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# Technological capabilities assessment in the transformer industry: A case-study of investigating technological capabilities in Iran-Transfo Company

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**Abstract** In this research is presented a method for technological capabilities assessment in a company in transformer industry. Used and discussed criteria in this technique are merely developed to assess technological capabilities in transformer industry. Based on literature, technological capabilities in transformer industry are divided into three main categories: production capability, development and investment capability, and innovation capability. For assessing each of the above mentioned using four technology components as an entry and indicators of different technological capabilities assessment models, and for quantifying different components, it is required to use Atlas technology model. It is required to mention that indicators relating to transformer production industry have been recognized and technological capabilities status has been determined. Finally, it could be concluded that how the level of this company is in terms of production capability, development, and innovation capability. From the conducted studies in the case, some technological capabilities indicators, effective factors in technological capabilities enhancement are drawn and procedures to increase technological capabilities are presented. Finally, problems and obstacles are identified.

**Keyword:** Technological Capability, Technology Assessment, Technology level, Transformer.

## 1 Introduction

Technology, is one of the most important factors in the success of organizations that will be present in the arena of global competition. Regarding technological changes speed in recent decades which follows the flourishing pattern, it has been as quickly that resulted in in-depth gap between developed and developing countries. In order to reduce the technological gap, it demands something above importing technology, learning production procedure and more productivity. Recent studies on newly industrialized countries, consider that the technology changes importance as well as technological capabilities are effective in success of these

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countries. By and large, technological capabilities imply a set of human skills which includes managerial and technical cases. Experts consider the technological capability as an ability to effectively use technological knowledge in order to satisfy needs of an industrial unit. Extant models of technological capability assessment, are almost highly general, and do not focus on main forming components of technological capability of firm. It limits the use of resulting information from extant capability assessments methods in compilation of strategies and policies. Due to this, a search for finding an optimal method compatible with internal factors of an organization is a basic requirement to assess a firm technological capability to develop technology and collect technology development strategy [5]. One of important steps in codification of each plan or strategic decision is to recognize internal environment or detect strengths and weaknesses of internal environment of an organization [1]. In general, it should be observed what capabilities are required for strategic planning regarding an organization high goals and strategies, following that planners were aware of organizations required capability type, they should be aware of these capabilities existence or non-existence in their organization and in case of existence of these capabilities, recognize their extant in existence and optimal level. On the other hand, they must know in which capability are able and disable [7]. Technology is also one of the important strategic variables and it is required to recognize its strengths and weaknesses for organization. If "technological capabilities assessment process" is done for a technology, organization capability in creating that internal research and development technology or transmission technology, development, and exploitation better than that technology (technical knowledge extent, proficient human forces, infrastructures management, and suitable structure, and…) is recognized. If organization in each of above had shortcomings and weaknesses, with regard to capability it could adopt different policies [4]. This study attempts to investigate the current condition of Iran Transfo Company for technology capabilities and also detecting effective factors in assistance to technological capabilities level increase. Every kind of planning and policy-making for technology development requires being aware of current technological capabilities level of company, therefore, capabilities status in different parts of company must be assessed. Whereby managers learn about company's status, could use the extant potentials in their decisions and relieve the bottlenecks. So, in respect of not having background in use of these standards to assess transformer industry technological capabilities and also mangers adaptation to increase capabilities and technology development in this industry, requirement to accomplish such a research to present an appropriate model for technological capabilities level assessment is evident. General goal of the study is technological capabilities enhancement by increasing production capabilities, development and investment, and also innovation capabilities in order to increase competitiveness ability in domestic and foreign markets. The main research question is how to recognize the technological status of Iran Transfo Company, how to present a pattern for technological capability assessment, how to detect difficulties and limitations, and how to provide applicable suggestions and procedures.

## 2 The of technological capabilities assessment

technology is a combination of hardware and software in a range that its combination is variable across the range. However, on economical exchange of resources, it could be said that technology is made of physical tools and technical knowledge. With regard to Atlas technology categorization, four main components of technology could be distinguished from each other as follow. A thing that technology is embedded in it could be called facilities or

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(hardware). A human that is embedded in technology could be called ability or (human ware). A document in which the technology is embedded could be called facts or (information ware). An organization in which technology is embedded could be called framework or (organization ware) [2]. According to Radosevic, technology on the basis of nature has two dimensions. One is a set of information that is readily available. In fact, explicit aspect of technology is addressed in this dimension. In second dimension, the latent and implicit aspect of technology is addressed that is the same firm-specific knowledge of a company which is a constituent of main capabilities of a company or organization. According to these categories, it could be easily understood that complete achievement of technology is not as easy as that without addressing latent and linked aspects with organizations having it be possible [1]. It is important and crucial whether on technology transformation from out of organization into the organization and whether on technology internal capabilities development by technological innovation and could affect many of our activities [11]. It is evident that each technology initially spends a period of fostering and introduction in its life span which in this step, of the proposed ideas, finally one of them would overcome others and will be offered to market. In this level, in fact, a new technology is offered and introduced to market. At first, utilization of technology is developed slowly, and then when it increased rapidly, technology has stepped in its growth level. After that the saturation or maturity level arrives in which a kind of stability is observed, and finally emergence of more developed technology results in decline of prior technology [13]. Technology like other organizational assets and resources such as, human resources, and financial resources requires management [3]. Hence it could be stated that technology management is management of technological assets which in different sources various duties are explained for them. In a general category, technology management includes detecting responsibilities, choice, acquiring, and utilization and support of organization technologies [10]. Technology management is an extensive activity which includes all dimensions of technology such as policy- making, planning, technology transformation and development, research and development, teaching, testing and assessment. Ordering technology activities in a way that the extant technology is used optimally and result in effective attraction of received technology is its goal [9]. On the other hand, how technology received and appropriate use of it to reach to pre-determined goal in the framework of facilities and limitations is called "technology management". Technological capability is a technique in which an organization combines all cases such as skills, individuals learning, education qualifications, imagined technologies in machinery, etc. to perform like an organization (organically). The process comes up with permanent balance among member, efficient flow of information, decision-makings and "synergetic" [9]. In order to compile any strategy, it is required to recognize opportunities, threats, strengths and weak points. Technology capability assessment with investigating technological capabilities level determine our strengths and weak points fields in technology and provide required background to decide for technological capability development. Technology capability assessment is an approach that allows us could recognize and analyze our strengths and weak points and or a special technology [12]. Therefore, it allows us that could analyze the technological gap amount with optimal state, competitors and other assessed technological items. The analysis could highly help us in compilation of technology macroeconomic policies and on acquiring technologies. So, the approach may have many applications in organizations level [2]. The method and standards that are used to assessment technology capability is in direct relationship with assessment goals. Technology capability assessment is frequently carried out with following three goals in which we could use specific methods for each of them to assess technology gap, effective factors creating technological gap, and

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organization ability to remove technological gap [7]. In order to compile appropriate model and questionnaire for technology capability assessment of manufacturers, while considering various models, combination of them are used and native questionnaires to assess technological capabilities are collected. Not many studies on the above fields regarding transformer industry have been done [8]. With regard to this that after evaluating abilities and requirements is launched to choose appropriate growth of technology effect, highly limited studies have been done. In a conducted study on trusted scientific sources about technology level assessment, it was observed that limited researches have been conducted on this field. Jasper under an article, called "maintenance of your own technology", states that company's technology is the most important source that is mostly addressed in audit of company's sources [12].

## 3 Methods

This section introduces the tools and methods of data collection in this research. As well as statistical techniques for analyzing research data in both descriptive and inferential statistics section is explained. Field studies such as observation and interview are used to recognize indicators and criteria of technology components' and technological capabilities. On the other hand, in the study in order to analyze different angles of subject and also to achieve their goals and nature of what the study follows to recognize and analyze, that is technology component assessment and technology capabilities three research methods has been used: Descriptive Research Method (description is recording and analysis of extant context or in other words systematic and continuous description of a special situation of favorite field in a real and concrete way). This method was used to identify literature subject and theoretical basis of research. It is case and field study which is wide investigation of prior and current context or actions or reactions of a social unit or an individual or a group. The method is used to study and examine the extant condition of company's technological capability, determine optimal condition of technology capability, investigate effective factors in technology capability level enhancement and present an approach to increase technological capabilities level. Robert Yen who has written an independent book called "case-study" (1989), in definition of it states: case-study is an experimental explore which utilizes multiple sources and evidences to investigate an extant phenomenon on its real context in a condition that its field is not evident [6]. Case-study is one of qualitative research methods, and regarding that one of main characteristics of qualitative researches is focus on in-depth study of a certain sample of a phenomenon (which is called case). Because of this, sometimes qualitative study is called case-study as well. Although the two mentioned methods are not identical, the present case-study as a professional approach of scientific research, especially as a reaction to understanding of qualitative research limitations has been evolved [8]. Qualitative research deals with data which indicate realities of the case under study in a verbal- video or so (not quantitative or numerical) and analyze them. This kind of research emphasizes the implication which related individuals (participants in research process) have in their minds about the case under study. Correlational or associational research method is an investigation of variations degree of one or more factors because of changes in one or more other factors by calculating coefficient correlation [13]. In correlational research, the main goal is that determine whether there is a relation among two or more quantitative variables or not. If there is a relation, how much is its size and limit? Purpose of studying correlation is to create a relation, and use relations in predictions. Correlational studies assess some of the variables which are thought

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to be related to the problem. This method is used to examine the mutual relationship of technology components' and technological capabilities. In the study, documentary method has been used to collect data that in the method documents (visual and non-visual), statistics and information; Persian and Latin texts were gathered by referring to library, using magazines, specialized journals, internet sources, and, etc. in addition, Field Research Method was used on the basis of using observation and interview obtained data from Field Research Method will include qualitative and quantitative data. Qualitative data resulted from observation, without interruption techniques, photography, and… will be analyzed and quantitative data resulted from questionnaire, interview and … will be tested by statistics methods. It should be noted that interview is the main tool used in the study and related software including SPSS, EXCEL was used in data analysis. Also, it was used to transfer more concrete and evident contents, tables, shapes, curves, maps, and graphic techniques in the study. To collect interview questions variables were determined and then to assess each of them indicators and questions were proposed that form the structure questions of the interview. To answer the questions, questioner refers to respondents and interview with them. Interview was used to determine extant technological capability level of under study organizations and required technology level for production in comparison to the best world interviews. To collect technology capability level indicators in this company, transformer industry experts' knowledge which its illustration has listed in the population and after some recurrence of indicators and information determination, final consensus will be achieved. Population is a set of units which have at least one characteristic in common. Iran Transfo Company which its major product is different kinds of transformers has formed a population of middle and senior managers with bachelors' degree or higher and work experience over seven years as experts. The study is relied on using ideas of all senior managers, supervisors of production sections, and strategic planning of Iran Transfo Company. Variable is what could be changed for its measure and frequently "what that could accept different values (that is, has variance). Therefore, if one thing exists, it will be variable. In fact, they are characteristics which researcher observes, controls, and or manipulates them. Variables could be categorized into two following categories: dependent variable which its variations are influenced by independent variable [5], and independent variable which is a characteristic of physical or social environment which after selection, involvement, or manipulation by researcher will accept some values to observe its influence on other variable [7]. Using combination of technology components of Atlas technology model and categorizing technological capabilities of Westfall following concept is formed which using four technology components as threshold and collecting native indicators is applied to determine condition of these four technology components and finally determine condition of production capability, development capability, investment and innovation capability. Consequently, some approaches are presented to develop technology capabilities. In the study, dependent variable is technology capability development in Iran Transfo Company (production, development, and investment capability, and innovation capability) and independent variable is effective factors in technological capability enhancement level (techno ware, human ware, information ware, and organization ware).

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**Table 1** Dependent and independent variables

| Dependent variable | Independent variable |
|---|---|
| Techno ware | Technological capabilities development in Iran Transfo Company |
| Human ware | |
| Information ware | |
| Organization ware | |

With regard to the study topic which is determination of technology capabilities level status, the study focuses on effective factors investigation on technological capability enhancement level. Parallel with literature review of the research technological capabilities indicators were chosen and used as selected standards in the study in terms of that they are measurable in the level of the firm on transformer industry. These standards were enquired the experts in some analysis items, in the form of questions, and on a Likert. Response options in this scale frequently indicate degree of agreement and disagreement of the respondent on a subject or certain concept whether positive or negative. When scale expressions were scored on the basis of numerical values; and each response score relating to each question was determined; score of each respondent in respect of each expression is determined. Total score of a respondent which is sum of his/her scores in respect of all expressions, is calculated as a wise response of a respondent on subject or desired concept. Then respondents could be differentiated in terms of sum of scores or sum of resulted numerical values. Standards include: hardware, human-ware, information-ware, organization-ware which are assessed by several questions and in a range of 5-point Likert scale. Technological capability assessment has been conducted by adopting from qualitative models and regarding research scale, using production capability standards, investment capability, and innovation capability. As previously noted, these standards in terms of that are assessable in firms' level, were used as selected standards of the study. The standards were asked from managers in firms in the form of some analysis items, questions, and Likert range. Product capability examines the product quality control system, repair and maintenance status and plan, materials planning, production output, capability in removing the encountered problem in production. In order to assess the investment capability, the variable was also, doing civil works and building, selecting the best source for buying technology, machinery selection capability, installation and setting up capability, and innovation capability was investigated by materials replacement capability, interior parts manufacturing capability, final cost reduction, capability in product optimization, capability in production process modification.

In next level, concrete manifestations of technological capability were addressed to recognize and investigate it. For that reason, it was addressed to identify research, development, production, and development plan. To test the variables, each variable was assessed by related standards, and then since all variables were based on distance assessment, using multi-variable Regression Analysis that effect of independent variables indicators (hardware, information ware, human ware, organization ware) on technological capabilities dependent variable indicators (production, investment, and innovation capability) was assessed simultaneously, Pearson correlation coefficient was determined and relationship between two was examined. Regarding Pearson correlation coefficient it is essential that if two variables are measured in interval scale or relative, to determine the relationship between them the Pearson correlation(r) was used.

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# 4 Results

## 4.1 Survey Results Based on Descriptive statistics

According to managers, final result of information ware component based on average calculated score for each of three indicators of information ware component (information update, utilization of information technology tools, informing procedures and data unity) and analysis of data is 3.2 in average. Regarding that this average is considered to be out of moderate, so it could be concluded that this component is in optimal level. According to managers, final result of organization ware component in the company on the basis of indicators relating to organization ware and data analysis is 3.8 in average. Since the average is considered to be out of moderate, so it could be concluded that the component is in middle toward higher. Final results from questions of re-survey, interview, and focused group discussion in hardware component from Iran Transfo managers' viewpoint on the basis of measurement indicators relating to hardware component and the data analysis is 3.48 in average. In order to compare technology components with each other, the THIO chart was used. In addition to this that the chart provides the possibility of four technology components comparison, it shows distance of each component in a possible optimal status. THIO chart of Iran Transfo Company with resulted scores are as Diagram 1.

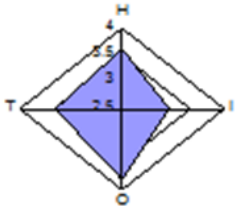


**Diagram 1** Technology component status in Iran Transfo Company

As can be seen in the Radar chart, the organization ware component, O, with score of 3.8 has the highest portion. Hardware and human ware components, H, T, include scores of 3.48, 3.2 respectively. Overall, technology status in comparison to the optimal status, in world level is medium. As the results shows, organization ware component has the more appropriate status in comparison to three other components including: information ware, hardware, and human ware. Conducted studies to upgrade weaker components could improve education system in human ware component, modify processes and extant procedures, and use of management tools in information ware component, and review, improve, and develop Net system (PM) (Machinery and installations, information and communication infrastructures) in hardware component. Regarding organization ware component, customer satisfaction increases and export markets developments are emphasized. According to Westfall model, technological capability assessment is conducted in Iran Transfo Company based on three main indicators. In order to assessment indicators, some questions were used in interviews on each of three technological capability indicators that collected results from technological capability assessment with regard to technological capability indicators average are represented in the following Table 2.

**Table 2** technological capability indicators average

| Number | Title of index | Score |
|---|---|---|
| 1 | Production capability | 3.05 |
| 2 | Development and investment capability | 3.62 |
| 3 | Innovation capability | 2.80 |

In the following, it is presented analyses of technology components status, technological capabilities and strategic results (Diagram 2).

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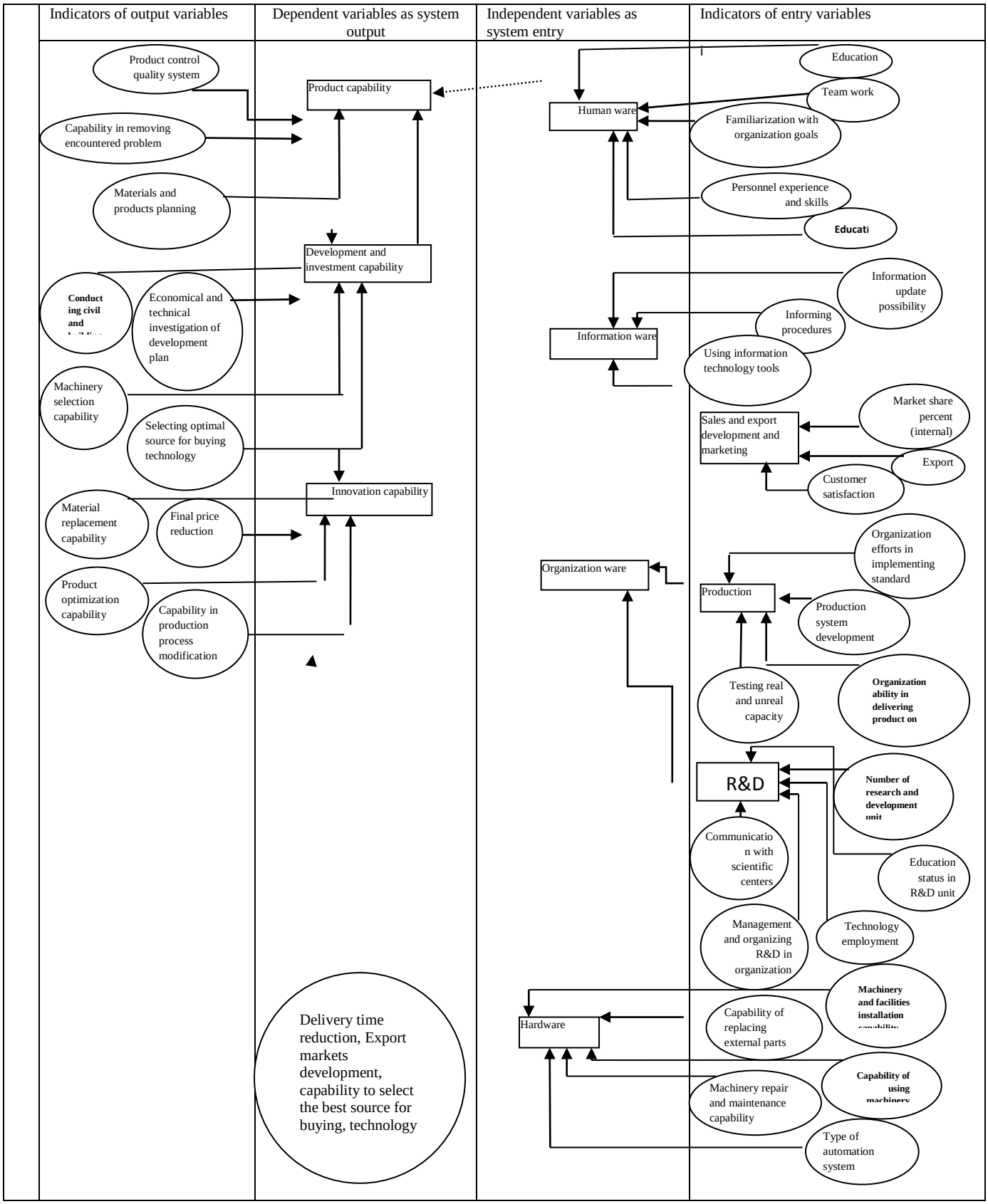


**Diagram 2** Technology capability assessment analytical model

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### 4.2 Inferential Statistics Results

In this section, inferential statistics are conducted to assess validity of proposed hypotheses and consider correlational among independent and dependent variable indicators. Result of correlation with Pearson correlation (r) are shown, if the result of it is lower than 30 percent, it will be a weak relationship, and if it is between 30 to 60 percent, the relationship will be in medium level. If it is over 60 percent, the relationship among variables will be strong. If the result is a negative number, there will not be effective relation among the variables. Furthermore, test statistics has been used to assess the hypotheses. Human ware component affects the technological capabilities level upgrade. Table 3 shows the correlation between education system and technological capabilities which correlation coefficient between two variables is 0.68 and its significance level is 0.02. From the above it could be concluded that $H_1$ is acceptable since Sig is lower than 0.05. So it could be concluded that there is a significant relationship between education and technological capabilities.

**Table 3** Correlation between education system and dependent components (technological capabilities)Friedman test for ranking transfer factors

Correlations

| | | x1 | yy |
|---|---|---|---|
| x1 | Pearson Correlation | 1 | .688 |
| | Sig. (2-tailed) | | 0.02 |
| | N | 5 | 5 |

$X_1$: education yy: Technological capability

A correlation between tenderness to teamwork in Iran Transfo and technological capabilities shows that correlation coefficient between two variables is 0.92 and its significance is 0.02. According to the above results, it could be concluded that $H_1$ is accepted since Sig is lower than 0.05. Therefore, it could be concluded that there is a significant relationship between tenderness to teamwork and technological capabilities (table 4).

**Table 4** Correlation between teamwork and dependent components (technological capabilities)

**Correlations**

| | | x2 | yy |
|---|---|---|---|
| x2 | Pearson Correlation | 1 | .919* |
| | Sig. (2-tailed) | | .028 |
| | N | 5 | 5 |

*. Correlation is significant at the 0.05 level (2-tailed).

$X_2$: tenderness to teamwork yy: technological capability

Table 5 shows the correlation between personnel flexibility and variability in Iran Transfo Company and technological capabilities. Correlation coefficient between two variables is 0.35 and its significance is 0.04. Since Sig is lower than 0.05, it could be concluded that $H_1$ is accepted. Therefore, it could be concluded that there is a significant relationship between flexibility and technological capabilities.

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**Table 5** Correlation between personnel flexibility and dependent components (technological capabilities)

Correlations

| | | x4 | yy |
|---|---|---|---|
| x4 | Pearson Correlation | 1 | .350 |
| | Sig. (2-tailed) | | .048 |
| | N | 5 | 5 |

$X_4$: personnel flexibility yy: technological capabilities

Table 6 displays the correlation between expert human forces capability in Iran Transfo Company and technological capabilities. Correlation between two variables is 0.87 and its significance is 0.05. According to the above results since the Sig is 0.05, it could be concluded that $H_1$ is accepted. Therefore, it could be concluded that there is a significant relationship between expert human forces capability and technological capabilities.

**Table 6** Correlation between expert human forces capability and dependent components (technological capabilities)

Correlations

| | | x5 | yy |
|---|---|---|---|
| x5 | Pearson Correlation | 1 | .875 |
| | Sig. (2-tailed) | | .050 |
| | N | 5 | 5 |

$X_5$: expert human forces capability yy: technological capability

Investigation of information update indicator effect and technological capabilities shows that correlation between information update in Iran Transfo Company and technological capabilities has correlation coefficient of 0.35 between two variables and its significance is 0.03. Since Sig is lower than 0.05, it could be concluded that $H_1$ is accepted. Therefore, it could be concluded that there is a significant relationship between information update and technological capabilities (Table 7).

**Table 7** Correlation between information update and dependent components (technological capabilities)

Correlations

| | | x8 | yy |
|---|---|---|---|
| x8 | Pearson Correlation | 1 | 0.352 |
| | Sig. (2-tailed) | | 0.03 |
| | N | 5 | 5 |

$X_8$: Information update yy: technological capability

Table 8 shows the correlation between technology tools utilization in Iran Transfo Company and technological capabilities. Correlation coefficient between two variables is 0.40 and its significance is 0.45. Since Sig is lower than 0.0, it could be concluded that $H_1$ is accepted.

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Therefore, it could be concluded that there is a significant relationship between technology tools utilization and technological capabilities.

**Table 8** Correlation between technology tools utilization and dependent components (technological capabilities)

Correlations

| | | x9 | yy |
|---|---|---|---|
| x9 | Pearson Correlation | 1 | .408 |
| | Sig. (2-tailed) | | .045 |
| | N | 5 | 5 |

$X_9$: Technology tools utilization yy: Technological capabilities

Table 9 shows the correlation between information integrity in Iran Transfo Company and technological capabilities. Correlation coefficient between two variables is 0.68 and its significance is 0.05. Since Sig equals to 0.05, it could be concluded that $H_1$ is accepted. Therefore, it could be concluded that there is a significant relationship between information integrity and technological capabilities.

**Table 9** Correlation between information integrity and dependent components (technological capabilities)

**Correlations**

| | | x10 | yy |
|---|---|---|---|
| x10 | Pearson Correlation | 1 | .869 |
| | Sig. (2-tailed) | | .050 |
| | N | 5 | 5 |

$X_{10}$: Information integrity yy: Technological capability

Organization ware component affects the technological capabilities level upgrade.

Investigating the customer satisfaction indicator effect and technological capabilities in table 10 shows the correlation between customer satisfaction in Iran Transfo Company and technological capabilities. Correlation coefficient is 0.40 between two variables and its significance is 0.49. Since Sig is higher than 0.05, it could be concluded that $H_0$ is accepted. Therefore, it could be concluded that there is not a significant relationship between customer satisfaction and technological capabilities.

**Table 10** Correlation between customer satisfaction and dependent components (technological capabilities)

Correlations

| | | x12 | yy |
|---|---|---|---|
| x12 | Pearson Correlation | 1 | .408 |
| | Sig. (2-tailed) | | .495 |
| | N | 5 | 5 |

$X_{12}$: Customer satisfaction yy: technological capability

Table 11 shows the correlation between implementing environmental standards in Iran Transfo Company and technological capabilities. Correlation coefficient is zero between two

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variables and its significance is 1. Since the Sig is higher than 0.05, it could be concluded that $H_0$ is accepted. Therefore, it could be concluded that there is not a significant relationship between implementing environmental standards and technological capabilities.

**Table 11** Correlation between environmental standards implementation and dependent components (technological capabilities)

**Correlations**

| | | x16 | yy |
|---|---|---|---|
| x16 | Pearson Correlation | 1 | .000 |
| | Sig. (2-tailed) | | 1.000 |
| | N | 5 | 5 |

$X_{16}$: environmental standards implementation yy: technological capability

Table 12 shows the correlation between in Iran Transfo Company and technological capabilities. Correlation coefficient is -0.87 between two variables and its significance is 0.52. Since the Sig is higher than 0.05, it could be concluded that $H_0$ is accepted. Therefore, it could be concluded that there is not a significant relationship between flexibility in production and operation and technological capabilities.

**Table 12** Correlation between flexibility in production and operation and dependent components (technological capabilities)

Correlations

| | | x19 | yy |
|---|---|---|---|
| x19 | Pearson Correlation | 1 | -.875 |
| | Sig. (2-tailed) | | 0.52 |
| | N | 5 | 5 |

$X_{19}$: Flexibility in production and operation yy: technological capability

Table 13 shows the correlation between on time delivery of product in Iran Transfo Company and technological capabilities. Correlation coefficient is 0.27 between two variables and its significance is 0.5. Since the Sig is higher than 0.05, it could be concluded that $H_0$ is accepted. Therefore, it could be concluded that there is not a significant relationship between on time delivery of product and technological capabilities.

**Table 13** Correlation between time delivery of product and dependent components (technological capabilities)

Correlations

| | | x20 | yy |
|---|---|---|---|
| x20 | Pearson Correlation | 1 | .275 |
| | Sig. (2-tailed) | | 0.52 |
| | N | 5 | 5 |

$X_{20}$: On time delivery of product yy: Technological capability

Table 14 shows the correlation between the ability to set up machinery in Iran Transfo Company and technological capabilities. Correlation coefficient is 0.40 between two variables

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and its significance is 0.045. Since the Sig is lower than 0.05, it could be concluded that $H_1$ is accepted. Therefore, it could be concluded that there is a significant relationship between setting up machinery and technological capabilities.

**Table 14** Correlation between the ability to set up machinery and dependent components (technological capabilities)

**Correlations**

| | | x33 | yy |
|---|---|---|---|
| x33 | Pearson Correlation | 1 | .408 |
| | Sig. (2-tailed) | | .045 |
| | N | 5 | 5 |

$X_{33}$: Ability to set up machinery yy: Technological capability

Table 15 shows the correlation between repair and maintenance in Iran Transfo Company and technological capabilities. Correlation coefficient is 0.37 between two variables and its significance is 0.34. Since the Sig is lower than 0.05, it could be concluded that $H_1$ is accepted. Therefore, it could be concluded that there is a significant relationship between repair and maintenance and technological capabilities.

**Table 15** Correlation between repair and maintenance and dependent components (technological capabilities)

Correlations

| | | x34 | yy |
|---|---|---|---|
| x34 | Pearson Correlation | 1 | .375 |
| | Sig. (2-tailed) | | .034 |
| | N | 5 | 5 |

$X_{34}$: Ability of repair and maintenance yy: Technological capability

Tables 16 is shown the correlation between used automation in Iran Transfo Company and technological capabilities. Correlation coefficient is 0.37 between two variables and its significance is 0.05. Since the Sig is 0.05, it could be concluded that $H_1$ is accepted. Therefore, it could be concluded that there is a significant relationship between used automation and technological capabilities.

**Table 16** Correlation between used automation and dependent components (technological capabilities)

Correlations

| | | x38 | yy |
|---|---|---|---|
| x38 | Pearson Correlation | 1 | .375 |
| | Sig. (2-tailed) | | .050 |
| | N | 5 | 5 |

$X_{38}$: Used automation $y_{141}$: Production capability
$y_{252}$: Development and investment capability $y_{353}$: Innovation capability

According to the results effective factors in production capability level upgrade, that is, expert human forces capability indicators, ability of repair and maintenance, ability to set up

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machinery, flexibility and variability, have the highest to lowest effect on each of technological capabilities components respectively. Effective factors on development and investment capability level upgrade on the basis of importance include utilization of information technology tools, education, expert human forces capability, ability of repair and maintenance. Effective factors on innovation capability level upgrade include personnel flexibility and variability, ability to set up machinery, education, tenderness to teamwork, information integrity.

## 5 Discussion and conclusion

Regarding that the main issue of this study is to determine the technological capabilities level (case-study of Iran Transfo Company), following results of the study shows that total technology level in Iran Transfo Company is in average level. Comparing technology components in Iran Transfo Company showed that organization ware component has better status. Investigation of each of four technology components in Iran Transfo Company shows that in comparison to other components the highest amount has been allocated to organization ware, and then human ware and hardware components have been placed. Among the four components, information ware is the weakest component. Considering extant weaknesses of technology components in Iran Transfo Company on the whole following are: failure to use appropriate technology transmission mechanism, high price of product, high time of product delivery, low rate of export, lack of unified system of organization resources planning, and need to reload the preventive repair system, lack of required trainings for major jobs (which directly affect the production) lack of internal instructors to train R&D experts. Technological capabilities in Iran Transfo Company have been placed in average level. On the other hand, basic and main weakness of transformer industry is in innovation technology. According to the managers, failure to use appropriate technology transmission methods could be the maximum weakness in innovation capability in Iran Transfo Company. Regarding that 85% of technology transmission is in the form of machinery and facilities, therefore, the company must more address to technology transmission methods. According to the predetermined hypotheses for investigating effective factors on technological capabilities level upgrade, following results were obtained:

- Human ware influences on technological capabilities level.
- Information ware influences on technological capabilities level.
- Hardware influences on technological capabilities level.

- Based on results, the hypothesis "organization ware influences on technological capabilities level" is rejected. According to the relationship of all basic factors with each other and conducting regression, it could be concluded that in Iran Transfo Company the organization efforts to implement environmental standards could be referred as the most effective factor on production capability upgrade. In addition, customer satisfaction will have the highest relationship as the most effective factor on development and investment capability. Effective factor on innovation capability upgrade is the personnel flexibility and variability. These cases illustrate that the most effective factors on technological capabilities upgrade in Iran Transfo Company are use of environmental standards, customer satisfaction, and personnel flexibility and variability. In addition to variables relationship, and with regard to extant information, the reason for this is that transformer industry is not regarded as polluting industry and its current products are manufactured in accordance with international standards. Regarding information and evidences customer satisfaction of products and services are high

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in the company. Furthermore, due to high cost of customer attraction, therefore, the most of company's effort must be based on that place customer satisfaction in optimal level. Since number of young and educated workforce is high, according to managers the flexibility and variability is acceptable level.

## 6 Suggestions for future researchers

Based on the study findings, following axes are suggested to recreate human ware dimension: review and development of personnel performance assessment system, and planning for on the job training to increase human forces skills and personnel's technical capability upgrade (in the welding professional training workshop, in research and development of expert human forces training). According to the findings to improve information ware component, it is required to enhance information systems and it is prescribed to try parallel with use of modern methods in management information system, supply chain management, enterprise resource planning, knowledge planning, calculation software, efficient designing. In order to keep technical information as technical knowledge development, a database is created in production processes. Based on findings of study, following axes are suggested to develop organization ware component: set up a technology management system under research and development unit, in-depth studies for acquiring appropriate technologies, use of high technologies transmission mechanisms to manufacture transformer, enhancement of relationship among the company, university and research centers. In order to develop hardware component on the basis of study findings the planning improvement, preventive maintenance, persuasion, encouragement, and training on the field of tendency to use of mechanized systems and automation.

For further research, it is suggested that technology transmission methods to be studied to develop technology in Iran Transfo Company. In addition, it is suggested to study establishment of technology management system in Iran Transfo Company following that all companies which have in common products. Also, further researches could investigate the technological capabilities status in similar companies in transformer industry and compare their results with the present study.

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