A MODEL ON KNOWLEDGE WORKERS PERFORMANCE EVALUATION

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ABSTRACT

The economic structure of society is constantly changing, whereas companies were dependent on manual labor in the past, today they are dependent on the knowledge worker. Since that knowledge workers make up two-thirds of the labor force, the focus of strategic plans nowadays are to improve their efficiency. Currently, there is not any adopted method for evaluating the performance of the knowledge workers. But the fundamental change in the nature of the labor force necessitates this issue. This paper aims to develop a model for evaluating the performance of knowledge workers in an Iranian research center using structural equation modeling, therefore this is a descriptive study based on co relational and regression analysis. Results proved that among the various appraisal criteria, innovation is the most important and significant factor which is equal to 4.35 in average from 5 and collaborate on research projects as well as attending seminars are the least important criteria according to the respondents point of view.

Keywords: Knowledge workers (KWs), Performance evaluation, Productivity, Research, SEM, Human capital.

JEL Classification: J50, J53, M12.

Contribution/ Originality

This study originates a new model for knowledge worker's performance evaluation for an Iranian research center. The proposed model investigates the researcher performance through four aspects including executive, educational, scientific and research works. This model contributes in the existing literature of KWs performance modeling.

1. INTRODUCTION

Initially, the industry was properly focused on labor productivity, while these days industry focus on the productivity of knowledge worker. In line with transition from manual to automated manufacturing and knowledge-based production, the proportion of knowledge workers is widely increased. Knowledge workers are rapidly becoming the only major group within all developing

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countries (Helton, 1988; Drucker, 1999). In 1920, the ratio of manual worker to knowledge worker was 2 to 1 (Davenport, 2002) while in 1956, the number of white-collar workers to blue-collar workers became the same and this trend continued so that in 1980, this ratio became 1 to 2 (Mundel, 1975; Soltani *et al.*, 2004; Takala *et al.*, 2006).

Nickols (2000) noted that shift of manual worker to knowledge worker will continue on an ongoing basis (Naisbitt, 1982). Some believed that this trend will result in a larger change which called transforming to postindustrial society from an industrial society (Drucker, 1988). In such a circumstances, Drucker (1999) stated that, "The challenge today is not to increase the manual labor productivity, but it is to measure and improvement of knowledge labor productivity." (Drucker, 1999).

Since 1911, scientific management school is developed and deployed many tools to evaluate the performance and productivity of the workforce. The assessment methods of this school was generally based upon output or input (Drucker, 1999; Horvath, 2001; Huang *et al.*, 2003; Josu *et al.*, 2006). But with the shift from manual labor to knowledge labor, the challenge which is associated with KWs productivity is how to measure the performance of KWs. Their tasks are not tangible, measurable, or schedulable and everyone does it in his own way (Davenport and Prusak, 2000). Knowledge works usually are influenced by various external factors, consume more time and can be done based on teams (Soltani *et al.*, 2004), Which harden the KWs performance evaluation.

As it mentioned, the nature of knowledge work is too complex, which makes it harder to measure (Soltani *et al.*, 2004). Researchers developed productivity measurement tools based on quality, quantity, outcomes and costs. These tools are different in terms of complexity and ease of use, But there is an agreement that no effective and practical tool is developed for assessing knowledge labor performance (Davis, 1991; Drucker, 1999; Ramı́rez and Nembhard, 2004). At the present time due to the continuous growth of knowledge workers and their importance in modern industry, the existing literature emphasis on the need and importance of developing quantitative models to evaluate the performance of knowledge workers (Schroeder *et al.*, 1985; Salleh and Wee-Keart, 2002; Ramı́rez and Nembhard, 2004; Takala *et al.*, 2006). Existing literature solely emphasis on importance of knowledge workers performance evaluation, but does not provide in order to fulfill and realization of KWs performance evaluation. The researchers consensuses on the necessity of knowledge workers effectiveness appraisal tools to improve their productivity (Ramı́rez and Nembhard, 2004). So, the need to develop a framework for evaluating the performance of knowledge workers has been emphasized by lots of resources as a critical element for managing KWs in recent years (Soltani *et al.*, 2004).

Regarding above this paper aims to develop a customized model of KWs performance evaluation for an Iranian research center.

2. RESEARCH LITERATURE

The term knowledge worker that sometimes arises as white-collar is relatively a new term. Drucker (1959) used this term for the first time in order to refer to employees who worked with intangible resources. Since then KWs are introduced as high rank workers with academic and analytical knowledge who expected for development of new products and services (Drucker, 1994). Other researchers updated Drucker's opinion and believed that KWs can learn from informal sources of knowledge through experience and other sources of knowledge in addition to academic education (Naisbitt, 1982; Dreger, 1989; Drucker, 1999). Davenport and Prusak (2000) defined knowledge workers as those who engage in the production of knowledge, such as product development engineers, or those who knowledge is the major part of their work such as financial experts. This concept was developed over time and people with high degrees of education or experience, whose works comprehend creation, distribution, or use of knowledge were included (Davenport, 2002). Another definition of KW is: Anyone has special tasks to develop and use of knowledge. With this broader definition, KWs are people like managers, engineers, accountants, systems analysts and programmers (Horvath, 2001). Nickols (2000) presented several differences between manual and knowledge labor, and stressed that the most important difference is KWs work with information while MWs work with materials. Although knowledge works are featured with distinguished career, both of knowledge and material works are at the ends of a spectrum, which means any works contains elements of both groups (Naisbitt, 1982). Drucker called knowledge workers who does crafts, "Technologist" and noted that this kind of workers will have the highest growth in the world (Drucker, 1999). In another view Dove (1998) classified knowledge worker into three sub-sectors (Dove, 1998):

1. Innovation-based knowledge work: Employees such as managers and engineers and inventors pursue innovation in their work.

2. Flexible knowledge work based on extensive capabilities and quickness: The staff, providing knowledge that can be applied in general. It can be used in organizations and in various scenarios such as the MBA students and programmers.

3. Professional knowledge work based on deep expertise and limited: Specialist whose expertise cannot easily transferred to other fields like programmers who work in a specific language.

In general, there are many definitions of KW. Most of the literature used KW in comparison to MW. Most researchers accepted that KWs are basically in tangible than MWs and need more intellectual capability.

3. EVALUATE THE PERFORMANCE OF KNOWLEDGE WORKERS

Organizations to achieve their goals, requires the use of a variety of measures to monitor, evaluate and improve their processes (Ramı́rez and Nembhard, 2004). Performance appraisal is most widely attended in the field of human resources (Soliman and Spooner, 2000) which ensures

its importance. In recent years, development of performance appraisal systems are highlighted, especially in comparison with the other functions of human resource management (Soliman and Spooner, 2000) although the dominant purpose of performance evaluation, is improving the performance, the traditional appraisal systems were designed to ensure the minimum standards and to control staff's performance. It was named in 1994 by Randall as staff control.

In short, the shifts in performance evaluation, in recent years are asfollows: Soliman and Spooner (2000):

1. Emphasizing on the development instead of control

2. Use of consensus based approaches

3. Assess performance rather than meriting competencies and behavioral standards

4. Provide performance feedback from subordinates and colleagues

5. Leading appraisal results to performance based payments

6. Reducing bureaucracy and determining the process owners

7. Focusing on their potential rather than focusing on skill shortages

The success of a staff performance appraisal system should be scrutinized by several key indicators (Thomas and Baron, 1994). Another point about the appraisal system, is the extent of compatibility with the organizational context (Soliman and Spooner, 2000). The performance evaluation becomes more complex by introducing new measures and this leads to a lack of appropriate valuation because of visibility, relativeness, importance and practicality and this may weaken usefulness of performance appraisal system (Ghorpade *et al.*, 1995). Today, numerous human resources appraisal systems are used, but they do not have the sufficient effectiveness (Ebrahim, 2003).

There are several methods which are proposed to evaluate the performance of KWs, but none of them has been accepted universally (Drucker, 1999). Drucker (1968) noted that the productivity of knowledge workers is the hardest task in the present era as productivity of manual workers in last age was the most important task of manager. Evaluating the performance of knowledge workers is the first step for their productivity analysis. Benefits of knowledge workers performance evaluation include improved personnel selection, allocation of tasks, identification of additional expertise, rewards and payments, anticipated performance, strategic planning, identifying needs and improve planning to reduce the subjectivity of evaluation and identify best patterns (Drucker, 1968). In addition to above performance assessment impacts on all dimensions of knowledge management, including knowledge acquisition, documentation, transmission, creation and development, so it does have an important role in knowledge management as well (Ray and Sahu, 1989). In this regard, Soliman and Spooner (2000) developed a model of human resource management with performance evaluation as one of fundamental aspects of knowledge management (Sink, 1985).

In addition to the benefits provided by KW performance system, its disadvantages should also be considered. For example, the uniqueness of knowledge workers nature should not be forgotten. The difference between craft and knowledge should be considered in the designing measures (Overby, 1983). It should be remembered that performance system must examine the efficiency of knowledge workers for an industry, a job or specific organization (Pepitone, 2002).

There are three keys elements that should be included for evaluating the performance of knowledge workers (Soltani *et al.*, 2004):

1. What is measured
2. How to measure
3. Cultural issues

Since that usually there is no job description for KWs, therefore defining both qualitative and quantitative measures particularly in high organizational levels is perplex (Soltani *et al.*, 2004). Mundel (1975) debated that the productivity of KWs can be measured through the following questions (Mundel, 1975):

1. What are the job objectives?
2. What are the successful outcomes of the job?
3. How can one measure the outputs?
4. What resources and how much are needed to produce the intended outputs?
5. Can the measure be standardized (Montgomery, 1997)?

Bumbarger (1984) focus on the concept of KWs performance based on 4 factors of operation functional analysis (OFA). Therefore the appraisal system should focus on these according to his point of view (Bumbarger, 1984).

1. should have demand-oriented approach,
2. should focus on internal of the organisation,
3. make promote on creativity,
4. to encourage the independence of people

Drucker (1999) defined 6 factors to assess the productivity of KW force (Drucker, 1999):

1. KWs have to identify their duties.
2. KWs need independency in running their affairs.
3. Innovation must be part of the KW.
4. It needs continuous learning.
5. KW Productivity has to focus on quality rather than quantity
6. KWs are considered as an asset.

The proposed methodologies in the KW performance literature are very diverse. They include dimensions such as quality, result-orientation, cost and so on. Many of the methods have been structured in one or more of the above mentioned dimensions. Sometimes they are widely applied in the area of industry, and sometimes not. Function point analysis, pragmatic efficiency

analysis and data envelopment analysis, are examples of methods that are used in a variety of studies (Bok and Raman, 2000).

Ray and Sahu (1989) suggested a methodology of measuring knowledge workers productivity as "pragmatic efficiency measurement" that involves three main steps (Ramı́rez and Nembhard, 2004):

(1) Classification of knowledge works

(2) The relationship between them

(3) The development of models to measure efficiency

This method measures the efficiency of KWs by viewing sample in predetermined periods of time rather than random times during the working day deals. It does meet a flexibility, simplicity and low cost which ensure its application in the enterprise area (Nickols, 2000). Ray and Sahu (1989) suggested a method to measure efficiency by assessing how much of what should be done, is really done, which they called it achievement method. The efficiency is the ratio of the number of tasks performed to total assigned tasks (Ramı́rez and Nembhard, 2004). Percentage of time spent on value-added activities is another potential measure of KWs productivity (Agarwall, 1980). This method pursues desirable and useful activities, based on their contribution to achieving objectives and the amount of time spent on those activities. Productivity measures are the number of hours spent on value added activities to the total working time (Agarwall, 1980).

Professional time utilization (PTU) is another a measure of KW efficiency which is defined by the ratio of time spent on useful tasks to the total time spent on the whole job (Ramı́rez and Nembhard, 2004). This is a measure helps to quantify the percentage of time that workers participate in sampling and other techniques. Higher PTU shows that worker spent more time on added value activities. The value-added method is debated as a fruitful method to measure KWs productivity, while it is accompanied by qualitative measures. Some researchers have emphasized on the importance of quality as a main factor of KWs efficiency and advocated it uses in KWs efficiency measurement (Naisbitt, 1982; Drucker, 1999; Davenport and Prusak, 2000).

There is consensus on the vital role of quality in KWs efficiency based on the literature. Output by itself is not enough to determine the efficiency KWs. For instance, one can measure the productivity of scholars by the number of published articles since that the quality of articles are assessed in peer review process (Green and Secret, 1996).

Economic Analysis (value added approach) is another method for measuring the efficiency of KWs where organizations look for outputs such as money, savings, earnings and higher sales (Davis, 1991). This revenue per employee compared with each employee related costs. The more the net income per knowledge worker is, the better the performance is. However, this method is employable easier for a variety of KWs such as vendors, consultants and some engineers than the others including Executive Vice President and designers.

In almost 60 years of literature review, researchers directly and indirectly measure the various aspects of KWs efficiency. It is evident that one method by itself cannot cover all aspects of KWs productivity. Some aspects of productivity which are considered important by scholars were not as important in practical models (Pepitone, 2002).

KWs productivity measures after a deep literature review based on the frequency of use in different methodologies can be summarized as follows (Pepitone, 2002):

1. Quantity

2. Fees

3. Time

4. Independence

5. Efficiency

6. Quality

7. Effectiveness

8. Customer Satisfaction

9. Innovation / creativity

10. Project success

11. Liability / importance

12. Understanding of the knowledge worker productivity

Finally, the method proposed by Takala *et al.* (2006) which is developed for assessing the KWs efficiency analysis methods is shown in figure1. Based on this model, performance indicators of assessment models includes easy of measurement, appraiser and appraise acceptance, power of applicability in different situations, coverage of measurement indices, strategic convergence and reliability. The two last indices are the basic components of a measurement model.

Reliability is the capabilities of model in practice and strategic convergence in line with the strategic objectives (Soltani *et al.*, 2004).
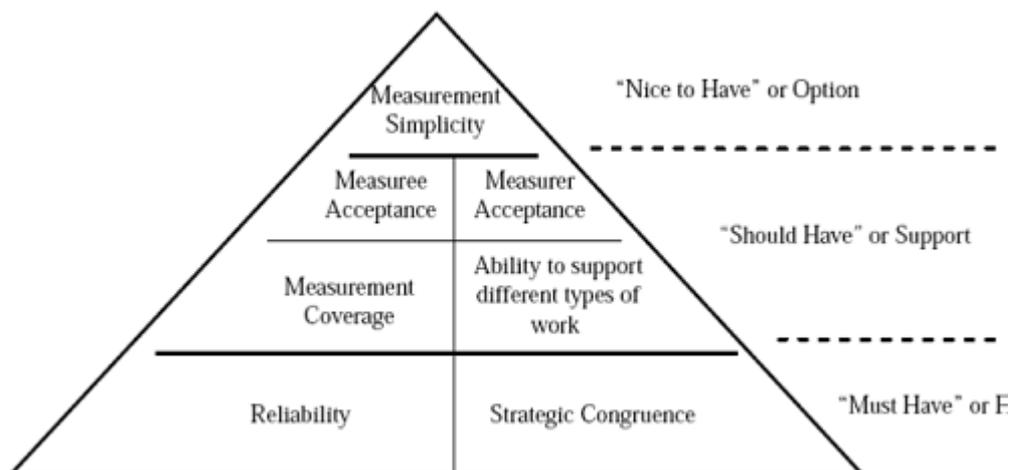

Figure-1. Model of assessing KWs efficiency methodologies
Source: Adobted from Takala *et al.* (2006)

4. RESEARCH METHODOLOGY

This study aims to develop a model on knowledge workers performance evaluation for a knowledge-based Iranian research center. It is a descriptive research based on correlational analysis. To this aim, some important and frequent measures are extracted from literature review, then Delphi method applied 5 times to reach consensus among expert's opinions. Ultimately the conceptual model of KWs appraisal as depicted in Figure 3, developed and scrutinized with CFA analysis which lead to model confirmation at the end.

A justified questionnaire administered among 212 sampled researchers as a research tool. The questionnaire reliability also investigated employing Cronbach's alpha which was about 0.895 and the validity was confirmed by construct validity through CFA. SPSS and LISREL software were employed for data analysis.

5. RESULTS AND DISCUSSION

After reviewing the literature and the deploying Delphi technique among experts KWs appraisal model were obtained as depicted in figure 2. Researcher's appraisal model consists of four dimensions, including executive, scientific, educational and research activities. Each of these dimensions has several measures. The total weighted score for each researcher determines his performance grade.
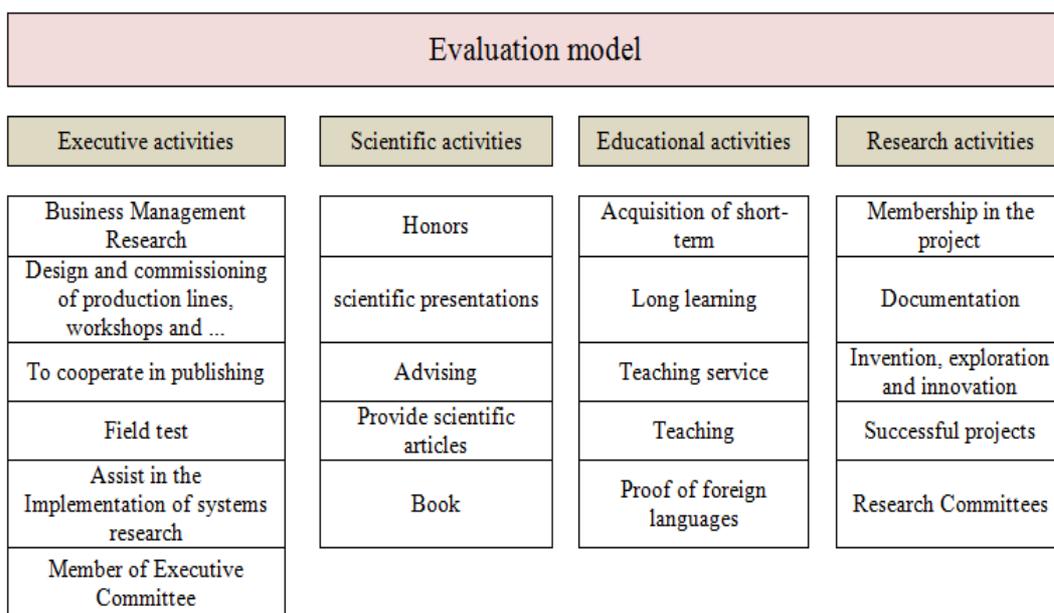

Figure-2. Researcher appraisal conceptual model

Source: Research findings

The range of respondent's age was about 30-40 and the average experience was about 10. To prove sample adequacy, KMO Test is deployed which was about 0.754 and Bartlet significant

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level was equal to 0.00 The results of the adequacy tests indicate that the gathered data was well enough and the model fit indices proved the model fitness. Therefore based on the collected data the final model was valid.

GFI and AGFI values were 0.95 and 0.89, respectively and the amount χ2/df was equal to 2.2 and RMSEA index was equal to 0.081 which proves a good fit of the model to gathered data. Furthermore in order to determine the importance and ranking of appraisal indices Friedman test were deployed. Implementation of the Friedman nonparametric test achieved a significant level of 0.00, which indicates there is a significance difference between the appraisal indices. Table 1 shows the results of the test. Based on results the most important indices are ranked decreasingly.

Table-1. The results of Friedman test

Number	212
chi-square	1376.373
df	24
Significant level	0.00

Source: Research findings

Table-2. Appraisal Indices rank based on Friedman test

Row	Indicator	Average Rating	Average response	Standard deviation
1	Invention, discovery and innovation	19.4	4.35	0.92
2	Undergraduate research projects	19.14	4.32	0.76
3	The documentation of the results of research activities	17.67	4.05	0.87
4	The success of a research project researcher	17.47	4.03	0.91
5	Scientific articles related to the field of inventors	16.97	3.9	0.93
6	Design and installation of production lines, assembly or workshop	16.47	3.88	1.00
7	Managing research projects	16.41	3.90	1.06
8	Writing books related to the field of inventors	15.7	3.75	0.97
9	Management of the research activities	13.95	3.49	0.94
10	Advice on research projects	13.86	3.52	0.89
11	Long-term training courses	13.74	3.47	1.09
12	Monitor research projects	12.59	3.34	0.94
13	Cooperation in field trials	12.47	3.29	1.08
14	Business Awards and honors	12.09	3.25	1.05
15	Tips academic thesis	11.92	3.22	1.01
16	Scientific lectures	11.82	3.2	0.97
17	Short-term training courses (specialized)	11.80	3.23	0.96
18	Teaching job (specialized courses)	11.32	3.16	1.09
19	Taught university courses (technology-oriented courses)	11.04	3.08	1.07
20	A certificate in foreign languages	10.27	2.99	1.02
21	Cooperation in the implementation and execution of research	9.95	2.92	0.97
22	Member of the research committees	8.41	2.71	1.05
23	Collaborated in the publication of scientific journals	7.46	2.56	0.96
24	Member of Executive Committee	7.28	2.51	1.06
25	Cooperation in setting up seminars or conferences	5.81	2.29	0.98

Source: Research findings

Table 2 ranks of Friedman test are presented in descending order. It can be seen that the indicators of operating parameters of the model are more important. This shows that organization has managed strategic orientation, which would be established between the researchers and experts. The respondents of the questionnaire were researchers and experts that are shown the strategic direction of the organization, the institutionalization of the organization's goals and strategic objectives align with the goals of individuals (Table 2). Also, results indicate good alignment between organizational goals and individual researchers. The model is summarized and finalized in figure 3.
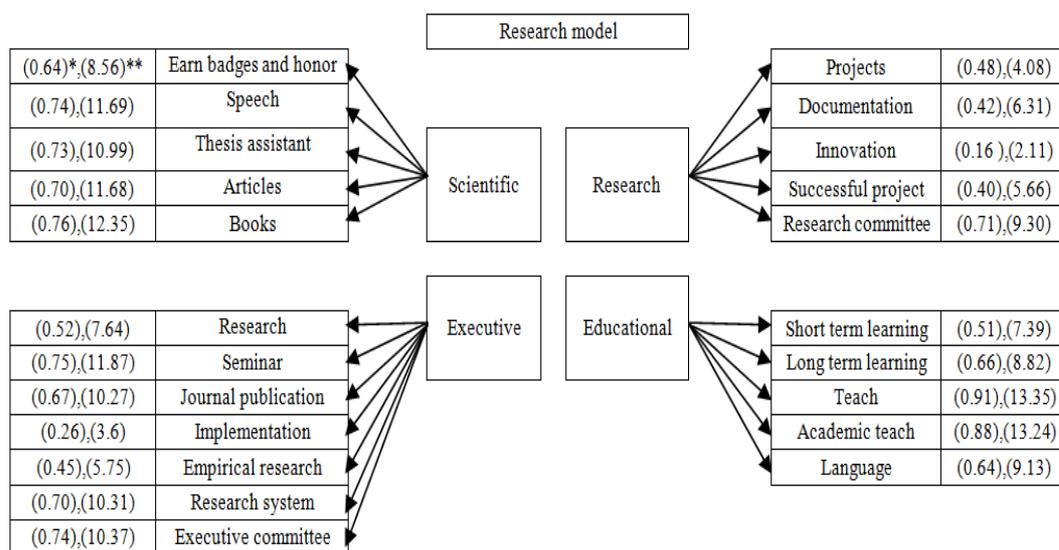

Figure-3. The Final model of researcher appraisal

GFI = 0.95, AGFI = 0.89, RMSEA = 0.081, χ^2/df = 2.2
*Regression coefficient   **Significant level

6. CONCLUSION

Nowadays, Performance evaluation of researchers in knowledge-based organizations in one of the most important management tasks, because promotion of this labor type and the knowledge organization as well necessitate giving feedback to researchers in addition to fairness in their compensation. In this regard, many scholars have developed ideas on how the KWs assessment model should be, but there is no universal model for all KWs. In this paper, a customized model has been developed as an outcome of a research project for evaluating the performance of research workers.

Results depicted that among all the performance measures, invention and innovation within the research aspect is the most important and significance factor with average response equal to 4.35, among the 212 gathered questionnaires. Collaborating on research projects and presenting seminars are the least important factors according to respondents points of views and other factors are distributed between these two factors. Based on Takala *et al.* (2006) assessment model

which mentioned above, the proposed model is easy to deploy and also it is accepted by appraisers and researchers since that the model is developed according to their points of view. During the model development process in order to cover the measures adequacy, researchers' perspectives are considered complementary to deep literature review. Finally the measures are designed in many fields of research and their weights are aligned with the organization strategy and its goals. This ensures the proposed model is well enough for studied case. it is successfully implemented since its development and can be adopted for the other research centers all around the world.

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