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AN APPROPRIATE PATTERN TO INCREASE ABSORPTIVE CAPACITY OF TECHNOLOGY IN AUTOMOTIVE INDUSTRY IN IRAN (CASE STUDY: PARS KHODRO COMPANY)

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ABSTRACT
Current work was done aiming at determining factors influencing formation and increase of absorptive capacity of technology in Pars Khodro Co. in automotive industry. 168 ones from deputies, directors, heads and top experts of Pars Khodro Co. were selected using simple random sampling. Structural equations were used for statistical data analysis. Influencing factors were identified based on library studies as well as interview with experts, and preliminary classification of the factors was done. Preliminary classification included 7 main factors as follows: 1. Level of education, 2. hard working, 3. Research & development, 4. Human resource, 5. Technology transfer, 6. Prior knowledge related, and 7. Age and size of firm. Face validity and content validity of the questionnaire was confirmed using expert ideas and reliability of the questionnaire was obtained as 0.83 using Cronbach's alpha coefficient. According to research findings, age and size of firm, level of education, prior knowledge related, technology transfer, human resource, hardworking, research and development are influential in automotive industry respectively.

KEYWORDS: Absorptive Capacity, Automotive, Technology

INTRODUCTION

Considering rapid global changes, developing countries seriously are increasing their technological capabilities so that it leads to more efficient use of import technology, since import technology is rarely matched to the conditions in third world countries, and efficiency significantly may be increased through the process of adapting imported technologies and bonding them to the socio-economic conditions.

Development local absorptive capacity of technology leads to reduction of dependence on the advanced countries and subsequently it can lead to competitive advantages. To this end, absorptive capacity as a factor affecting successful technology transfer should be more considered. Various factors influence increasing absorptive capacity of technology including human resources, physical capital, and adaptation of imported technologies to the goals, valuesand resources and needs of the country. Each of these factors refers to presence of suitable infrastructures for the received technology (Mahdizadeh and Heydari Gharebagh, 2010). Importance of absorptive capacity has been considered in recent years in such areas as strategic management, technology management, international trade and knowledge management. Despite of growth in use of this subject, increasing absorptive capacity in the firms is yet difficult due to different reasons such as ambiguity, variety in its definitions, elements, background and outcomes.

Today one of the main priorities in automotive industry is discovering updated technologies, acquisition of them, adopting with the country's conditions and their localization for facilitating progress in different industries. Current work focuses on the country's automotive industry and specifically Pars Khodro Co. current research study can help solving problems of Pars Khodro Co. in identifying, acquiring, absorbing, utilizing, and improving latest technologies through proposing an appropriate pattern for increasing absorptive capacity of technology. In fact, current work aims at specifying main areas and factors in increasing absorptive capacity of the country's automotive industries and specifically, Pars Khodro Co. and determining the way of acquiring specific technologies and localizing these technologies with the current status with comprehensive and adequate studies, so that the past drawbacks are compensated, and finally an appropriate pattern for increasing absorptive capacity of technology in Pars Khodro Co. and enabling automotive industries is propose so that the gap is reduced and the optimal goal, i.e. becoming the top country in the region, is achieve. Considering mentioned facts on importance of absorptive capacity, current work seeks for answering following question: what are factors influencing formation and increase of absorptive capacity in automotive industry?

Theoretical Foundations

The concept of absorptive capacity recently has been mostly used for describing difference between phenomena, from technology transfer among the countries to a single international strategy. Absorptive capacity is commonly used from organization level to investigation of innovation process and influence of organizational learning on competitive advantage creation (Mowery and Oxley, 1995). In fact, absorptive capacity is applied to the phenomenon, through which the people learn and increase their ability in absorbing information (Lundvall, 1992). Absorptive capacity concept is originally related to the macroeconomics, where Adler refers to abilities of an economy in application of external information and acquired resources (Adler, 1965). Kodia et al. (1998) used this term in the concept of technology transfer in the countries, and associated it to the firms as the potential for understanding technologic changes. Van-den-Bosch defined absorptive capacity as evaluation, acquisition, integration, and commercial utilization of external new knowledge. Also, he considers two factors of organizational forms or states and accumulated capabilities in the firm as influential in increasing absorptive capacity.

Zahra and George (2002) identified four aspect of absorptive capacity including: acquisition, absorption, transfer, and utilization. Then a new way is proposed for conceptualization of distinction between potential (knowledge acquisition and absorption) and acquiring (change and utilization) of absorptive capacity. Acquisition is defined as a capacity for recognition, understanding importance, and obtaining external knowledge needed for operations of the organization (Lane and Lubatkin, 1998; Zollo, George, Lane). The company's absorptive capacity refers to external knowledge integration (Zollo and George, 2002). The company's transfer ability for development and improvement is a process which facilitates combination of existing knowledge and newly acquired knowledge. This goal can be achieved by adding or inhibiting knowledge, or reinterpretation of the existing knowledge. It requires two basic elements: internal and transformation. Van-den-Bosch et al. identified three features in knowledge acquisition: productivity, range, and degree of flexibility. Productivity in knowledge acquisition refers to the fact that how the specific companies integrate and utilize knowledge of cost and economics in the view of scale. The range refers to the extent of the knowledge which is drawn by the company. Flexibility refers to the extent by which the company is able to have additional access and reconfiguration of existing knowledge. Van-den-Bosch et al. argue that flexibility and range features are observed in knowledge acquisition and highly related to the structures of organizational knowledge which is exploration in the nature, while productivity is related to the higher accuracy for compatibility and leads to utilization.

Khosravi *et al*. (2012) in their work entitled *Individuals' Absorptive Capacity in Enterprise System Assimilation* stated individual capacity for knowledge absorption on Enterprise resource planning (ERP) is considered as a critical element in improving absorptive capacity (ACAP) of the organization in HR planning absorption stage. In their paper, they developed a theoretical model for investigating absorption of organizational systems in the stage next to implementation. Specifically, this model adjusts the way of management communication and participation of managers and effects of individual absorptive capacity on absorption of HR planning systems. In summary, this paper states that individual abilities in knowledge absorption regarding HU planning is one of the key factors in development of the organization's absorptive capacity. They proposed a model and explained effect of individual absorption capacity on absorption off HR planning system.

Yongping *et al*. (2011) in a work entitled *Analysis of Influence of Network Structure, Knowledge Stock and Absorptive Capacity on Network Innovation Achievements* discussed on influence of network structure, knowledge stock and absorptive capacity on network innovation based on domestic and foreign studies. They investigated achievements and model structures using experimental analysis in 124 companies in industrial parks. The authors found that network structure and knowledge stock positively affect absorptive capacity and both influence innovation performance. Roshartini, Roshana, and Nawawi (2011) in a work entitled *The Concept of Absorptive Capacity in Technology Transfer (TT) Projects Malaysia* studied absorptive capacity concept in technology transfer in HR perspective, and maintained that absorptive capacity is the company's ability in simulating imported technology which depends on organizational technological ability. Models of absorptive capacity in technology transfer in HR perspective include:

- Conceptual model by Minbaeva *et al*. (2003) based on ability of staff, staff motivation, and organization's strategic mission
- Abu Bakr theoretical model (2004) based on independent variables and micro variables
- Absorptive capacity of innovation performance by Escribano *et al*. (2008) based on variables of innovation performance, external knowledge flow and absorptive capacity

- Liao's technical social system framework model (2007) based on relationship between absorptive capacity, knowledge acquisition, and innovation ability
- Quantitative analytical approach model by Sazali *et al*. (2009) based on identification six major variables: academic background, technical capacity, educational programs, financial support, abroad educational opportunities, and commitment.

Jackson (2011) in a work entitled *Organizational culture and information systems adoption: A three-perspective approach* refers to organizational culture as an important factor in success or failure of information systems adoption. This paper specifically emphasizes the fact that with combination of three views by Martin (2002) from culture – integration, separation and fragmentation and network and theory of cultural group it is possible to have more insight on how organizational culture can influence adoption of information systems. Kostopoulos *et al*. (2010) in a work entitled *Absorptive capacity, innovation, and financial performanc*e tested absorptive capacity role as a mechanism for specifying and translating external knowledge flow to tangible benefits and achieving top innovation and financial performance with time delays. Using path analysis in a sample size of 461 from Greek investors participating in Third Innovation Conference, this work approved that external knowledge flows are directly to the absorptive capacity and indirectly related to innovation. Murad Ali *et al*. (2010) in a work entitled *A Study on the Process Model of Knowledge Absorptive Capacity for Technological Innovation Capabilities :The Case of Samsung Electronics* studied theoretical stages of knowledge absorptive capacity (KAC) model development. The theoretical model included 4 stages: 1. Knowledge initiation, 2. Knowledge imitation, 3. Knowledge improvement, 4. Knowledge innovation. This work reviews literature, models and framework related to KAC. Then, it analyzes a case study (Samsung Korean Co.). Using Samsung case, this paper indicates that electronic companies in Korea developed their KAC through a KAC process model.

MATERIALS AND METHODS

Applied research method was used in terms of purpose of study, because it is conducted aiming at rapid problem solving, and taking necessary measures, so that existing problems and obstacles are eliminated by accurate and systematic planning, or they are diminished. On the other hand, this research study is descriptive of survey type, and actually it is a field research. It can be said current work is a cause0effect work. This work is initiated from statement of the problem and then findings are processed, discussed and studied following data collection using statistical software such as LISREL.

Research Model and Hypotheses

Kim's research integrate model (1998) including components of education level, hardworking, R & D, human resource, technology transfer, prior knowledge related, age and size of firm as components influencing absorptive capacity of technology (case study: South Korean Hyundai Co.) was used so that factors affecting absorptive capacity of technology I automotive industry are identified, and finally research theoretical framework was formulated using mentioned variables, shown in Fig 1.

According to the model proposed in Fig 1, research hypotheses are given as follows:

1. Education level factor influences absorptive capacity of technology in automotive industry.
2. Hardworking factor influences absorptive capacity of technology in automotive industry.
3. Research and development factor influences absorptive capacity of technology in automotive industry.
4. Human resource factor influences absorptive capacity of technology in automotive industry.
5. Technology transfer factor influences absorptive capacity of technology in automotive industry.
6. Prior knowledge factor influences absorptive capacity of technology in automotive industry.
7. Firm's age and size factor influences absorptive capacity of technology in automotive industry.

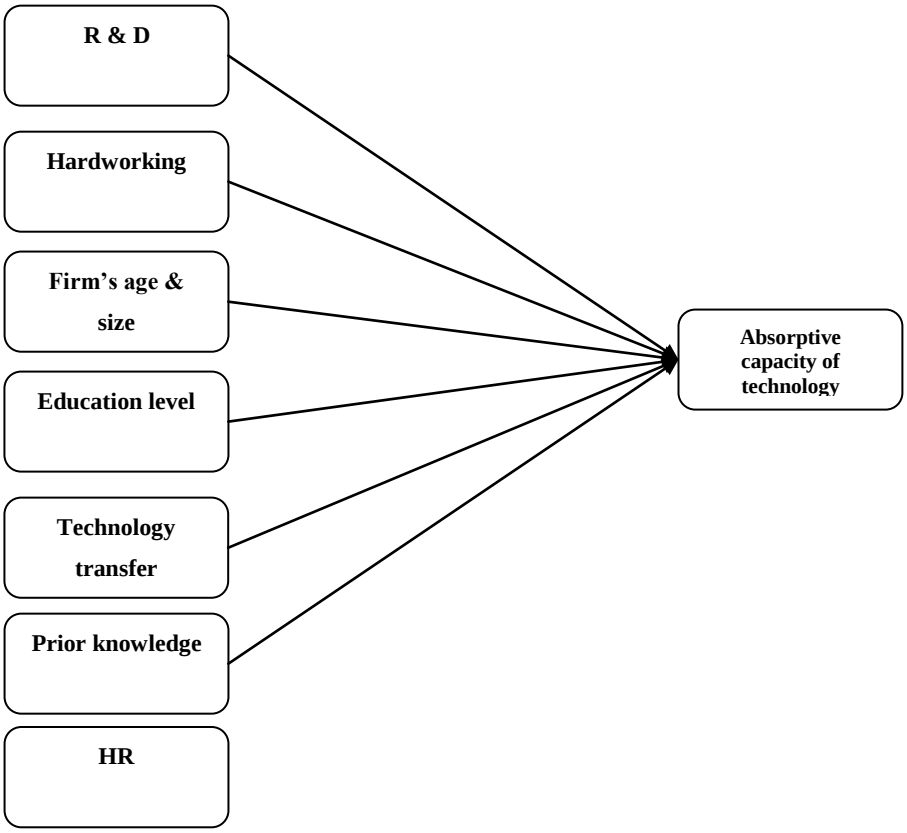

Figure 1. Research conceptual model

Statistical Population, Sample, and Sampling Method

Research statistical population includes all deputies, directors, heads and top experts of Pars Khodro Co. (n = 300). Cochran formula was used (for finite population) in order to specify sample size from this finite population, which is shown in Eq. 1. Following specifying sample size (n = 168), simple random sampling method was used.

Data Collection Tools and Methods

An author made questionnaire was used in order to collect data. A questionnaire with 50 items was designed so as to investigate factors influencing absorptive capacity of technology. Likert scale was used as numerical scale for closed items. Internal consistent method was used in the questionnaire in the current research for estimating reliability, and this method stresses consistency of the items. Cronbach's alpha coefficient is used to assess the uni-dimensionality of attitudes, beliefs and perceptions, and it indicates the extent to which respondents had the same perception of the items. The Cronbach's alpha (α) is calculated as 83% by SPSS 19 software, indicating the validity of the questionnaire.

RESULTS AND DISCUSSION

Firstly demographic variables including gender, marital status, age, education, and working experience were studied. 57.74 percent of the respondents were males and 42.26 percent were females. Most respondents were 25 to 30 years old. Research findings suggest that 9.5 percent of respondents had high school diploma, 13.1 percent had associate

degree, 33.9 percent had BA degree and 43.5 percent had MA degree. 71.43 percent of them were married and 28.67 percent were single. Most respondents had 0 to 5 years of working experience.
Fit indexes for scales of research and development, firm's age and size, technology transfer, education level, prior knowledge related and hardworking are given in Table 1. The values suggest that data of this research with factor structure of seven scales has good fit. It indicates consistent of research variables.

Table 1: Fit indexes for R & D scale

Characteristic	Estimation						
	R & D	HR	Firm's age & size	Technology transfer	Education level	Prior knowledge related	Hardworking
Chi-square vs. degrees of freedom x^2 / df	0.875	1.82	1.43	1.49	1.53	1.60	1.07
Root Mean Square Error of Approximation, RMSEA	0.023	0.07	0.051	0.054	0.056	0.06	0.021
Goodness of fit index, GFI	0.97	0.95	0.98	0.97	0.96	0.96	0.99
Adjusted goodness of fit index, AGFI	0.95	0.92	0.93	0.93	0.94	0.93	0.96
comparative fit index, CFI	0.99	0.98	0.99	0.99	0.99	0.99	1
Normalized fit index, NFI	0.97	0.96	0.98	0.98	0.98	0.98	0.99

Second-Order Confirmatory Factor Analysis
Second-Order Confirmatory Factor Analysis is defined as a kind of factor models in which latent factors are measured using observed variables and they are influenced by a more fundamental variable. In other words, it is latent variable, but at a higher level. Since absorptive capacity of technology has three components in this work, which can act as indicator of this factor, thus second order factor analysis is used to test measurement model as well components validity of absorptive capacity of technology construct. T coefficients above ±1.96 to ±2.58 are significant at level 0.05, and t coefficients above ±2.58 are significant at level 0.01. As observed in Table 2, all t coefficients of the factors are above 2.58, which suggest all factors influence absorptive capacity of technology at level 0.01. In addition, direction of factor loads and t coefficients is positive in all factors, indicating positive and significant influence of these factors. The table reports fit indexes of measurement model for Figure 2.

Table 2: Factor loads for components of absorptive capacity of technology

No.	Component	Factor Load	T coefficient	R^2
1	Firm's age & size	0.90	5.94	81%
2	Education level	0.89	6.14	79%
3	Prior knowledge related	0.88	6.47	77%
4	Technology transfer	0.83	5.59	69%
5	HR	0.82	5.99	67%

Table 3: Total fit indexes of tested model

Feature	Estimation
Chi-square vs. degrees of freedom x^2 / df	2.15
Root Mean Square Error of Approximation, RMSEA	0.077
Goodness of fit index, GFI	0.98
Adjusted goodness of fit index, AGFI	0.94
comparative fit index, CFI	0.97
Normalized fit index, NFI	0.95
Chi-square vs. degrees of freedom x^2 / df	0.95

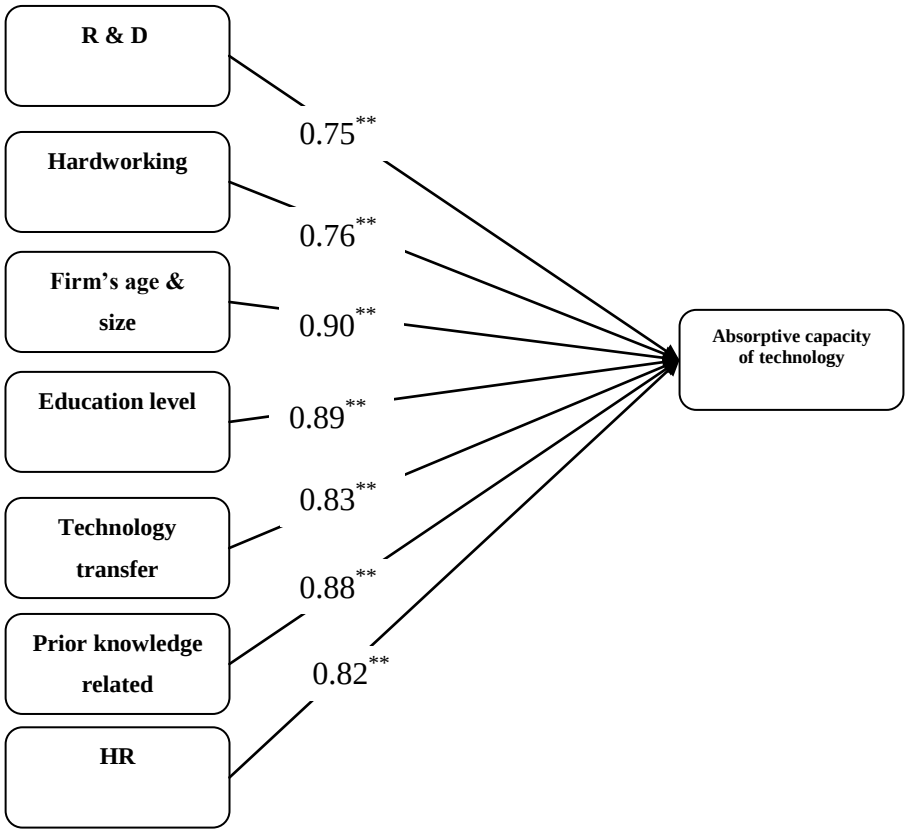

Figure 2. T coefficients for absorptive capacity of technology construct

Testing Research Hypotheses

Research findings indicate that education level factor with factor load 0.89 has positive significant influence on absorptive capacity of technology in automotive industry at level $p < 0.01$. Thus, H1 is supported and education level factor influences absorptive capacity of technology in automotive industry. Hardworking factor with factor load 0.76 has positive significant influence on absorptive capacity of technology in automotive industry at level $p < 0.01$. Thus, H2 is supported and hardworking factor influences absorptive capacity of technology in automotive industry. Research and development factor with factor load 0.75 has positive significant influence on absorptive capacity of technology in automotive industry at level $p < 0.01$. Thus, H3 is supported and research and development factor influences absorptive capacity of technology in automotive industry. Human resource factor with factor load 0.82 has positive significant influence on absorptive capacity of technology in automotive industry at level $p < 0.01$. Thus, H4 is supported and human resource factor influences absorptive capacity of technology in automotive industry. Technology transfer factor with factor load 0.83 has positive significant influence on absorptive capacity of technology in automotive industry at level $p < 0.01$. Thus, H5 is supported and technology transfer factor influences absorptive capacity of technology in automotive industry. Prior knowledge related factor with factor load 0.88 has positive significant influence on absorptive capacity of technology in automotive industry at level $p < 0.01$. Thus, H6 is supported and prior knowledge related factor influences absorptive capacity of technology in automotive industry. Firm's age and size factor with factor load 0.90 has positive significant influence on absorptive capacity of technology in automotive industry at level $p < 0.01$. Thus, H7 is supported and firm's age and size factor influences absorptive capacity of technology in automotive industry.

CONCLUSION

Findings in data descriptive analysis (underlying variables) in indicated 42.3 percent of subjects were females and 57.7 percent were males. Highest frequency is in ages 26 – 30 and lowest frequency is in ages 31 – 35. Most subjects had MA degree and least had associate degree. 28.6 percent of subjects were single and 71.4 percent of them were married. Highest frequency of working experience was 0 – 5 and lowest frequency of working experience was 16 – 20 years. Findings for data inferential analysis indicate:

Findings on the research question identified seven factors as the main influential factors following collecting expert ideas. These factors include: research and development, technology transfer, human resource, hardworking, firm's age and size, prior knowledge related. Using structural equations analysis it was concluded these factors influence Pars Khodro Co. in order to weigh these factors in Pars Khodro Co., structural equations were used, and finally weight significant of the factors is specified as follows:

1. Firm's age and size
2. Education level
3. Prior knowledge related
4. Technology transfer
5. Human resource
6. Hardworking
7. Research and development

Findings on H1 indicate education level factor influences absorptive capacity of technology in automotive industry. Research findings are consistent somehow with findings by Vinding (2000) and Rothwell and Dougson (1991). Vinding (2000) in a paper entitled *Absorptive Capacity & Innovative Performance: A Human Capital Approach* proposed that human resource is considered as the main factor in increasing absorptive capacity. He referred that high educational level, using HR management methods, and communication development leads to increasing absorptive capacity and increasing innovative activities.

Findings on H2 show hardworking factor influences absorptive capacity of technology in automotive industry. Findings in this work are consistent with findings by Huber (1991) and Kim (1998).

Findings on H3 indicate research and development factor influences absorptive capacity of technology in automotive industry. This finding is consistent with finding by Cohen and Levinthal (1990), Veugelers (1997), Vinding (2000), Rocha (1999), and Stock (2001). Finsings on H4 indicate human resource factor influences absorptive capacity of technology in automotive industry. Findings of this work are consistent with findings by Bosch (1999) and Kogut and

Zander (1992). Van-den-Bosch (1999) in his work on absorptive capacity, proposed two factors as influential on absorptive capacity: 1. Organizational forms or states, 2. accumulated capabilities, and indicates how these factors influence absorptive capacity level.

Findings on H5 indicate technology transfer factor influences absorptive capacity of technology in automotive industry. This finding is consistent with finding by Minbaeva (2003), Abu Bakar (2004), Escribano (2008), Liao (2007), and Sazali (2009). Findings on H6 indicate prior knowledge related factor influences absorptive capacity of technology in automotive industry. This finding is consistent with finding by Cohen and Levinthal (1990), Noinaka and Takeuchi (1995), Waalkens (2006), Bosch *et al*. (1999), Fiol (1996), and Lane and Lubatkin (1998). Findings on H7 indicate firm's age and size factor influences absorptive capacity of technology in automotive industry. This finding is consistent with finding by Liao (2003), Sorensen and Stuart (2000), and Lee and Sung (2005). Haji Karimi and Hajipour (2007) provided a paper entitled *Designing Model for Measurement of Knowledge Absorptive Capacity in Pharmaceutical Industries*. Their findings indicate absorptive capacity of knowledge can be stated through elements of environment survey, research and development, knowledge related to staff and communication climate. To this end, environment survey, research and development activities, communication climate, knowledge related to the organization's business can lead to development and improvement of absorptive capacity of knowledge in the organizations. They also argue that absorptive capacity is an effective ground for knowledge creation process, thus it should be improved by increasing investment in research and development, holding workshops and skill training courses.

Studies by Haji Husseini, Rahimi and Masumzadeh (2012) were provided in a paper entitled *Factors Affecting Success of Technology Transfer Projects in Rail industry in Iran*. They maintained that factors influencing effective technology transfer process including suitable absorptive capacity of technology, hardware technology software and infrastructure, labor and responsibility division in technology receiving group considerably affect successful technology transfer. Training human resource and creating necessary skill for technology transfer, division of labor and responsibilities among staffs and training staffs, developing necessary skills for technology transfer, educational courses by transferor and technology localization training are considered as influential.

Bagherzadeh (2011) identified factors affecting technology transfer in the view of managers in the companies active in Screw Compressor in Iran. They identified following factors: management role and economic condition of the country, influence of country's environmental conditions, human resource (expert forces and technical staffs), and importance of research and development in success or failure of technology transfer. Following studying theoretical foundations and proposed models as well as reviewing literature on research variables in the country and abroad and interview with experts on automotive industry, the factors affecting absorptive capacity of technology in automotive industry were proposed as follows: education level, hardworking, research and development, human resource, technology transfer, prior knowledge related, and firm's age and size.

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