web-based Prototype System

This model provides an effective competency-based approach to planning a training program. This research converted the above conceptual model into an automated

process with necessary activities for the training specialist to accomplish the task of analyzing training needs. A supporting web-based environment is then constructed to assist the training specialist to design the training curriculum more efficiently. The functional structure chart as shown in Figure 4 illustrates the five sub-modules for training needs analysis, which includes 1) employee data management, 2) needs assessment management, 3) questionnaire design management, 4) training classes management, and 5) information. Employee data management includes basic data and training records sub-modules. Needs assessment management includes organization analysis, work analysis, and employee analysis sub-modules. Questionnaire design management includes questionnaire design, online questionnaire fill-out and questionnaire delivery sub-modules. Training classes management includes class data, scheduling data, and registration sub-modules, while information management includes BBS and message board sub-modules.



**Figure 4. Functional structure chart**

The web-based environment is designed to assist the training specialist to efficiently perform training needs analysis with the aid of intranet technology in the company. [10] The proposed prototype does not replace the role of a training expert. That is, the training specialist still needs to be skillful with the tasks of a training needs analysis, but the proposed web-based information system will make the execution of the process faster, easier and more automated.

### 4. Time Saving Benefit of the Prototype

Selander and Cross [8] proposed a two-stage process redesign analysis, which includes process mapping and value analysis, to evaluate the improvements and cost-savings of the new process. This research adopts the ideas of Selander and Cross by laying out the process of traditional training needs analysis, and identifying the tasks and errors which are not value added and can be deleted in the new process for cost-benefit justification. Accordingly, the claimed efficiency of our web-based prototype comes from the time saved for performing some of the tedious, time-consuming, and repeated tasks in training needs analysis processes, which include designing,

printing, and mailing the training needs questionnaires; collecting responding questionnaires, entering the data, calculating the survey results, and matching employee needs to training classes. These tasks have no value-added portions and can be converted to an automated process. The proposed system only requires the user to post the questions, setup the mailing list, schedule the survey, select the mode for calculation, and match intended training classes to needs questions; the computer will then do the

rest. Time saving increases with the employee size.

Table 1 compares the elapsed time by each process step of a traditional/manual training needs assessment with one that's done on the proposed prototype system. Time estimates for the prototype system are based on average operation, given basic employee data (e.g., name, department, e-mail address, etc.) are already entered in the system. For illustration purpose, we use very conservative, minimal time estimates for the manual process.

**Table 1: Assumptions of time spent on needs assessment process steps**

Process Steps- Manual Process		Process Steps- Prototype System	Elapsed Time - Manual	Elapsed Time - Prototype	Time Saving
Questionnaire design ( $\chi_1$ )		Questionnaire design ( $y_1$ )	3 hours	2 hours	S <sub>1</sub>
Print survey ( $\chi_2$ )	In-house ( $\chi_{21}$ )	Send survey via e-mail ( $y_2$ )	1 minute	2 minutes	S <sub>2</sub>
	Outsource ( $\chi_{22}$ )		24 hours		
Send survey ( $\chi_3$ )	On the spot ( $\chi_{31}$ )		1 minute		
	By mail ( $\chi_{32}$ )		24 hours		
Fill out survey ( $\chi_4$ )		Fill out survey online ( $y_3$ )	24 hours	24 hours	S <sub>3</sub>
Return the survey ( $\chi_5$ )	On the spot ( $\chi_{51}$ )		1 minute		
	By mail ( $\chi_{52}$ )		24 hours		
Code the returned survey ( $\chi_6$ )		Execute data analysis to find competence gaps ( $y_4$ )	1 minute	1 minute	S <sub>4</sub>
Enter survey data ( $\chi_7$ )			1 minute		
Conduct data analysis ( $\chi_8$ )	Using SPSS( $\chi_{81}$ )		1 minute		
	Using Excel( $\chi_{82}$ )		1 minute		
Calculate competence gaps ( $\chi_9$ )			1 minute		
Match competence gaps with employee training ( $\chi_{10}$ )		Match competence gaps with employee training ( $y_5$ )	1 minute	1 minute	S <sub>5</sub>

Total time saving (TS) equals the sum of time saving in each process step ( $S_1, S_2, S_3, S_4, S_5$ ). Using the prototype system eliminates the editing and styling usually required when designing a survey questionnaire ( $S_1$ ). Sending the survey across the web eliminates the printing, publishing and traditional dissemination process altogether ( $S_2$ ). Similarly, other than the time required for the employee to fill out the survey, the system does not take any time to return the survey to the investigating party ( $S_3$ ). Traditionally, survey coding and data entry were the most tedious during a training needs assessment, not to mention the most error-prone. With automatic return, online database and built-in analytical tools, the system eliminates the coding and data entry steps altogether, and minimized the time and effort to calculate competency gaps ( $S_4$ ). Last but not the least, the system's automatic gap-to-training capability saves HR personnel a lot of time compared to a manual process to match training modules with each individual employee's competency gaps ( $S_5$ ).

Assuming a company of 120 employees was to conduct a competence-based training needs assessment, the total time saving (TS) realized by the company using the web-based prototype system would be: ("n" = number of employees = 120)

$$TS = S_1 + S_2 + S_3 + S_4 + S_5$$

$$= (\chi_1 - \gamma_1) + (n\chi_{21} + n\chi_{31} - \gamma_2) + (\chi_4 + n\chi_{51} - \gamma_3) +$$

$$(n\chi_6 + n\chi_7 + n\chi_{81} + n\chi_9 - \gamma_4) + (n\chi_{10} - \gamma_5)$$

$$= (180 - 120) + [(120 * 1) + (120 * 1) - 2] + [1440 + (120 * 1) - 1440] + [(120 * 1) + (120 * 1) + (120 * 1) + (120 * 1) - 1] + [(120 * 1) - 1]$$

$$= 60 + 238 + 120 + 479 + 119$$

$$= 1016 \text{ minutes} = 16.93 \text{ hours}$$

### Sensitivity test of employee size on time saving

To demonstrate that time saving increases with the employee size, a sensitivity test was conducted. Holding other variables constant, we quadrupled the number of employees twice and calculated the total time saving for both cases.

1). Time saving for a company with 480 employees:

$$TS = S_1 + S_2 + S_3 + S_4 + S_5 \text{ ("n" = number of employees = 480)}$$

$$= (\chi_1 - \gamma_1) + (n\chi_{21} + n\chi_{31} - \gamma_2) + (\chi_4 + n\chi_{51} - \gamma_3) + (n\chi_6 + n\chi_7 + n\chi_{81} + n\chi_9 - \gamma_4) + (n\chi_{10} - \gamma_5)$$

$$= (180 - 120) + [(480 * 1) + (480 * 1) - 2] + [1440 + (480 * 1) - 1440] + [(480 * 1) + (480 * 1) + (480 * 1) + (480 * 1) - 1] + [(480 * 1) - 1]$$

$$= 60 + 958 + 480 + 1919 + 479$$

$$= 3896 \text{ minutes} = 64.93 \text{ hours}$$

2). Time saving for a company with 1920 employees:

$$TS = S_1 + S_2 + S_3 + S_4 + S_5 \text{ ("n" = number of employees = 1920)}$$

$$\begin{aligned}
&= (X_1 - Y_1) + (nX_{21} + nX_{31} - Y_2) + (X_4 + nX_{51} - Y_3) + \\
&\quad (nX_6 + nX_7 + nX_{81} + nX_9 - Y_4) + (nX_{10} - Y_5) \\
&= (180 - 120) + [(1920 \times 1) + (1920 \times 1) - 2] + [1440 + \\
&\quad (1920 \times 1) - 1440] + [(1920 \times 1) + (1920 \times 1) + (1920 \times 1) + \\
&\quad (1920 \times 1) - 1] + [(1920 \times 1) - 1] \\
&= 60 + 3838 + 1920 + 7679 + 1919 \\
&= 15416 \text{ minutes} = 256.93 \text{ hours}
\end{aligned}$$

Results of the sensitivity test are tabulated in table 2. As shown, the time required when implementing a full-scale training needs assessment using the traditional/manual process multiplies quickly with increasing employee number. Whereas, the time takes to implement the same needs assessment using the web-based prototype system remains the same regardless of employee size. Consequently, the prototype system realizes tremendous time saving: 39.37% in companies with 120 employees, 71.35% in companies which employ 480, and 90.79% in companies of 1920 employees. Thus, we conclude that the time saving benefit is very sensitive to the number of employees subjected to the competence-based training needs assessment.

**Table 2: Effect of employee size on time saving**

No. of Employee	(1) Total Time- Manual	(2) Total Time- Prototype	(1)-(2) Total Time Saving	(1)-(2) / (1) % Percentage Time Saving
120	43	26.07	16.93	39.37%
480	91	26.07	64.93	71.35%
1920	283	26.07	256.93	90.79%

## 6. System Evaluation

The prototype system was implemented using MS IIS 5.0 web server, ASP web programming language and MS Access 2000 database. The prototype went through a two-phase evaluation process to establish its validity and effectiveness.

### Phase one—Quantitative measures

The purpose of the phase one evaluation was to gauge the validity of the competency-based needs assessment model and the prototype system from a practical standpoint. We looked for experienced HR practitioners as our study sample because they were most qualified to judge whether the system was valid to use in the field as a needs assessment tool. We carefully selected a class of students who were all registered in a MIS (Management of Information Systems) course offered through the HRM program in a major university. These students were studying for their master's degree in a graduate program designed specifically for experienced human resource managers and professionals. We conducted the evaluation toward the end of the MIS course to ensure that the study sample had adequate knowledge of the use of IS in human resource management. Thirty-one students participated in the study, most of whom had experience in training related jobs.

The complete process of a needs assessment using the prototype system was demonstrated in the MIS class. The demonstration took 40 minutes followed by a 20-minute Q&A. Then the class was asked to fill out a questionnaire. The questionnaire was composed of demographical questions and several measures of validity using a Likert-type scale of 1 to 5 (1 means strongly disagree and 5 means strongly agree). Descriptive statistical analysis and ANOVA were used to analyze the data.

The respondents' demographic characteristics are described below. The gender was balanced between males and females. While a majority (61%) had more than ten years of working experience, respondents were normally distributed on the six categories of the length of training-related experience. Although 68% reported working with a company that employed training and development personnel, only 50% of respondents believed that their company regularly conducts needs assessment. The profile of the respondents fit the purpose of our research nicely, and their responses on company's training function were within expectations.

Table 3 revealed the results of the validity measures. Respondents showed positive reactions toward each of the seven measures. The concept of a competency-based training needs assessment received most favorable ratings, followed by the use of gap analysis to assess these needs. Respondents were also impressed with the ability of the system to shorten operation time required of the planning process of a competency-based training.

**Table 3: Results of validity measures**

Validity Measures	Mean	S.D.
1. Agree with the concept of a competency-based training needs assessment	4.23	0.88
2. Agree with the concept of using gap analysis to assess training needs	3.84	0.90
3. The system effectively assist the planning of a competency-based training	3.32	0.94
4. The system simplifies the planning process of a competency-based training	3.48	0.93
5. The system shortens operation time required of the planning of a competency-based training	3.71	0.97
6. The system can effectively expedite the transmission of needs assessment information	3.65	0.91
7. The system makes analysis results of employees' competence gaps more accessible to training specialists	3.48	1.06

We also conducted an ANOVA analysis to find out whether the respondents' demographic background had any bearings on the validity of the prototype system. The results are presented in Table 4. Data showed, with three exceptions (marked by an \* in Table 4), differences among categories of each demographic variable were insignificant

on any of the validity measures. This served as a strong proof that the design of the prototype system was not biased toward any particular demographic group. With that

being said, a closer look at the three exceptions revealed somewhat interesting notions about the use of technology in the corporate.

**Table 4: ANOVA**

Validity Measures	Demographic Variables				
	Gender	Experience	Training related experience	Have training personnel	Conduct needs assessment
1. Agree with the concept of a competency-based training needs assessment	0.074	0.297	0.970	0.160	0.420
2. Agree with the concept of using gap analysis to assess training needs	0.155	0.156	0.878	0.018*	0.071
3. The system effectively assist the planning of a competency-based training	0.147	0.761	0.759	0.626	0.852
4. The system simplifies the planning process of a competency-based training	0.212	0.883	0.712	0.113	0.249
5. The system shortens operation time required of the planning of a competency-based training	0.086	0.257	0.283	0.042*	0.201
6. The system can effectively expedite the transmission of needs assessment information	0.023*	0.721	0.309	0.060	0.564
7. The system makes analysis results of employees' competence gaps more accessible to training specialists	0.152	0.569	0.826	0.312	0.506

\*  $\alpha=0.05$

As shown in Table5, males were stronger believers than females in the system's ability to expedite the transmission of needs assessment information. This finding seemed to reflect the stereotype of gender differences on technology, e.g., men are better at computers; men are more willing to embrace technology than women, etc.

**Table 5: Gender differences on validity of system**

Validity Measure	Mean	
	Males	Females
The system can effectively expedite the transmission of needs assessment information	4.00	3.27

Whether the company has training personnel influenced responses on two validity measures: 1) acceptance of the concept of gap analysis in training needs assessment, and 2) the system's time-saving feature in the planning of a competency-based training. (See Table 6) It's possible that companies with training and development personnel already have in place certain training needs assessment process or procedures, and believe that the gap analysis system is a better and more efficient alternative to their own practice. The disparity may also come from the fact that companies which don't employ training and development personnel don't usually conduct training needs assessment, therefore it is difficult for those respondents to grasp the ideas presented in the prototype system.

**Table 6: Whether company has training personnel on validity of system**

Validity Measure	Mean	
	Yes	No
Agree with the concept of using gap analysis to assess training needs	4.10	3.30
The system shortens operation time required of the planning of a competency-based training	3.95	3.20

## Phase two—Qualitative measures

The purpose of the second-phase evaluation is to measure the effectiveness and the usability of the prototype system. To this end, we conducted one-on-one interviews with three training and development managers after they had experienced the operation of the prototype system hands-on.

The three T&D managers were from different industry background. Manager A was a T&D manager for a major department store and had 8 years of working experience in HR-related functions. Manager B worked as a T&D supervisor for a government agency for more than 10 years. Manager C was in charge of training for an area hospital and had 3 years of HR-related experience. Each manager received a 10-minute introduction of the competency-based training needs assessment model, then worked through each of the five modules of the prototype system to complete a hypothetical needs assessment process. The hands-on experience took 15 to 20 minutes, followed by a 30-minute semi-structured interview. Interview questions included the following: (See table 6 for a complete list of interview questions.)

1. Effectiveness, time-saving and accuracy of the questionnaire management module
2. Effectiveness and accuracy of the needs assessment module to calculate competence gaps
3. Whether the prototype system was easy to follow, straight-forward and user-friendly
4. Consistency of layout, appropriate size and amount of texts, appropriate use of graphics
5. Content accuracy, flow of information and legibility of the prototype system

Similar to the findings in the previous survey, all three managers agreed that the web-based prototype system provides a good model to assess employees' training needs, reinforces the concept of competency-based training, and simplifies the analysis stage of a planning process for training. While the training managers were positive about the effectiveness and the time saving prospects of the system, they also stressed the importance of customization to realize these benefits. The extent of customization included company organization and communication channel, a company-wise competency databank, training curriculum, process linkage to training

course registration and administration, etc. Concerns of employees mistaking a training needs analysis to performance evaluation were raised. Though not a system problem, one of the managers-Manager C-suggested adding this message to the survey: "For development purpose only, and will not be used in performance evaluation" to minimize the possibility of employees sending falsified information.

In terms of the functionality of the system, the managers suggested the following improvements:

- Provide multiple methods for data analysis or allow exporting of data to other statistical program for further data manipulation.
- Send an automatic confirmation when the survey is received by the intended employee.
- Provide better tracking mechanism, such as stats on send, reply and follow-up status.
- Provide better navigation functions, such as backtrack, system maps and on-line instructions.
- Provide options to setup the order of how respondents fill out the questions.
- Remind respondents of missing answers.

**Table 7: Interview questions and findings**

Interview Questions	Results	Improvement Suggestions
1. Do you agree with the concepts imbedded in the prototype system?	Positive	
2. Will the system facilitate the use of competence-based training needs assessment in your company?	Positive	- Customization is required prior to implementation.
3. Will the system help save time in planning employee training?	Positive	
4. Will the system simplify the planning process for employee training?	Positive	- Provide choices of analytical tools
5. Is the system effective in assisting the planning of a competency-based training?	Positive	
6. Effectiveness of questionnaire management module: Design? Dissemination? Collection?	Positive	- Automatic confirmation when message is received by the receiver. - Provide stats on send, reply and follow-up status.
7. Effectiveness of needs assessment module in quantifying employees' competence gaps?	Positive	- Stress "the survey is for developmental purpose only, and will not be used in performance evaluation"
8. Is the prototype system easy to follow and user-friendly?	Positive	- Provide system maps and on-line instructions.
9. Aesthetic appeals of the screen display: Consistency? Appropriate placement and size of text and graphic?	Positive	
10. Legibility, accuracy and flow of contents in the system?	Positive	- Provide option to setup the order of how respondents fill out the questions. - Remind respondents of missing answers.

## 7. Conclusion

We have presented a conceptual model in training needs assessment to assist organizations in their pursuit of competitive core competencies. We have also designed a web-based prototype system based on this conceptual

model to improve the efficiency and effectiveness in collecting and analyzing competence data for training and development purpose.

Neither the competence-based training approach or the needs assessment method is new to seasoned HR professionals. The method of using survey questionnaires

to uncover skill gaps in the organization has been around forever. Competence-based theories, or more specifically, building organization core competencies for sustained competitive advantage, have been the topic for discussion since the 80's. But these concepts are rarely implemented in the real world because the process required is both tedious, and time-consuming. [2] [3] [4]

This study contributes to the HR practice in several ways. First, it confirms that HR professionals agree with the competence-based approach to build company's training curriculum. Second, it observes that an effective tool to help HR professionals in the task of training needs assessment is long over due. Third, it shows that HR professionals acknowledge the power of web technology in helping them become more efficient. Lastly, A web-based training needs assessment system for competence-based training, like the one designed for this study, is well-received by the HR professionals.

These claims are further evidenced by several eager HR managers coming up to the researchers after the system demonstration to express interest in utilizing a complete system based on experiences on the prototype. In addition, this prototype not only works for the core-competency based training, it can be applied to other planning approaches for other purposes as well, , such as a skill-based training needs assessment, or analyzing knowledge deficiencies in an organization for knowledge management purpose.

The goal of this research is to demonstrate how web-based applications improve the efficiency of a very important HR function. Future work includes either enhancing our conceptual model and prototype structure by various activities commonly seen in practical training process or expanding the prototype to include the upstream of hiring and the downstream of evaluation related to

human resource management.

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