

The Influence of Economic and Technological Factors on HRM Plans Effectiveness in EPC Contractor Companies

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Abstract:

More careful and considerate people management is investigated in EPC companies involved in a mega project of Iranian petroleum Industry. Some main factors of human resources management (HRM) including economic and technological features have been improved by applying practical programs in companies and its effects on organizational performance have been explored. Participants from engineering, procurement, and construction (EPC) contractors were surveyed to assess how the HRM improvement can play a main role in their client satisfaction and product quality. 430 participants from eight EPC contractors are surveyed. The roles of participants in each company especially in under-study project are investigated. Moreover, 25 participants from project client are also surveyed to monitor the client satisfaction changes. The main improvement factors in HRM are divided in two main categories: technological and economic factors. In first category, on the job training as well as knowledge management systems are implemented or upgraded in the companies. In second category, pay for performance system as well as reward and incentive program are renovated and modified among the under studied organizations.

It was found that the effects of the programs on company performance and client satisfaction are completely different according to the role of staff. It is concluded that some programs, with higher costs and times, have not significant effects on company performance. Conversely, based on the type of the program and the role of staff in the company, some short-term financial programs can be assumed as the main incentives to stimulate and encourage the staff. Significant correlation between economic factors and organizational performance was found especially in employees with engineering-based role. For employees with construction-based role in the project, knowledge based HRM programs lead to better results in organizational performance. The relationship between each of HRM programs as independent variables of the research and client satisfaction as main dependent variable are also discussed. Monthly tracking of organizational performance is also done using data gathered at 6 weeks time intervals. The data is analyzed to investigate the relationship between the required time for affecting staff in both engineering and construction department.

Keywords: HRM Effectiveness, EPC Contractor, HRM Economic Factors, HRM Technological Factors, Client Satisfaction.

1. Introduction

In recent decade, caring about the factors that affect human resources are becoming one of the top determinants for organizational success. The effects of external and internal forces on human resources management can be complicated in multi task organizations (Pinnington and Edwards, 2000). Contractors with engineering, procurement, and construction (EPC) roles in projects can be assumed as one of the multi task organizations that the effects of factors on human resources management need special requirements. The matter is more importance because of the different behavior as well as various organizational cultures that govern in each department of EPC contractors.

As per review on related literature, it can be seen that the individual parts of EPC working is majorly focused by researchers in human resources management features (Kane and Palmer, 1995). Applicable reviews and investigations show that success practices in linking between material supplying and procurement as well as project construction can be lead to project success (Decell et al. 2007). Client needs and satisfaction can be assumed as the main subject to real measurement of human resources management effectiveness (Mbachu and Nkado, 2006).

The way in which staffs are managed can have important effects on each individual department of an EPC contractor as any functional organization (Lingard et al. 2008). But in multi tasking point of view, it seem that there are a lot of concerns when an organization undertake all of three main roles in a project including design and engineering, purchasing the materials and equipments, and lastly installing and construction. In petroleum megaprojects, where combining multiple stages of the project is really complicated, forecasting of effectiveness in human resources management plans can be lead to save of time and costs in a high scale. The special effects of economic concerns shall also be applied in any performance assessment in human resources management plans (Okpara and Wynn, 2008).

In EPC contractors, some of various patterns such as employee training and development that can improve the organization effectively may be needed to change in companies with various multi functional tasking plan. Based on some related studies (Pardo and Fuentes, 2003), one of the main factors that affect the efficiency of HRM plans and can be completely differ in various departments in an EPC contractor is the economic environmental conditions. Especial studies in manufacturing companies show the different levels of effectiveness in each enhancement programs on staff management according to the role of staff as well as other features (Katou and Budwar, 2007). The similar researches about the effect of role of staff on improving level of HRM plans illustrated the same results especially in small business firms (Mcpherson, 2008). So, based on a summarization of literature, it can be concluded that the predicted effects of a human resource planning in a multi task project oriented organization such as EPC contractor shall be generally investigated considering different level of effects in each department of the organization.

2. Research Methodology

This research set out to investigate the human resources management practices in companies involved in an industrial mega project. A survey design was developed and questionnaires adopted based on it and distributed to eight different companies with various roles in the project. The

project scope of work was upgrading a petroleum refinery in central province of Iran. Total investment of the project is about 1.5 billion USD. The main and major role of companies was commonly engineering, procurement, and construction (EPC). The project is named as IRUP (Iranian Refinery Upgrading Project) hereafter.

To determine adequate sample specification to be a real represent of the population in all companies, random selection method is applied (Borget et al, 1996). So, in each stage of the completion of the questionnaires, any staff in the target population has equal chance of being selected as a participant. An outline of main and specific roles for all participants is listed in Table 1.

Table 1. Participants features including organizations and specific role in the project

Participant's Role	Frequency	Percent
<i>EPC Contractor Company Staff</i>	430	100
Engineering Dept.	142	33.0
Junior Designer	28	6.5
Senior Designer	58	13.5
Lead Engineer	35	8.1
Group Manager	21	4.9
Procurement Dept.	93	21.6
Officer	5	1.2
Vendor Data Reviewer	39	9.1
Purchasing Coordinator	35	8.1
Group Manager	14	3.3
Construction Dept.	195	45.3
Officer	9	2.1
Yard Laborers	38	8.8
Structure Eng.	47	10.9
Grading Eng.	18	4.2
Construction Coordinator	29	6.7
Construction Inspector	19	4.4
Field Engineer	21	4.9
Group Manager	14	3.3
<i>Client Staff</i>	25	100
Client Field Supervisor	6	24.0
Management Consultant Supervisor	11	44.0
Group Manager	8	32.0

It shall be noted that the working department of the employees has been considered in sampling procedure. The sample consisted of 430 participants in EPC contractors which were evenly distributed in eight companies. Moreover, 25 participants from client body including main employer as well as management consultant (MC) of the project are questioned to recognize the changes in client satisfaction after improving of the human resources factors in EPC contractors. All of the data were collected in particular divisions of the companies that directly involved in IRUP. Required time for completion of questionnaire was about 20 minutes. Before distribution of questionnaire, the

respondents were completely advised that participating in the research is voluntary, how they have to answer to the questions in a fuzzy manner from 1 to 9, and when the forms will be collected. They were blind about main goals of the research.

As a basis structure of the questionnaires, two main groups of factors as independent variables of the research are defined to represent the status of human resource management in the company. First group consist of knowledge-based factors including on the job training schedule applied during last six months for EPC contractor staff (Tan and Nasrudin, 2011). Also, knowledge management system as well as technical supporting system implementing in the company during a 6-month time period ending to research time is considered in this group. Second group consist of economic factors of HRM including pay for performance system, reward and incentive program, and staff welfare scheme which were applied in the companies in six-month duration before completing of questionnaires. Based on this basic frame explained before, questionnaires have two main sections.

At the first section of questionnaire, the main question as a context was “is there any effective human resources management in your company especially considering knowledge-based factors?” ten detail questions included in this part of questionnaire about the quality, applicability and usefulness of company on the job training program. Some main topics of questions were the appropriate diversity of training subjects, adequacy of courses according to IRUP requirements, qualification of trainers, duration, intervals, and intermission of training courses, considering interdisciplinary trainings, and professional level of vocational courses.

Qualification of knowledge management system of company and staff loyalty about it is also considered in the first part of questionnaire. It shall be noted that these context questions are changed to positive statements to be able to analyze the answers based on Likert scale pointing.

At the second section of questionnaires, the main statement as a context was “there is an effective human resources management in your company especially considering economic factors” Again, ten detail statement included in this part of questionnaire about the adequacy of financial stimulate of staff, performance appraisal system, rewarding values and time intervals, ranking method of staff in rewarding program, and interacting between salaries and promotional plan is considered in the second part of the questions. All of the statements set up as positive.

So, in a 9-point scale of answering, 9 mean that “I strongly agree” and on the other side, 1 mean that “I strongly disagree”. 5 mean neither agree nor disagree with it. Points between 1 and 5 present somewhat disagree in a range and similarly, points between 5 and 9 show somewhat agree. This scaling pattern which advocate by some practitioners, add more granularity to raw data gathered from participants.

Another simple-form questionnaire is prepared only for client staff to evaluate the main goal of the research as its major dependent variable: client satisfaction. Five simple positive statements about the quality level of each EPC contractor in IRUP are included in the questionnaire. Observing contract essentials, actual high performance of the companies in engineering, procurement, and construction progresses in each month and in total, no lag of the progresses between plan and actual statuses, and excellent ethical and professional behavior of EPC contractors from client point of view considered in the statements of this special questionnaire.

In order to investigate the improvement procedure along the time, the questionnaires were filled at each six weeks time interval after the beginning of the HRM plans implementation in all eight companies. All of data gathered at about 1.5 month intervals for the entire questionnaires.

3. Data Analysis

Each specific question or statement can have its response which may be analyzed individually. But in this research, for raw data analysis, all of the related statements in a same group have been summed and one concluded point is determined for each group. We evaluate the results as a whole. The raw data received from participants are treated and descriptive data is produced. For treating Likert scale response data, integer part of the average of all responses in each group is selected as whole point for the group. The participants' responses received from questionnaires completed by EPC contractors staff have been summed into two main groups named as "technological factors" and "economic factors". On the other hand, the raw data gathered from IRUP client side have been summed as client satisfaction based on client staff point of view about each of the eight EPC contractors.

This data summarized for each EPC contractor and named as "HRM effectiveness" because the main expected result from an effective human resource management in each EPC contractor is surly client satisfaction. Then, the relationships between these groups of data are investigated. Data analyzed to inspect the correlation between each of group data gathered from EPC contractors in one side and client satisfaction as evaluated effectiveness of human resource management in each contractor in the other side. Descriptive data in each group is applied for analysis.

It shall be noted that all of the technical requirements for summing of multiple Likert question responses together is completely provided in data analysis. So, there is not any statistical dangerous about the results and the concluded judgments. In all questions, the same scale point is applied. Interval scales are used to provide a defendable approximation where coding clearly indicates the order of magnitudes for differences between items. In all items and statements, an individual latent specification of the company is measured. The measured specification cannot directly be estimated, but clearly can be inferred by participants based on some other measurable and directly observable specifications in the company.

Based on this quantitative approach, data analysis is done using correlation analysis method. Correlation factor between various descriptive data series is calculated and based on the values of factors, the importance of any independent variable on the main dependent variable is analyzed. There are two independent variables which affect the one main dependent variable. This analysis is separately carried out for each division of the companies including engineering division, procurement department, and construction division. The raw data is gathered separately from all three parts of each company. So, the descriptive data can be analyzed separately in these various divisions.

For determination of correlation factor in each analysis stage, a linear trend line with zero intercept is considered. The best value of correlation factor (i. e. 1), means that the independent variable or HRM studied factors have strong effects on the dependent variable or client satisfaction. This means that the studied factors role on effective management of human resources is statistically significant.

On the other extreme, zero value for correlation factor means that there is not any significant or meaningful relation between studied factors and increasing of HRM effectiveness and considering these factors in staff management in the company may leads to waste of time and cost. A range between zero and one for correlation factor can be paraphrased based on these two extreme definitions. The results of data analysis as well as comprehensive description of it are presented in the next session.

4. Results and Discussion

Based on the correlation method of analysis, the results can be categorized in three main parts. Firstly, the importance of HRM factors in both knowledge and financial based situation is investigated in engineering staff of the companies. In this division, all staff are responsible to produce engineering documents for project and follow it to be approved by the client and to be able to sent to procurement or construction departments for purchase ordering, constructing and installing of the equipments. In second part of the results, similar investigations are carried out for procurement division of the contractor, where all employees are responsible to float material requisitions for any required material in IRUP, such as equipments, bulk materials, or refinery process packages.

They have to follow the requisitions to be able to buy required materials and send it to project site. The last and third part of the results in this research is dedicated to construction department of the companies. Major parts of the respondents in this section are residents in the project site. Replies received from a wide range of the participants in the project site are analyzed separately and the results are presented at the last part of the discussion.

As illustrated in Figure 1, the influences of economic factors on human resources management plans are investigated in engineering employees of EPC contractor along eight companies involved in a same mega project named as IRUP. It can be seen that significant correlation between economic factors and organizational performance was found especially in employees with engineering-based role. It shall be noted that knowledge based factors named as technological programs, with higher costs and implementing time duration, lead to less efficiency rather than economic factors. It may be caused by the nondirective effects of the engineering culture of EPC companies that feel no need to more technological support for encouragement but required to more financial support at least in the study area of this research.

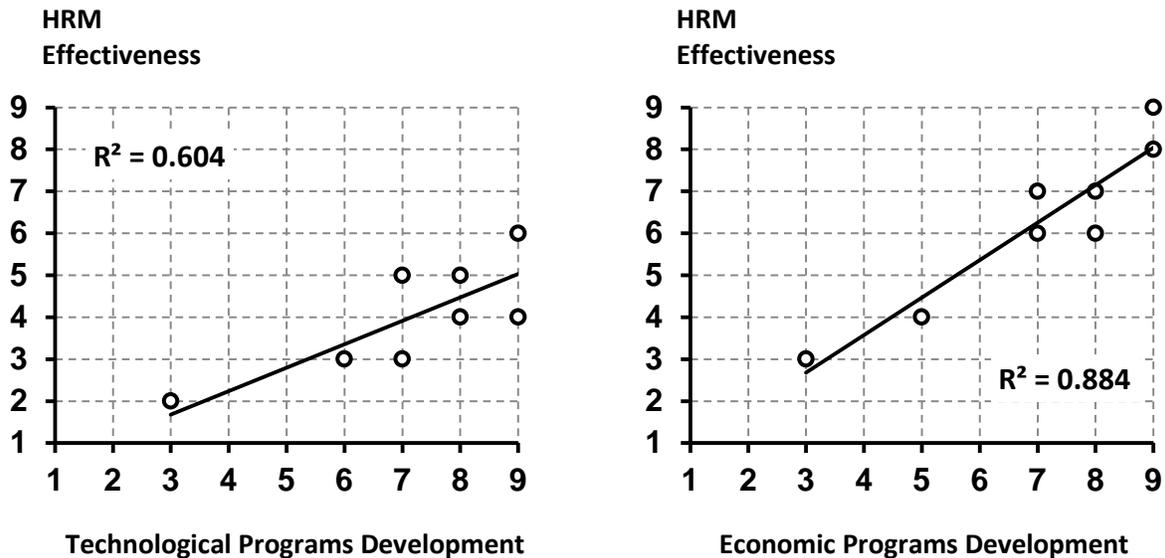


Figure 1: Correlation between HRM effectiveness and factors affect the staff in Engineering Division of EPC contractors

It can be paraphrased about the results that an acceptable correlation can be seen between client satisfactions and financial based factors in HRM programs. In companies with more caring about economic issues in engineering division, more client satisfaction is achieved. The reason can be related to limitation of time duration in which, the technological programs implemented in the company. It seems that there is not enough time to show the results of these programs in the form of client satisfaction. Less efficiency of technological HRM plans may also be another reason for this result.

For comparison and more investigation, the same results came from processed data gathered from procurement department of the companies are illustrated in Figure 2. In this commercially-based division, the results are completely different from engineering department of the EPC companies. Significant correlation cannot be seen between any factors, neither economic nor technological and HRM effectiveness. While some companies launched expensive and applicable technologies for improving their staff efficiency, it seems that client, at least in our study area, is not significantly and essentially pleased about the results.

The cultural factors, which are not considered especially and directly in this research, can play a main role in differences between engineering and procurement departments from HRM effectiveness point of view. Also, the different behavior of doing jobs in these two divisions can be another rational reason for it. Various steps of procedure for buying equipment for a mega project, such as vendor data review and negotiations and disparate signals from a wide range of vendors and lastly finalization of contracts, may be a rigid and inflexible space. So, this inflexibility may be transferred to the staff of procurement department in EPC contractors. Dependence pattern and level between economic as well as technological factors and client satisfaction in procurement department of EPC contractor is at the lower level at least in studied area.

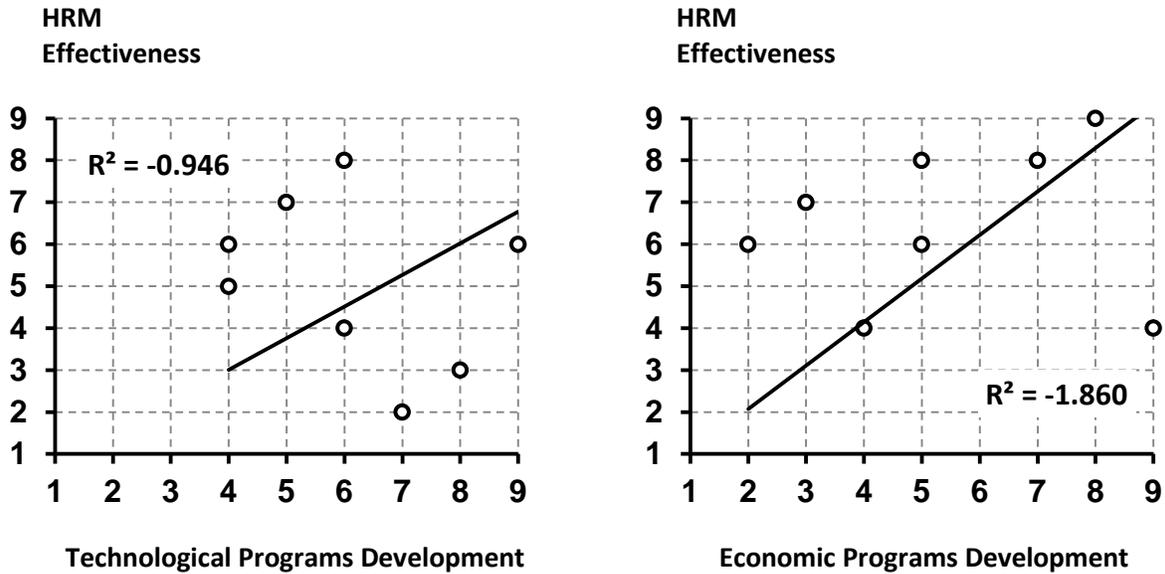


Figure 2: Correlation between HRM effectiveness and factors affect the staff in Procurement Division of EPC contractors

For employees with construction-based role in the project, knowledge based HRM programs lead to better results in organizational performance. This result can be clearly seen in Figure 3. In this figure, correlation between client satisfaction as the main prospect of HRM effectiveness and external factors affect the construction department of the companies is investigated.

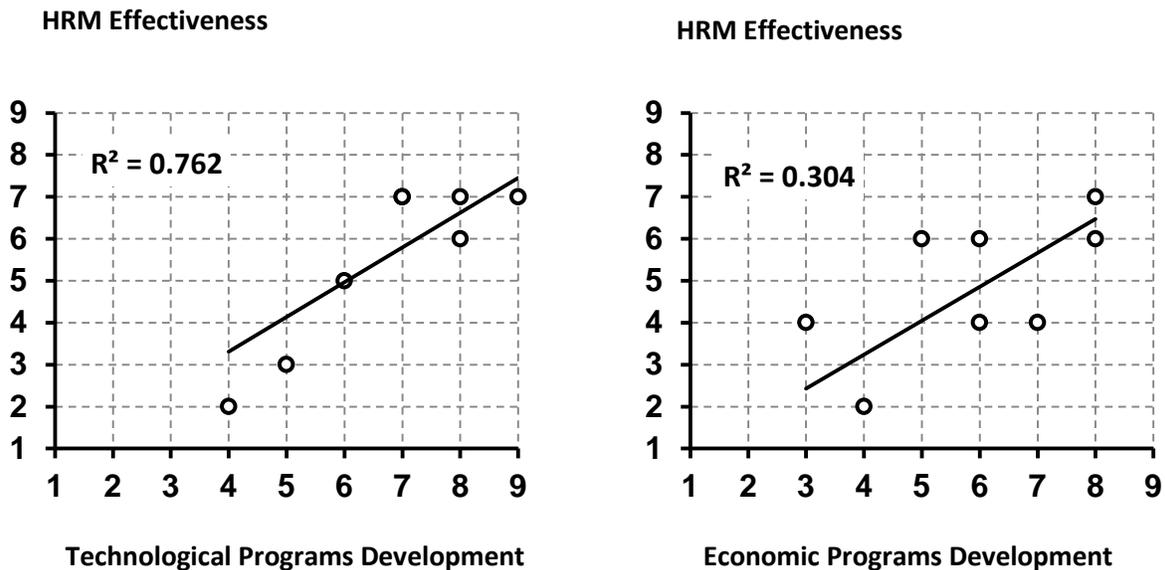


Figure 3: Correlation between HRM effectiveness and factors affect the staff in Construction Department of EPC contractors

Significant relation with high values of correlation factors are achieved between external technological incentives in construction staff and client satisfaction. It seems that enhancing the

technological prospects in project site, can directly upgrade the efficiency of construction team. Fair correlation can also be seen between economic factors and HRM effectiveness in construction department, but the preference of technological programs and their positive effects on organizational success is defensible based on the results. It can be seen on the figure that comparing all three departments in EPC contractors, client satisfaction level is generally lower in construction team.

For more investigations, the contractors with higher level of client satisfaction at the end of the tracking period are selected. As a criterion for selecting the successful EPC contractors, level 7 and more in Likert 9-point scale is considered. Based on this criteria, selected EPC contractors are studied for monthly tracking of improvement in their client satisfaction. According to previous results, two main categories are selected for this advanced inspection. Economic HRM plans effects on organizational performance, and secondly, technological factors effect on HRM plan efficiency in construction departments of EPC contractors.

At the first, economic HRM plans effects on engineering departments in all eight EPC companies are investigated. Monthly tracking for client satisfaction comparing to monthly tracking of HRM economic program development are illustrated in Figure 4. As it can be seen on the figure, significant relationship between monthly changes in both variables, (i.e. client satisfaction and HRM economic plan development) can be concluded. The main note that can be noticeable is that the effect of HRM economic plans on organizational performance is quickly achieved in engineering department.

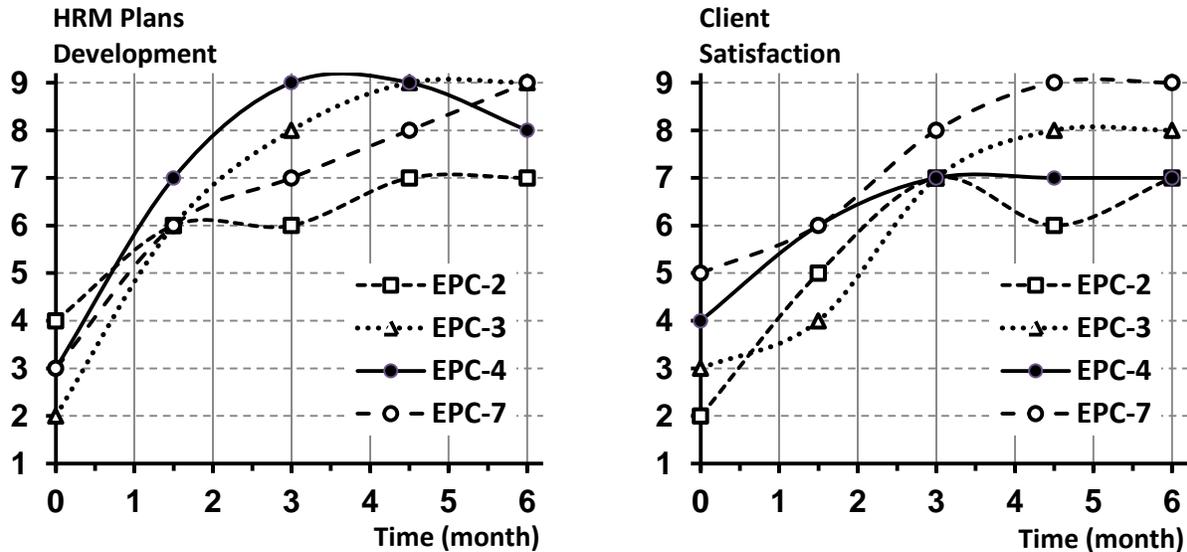


Figure 4: Monthly tracking for client satisfaction (a) and HRM economic plans development (b) for selected EPC contractors; sample: Engineering Department staffs

It seems that only about three months after effects of economic incentives, the engineering staffs are significantly encouraged. In well established contractors that selected for time tracking inspection, major parts of the improvement caused by economic factors occurred at about three months and after it, the trend of client satisfaction is relatively constant. The variations of

economic factors effect on client satisfaction is majorly the same in all four selected companies. It may be caused by the fact that financial supporting for engineering staff is more effective than any other stimuli. Financial based HRM plans such as rewarding as well as pay for performance systems have recognizable influences on engineering staffs behavior. The quality of engineering documents as the main outputs of engineering department has been significantly improved and it was the basis of client satisfaction.

Four EPC contractors that mentioned in Figure 4 have an acceptable level of client satisfaction in the last survey at the end of six month period. For all of these selected companies, it seems that if the surveying period will increases to more than six months, no significant changes will be happened in the level of client satisfaction. Efficiency and adequacy of HRM economic plans in all four companies can be easily founded from the results analysis. The most changes in staff efficiency are seen in engineering department of EPC-3, in which, client satisfaction is changed from level 3 to 8. It is occurred because of the changes of staff satisfaction due to financial supporting.

Data gathered from the staff shows that their satisfaction about financial condition in the company is changed from level 2 to 9 and it directly affect the organizational performance as well as client satisfaction. Another note that can be paraphrased using data analysis illustrated in Figure 4 is that initial levels of client satisfaction in all four selected companies are different, but the level after six month period is relatively the same and all of them passed the lower level of acceptance, 7 in Likert nine-point scale. The improvement trend is also completely different in companies that it may be related to the organizational culture in them.

At the second step, monthly tracking of client satisfaction as well as HRM plans development is carried out in construction departments of contractors. Based on gathered data presented before, for construction teams, the technological plans such as training and technical supporting of employees show more effects on EPC contractor's organizational performance and their client satisfaction. As illustrated in Figure 5, time tracking shows that the selected contractors with 7 and more client satisfaction level are different from selected contractors in Figure 4.

This means that organizational behavior in construction department and their responses to HRM plans are completely different from engineering staffs. Moreover, improvement rate during six month is relatively less than engineering department. No company can upgrade itself to more than 7-level in client satisfaction as a sign of its organizational performance. But as it can be seen in Figure 5.b, the trend of curves shows that if the study duration be more than six months, improving of companies may be continued and it can be concluded that a six-month period is not enough for studying of HRM plans effects in construction departments at least in our study area.

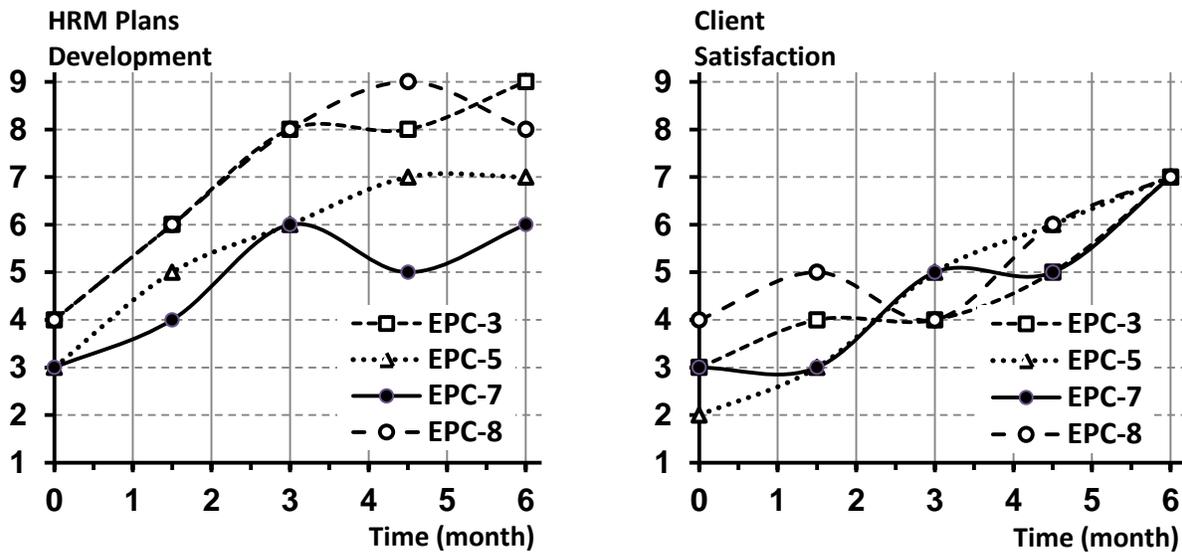


Figure 5: Monthly tracking for client satisfaction (a) and HRM technological plans development (b) for selected EPC contractors; studied sample: Construction Department

Comparing development rates in two corresponding parts of figure 5 shows that at least 5 months required to the construction staffs are affected by knowledge-based programs included in HRM technological plans. While the development of knowledge based plans is majorly completed after about three months, there are not any significant effects on client satisfaction. The delay between causes and effects especially in construction department can be clearly seen.

5. Conclusion

In eight organizations with engineering, procurement, and construction responsibilities involved in a megaproject in Iranian petroleum refinery industries, the external factors which can affect the human resource management efficiency is statistically investigated. Correlation method is applied to analyze the raw data gathered by questionnaires from employees in all companies. The data is analyzed separately for each of three departments in EPC contractors to inspect the relationship between external factors affect the personnel and organizational success. Client satisfaction is measured here as a main signal of success. The factors are also categorized into the two main groups named as economic or financial based factors and technological or knowledge based factors.

It is concluded that the influence level of the factors are completely different based on the role of staff in EPC contractor company. In E division, rather than it may was expected, technological factors have not higher levels of effects on organization positive changes. But economic factors and financial based stimuli can encourage better. In construction team, the effects of improving technological and knowledge based supports and backing of staff is significantly derived from analysis. It seems that the effects of this type of supports can be more efficient comparing to economical supports of construction employees. About the staff working in commercially based jobs on EPC contractors, the data analysis cannot be applied for achieving a clear result. It seems

that the questionnaires, external factors, time duration of the research or the selected companies shall be changed and modified to obtain more reliable and applicable results and surveying in this regard shall be rearranged.

Monthly tracking of client satisfaction is also done based on continuous data gathered at 6 weeks time intervals along total six month period. The data analysis is only done for some selected companies with higher levels of client satisfaction. The threshold is selected as 7 and more in 9-point Likert scale. It is concluded that lag time between HRM plans development and organizational performance can be clearly seen in construction department. But in engineering departments of EPC contractors, the lag time is significantly less

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