An empirical study on key factors for purchasing strategy on project based organizations: A case study of gas field development projects

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A R T I C L E I N F O	A B S T R A C T
	One of the primary concerns in development of oil and gas resources is to find the critical success factors associated with different important projects. Purchasing and procurement plays a key role in these projects. There is no doubt that in history of similar studies, there are not much studies to determine key factors. The proposed study of this paper presents an empirical study to find these factors in one of the most important gas filed in Iran is now South Pars Gas Field. The study distributes a questionnaire consists of various questions associated with purchasing activities. We investigate the feedbacks gathered from decision makers using factor analysis. The results of our survey reveal that there are three categories of organizational strategy, the relative importance of strategy and risk according to factor analysis. Each factor consists of many other factors and the relative importance of all factors are investigated.

1. Introduction

During the past few years, there has been growing interest to handle possible challenges associated with organizations. Today, many multinational organizations are not able to compete easily and they must plan based on specific geographical circumstances (Dobler & Burt, 1996; Trautmann et al., 2009). Internet, on the other hand, has created tremendous opportunities on purchasing activities (Bensaou, 1999). Croom (2000) investigated the impact of web-based procurement on the management of operating resources supply. Firms need to be responsible for national projects in one hand and compete with many international firms on the other hand. One of the most important issues surrounding business units is to have suitable purchasing plans (Ahnam, 2002; Engwall, 2003; Bartlett et al., 2004). In fact, during the past two decades, an improvement in purchasing strategy plays an important role on creating value added (Murray, 2001). The increase in purchasing expenses

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has significantly influenced cost of production (Gadde & Hakansson, 2001). There are many cases where the cost of raw materials is between 50 to 80 percents of the cost of goods and services (Cammish & Keogh, 1991). Purchasing operations play important role on cost of goods and services and it can substantially influence the profitability (Dubois & Pedersen, 2002). A survey of recent studies discloses that purchasing actions are not considered as an administration duties but it is more considered as management skill. There are many evidences, which indicate that purchasing technique could be an essential tool for improving relationships with suppliers (Gelderman & Van Weele, 2005). The recent increasing trend on cost reduction, quality improvement and customer relationship management has highlighted the relative importance of managerial decisions (Ogden et al., 2005; Dyer et al. 1998). According to Eriksson (2005), there is an increase on the complexity of executing various projects and one of the most important issues for the success of organizations is to provide creative offers. Eccles (1981) reported in his survey that over 75% of the cost of project based organizations are associated with purchasing necessary goods and services. According to Kraljic (1983), purchasing is the most important factor influencing productivity and profitability of organizations. Van Weele (2002) presented a remarkable work on strategic methodology for purchasing activities, which was based on portfolio optimization technique originated to Markowitz (Nellore & Soderquist, 2000; Olsen & Ellram, 2007). According to Kraljic's method, purchasing decisions must be done based on two important factors of purchasing power as well as supplier's capabilities. There are three strategies, which are diversity, balance and exploiting the opportunities.

For many years, ABC and Pareto analysis were the most important factors on making appropriate purchasing strategies. However, these methods rely only on financial figures and do not consider other important factors such as quality, risk, etc. Kraljic's method has influenced purchasing techniques, significantly. In fact, his method suggests considering many different factors when a purchasing order occurs (Van Weele & Geldrman, 2002, 2003).

When an organization deals with accomplishing a construction projects, purchasing plans must be performed in terms of project activities and they are managed by projects (MBP). There are different standards and techniques for managing projects such as Project Management Institute (PMI), engineer-procure-construct (EPC) (Nellore & Soderquist, 2002) and Project Management Body of Knowledge (PMBOK) (Turner, 1999; ISO 10006, 2003; Zolkiewski, J., & Turnbull, 2001).

The proposed study of this paper considers the following items (Lilliecreutz & Ydreskog, 1999),

- Supplier risk: This includes the existing competition among suppliers, planning system, price fluctuations, quality control, instability associated with country of service provider, contract issues, transportation, currency changes and political issues.

- The relative importance of strategy: This includes the impact of purchase on final product and services, the impact of purchase in final product, the portion of cost in final product and the portion of basic efforts needed for purchasing actions.

- Market and purchasing activities: Monopolization on behalf of suppliers and market demand, limited monopoly on behalf of suppliers, monopolized market on behalf of demand of supply, limited monopolized market in behalf of demand side, two-way multi-polar competition, two-way multi-polar competition in supplier part, multi perspective multi-polar competition.

- Organizational strategy: organizational objectives, relationship between contractors and order providers, product, organizational structure, competitors , industry, new technology and business environment.

- Suppliers' performance: Reliability, performance and ability, financial situations, capacity, job experience, knowledge and technology.

- Difficulty of purchase: frequency of purchase, technical complexity, complexity of performance items, complexity in business administration and fluctuation in demand.

In summary, there are various factors influencing EPC projects (Tikkanen & Artto, 2007) and Fig. 1 shows details of some of the most important factors.
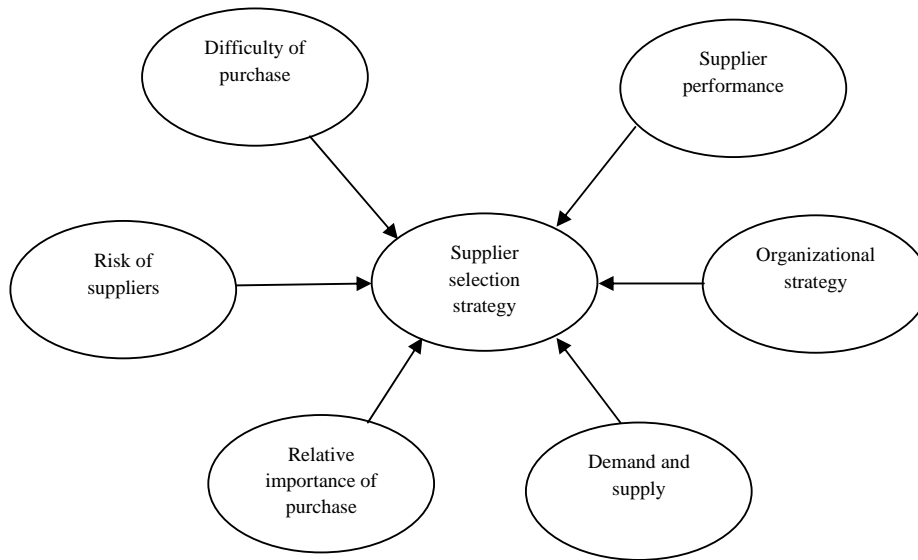
Fig. 1. Important factors influencing purchasing decisions

The organization of this paper presents an empirical study to find out important factors influencing project based organization on purchasing goods and services.

2. The proposed study

The proposed study of this paper first executed an interview with ten professional managers who were involved with oil and gas projects for many years. They had extensive experiences on various projects and we believe they could provide us important factors. The proposed study uses the following formula to calculate the minimum number of sample size,

$$n = \frac{N \times z_{\alpha/2}^2 \times p \times q}{\varepsilon^2 \times (N-1) + z_{\alpha/2}^2 \times p \times q}, \tag{1}$$

where N is the population size, $p = 1 - q$ represents the yes/no categories, $z_{\alpha/2}$ is CDF of normal distribution and finally ε is the error term. Since we have $p = 0.5, z_{\alpha/2} = 1.96$ and N=254, the number of sample size is calculated as n=107. We have distributed 150 questionnaires among the survey people and gathered 111. Among participants, there were 4 people with PhD degree, 69 hold master of sciences and 38 had bachelour degrees. In terms of age, 28 people were between 31 to 40 years, 60 people between 41 to 50 and 23 people were more 51 years old. In terms of job experiences, 48 people had fewer than 10 years of job experiences, 43 people had between 11 to 20 years of job experience and 20 people had more than 20 years of job experience. While 33 people were working for governmental agncies, 77 were hired by private sector. All questions were designed on Likert scales from one to five and the hypotheses were tested as follows,

$$\begin{cases} H_0: & \mu \le 3 \\ H_1: & \mu \succ 3 \end{cases}$$

The average numbers of 4 and 5 represent the high impact and the average numbers of 1 and 2 represent the medum impact. Whevener a particular index receives a number of 3 or more, it means that index has positive impact on purchasing strategy. In case we receive an average index less than this number we simply eliminate it from the questionnaire. Except organizational factor with an average of 2.67, all other questions were kept in our survey. In terms of the average ranking number, we have realized that policy making strategy has received the highest relative impact while the existence of compatitors received the lowest impact in our survey. All attributes associated with market were considered as important factors. In terms of multidimentional index, demand was the most important index while market monopoly was the least important one. All strategic factors were considered important in our survey. The impact of purchase was considered as the most important index while technology was the least important factor. In terms of risk of supplier, planning, transportation, quality and contract issues were not considered important and they were eliminated from our survey. Political factor was the most important factor and in terms of purchasing index, demand fluctuations was not considered an important factor and it was eliminated from our survey. Complexity of the technology was one of the most important factors. In terms of suppliers' characteristics, expect job experience, all factors remained important in our survey. The knowledge and technology has been considered as important factors. Cronbach alpha (Cronbach, 1951) was calculated for each factor and they are summarized in Table 1.

Table 1
The results of Cronbach alpha for questions of the survey

Question #	1	2	3	4	5	6	7
Title	Organizational strategy	Market	The relative importance of strategy	Supplier risk	Difficulties of purchase	Performance of supplier	Total
Alpha	0.681	0.870	0.652	0.809	0.725	0.763	0.787

As we can observe from the results of Table 1, most components are relatively meaningful and we could make a preliminary jugdment of the reliability of the test.

3. Factor analysis

In our survey, we have used Kaiser-Meyer-Olkin (KMO) and Bartlett tests were used and according to Heckerman, any ratio greater than 0.6 was considered as minimum level of meaningful ratio. Table 2 shows details of our survey.

Table 2
The results of different statistical tests

| Test	Factor					
	Organizational strategy	Demand and supply	The relevant importance of strategy	Risk	Difficulty of purchase	Supplier performance
Kaiser-Meyer-Olkin Measure of Sampling	0.741	0.804	0.713	0.841	0.817	0.805
Approx. Chi-Square	172.737	847.433	113.244	208.3	283.714	219.979
Df	21	36	10	10	6	10
Sig.	0.000	0.000	0.000	0.000	0.000	0.000

The factor analysis uses two software packages of LISREL and SPSS. After removing unimportant questions, there were eight questions in strategy, 9 questions in demand and supply, 5 questions in stratgey, 5 questions in risk associated with supplier, 4 questions in difficulty of purchase and 5 questions in supplier performance. In our analysis, we have considered all factors above 0.4.

According to our analysis, there were eight questions associated with organizational strategy, which were categorized in two different parts of internal and external factors. The internal factors include objectives, the relationship between the contractee and contractor, while the performance of competitors, the nature of industry and the new technology are considered as the external factors.

In terms of demand and supply factors, there were 9 factors and after a comprehensive investigation we ended up having demand/supply market as an exclusive factor.

The relative importance of strategy was another factor, which included only 5 factors, which were categorized in two groups of economical and efficiency. The economical factors include the impact of purchase in final product, profitibility and additional cost of purchase while the relative importance of technology as well as the amount of organizational efforts are considered as technical efficiency factor.

In terms of risk of suppliers, we have kept 5 out of 9 factors and all have been categorized in one single group called risk of suppliers. Similarly, we have maintained 5 out of 6 factors for the performance of suppliers and all factors were categorized in one single group. The bartlett test yields 0.722 and 0.000 for sufficiently of sample size (KMO) and significance level, respectively. In the final stage, there were 33 indexes and they were categorized in 9 groups. Based on different brain storming and negotiations, we have decided to remove the 9th factor, which was associated with fluctuations in currency, leaving us to have 8 factors for final investigations. These items are internal factors, external factors, demand and supply market, economical factors, efficiency factor, supplier risk, diffucly of purchase and the performance of suppliers. Fig. 2 shows details of our groups.
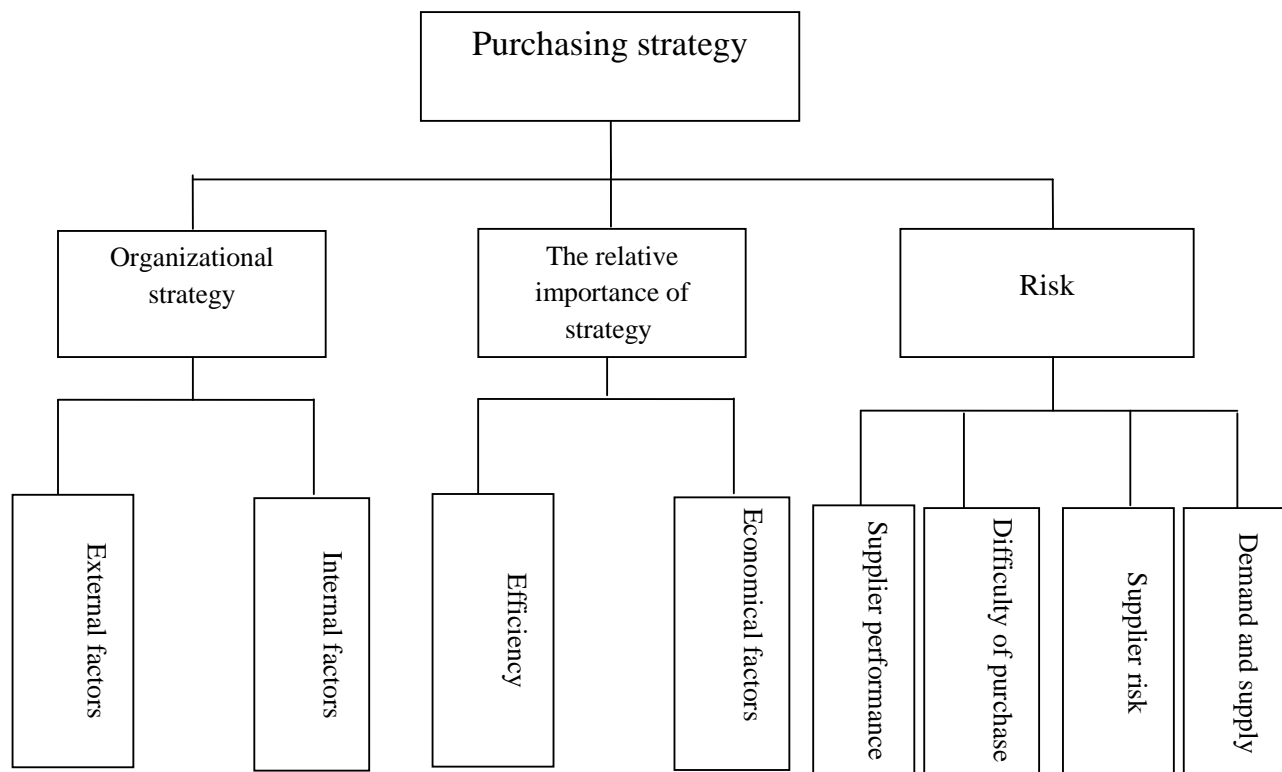
Fig. 2. Purchasing strategy

The results of statistical test obtained from SPSS are 0.7 for KMO sufficiently of sample and size and 0.000 for the level of significance, respectively. These results are good enough for factor analysis. According to the results, the eight factors have been categorized in three

groups of organizational strategy, the relative importance of the strategy and risk shown in Fig. 2. We have performed a two-stage factor analysis in this section. The first section is associated with three factors of strategy, the relative importance of strategy and risk. In the second stage, we have performed the analysis for details of purchasing strategy.

3.1. Two stage factor analysis for strategy

The first test is associated with the strategy and Fig. 3 and Fig. 4 show details of this variable in standard and the first stage forms, respectively. In these figures, INTERNAL and EXTERNAL represent the internal and external factors, respectively.
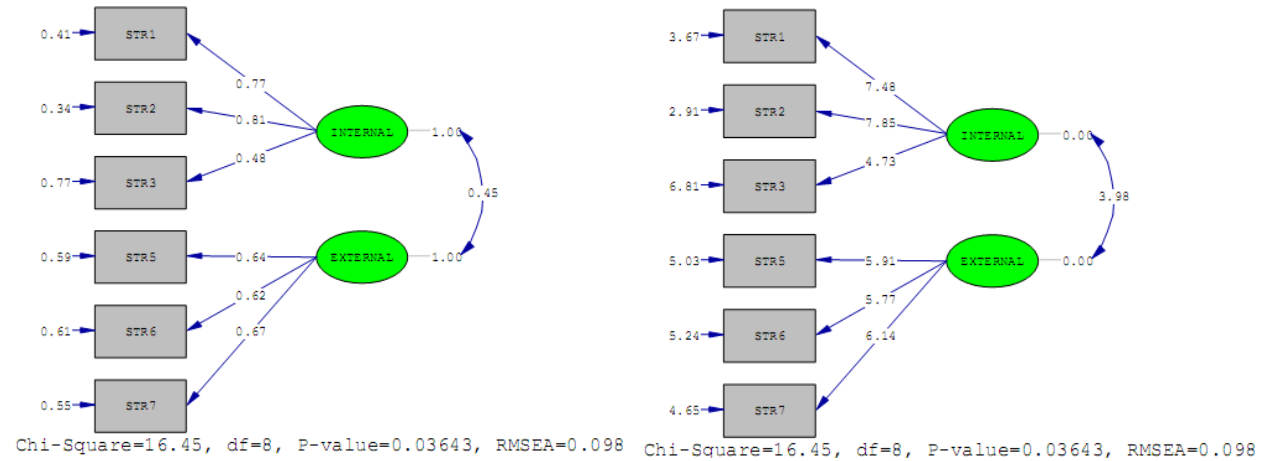

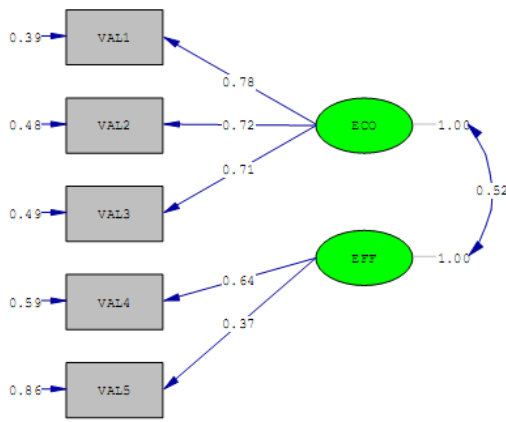**Fig. 3.** The values of strategy variable in standard stage

Fig. 4. The values of strategy variable in the first stage

As we can observe from the results, $\chi^2 = 16.45$ with 8 degrees of freedom, which is well above the critical value of 3 and RMSEA is 0.098, which is above the critical value of 0.08. The other three statistical values of AGFI, GFI and NFI are 0.85, 0.95 and 0.91, respectively. These results indicate that test results are highly meaningful. According to the results, we can measure the weight of each factor influencing total variance. For instance, the first items has a factor weight of 0.77 and .41 is the variance of the first factor.

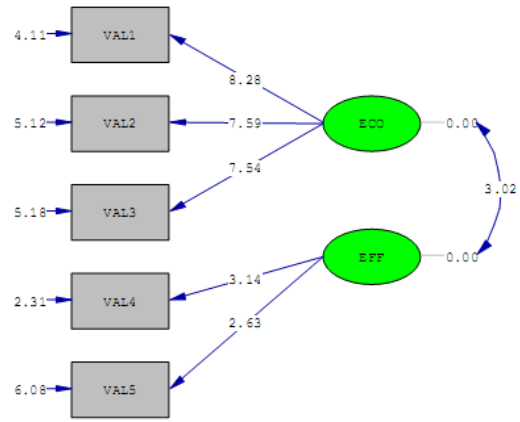### 3.2. Two stage factor analysis for relevant importance of strategy

The second test is associated with the strategy and Fig. 5 and Fig. 6 show details of this variable in standard and the first stage forms, respectively.

As we can observe from the results, $\chi^2 = 5.17$ with 4 degrees of freedom, which is well above the critical value of 3 and RMSEA is 0.052, which is above the critical value of 0.05. The other three statistical values of AGFI, GFI and NFI are 0.93, 0.98 and 0.96, respectively. These results indicate that test results are highly meaningful. According to the results, we can measure the weight of each factor influencing total variance. For instance, the first items has a factor weight of 0.78 and .39 is the variance of the first factor.

Fig. 5. The values of the relative importance of strategy variable in standard stage

Fig. 6. The values of the relative importance of strategy variable in the first stage
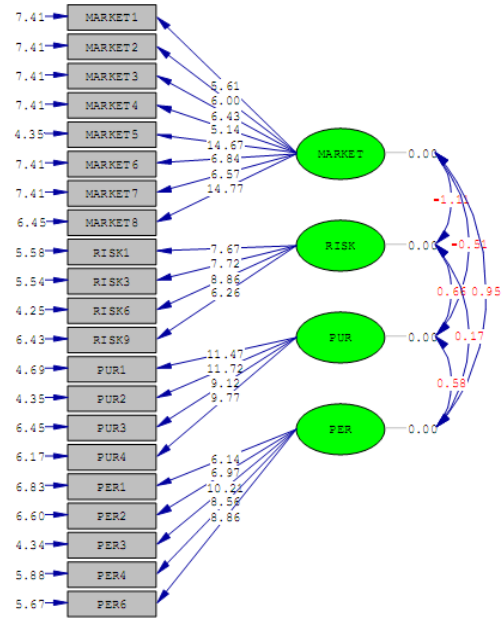
3.3. Two stage factor analysis for risk

The first test is associated with the strategy and Fig. 7 and Fig. 8 show details of this variable in standard and the first stage forms, respectively.
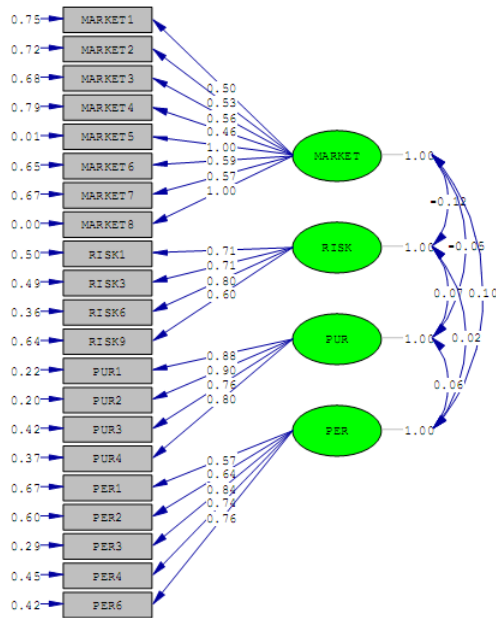
Fig. 7. The values of the risk variable in standard stage

Fig. 8. The values of the risk variable in the first stage

As we can observe from the results, $\chi^2 = 387.22$ with 183 degrees of freedom, which is well above the critical value of 3 and RMSEA is 0.076, which is above the critical value of 0.08. The other three statistical values of AGFI, GFI and NFI are 0.91, 0.93 and 0.95, respectively. These results indicate that test results are highly meaningful. According to the results, we can measure the weight of each factor influencing total variance. For instance, the first items has a

factor weight of 0.50 and .75 is the variance of the first factor. In other words, economical factors can be accounted for 61% of the variance.

3.4. Factor analysis for purchasing strategy

Second factor analysis has been accomplished for purchasing strategy. Fig. 9 and Fig. 10 shows details of statistical tests.
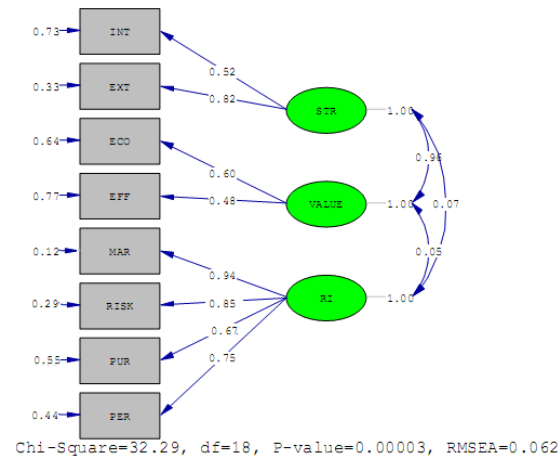

Chi-Square=32.29, df=18, P-value=0.00003, RMSEA=0.062

Fig. 9. Statistical values for purchasing strategy in standard stage

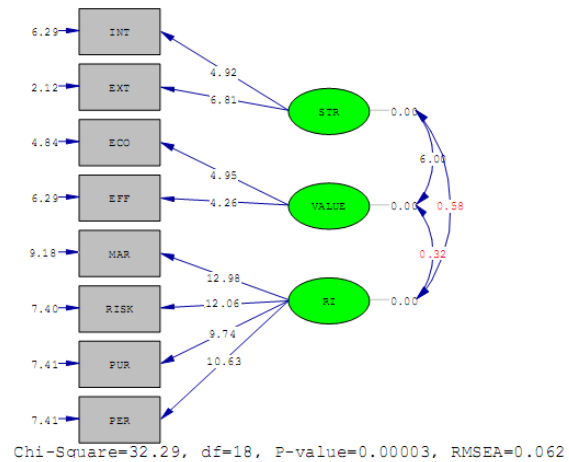Chi-Square=32.29, df=18, P-value=0.00003, RMSEA=0.062

Fig. 10. Statistical values for purchasing strategy in the first stage

In these figures, INT, EXT, ECO, EFF, MAR, RISK, PUR and PER are internal, externals factors, economic, efficiency, market demand and supply, risk, purchase and performance of suppliers, respectively. As we can observe from the results, $\chi^2 = 32.29$ with 18 degrees of freedom, which is well above the critical value of 3 and RMSEA is 0.062, which is above the critical value of 0.08. The other three statistical values of AGFI, GFI and NFI are 0.90, 0.95 and 0.96, respectively.

4. Conclusion

In this paper, we have presented an empirical study to determine important factors influencing purchasing strategies. The proposed study of this paper distributed a questionnaire consists of various questions associated with purchasing activities. We have analyzed the feedbacks gathered from decision makers using factor analysis. The results of our survey revealed that there are three categories of organizational strategy, the relative importance of strategy and risk. Each factor consists of many other factors. The proposed study was implemented for oil and gas industry and detailed results measured the impact of each item on purchasing strategy.

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