



The Relationship between Chaos Theory and Technology Transfer in the Detergent Industry

Case Study: Condor Company

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ABSTRACT

The present article examines the relationship between chaos theory and technology transfer in the detergent industry. Due to Nawaz Sharif's technology transfer model, technology transfer dimensions include hardware, software, Human ware and orgaware and chaos components involve the butterfly effect, dynamic adaptation, self-similarity and strange attractions. The study is an applied research in terms of objective, Correlation in terms of the nature and descriptive research in terms of the method. The study sample consists of 30 managers of Condor Company who are directly related to the technology transfer that all of them were selected as sample members. The questionnaire was used to collect data. The Questionnaires were distributed between the sample members with the return rate of 80% and analyzed using the Smart PLS software. The results of the structural equation model show that there is a bidirectional relationship between technology transfer and all elements of chaos theory.

Keywords Chaos Theory; Technology Transfer; Condor Company.

INTRODUCTION

Technological advances enhance the efficiency of the other elements involved in the production and development process and highlighted its own role in this process. In other words, technology is the most critical component of commercial, industrial and service organizations and its role and importance increases over time. A group of economics scholars called technology as development motor. Today, the subject of planning and preparation of technical programs have been proposed at an extensive level. One of the most important issues in today's complex and turbulent environments is rapid identification of opportunities and development of new products and transferring technology. Since decisions are made without complete and clear information of Chaotic environment, therefore planning must be concentrated on the options of "how to act" and the options of "what should be done" must be clear as much as possible. Therefore, the transfer of technology must be proactive not reactive. In response to the complex and chaotic environments that are increasingly becoming complex and chaotic, proactive companies try to manipulate and change some of the determinant factors in the environment. Since the

competitors copy the reaction easily to follow the customer requests, therefore, the technology transfer should create events.

Chaos theory and its findings will strongly influence our attitudes toward management practices, leadership and technology, in a way that traditional authoritarian leadership has turned to the contingency leadership. The present study examines the relationship between chaos theory and the technology transfer in the Detergent Company of Condor.

THEORETICAL FRAMEWORK

Chaos Theory

Chaos theory or order in disorder is of the theories that phase-out previous management theories include scientific management, human relations movement and etc. this theory has 4 main components as follows:

- The Butterfly Effect
- Dynamic adaptation
- Self-Similarity
- Strange attraction

The Butterfly Effect

The Butterfly Effect is a new subject in management science but this thought has existed among ancient

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people so that the Butterfly Effect has been expressed in a local Chinese song as follows:

“For the want of a nail the shoe was lost, For the want of a shoe the horse was lost, For the want of a horse the rider was lost, For the want of a rider the battle was lost, For the want of a battle the kingdom was lost, And all for the want of a horseshoe-nail.”

Dynamic adaptation

Morgan knows the self-regulation feature as these four principles:

- First, the system must be able to feel and understand the environment and absorb information from that.
- Second, the system must be able to communicate between the data and its operations.
- Third, the system should be aware of deviations.
- Fourth, has the ability to corrective actions to solve problems.

When these four principles is met, the relationship between the system and environment creates and system become self-regulating and indicates a kind of intelligence in dealing with events (Alvani, 2009).

Self-similarity

This feature is recognizable in the leaves, a snowflake, von Koch curve (through frequent replacement of each segment followed by four segments) and holograph effect. Holographic effect or self-similarity can be used in organizing new organizations that each of their units is able to perform organizational tasks independently (Alvani, 2009).

Strange attraction

The wider the prospect and horizon of view is, it is more possible to find strange attraction and the predictive power is more. Finding strange attractions by management is an art. Regular patterns of crisis will not get in short periods. From the standpoint of chaos theory, complex systems merely have chaotic Appearance and therefore they seem irregular and random, but may be subject to a certain flow and a specific mathematical formula (Moshiri, 2002).

Butterfly effect and its impact on management

Based on this feature, a small change in the initial conditions could make basic changes in the results. For example, an organization that is able to use a key point like people' willingness and call them to participate in its activities, is able to fulfill large movements using this lever.

According to the butterfly effect, the efficient managers are people who can recognize the production indicators and use it timely and accurate like a particle that creates energy (website of management theory).

Dynamic adaptation feature and its impact on the management

Adaptation with chaotic environment needs flexible organizations and flexible expertise and

this is a basic principle in today's organizations. In establishing the new organizations, each component must have relationship with the other components while can perform its tasks independently so that there is a dynamic and synergistic relationship among them. In addition there must be a similar attitude among components (website of management theory).

Self-similarity feature and its impact on management

This property can be used to organize new organizations that each unit of them is designed to perform its tasks independently. This can causes some kind of unity in members' behaviors so that all members consider a unit direction and purpose (website of management theory).

Strange attraction Feature and its impact on management

Big Changes, erratic behaviors, unpredictable changes, critical movements, all of them will lead to patterns that finding it is the art of management so that some kind of forecasting can be possible using it.

These attractions allow administrators to find patterns that regulate disorders and form chaos in a regular format. Future management needs to find a strange attraction to reveal the final order (website of management theory).

Technology transfer

Technology is as the knowledge, products, processes, tools, methods and systems that are used to create goods or services. Technology transfer can be defined as transmission of intellectual-technological assets such as skills, knowledge, equipment and manufacturing methods from the resource to the other location, through the common or law methods. Strengthening the production and the establishment of strong and dynamic economy requires the development and deepening of industrialization that the technology plays a fundamental role in this arena. Technology transferring takes place in two types:

- Vertical transmission

The vertical transmission or transferring of research and development, technical information and findings of the applied research transfer to the development and design stages of and then enters to the production process through the commercialization process of technology.

- Horizontal transmission

In horizontal transmission, the technology transfers from one level of competence to the other level. In this case, the higher the level of the receiver technology,

technology transfer costs are reduced and absorbed more efficiently.

According to Barney, a firm can experience the competitive advantage when its activities create economic value in the industry or market and a small number of firms are engaged in similar activities. Barney relates competitive advantage to the firm performance

and says that a firm can obtain the performance higher than normal when creates more worth than the expected value of the resources (Barney, 2002).

Technology transfer means the export of certain technology agents from developed countries to developing countries, So that developing countries can build new production facilities and mobilize or expand their existing facilities (Akhavan,2000).

Technology transfer is the required knowledge to design and produce products or services that an organization possesses. Technology may be used in the machine or the products or services (Chisa, 2001).

CONDOR COMPANY

Condor Company (Limited) is located on a land with 20 hectares in 10th km of Semnan- Mashhad Road in Eastern Industrial town. The company were established in 1998 with the aim of producing detergents such as washing powder, soap, shampoo, etc.

Condor Company was able to produce annually 40,000 tons of powder per year at the beginning of establishment, but with the implementation of development plans, annual production capability raised to 85,000 tons of powder per year.

At the beginning of the establishment of Condor company, had been only created for 400 jobs but after 10 years, more than 600 people are employed at the company. The major markets of the Condor company are foreign markets and its products are exported to Central Asian countries such as Turkmenistan, Kyrgyzstan, Tajikistan and Iraq etc and also part of the company's products are offered in local markets. Condor company supply detergents with the Punel, A.B.C, Banoo, Aaj, clothes, brands in the packages of 150, 300 and 480 grams in the domestic consumer markets. Its export products has the brands called ARTA, ABC, Banoo etc. (Condor Company, 2014).

RESEARCH BACKGROUND

- Talebi (2013) in a study entitled "the role of technology transfer in performance improvement, case study: the food industry in the industrial cities of Khorasan Razavi" said that Technology is as the symbol of wisdom in industrial development and the main source of enhancing the competitiveness of enterprises and thus the competitiveness of the economy. Thus technology-based industrial development, is the main strategy to achieve top rankings in the region and the world economy.

- Karimi dastjerdi et al (2010), in a research entitled "the impact of technology transfer on the competitive performance of firms: case study of Iranian manufacturer of auto parts L 90, stated that the development of the capabilities of technology is one of the effective method in improving the competitiveness of firms. Appropriate transfer of technology helps businesses strengthen their competitive position in the industry in a shorter time than developing technology within organization. The success of technology transfer projects in firms can be assessed based on various criteria such as improving competitive performance through technology transfer. This study has been conducted to assess the impact of the technology transfer of L90production on competitive performance of car parts makers using structural equation modeling. According to research, technology transfer has had a direct effect on the competitive performance of active companies in the project of L90 production and has helped to increase the quality and reduce production costs and on the other hand, in the process of technology transfer, firms are more concentrated on the the hardware and software dimensions of technology (Karimi dastjerdi et al., 2010).

- Amir Behdad Salami (2002), has addressed the presence of the chaos process in the stock index returns in Tehran. He utilized the daily data on this indicator since 05.01.1375 to 09.14.1380. using Lyapunov and Antropikolmogrov's BDS tests, he could prove a high degree of confidence existence in this series (Rostami et al., 2011).

- Cetindamar et al (2009), in their research, stated that during the last two decades, technology development, especially new technologies has been an important factor in integration of markets and the globalization process. Technology in the economic sense is a product based on knowledge, research and development, can be traded on the market and has the specific characteristics of a product whose price is determined by the interaction of supply and demand. Technological capabilities that are the basis of competitiveness of the world-class enterprises, has two aspects of production technology and technology production. Getting ability in research and development is a key element for the development and dissemination of technology and reaching technology maturity (Sdyndamar, 2009).

- Yousef Pour, Esfahani and Nojoumi (2007), using BDS, Lyapunov function and fast returns, investigated the chaoticity at some of the Tehran stock exchange from March 2000 to September 2006. Their Sample included the final price of the Iran Khodro company with 1390 observations, Kaf company with 1275 observations, Pars Oil Company with 1130 observations, Razi pharmaceutical company with 1189 observations and Tehran Cement with 1315. the investigated stocks were not chaotic, but there was the evidence of nonlinearity in them (Rostami et al., 2011).

- Nawaz Sharif and Escap (2001) view technology consisting of 4 domains: hardware, software, Human, organizing and management. To assess the functional aspects, they selected the Garvin's research model at first and then through interviews with teachers and administrators in Food industry, they concluded that they must adopt the quality dimension from the Garvin's model, and other aspects like cost, flexibility and timely delivery and services using the table presented in literature, accordingly, five dimensions have been offered in the theoretical framework. The needed Data to confirm or reject these questions, were collected using a closed questionnaire with 20 five-option questions and the technology dimensions has been adopted from Nawaz Sharif's model and using 9 Questions due to the less emphasis we applied to the technology dimensions. Because the research variables are interval, the Kolmogorov-Smirnov test was used to evaluate the Normality of data distribution. After securing the normal distribution of the data, the Wilcoxon and paired T-test were used (Talebi, 2013).

- According to Hampson (1995) and Narayanan (1994) research, technology transfer causes improving the competitive performance of organizations. The research shows a strong relationship between the acquisition of technology (including transferred technology from abroad and internally developed technology) and competitive priorities (Karimi dastjerdi *et al.*, 1389).

- Prahalad and Hamel (1994), in their research, highlighted the importance of concentrating technology dimensions to develop key competencies and consequently increase the competitive advantage. The researchers view key competencies as a rug that organizational technology and employee skills have likened as its warp and woof (Prahalad, 1994).

Summarizing the theoretical framework

Nawaz Sharif (1995) has classified the technology dimensions that the firms should consider to achieve competitive position, in four categories, which are:

- Hardware
- Software
- Humanware
- Orgaware (Sharif, 1995).

In the present study, these four components will be used as technology transfer dimensions. according to a research articles entitled "marketing mix model for complex and turbulent business environment" (Hosseini *et al.*, 2011), the elements of order in chaos include:

- The Butterfly Effect
- Dynamic adaptation
- Self-similarity
- Strange attraction

that are used as components of chaos theory in recent study.

Accordingly, after studying theoretical foundations and models

As well as the background of the research about the variables within and outside the country using the mentioned models, the theoretical framework of the study were developed, as shown in the figure below. The relationship between each of the variables is listed.

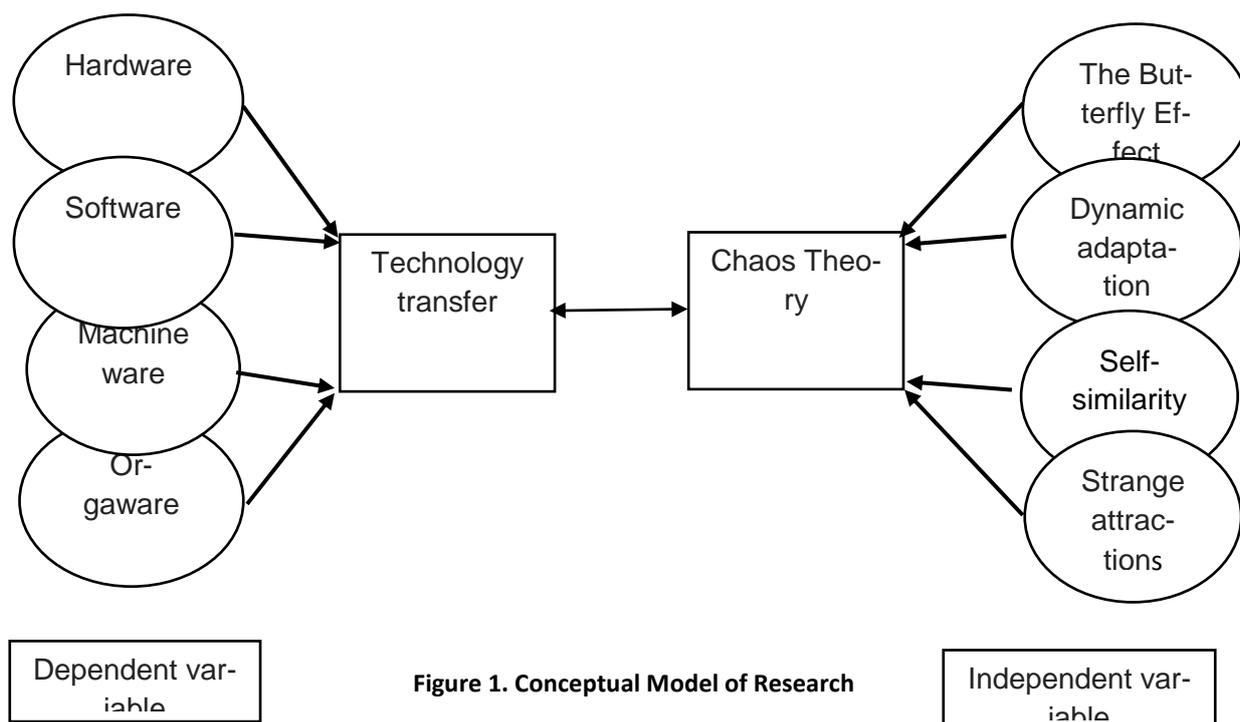


Figure 1. Conceptual Model of Research

RESEARCH PURPOSES

The main objective

- The relationship between chaos theory and technology transfer

Minor goals

- The relationship between the Butterfly Effect and technology transfer
- The relationship between Dynamic adaptation and technology transfer
- The relationship between self-similarity and technology transfer
- The relationship between strange attractions and technology transfer

ORIGINALITY/INNOVATIVENESS OF RESEARCH TOPIC

Based on the conducted research in domestic journals and conferences and master's and doctoral theses in the field of technology management, it was found that the chaos and the technology transfer is a neglected subject among the researchers of our country.

The Selection of subject in this research has been innovative and creative and it was performed after investigation by the researcher. Chaos theory has less background than the technology transfer. No previous research has explored the impact of turbulence on technology transfer.

RESEARCH METHODOLOGY

This study is an applied research in terms of purpose of a correlation research In terms of nature, and a descriptive research in terms of the method. The study sample consists of 30 executives of Condor Company who are directly related to the technology transfer. Due to the low number of research community, all of them were selected as members of the sample. Researcher-made questionnaire was used to collect data. The questionnaire distributed among the sample members with the return rate of 80% and analyzed using the Smart PLS software.

DATA ANALYSIS

Central and dispersion measures and distribution of the variables have been indicated in the table below.

Table1. Central and dispersion measures and distribution of variables (research data)

Kurtosis	Skewness	Variance	Standard deviation	med	Average	variables
0/44	0/26	0/15	0/39	3/19	3/16	Technology transfer
-0/45	-0/15	0/37	0/61	3/25	3/17	human ware
0/12	-0/35	0/48	0/69	3/00	3/07	software
-0/26	0/40	0/86	0/93	3/00	2/80	hardware
-0/25	-0/18	0/42	0/65	3/33	3/12	orgaware
-0/61	0/05	0/21	0/46	3/00	2/97	Chaos Theory
-0/80	0/24	0/46	0/68	3/00	2/82	The Butterfly Effect
-0/37	-0/35	0/37	0/61	3/00	3/12	Dynamic adaptation
-0/37	-0/15	0/35	0/59	3/00	3/07	self-similarity
-0/15	0/03	0/35	0/59	3/00	2/86	strange attraction

According to Table 1, the technology transfer variable has the highest mean (3.16) between the two variables of the study, and Chaos Theory variable has the least mean of (2.97). Also among the minor objectives of the research, the humanware has the highest mean (3/17) and the hardware has the least mean (2.8).

Also, the dispersion of hardware variable data is more according to a higher standard deviation of (0.93). Considering the coefficients of skewness, most of the research variables are skewed to the left (negative coefficient of skewness). Other variables are slightly different than the normal distribution. Most variables has negative kurtosis factor which represents the shorter distribution (more dispersion) than the normal distribution.

Kolmogorov-Smirnov test

This test investigates the normality of data.

According to the table of Kolmogorov – Smirnov test, if the significance level for all of the variables is greater than the test level (0.05), the data distribution is normal. The results of this test are shown in Table 2.

Table 2. the significance level of Kolmogorov - Smirnov test of indicators

Test result	Significance level	test statistic Value	variables
confirmed	0/873	0/593	Technology transfer
confirmed	0/144	1/15	humanware
confirmed	0/129	1/17	Software
rejected	0/001	1/90	Hardware
rejected	0/031	1/44	orgaware
confirmed	0/944	0/527	Chaos Theory
rejected	0/000	2/30	The Butterfly Effect
rejected	0/027	1/47	Dynamic adaptation
rejected	0/024	1/49	self-similarity
rejected	0/000	2/91	strange attraction

Testing research hypotheses

Each research hypothesis has been analyzed using the partial least squares technique. Finally, the general model of the research has been tested using the same technique. Several points are considerable in the partial least squares technique:

1. The strength of the relationship between factor (latent variables) and visible variables is shown using factor loading. Factor loading is a value between zero and one. If the factor loadings are less than 0.3, the relationship is weak and can be ignored. Factor loading between 3.0 and 6.0 is acceptable and if it is greater than 6.0, it is very desirable.
2. When the correlations between variables were identified, the significant test should be done. To investigate significance of observed correlations, the boot-

strapping methods or transverse Jackknife incision can be used. In this study, the bootstrapping method is used that results in t-statistic. In the error level of 5%, if the bootstrapping t-value is greater than 1.96, the observed correlations are significant.

In general, the relationships between variables in partial least squares technique is classified into two categories:

1. The external model: the external model is equivalent to measurement model (confirmatory factor analysis) in structural equations and indicates the relationships between the latent and observed variables.
2. The internal model: the internal model is equivalent to structural model (path analysis) in structural equations and studies the relationships between the latent variables (Davari and Rezazadeh, 1392).

Table 3. External partial least squares model

chaos	Technology transfer	variables
	0/83	Hardware
	0/72	Software
	0/77	The software
	0/63	Human Software
0/89		The Butterfly Effect
0/85		Dynamic adaptation
0/55		self-similarity
0/75		strange attraction

Table 4. Partial least squares bootstrapping value

chaos	Technology transfer	Variables
	31/91	Hardware
	12/52	Software
	14/35	The software
	7/44	Human Software
48/42		The Butterfly Effect
33/63		Dynamic adaptation
6/78		self-similarity
14/97		strange attraction

The observed Factor loading in all cases is greater than 0.3 which shows a good correlation between observable variables with their corresponding latent variables.

than the critical value of 1.96 which shows that the correlation between observable variables with their corresponding latent variables is significant.

Also, based on the results of the measurement model, the bootstrapping value (t-value) in all cases is greater

Table 5. Results of structural equation modeling

result	T	Path coefficient	path		row
Confirmed	6/92	0/52	Chaos Theory	Technology transfer	1
Confirmed	6/72	0/53	The Butterfly Effect	Technology transfer	3
Confirmed	6/62	0/48	Dynamic adaptation	Technology transfer	4
Confirmed	5/84	0/46	self-similarity	Technology transfer	5
Confirmed	6/45	0/45	strange attraction	Technology transfer	6

Friedman test

Table 6. Ranking of technology transfer dimensions

Priority	Average ranks	Technology transfer dimensions	row
Second	2/70	Orgaware	1
First	2/72	Humanware	2
Fourth	2/06	Hardware	3
Third	2/52	Software	4

Table 7. Significance level of Friedman test

Calculated values	Statistical indicators	row
24	Count	1
13/526	Chi square	2
3	Degree of freedom	3
0/004	Significance level	4

Table 8. Ranking Chaos dimensions

Priority	Average rank	Chaos Theory	row
Fourth	2/18	The Butterfly Effect	1
First	2/81	Dynamic adaptation	2
Second	2/74	Self-similarity	3
Third	2/27	Strange attractions	

Table 9. Significance level of Friedman test

calculated values	Statistical indicators	Row
24	Count	1
18/281	Chi square	2
3	Degree of freedom	3
0/000	Significance level	4

CONCLUSION

This paper examined the relationship between chaos theory and technology transfer in the detergent industry through analyzing the relationships between 4 components of technology transfer and 4 components of chaos theory. Using the Smart PLS software, we suggested that after utilization of Kolmogorov-Smirnov test, the variables of technology transfer, human, software and chaos theory have normally distributed, and other variables have non-normal distribution. by testing hypotheses we concluded that the observed value of loading factor in all cases is greater than 0.3 which shows a good correlation between the observed variables with their relevant latent variables and based on the results of the Bootstrapping measuring model, correlations between observable variables and latent variables were significant. The results of the structural equation model show a bidirectional relationship between technology transfer and all elements of chaos theory.

In the Condor Company, utilizing the Friedman test, the human, organization, software and hardware in technology transfer and dynamic adaptation, self-similarity, strange attractions and butterfly effect in chaos theory have been obtained respectively as the preferred dimensions.

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