

# Exploring Chaotic Performance in Projects and its Relationship with Knowledge Creation Process

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## ABSTRACT

In this study the researcher is focusing on the performance of the project. During the life cycle of projects managers are striving to forecast the future performance of the project according to the historical patterns of performance. Irregular performance and randomness are representing chaotic performance periods in project's life. The study proposes five propositions. The first proposition is that Manager have different conscious perceptions about accepted levels of order and chaos in their project performance. The second proposition is that Knowledge Creation Process has different characteristics in chaotic perceived projects and order perceived projects. The third proposition is that managers have different prioritization of knowledge assets from which they create new knowledge for chaotic performance projects. The fourth proposition is that Sources of knowledge creation differ according to the context of project performance. The fifth proposition is that Assets used for knowledge creation during chaotic performance periods differ according to managers' tendency to innovate. This study is a qualitative analysis of secondary data that comes from literature review and primary data that comes from interviews with experts and project managers. The researcher investigated four styles of knowledge creation during chaotic performance periods; experiential knowledge creation style, innovative knowledge creation style, precautions and risk minimization knowledge creation style, and specialty based knowledge creation style. Conclusions and recommendations are provided to project managers on which knowledge assets are leading to innovative knowledge creation.

## CCS Concepts

• Social and professional topics → Professional topics → Management of computing and information systems

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## Keywords

Knowledge creation styles, chaos and order, project performance

## 1. INTRODUCTION

The phenomenon of how project companies can reconcile order (efficiency, control, clarity) and chaos (creativity, trust, uncertainty, ambiguity) (Geraldi, 2009) is important to study. Geraldi found that multi project firms really have both and need both chaos and order; however she found that organizations tend to avoid the coexistence of order and chaos. The researcher thinks that Geraldi linked between reducing uncertainty and reducing flexibility in project organizations. In other words she thought that if we were more flexible then we are less certain about the results and it seems that it is a control problem. More order includes less flexibility and more chaos includes more uncertainty. The results of her research recommended having bureaucratization of chaos, and avoiding the excessive flexibility that may lead to re-work and unnecessary chaos. The researcher thinks that the word excessive flexibility has to become more specific. There has to be a goal that determines the path of the projects which may affect the level of performance. Also the bureaucratization of chaos from the researcher's point of view is how to control chaotic situations. Controlling means bringing chaos to order and designing a structure of knowledge assets which leads to acceptable level of certainty. The problem is that organizations according to Geraldi, (2009) are divided into 2 types: companies that use flexible structures to be able to adapt and companies that build internal inflexible controlling systems. Her results showed that bureaucratization of chaos (excess of order) is more harmful than chaotification of order (excess of chaos). This again shows that decision makers are not the same and that they have different styles in depending explicitly on available knowledge assets or tacitly innovate new knowledge and that this combination may affect the level of performance stability and regularity in the marketplace. The researcher thinks that the determination of harm is based again on the goal achievement. If the goal is harmed then we can compare which style has less harm and which style has more harm to the improvement of the level of performance regularity and stability.

## 2. Review of Related Works

In this section, we will discuss works that related to the paper, including chaos, order, and knowledge creation process performed by project managers.

### 2.1. Bringing Chaos to Order

Cynefin (2009) assumed that not everything that is important can be analyzed in advance and this minimizes the accountability about those kinds of things. He also found that there are some strategies that can be used to help in working with the unpredicted variations “the unknown”. The work of Cynefin (2009) is shedding more light on the chaotic domain as one of the four disorder domains presented in his model. The definition of the chaotic situation that was presented by Cynefin (2009) is that no matter how hard we try we cannot predict what will happen, nor can we fully explain what happened even after a major event. The variables that are not available in the chaotic situations are mainly enough time, understanding cause and effect relationships. Both are needed critically in the knowledge creation process. The researcher thinks that both are depending on the ability to choose and the ability to avoid certain pieces of knowledge based on their level of certainty in affecting the improvement of performance order in the marketplace. Creation of new knowledge that has no expected effect on the goal of increasing ordinary performance against chaotic performance may lead to the case where the project lies in the domain of the chaotic situation. In this domain chaos is higher than order and managers do not know about the attracting factor or the piece of knowledge that can change chaos to order. The consciousness in this model is against the case of the disorder which represents the unconsciousness of the ability of having different understandings of a system. This consciousness is raised up from the researcher’s point of view by knowledge creation. This matches with the usage of mindfulness in creating new knowledge and its importance in dealing with unknowns. Individual mindfulness and consciousness are both part of styling project managers thinking when they create new knowledge. Project managers with high levels of consciousness and mindfulness may be able to find the attracting factor faster and more accurately than managers with lower levels of mindfulness and consciousness. The researcher wants to know which style of project managers is able to bring chaotic performance to ordinary performance. The model showed that experimentation is the tool that we can use to sense the patterns of relationships during its occurrence not before that. This shows that one of the patterns that we can use at the stage of creating knowledge inputs is the experiential pattern. If the experiential pattern is used for managing the complex situations then it is needed for the chaotic ones as well. Cynifen model revealed that in chaotic events there is no chance to learn how to minimize the probability of being surprised again. However; Cynefin said that whenever we take a decision, there is always a gap of knowledge because of not being able to know everything about the decision. This means that there is ambiguity in any decision and that chaotic decisions represent a high degree of ambiguity, so that it needs more effort in filling the knowledge gap that he pointed at. Because of that the role of project managers as decision makers is important in creating the needed knowledge. Cynifen said that ambiguity is found in the decision as well as in the needed requirements. Those requirements may be complex and may be simple. Logically it is more difficult to control complex requirements than to control simple requirements for a project. The literature now is moving toward avoiding high standardization (Wang, 2010); however the researcher thinks that we must not avoid standardization. We must avoid the stability of standardization. The continuous adjusted

controlling knowledge assets have to be linked to the new knowledge creation process to come up with new adapting controlling knowledge and then contribute to bring chaos to order.

Batra et al, (2010), conducted a research on how to balance between the agile and structured development approaches to successfully manage large distributed software projects. One real example was found in this research about how to make this balance. The example is that one of the challenges was lack of risk analysis and planning that led to significant difficulties in responding to unanticipated changes in scope, cost, schedule, and quality. The agile approach recommended agile decision making process by enabling the management team to learn and reassess what was not working and make necessary adjustments. The structured approach was recommending outsourcing the development to the vendor who helped in migrating the risk caused by lacking internal resources with the needed technology and methodology skills. From this example the researchers concluded that success can be determined by meeting the evolving requirements by agile approach while controlling budgeting and scheduling by structured approach. Researchers rationalized this interpretation to the fact that control approach gives time-boxed sense-and-respond capability, while agile approach gives fast turnaround of sense and respond across time boxes. The researcher thinks that the statement of “across time boxes” means that structured “order” approach and agile “chaotic” approach should not be separated. A link has to be found on those two types of performance in knowledge creation process. The order accordingly is updated faster as well as the novel adaptation with chaos is reached in a better way. Fixing time and flexing respond is how to link between chaotic changes and order. Another research conducted by Bernard Burness from Manchester University entitled “Kurt Lewin and Complexity Theories: back to the future?” showed that chaos are the pure randomness that is unpredictable; however if organizations became too unstable, they may get out of control or order and destroy themselves. Bernard discussed the idea of Chaordic situation in which the organization reaches the edge of chaos where it has the maximum level of innovation but has also the maximum level of control and order they can keep. This is matching with the researcher’s opinion about the relationship between both; however the amount of each side may differ from one decision maker to the other and hence causes different effects on the improvement of performance regularity levels. Bernard supported the link between control and chaotic situations when he found that chaos and order are twin attributes and when he found that chaos has a hidden order that may be concealed beneath what look like randomness. As a conclusion the chaos exists in the perception of the manager until he realizes the hidden order in it. Based on analysis of literature in this area the researcher formulated the following proposition:

*2.1.1. Proposition 1: Manager have different conscious perceptions about accepted levels of order and chaos in their project performance*

### 2.2. Chaotic projects versus ordinary projects

The researcher started to find out about the consistency between the practical conclusions and research findings. The following table shows some research contributions that shows that there is consistency:

*Table 1 Chaos between theory and practice*

Scientist	Year	Scope of research	Consistent with ..
Distere	2002	There is a significant relationship between knowledge management and project management	It is important to study knowledge creation in project contexts
Nissen	2003	Why managers want to create new knowledge?	Project managers solve problems and innovate by creating new knowledge
Grey	2014	Knowledge creation is related to achieving organizational success Time is a constraint that is limiting the chance to draw wider range of inputs during chaotic situations	There is no enough time to process or gather more information Accordingly the decision maker is forced to block receiving inputs and depends highly on tacit knowledge The time available for making the decision is relatively very short
Collier	2012	Levels of knowledge creation – individual – team – organization	Most probably during very fast chaotic situation the decision is made individually and there is no enough time for two way communication styles.
Satir	2012	Relationship between changing status quo during chaotic situations and consistency in the level of performance.  Replacing the current controlling system with innovative methods of coping depends on the personality of the decision maker.	Well trained and well experienced managers are more capable to use their intuitive decision making than less ones  Success in previous chaotic situations may or may not lead to success in the current situation because the inputs are always different.  Personality balance during chaotic situation plays role in making chaotic decisions
Michael R., Lissack and Johan Roos	2008	Larger projects experience more complexity	It is important to study chaos in projects.  The outcomes of making the decision are relatively highly uncertain  The decision is characterized by very high level of risk or fatal
Katheleenn & Hass	2009	Complexity leaders are more able to manage project knowledge.  Tools for creating connectivity of inputs.  Change is the uncontrollable controller.	There could be some kind of competition accompanying the chaotic situation  The decision is opportunistic  The damage of taking wrong decision is great  The time for taking the decision is relatively very short.  The chaotic situation is highly challenging  The probability of failure is higher than the probability of success

Aucoin	2007	2 approaches of knowledge production: iterative “using available knowledge” and adaptive “ using agility and novelty”	The outcomes of making the decision are relatively highly uncertain  The decision is characterized by very high level of risk or fatal
DeCarlo	2007	Agility is the balance between creativity and reality	There could be some kind of competition accompanying the chaotic situation  The decision is opportunistic  The damage of taking wrong decision is great  The time for taking the decision is relatively very short.  The chaotic situation is highly challenging  The probability of failure is higher than the probability of success

Source: the work of the researcher on the comparison between practical findings and research findings.

Based on the table above we can formulate the second proposition of this research as follows:

*2.2.2. Proposition 2: Knowledge Creation Process has different characteristics in chaotic perceived projects and order perceived projects*

### 3. RESEARCH METHODOLOGY

The study is applied on the projects context which is characterized by high complexity. Due to the fact that the research is concerned about studying the knowledge and the practice of members of top management teams (TMT) toward certain changes, and to describe certain phenomenon of managing chaotic versus controlled knowledge the project context will be suitable one. The research population is all projects that are profit oriented and that are led by top management teams or by individuals. The sectors of it and of constructions projects are chosen because of its characteristics. Those sectors are classified as a rapidly changing sectors with high opportunities for growth. Primary data was collected from project managers in both sectors. The researcher checked historical performance graphs of productivity and focused on classifying projects to two groups. Group of ordinary performance projects that has trendy performance, seasonal performance, of life cycle performance. The other group is the chaotic performance projects group that has irregular performance or random performance. Accordingly the sample is a non-random sample. The interviews were conducted through face to face, telephone, and skype interviews. Interviewees are project managers who have experience for not less than 3 years to be able to classify their projects into ordinary or chaotic from their historical data. Interview guide was sent in advance to assure that interviewees are well prepared for the answers. All projects are profit oriented so that managers are keen to increase efficiency and productivity in the future. The sample of this research consists of in depth interviews with ten managers from constructions sector and IT sector. All projects were small projects based on the number of employees which was less than 100 employees in all projects. The researcher prepared a table of demographics for the interviewed managers as follows:

Figure 1 Demographic variables of the sample of the study

Age of the manager	Age of the project	Years of experience of the manage in the project field	Context of the project
33	5	5	Software programming
24	8	10	Buildings
50	15	25	Electronics
57	8	25	Buildings
34	5	10	Internet constructions

39	7	11	Wireless networks
30	6	12	Electrical connections
65	3	5	Solar mirrors constructions
22	3	3	Solar mirrors constructions
42	18	16	Computers and hardware

Source: created by the researcher from field data of the sample.

The researcher is not interested in measuring the chaotic change itself and understanding it. The researcher is more concerned about how the project manager copes with it. Based on the research propositions the researcher will cover the following interview points:

- Managers perception about the accepted levels of chaos and order in project performance
- The process of knowledge creation during chaotic performance periods
- The process of knowledge creation during the ordinary performance periods
- The sources of knowledge creation during chaotic and ordinary performance periods
- The prioritization of using knowledge assets during chaotic performance periods
- The effect of knowledge creation on project performance
- The effect of experience on project performance
- The effect of innovation on project performance
- The effect of precautions on project performance
- The effect of specialization and education on project performance
- The contextual differences of projects and its relationship to knowledge creation

The interviews will be individual interviews. Each top management team member will be interviewed separately to be able to determine the dominant style of the whole team without having the members affecting each other in a group meeting. If possible and convenient for the top management teams the researcher will follow the individual interviews with a group interview with all team members to assure that the dominant style that was determined by the individual interviews is as the same as the team overall style in the group interview. If the project is managed by one manager then the interview will determine the style of knowledge creation for the project management through the analysis of the interview with this project manager.

#### 4. DATA EXTRACTION

In the following lines the researcher shows the main research results then the findings for each proposition in this study:

From the exploratory research we found the following indicators:

- Project managers' start with one of the four style and if they perceive its failure they may try using another one of the four styles
- Project managers have tendency when they want to create new knowledge. They tend to process information in ordinary way or they tend to process information in chaotic way.
- Innovative style was the least existing style.

- Some of project managers may prefer not to make a decision if they do not have enough time or enough information.

- Less experienced project managers tend to take more precautions especially the financial ones compared to more experienced project managers.

- There is association between the ordinary nature of the project performance and the specialization of the project.

- Projects of the exploratory research are easily classified to ordinary versus chaotic performance projects. This is illustrated by the following table of comparison between ordinary performance projects and chaotic performance projects:

Table 2 comparison between ordinary performance projects and chaotic performance projects

#	Criteria of comparison	Ordinary projects	Chaotic projects
1	Results certainty	Relatively high	Relatively low
2	Availability of time for making decisions	Relatively high	Relatively low
3	Availability of time for taking decisions	Relatively high	Relatively low
4	Damage of wrong decisions	Could be high	should be high
5	Availability of previous related experiences	Enough experience	Not enough experience
6	Level of risk taking	Relatively Low to moderate	High
7	Types of knowledge assets used	More explicit	more tacit
10	Impact of innovative solutions	High	Very high
11	Complexity	Is positively related to the scale of the project	is positively related to the unknown part of the project
12	Connectivity	Relatively easier	Relatively more difficult
13	Level of control at the beginning of the project	Relatively high	Relatively low
14	Ability to forecast	Relatively high	Relatively low
15	Parties involved in taking decisions	Mainly teams	Mainly individuals

Source: the researcher's analysis of the difference between order projects and chaotic projects based on the findings of previous researches and interviews.

### 5. DATA ANALYSIS

#### 5.1. Proposition 1: Manager have different conscious perceptions about accepted levels of order and chaos in their project performance

Managers were asked about the accepted levels of order and chaos in their project performance. Most respondents showed that inability to forecast the future trends in performance is an indicator of lack of previous experience. They mainly learn about changes that happen for the first time from other's experiences before depending on themselves in innovating new risky innovative solution. The researcher found that managers tend to bring chaos to order most of the time. They consider irregularity in performance as an early indicator of failure. Young managers tend to think of financial performance and care a lot about the precaution

based thinking of how to bring chaos to order. It was rarely found that managers are trying to get out of the ordinary performance to chaotic performance. Managers expressed how they are forced to deal with chaos however they do not create it. Competition in the market is a major source of this chaos. In the literature the researcher found that chaos is an important source of innovation but in reality some managers who are preferring to have more order than chaos are willing to withdraw from decision making process during chaotic performance periods because they can't handle the unknown risks. As a conclusion managers of the sample prefer to have higher levels of order than levels of chaos and they tend to bring chaos to order by trying solutions like others' experience or precautions and thinking of innovative solutions becomes at the end of the list of preferred solutions. We tend to say that managers of the sample are order oriented.

### *5.2. Proposition 2: Knowledge Creation Process has different characteristics in chaotic perceived projects and order perceived projects*

The researcher depended on data that came from project managers who live in war. Some countries are unsafe so managers of projects experiences chaos in the performance of their projects. Their countries were under siege so they were not able to keep regular trend of their productivity especially for those projects that depend highly on outsourcing and subcontracting. Managers of those projects perceive that their projects are chaotic performance projects. Fluctuation in performance trends makes it difficult for them to predict the future demand and accordingly the future productivity, however; most of those managers expressed how demand is increasing and supply is decreasing. More innovative solutions are found to their chaotic performance projects. Order has less value in their perception than innovative solutions. They accept agility and high risk but flexible solutions. They accept to test solutions for the first time or even without reliable research. Moreover that they stress on the financial precautions even when they tend to try innovative risky solutions. In less chaotic performance projects and higher levels of order managers tend to depend more on reliable research. In order to be able to find more about how knowledge creation differs according to the level of chaos and the level of order of the project performance, the researcher conducted in depth interview with professor Cornelius Ncube who teaches project management in the British University in Dubai. Cornelius discussed how the project manager in different chaotic situations is dealing with knowledge creation for the sake of making very fast decisions. There were many examples of chaotic situations like the dealings in the stock market. It shows how people on seconds take decisions that are high in risk but at the same time being late in taking the decision includes higher levels of risks or lost opportunities. Accordingly this is the first characteristic of a chaotic situation. The given information is different every time, the inputs to make decisions and the relationships among variables are not static. The decision

maker is forced to take the decision under the stress of lacking time and information. Part of the striving to make accurate decision is based on intuition not on accurate and enough information. Another situation which is very risky is the situation of the Formula One Car Racing. It is characterized by the very fast process of decision making, the sever competition, the high risk, the decision could be fatal and takes parts of a second. The decision maker uses the maximum concentration and mind functioning capabilities. High impact of previous training and experience about such situations plays a role in the balance and making better decisions. In more difficult situations where there are no previous experiences, no enough information, the decision is fatal and there is high time pressure like what happened with Nil Armstrong and his team. The computer gave them wrong information about the location of landing and Nil Armstrong was the only one who took the risk of changing the location against the computer directions and accordingly he saved the team's life. In this situation the strength of personality in chaotic situation, the no accurate inputs of information, the opportunistic decision making process, may lead to different knowledge creation model during chaotic situations. Soldiers in a battle are another example of how fast is the decision made. It depends on high levels of intensive training, high levels of risk management, opportunistic decisions, and intuition as well. Seconds late decisions may lead to death and seconds earlier may save lives. In the field of project management some projects are chaotic in their results. For example the decision of building Burj Khalifa in Dubai depended on having engineers who had previous successful experience not only previous experience, however; project managers expressed their worries about what could be the results and whether the project will succeed or not. Many huge projects with great ideas and after spending huge amount of money are failures because of the chaos results of the project, that is the manager is not sure that it will lead to success after having all needed precautions. The manager of Nokia said that we did everything write but we failed. This shows that failing for him is a chaotic performance that he does not know why it had happened to Nokia. Another example on this according to Prof. Cornelius is the example of a giant health project where British government was trying to build a map for all doctors all over the country and their agendas so that any patient at any time can find which doctor is free and through technological system the patient can book an appointment and the medical history of the patient automatically is transferred to the clinic of the doctor. After all this project with this great idea and with all feasibility studies was a failure because of technological problems. Sometimes there are delays in the implementation of the plan which means that the chaos may be found in the duration of implementation or timing results. Sometimes it is in the needed budget. So practically chaos is a type of unexpected change. Chaos is a sudden new direction of change that happens within relatively short time and lack of enough information. From the above discussion and the conducted

interviews with project managers we can conclude some determinants of a chaos situation from practical point of view:

- Input information is not enough
- There is not enough time to process or gather more information
- Accordingly the decision maker is forced to block receiving inputs and depends highly on tacit knowledge
- The time available for making the decision is relatively very short
- The outcomes of making the decision are relatively highly uncertain
- The decision is characterized by very high level of risk or fatal
- There could be some kind of competition accompanying the chaotic situation
- The decision is opportunistic
- The damage of taking wrong decision is great
- The time for taking the decision is relatively very short.
- The chaotic situation is highly challenging
- The probability of failure is higher than the probability of success
- Well trained and well experienced managers are more capable to use their intuitive decision making than less ones
- There is big space for innovating new solution and use it for the first time.
- If the decision is taken successfully it leads to higher level of gains "like profits, breakthrough, saving lives, winning challenging competition ... etc."
- Success in previous chaotic situations may or may not lead to success in the current situation because the inputs are always different.
- Personality balance during chaotic situation plays role in making chaotic decisions
- Most probably during very fast chaotic situation the decision is made individually and there is not enough time for two way communication styles.
- Chaotic situations and decisions are related to the level of perceived stress and this can lead to a failure or a success.
- The knowledge creation process during chaotic situation has different characteristic than the knowledge creation process in order situations.
- It is important to study knowledge creation in project contexts
- Project managers can innovate and solve problems by creating new knowledge
- It is important to study chaos in projects

As a conclusion the researcher found that knowledge creation process *has different characteristics in chaotic perceived projects and order perceived projects.*

## 6. RESEARCH CONCLUSION AND LIMITATIONS

This research is a qualitative research that is shedding the light on two types of project performance. The ordinary performance and the chaotic one. It is recommended that project managers watch the performance of their projects to determine periods where they have chaotic performance and act differently to create new knowledge. In advance training on higher skills of self-learning and tacit innovations will be recommended for managers who work in chaotic performance projects. Knowledge assets that are built on enough research are more suitable for ordinary performance projects. There is not only one solution for creating new knowledge. This research reveals that creating new knowledge is associated with contextual factors as well as a manager's styles of creating new knowledge. It was found in this research that chaos is an important source of rapid innovations, however; managers tend to bring chaos to order and prefer having higher levels of order rather than having higher levels of chaos. Project managers are able to create more knowledge for ordinary projects decision making; however managers of chaotic performance projects create less amount of knowledge but more novel one during the same periods of time. Some managers can be classified to ordinary decision makers. Those kinds of managers tend to stop thinking and apologize maybe when they face chaotic performance periods. On the contrary chaotic managers tend to violate conclusions of knowledge assets for more innovative solutions. The example that was given by Prof. Cornelius of Nil Armstrong's decision and how did he violate the technological knowledge sources and was right at the end is a good example on this. Projects in unstable contexts are recommended to seek hiring managers who have higher tacit knowledge processing abilities; whereas projects in stable contexts are recommended to seek hiring managers who have higher explicit knowledge processing abilities. The research is not including the psychological aspects of reacting to the chaotic situations. The research is not including also the social and cultural dimensions of reacting to the chaotic situations. The research is limited to the top management team members who are working in the technological sectors and constructions sector within the research sample and to those managers who are responsible about the decision making processes that are related to reacting to environmental changes as well as the increase of the market share and productivity. The research results are limited to the duration of the data collection period. The research is limited to the study of the relationship between the knowledge creation styles and the performance of the project without reasoning this relationship or finding out why there is positive or negative associations. The reasons are left for further research in the future.

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