**THE REPUBLIC OF TURKEY**

**BAHCESEHIR UNIVERSITY**

# CLASSIFICATION OF FACTORS THAT AFFECT IT PROJECT SUCCESS AND DETERMINE ROOT CAUSE

**Master's Thesis**

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**ISTANBUL, 2019**

**THE REPUBLIC OF TURKEY**
**BAHCESEHIR UNIVERSITY**

**INSTITUTE OF SOCIAL SCIENCES**
**MASTER OF BUSINESS ADMINISTRATION**

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## ABSTRACT


CLASSIFICATION OF FACTORS THAT AFFECT IT PROJECT SUCCESS AND DETERMINE ROOT CAUSE

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Earlier studies indicate that project failure rate in IT industries is much higher than that is in other industries. As noted that the complexity, size and budgets of IT projects are increasing in parallel with growing industry, it has been well recognized that high amount of money wasted due to abandoned and/or failed projects. These facts led academicians to search for causes of failure in IT projects.

Even though they provide interesting and useful results, most of these studies focused identification of failure factors and evaluate them independently. However, project failures are a result of combined factors, which could also be interrelated. Hence, the current literature lacks studies that analyse relationships between factors affecting IT project failures. In order to fill this gap, we identified factors that affect IT Project success and focused on finding interrelations among them.

In this study, Interpretive Structural Modelling (ISM) methodology is used. ISM provides a methodological, systematic and logical approach for simplifying the complex relationship between various of factors. In this study, we found that organizational structure, which have highest driving factor but slightly lower dependence power, lies at the bottom of hierarchy. Meaning that this is the root cause of IT project failure. Lack of management support and organizational culture, which are known as critical factors for IT project success on the other hand, emerged as main driving factors and placed at the top of organizational structure in hierarchy. In this context, the thesis makes several contributions to IT Project management literature. Lastly, our findings provide insight for managers to prioritize factors that need to be focused on for improving the IT Project success.



**Keywords**: IT Projects, IT Project Failure, Interpretive Structural Modelling

# ÖZET

BT PROJE BAŞARISINI ETKİLEYEN FAKTÖRLERİN SINIFLANDIRILMASI VE KÖK NEDENİN BULUNMASI

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Literatür incelendiğinde, proje başarısızlığının tüm endüstriler için çok yaygın bir gerçek olduğu görülmektedir. Ancak, BT sektöründe proje başarısızlık oranı diğer sektörler ile karşılaştırıldığında anormal derecede yüksektir. BT projelerinin karmaşıklığının, büyüklüğünün ve bütçelerinin, gelişmekte ve büyümekte olan sektörle birlikte giderek arttığı gerçeği göz önüne alındığında, yarıda bırakılan ve/veya başarısızlık ile sonuçlanan projeler nedeniyle yüksek miktarda para ve insan kaynağının boşa harcandığı görülmektedir. Bu durum, akademisyenlerin BT projelerinde başarısızlık sebeplerini tespit etmeye yönelik araştırmalar yapmaya yöneltmiştir.

Ancak bu çalışmalar, ilgi çekici ve faydalı sonuçlar sunmuş olsalar da birçoğu yalnızca tek bir faktöre veya birkaç faktöre odaklanmıştır, her bir faktörü de bağımsız olarak değerlendirmiştir. Ancak, proje başarısızlıklarında birden fazla ve birbiriyle bağlantılı olan faktörlerin rol oynadığı bir gerçektir. Bu nedenle mevcut literatür, BT proje başarısını etkileyen faktörler arasındaki karmaşık ilişkileri analiz eden çalışmalardan yoksundur. Literatürdeki boşluğu doldurmayı amaçlayan bu çalışma kapsamında BT projelerinin başarısını etkileyen faktörler ve bu faktörler arasındaki karmaşık ilişkilerin belirlenmesi hedeflenmiştir.

Çalışma kapsamında, faktörler arasındaki karmaşık ilişkiyi basitleştirmek için metodolojik, sistematik ve mantıksal bir yaklaşım sunan Yorumlayıcı Yapısal Modelleme (ISM) metodolojisini kullanılmıştır. Çalışma sonucunda örgüt yapısının hiyerarşinin en alt basamağında yer aldığı, farklı bir ifade ile diğer tüm faktörler üzerinde doğrudan veya dolaylı etkisi olduğu sonucuna ulaşılmıştır. Bu bulgular, BT proje başarısızlıkları için kök nedenin örgüt yapısı olduğu anlamına gelmektedir. İlave olarak, BT projelerinin başarısı için kritik faktörler olarak bilinen üst yönetim desteği eksikliği ve örgüt kültürü, diğer faktörleri etkileyerek hiyerarşik yapıda örgüt yapısının hemen üzerinde yer almaktadır. Bu bağlamda, bu çalışma BT Proje yönetimi literatürüne çeşitli katkılar sağladığı gibi, yöneticilere BT Projelerinde başarı oranını artırabilmek adına öncelikli olarak odaklanılması gereken hususlar hakkında yol gösterici bilgiler sunmaktadır.


**Anahtar Kelimeler**: IT Proje, IT Proje Başarısızlığı, Yorumlayıcı Yapısal Modelleme

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## ABBREVIATIONS

IEC : International Electrotechnical Commission

IT : Information Technology

ISM : Interpretive Structural Modelling

ISO : International Organization for Standardization

LL : Lessons Learned

PMI : Project Management Institute

SSIM: Structural Self-Interaction Matrix

# 1. INTRODUCTION

There are numerous academic studies that empirically illustrate that project failure is a very common phenomenon in all industries. Hence, it became a trauma not only for project-oriented organizations (Lindahl and Rehn 2007), but also within all organizations that use digital technologies to support other organizational functions. Related literature includes case studies about failed projects in different industries from construction to aerospace and IT (Information Technologies).

Within the IT context, the failure rate is higher than other industries. The Standish Group International found that just 16% of the IT projects were able to meet budget and time constraints, while 32% are abandoned and remaining 52% involved higher costs and longer time than originally estimated (The Standish Group 1995). Consistently, Beynon-Davies (1995) alleged that more than 75% of all IT projects fail. Today, it is predicted that around 20-30% of projects totally fail and abandoned while a 30-60% of them partially do fail due to exceeding planned time and budget as well as other related problems (The Standish Group 2013).

IT industry is growing every single day as well as the complexity and the scope of IT projects. Considering the high budget of IT projects, one can easily recognize the high amount of money wasted as a result of abandoned and/or failed projects. Billions of dollars have been ruined on unsuccessful and failed IT projects and it keeps increasing with the increasing complexity of projects (Ahmad et al. 2009). The cost of failures in IT projects is around 150 billion dollars in USA and 140 billion dollars in European Union (Savolainen ve ark. 2011).

Most researchers, experts and practitioners, as well as managers and academicians have confidence in that IT projects fail regularly (Ahmad et al. 2009). The high risk and cost of failure associated with IT projects led scholars to research the causes of failure. Hence, there exist numerous studies in literature that identified reasons for failure of IT projects. However, while they provide many interesting and useful results for academics and practitioners, most of these studies focused only on single variables. On the other hand, most of these mentioned factors do not directly affect success or failure of a project. Usually a mix of these factors (Belassi and Tukel 1996) which are also interrelated have a combined affect. The literature also lacks studies that analyse the complex relationships between these factors.

To be able to fill this gap, main target of this study is defining factors which affect IT Project success and their interrelations. First, the factors that affect IT Project success or failure are identified by an extensive literature review. Then, the complex interrelations between these factors are found using Interpretive Structural Modelling (ISM) methodology, which provides a methodological, systematic and logical approach for simplifying the complex relationship between various factors (Sahney et al. 2008).

The outline of this thesis is as following. Next section mentions about background on project, project management and also provides the literature related to factors that affect IT Project success/failure. Following section gives the definition of factors that are identified based on an extant literature review and then narrowed down to eleven according to expert opinions. Following section represents the ISM methodology, its steps and results of each step. Findings of data analysis are illustrated in the next section by illustrating final ISM model. In the final section findings of this study are discussed by considering current literature.

# 2. BACKGROUND

This section provides an overview of concepts related to IT projects. After providing information about project, characteristics of IT projects, project failure and management issues, we illustrated a brief overview of important research that are focused on identification of factors that affect IT project success.

## 2.1 PROJECT

A Project is described as “an endeavour with defined start and finish dates undertaken to create a product or service in accordance with specified resources and requirements” by International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) (ISO/IEC, 12207, 2008: 5). And according to Project Management Institute (PMI), it is “a temporary endeavour undertaken to create a unique product or service” (Schwalbe 2015).

From its definition, one can accomplish that each single project is unique itself and have its own particular characteristics (Cotterell and Hughes 1999). Following attributes of projects are listed below to provide a further understanding on definition of project (Schwalbe 2015);

i. *A project has a unique purpose:* Every single project has its own and clearly defined objectives.
ii. *A project is temporary:* All projects have a pre-defined beginning as well as pre-defined end.
iii. *A project is initiated by using oncoming elaboration or in a repetitive way:* Even if the projects are defined clearly and obviously at the beginning, specific details become clearer during the process.
iv. *A project requires resources:* Every project requires different types of resources. Such as human resources, hardware equipment, software and other related assets.

v. *A project involves uncertainty:* Since every project is special and unique, they are uncertain in nature.

## 2.2 CHARACTERISTICS OF IT PROJECTS

At the beginning ages of IT, plenty of the unit or company managers tend to own a new technology at first and after they attempt to figure out how to do with the new developed system and how they could implement it to their organizations (George 1988). In these days IT was started with only a few computers, however today many organizations have separate IT departments, which has important roles that affect other department that leads more benefits and advantages for the organization (Grindley 1995).

Hence, IT became a major unit in most of the organizations due to its impact which is noticed through the organization. As Grossman (2003) reported, IT departments spend 50% of expenses while 70% of their projects result in failure. Similarly, an academic study conducted by Saur and Cuthbertson (2003) found that only 16% of IT projects are successful, while 74% were challenged and 10% are abandoned. The high failure rate of IT projects made it an appealing area to research.

The high rate of failures in IT projects is due to some challenges brought by the characteristics of these projects. These characteristics are (RAE 2004);

i. *Lack of constrains:* Unlike other projects such as civil engineering projects, IT projects are not subject to the any laws/rules of physics or associated with constraints. Constraints of IT projects are difficult to perceive and communicate, they are prone to misunderstandings and/or unrealistic expectations.
ii. *Visualizations:* Software is invisible, which makes it hard to verify that the project is on time and the expenditure is correlated with the progress.
iii. *Flexibility:* The inability to visualize the boundaries of the software result in excessive requests for additional features or modification of functions during the process.

iv. *Complexity:* In IT projects, complexity is a multi-dimensional and diverse. This makes it difficult to evaluate the project initiation point at the beginning. Inability to realize the complexity of a project beforehand makes them more susceptible to failure.
v. *Uncertainty:* The outcome of IT project is inevitably uncertain, which consequently causes troubles during implementation of the specified system.

## 2.3 IT PROJECT FAILURE

As the software industry grows along the time, final products become more and more complex, diverse and costly. This complexity increases the probability of failure (Konstantinos et al. 2005). Bignell and Fortune (1984) explained failure as “the shortfall between performance and standards”. Laprie et al. (1992), but then, defined the concept of software failure as “a deviation of the delivered service from compliance with the specification”.

Even though it is easy to define failure as a concept, it is not an easy job to define failure of a project, especially if it is an IT project. In addition to meeting time, budged and quality expectations, project managers need to satisfy the customer/sponsor and the results of the project needs to satisfy the main objective such as providing return on investment, saving money, providing automation, or simply making the customer happy (Schwalbe 2015). Accordingly, Taylor (2001) found that the main reason of failure is “the poor project management and other things that were not managed properly are resources, organizational factors, project scope and planning”.

## 2.4 IT PROJECT MANAGEMENT

Even it is a public or a private organization, IT is a strategic tool and if placed effectively, it can encourage and improve the competitive advantage for all organizations (Porter and Millar 1985). This makes the management of IT projects more important than other projects of the organization. Project management is defined as “the application of knowledge, skills, tools and techniques to project activities to meet the project requirements" (PMI 2013). In this context, the role of project manager goes beyond solely struggling to meet scope, time, budget and quality requirements. A project manager has to facilitate the whole project process in order to meet the company needs and expectations (Schwalbe 2015).

In addition, even though we have witnessed significant improvement in software technologies, processes and methods, software engineering is still a people intensive process (Walker 2001). Hence, IT projects need to be managed effectively and efficiently decreasing costs associated with failed and abandoned projects. However, according to a large-scale survey conducted by Trevor and McManus (2003) revealed that the success of an IT project is not a case of single department of person. Hence, it is essential to focus on the management of whole parties involved in the development process rather than solely focusing on IT project team. Shareholders that have a direct impact on the success of IT projects are listed below (Ewusi 1997);

i. Top Management
ii. Team Leader
iii. Developers and Development Unit
iv. Project Manager (Non-Technical)
v. Users
vi. Sales & Marketing Team
vii. Stake and Share Holders

## 2.5 LITERATURE REVIEW

Critical success/failure factors of a project are first defined by Rubin and Seeling (1967). Later, Baker et al. (1983), suggested using perceived performance instead of cost, time and performance for scaling the project success. Then a survey is conducted by Hughes (1996) to identify factors that have influence on project performance. Meeting time, costs, functionality and quality goals are the most common criteria to measure the success or failure of IT projects (Anda et al. 2009; Savolainen et al. 2011). However, according to de Bakker et al. (2010) the requirements of IT projects change in most cases which consequently influence the schedule and the cost. Hence, they argue that it is impossible to define right time and budget calculation for IT projects at the beginning.

The further developments in information and communication technologies during 1990s led researchers to conduct research on IT project failure rates. The high failure rate of the IT Project is first revealed by the CHAOS report presented by Standish Group (The Standish Group 1995). As illustrated in Table 1, in 2015 only 29% of IT projects are completed on time and on budget while 19% result in complete failure. Finally, 52% of IT projects are challenged due to time and budget constraints. While following reports illustrate that the success rate is in an increasing trend during recent years, which is still at low level when compared to projects in different sectors. Nelson (2007) attributes the lack of enhancement to the complexity of projects, size, turnaround of team members and organizations failure to review previous projects.

**Table 2.1: IT Project Failure Rates from CHAOS Reports**

| Outcome | 1994 | 1996 | 1998 | 2000 | 2002 | 2004 | 2006 | 2008 | 2010 | 2012 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Success (%)** | 16 | 27 | 26 | 28 | 34 | 29 | 35 | 32 | 37 | 32 | 28 | 29 |
| **Failure (%)** | 31 | 40 | 28 | 23 | 15 | 18 | 19 | 24 | 21 | 24 | 17 | 19 |
| **Challenge (%)** | 53 | 33 | 46 | 49 | 51 | 53 | 46 | 44 | 42 | 44 | 55 | 52 |

*Source*: Standish Group CHAOS Report, 2015

Following the Standish Group's CHAOS report, Field (1997) defined 10 signs of IT project failure;

i. Misunderstood user needs,
ii. Unclear project scope,
iii. Poor management,
iv. Resistance of users,
v. Lost sponsorship,
vi. Absence of appropriate skills,
vii. Ignorance of best practices as well as lessons learned

Johnson (2001) argued that the success rate increased due to the use of Standish "Recipe for Success" published in 1998. Reporting that project success rate increased from 16% in 1994 up to 28% in 2000, he identified five factors that could affect IT Project success;

i. Lack of high level management support
ii. Lack of user interest and attention
iii. Experience of project manager
iv. Clearly identified business objectives
v. Changing scope of the project

Schmidt et al. (2001) conducted a research in which involved project managers from Hong Kong, Finland and USA. They identified a total of 53 IT Project risk items and the list is reduced to a set of 17 by ranking and pairing.

i. Lack of top management engagement
ii. Misunderstood user demands
iii. Change management problem
iv. Failure on gaining user engagement
v. Lack of sufficient user interest
vi. Disagreement between users and departments
vii. Changing project scope and project objectives
viii. Size of involved organizational parts
ix. Failure to meet end-user expectations
x. Not well-defined scope and objectives
xi. Inaccurate role and responsibility definitions
xii. Lack of clearly defined requirements
xiii. Promotion of a new technology
xiv. Low or no project management skills
xv. Lack of effective project management methodology
xvi. Lack of needed team knowledge, skills and collaboration
xvii. Inappropriate staff plan

A research conducted by Coverdale Organization found that IT project failures are subject to the following causes (Cushing 2002).

i. Poor Planning,
ii. Unclear goals and objectives
iii. Changing objectives during the process
iv. Unrealistic time and cost estimates
v. Lack of management support and user involvement
vi. Failure to threat as a team
vii. Inappropriate skill

According to Murray (2001), characteristics of tendencies tracked in complicated projects are;

i. Unrealistic project scope defined with the available resources
ii. Previous project development involvement
iii. Inaccurate management of scope change
iv. The continuous enlargement of the project scope
v. New technology which is crucial for the project was not developed yet
vi. The organization's problems and questions are not understood
vii. Traditional work is required for organizational business action items

Related researches classify certain attributes of IT projects that increase the chance of failure in seven categories (Peffers et al. 2000-3; Salmeron and Herrero 2005; Ahmad et al. 2009). These categories are;

i. Unrealistic expectations and overambitious projects
ii. Senior management pressure for excessively ambitious or unfeasible functions
iii. Extreme sense of flexibility
iv. Invisible complexity
v. Uncertainty
vi. Tendency to software failure

vii. The goal to change currently business processes

On the other hand, Wallace et al. (2004) have classified project risks into six categories:

i. Organizational medium risk
ii. User risk
iii. Circumstances risk
iv. Project complication risk
v. Planning risk and lack of control
vi. Team risk

Moreover, Tiwana and Keil (2004) classified factors in two sections considering the rate of managerial examination (Jani 2008): internal and external risk factors. Internal risk factors are defined as "variables that can influence the project outcomes negatively, such as project team morale, employee productivity, inadequate training, or inadequate project reviews" (Jani 2008). These are related to a project's internal factors and are generally managed by a project manager. External risk factors on the other hand, are because of the external events or factors that drive the project outcomes on negative way, such as environmental factors like industry or government regulations or change in business environment or change in project scope. These are generally cannot be controlled by a project manager (Jani 2008).

Organizational factors are listed as executive management support and decision making, organizational structure, organizational culture and motivational aspects (Dwivedi et al. 2013). In addition to these internal successes driving factors, there exist external failure factors which include social, economic, political and competitor factors (Dwivedi et al. 2013). However, these factors are not under control of project manager (Belassi and Tukel 1996) and which are not considered as failure factors in this study.

# 3. FACTORS THAT AFFECT IT PROJECT SUCCESS

Based on an extant literature review factors are identified that cause IT project failure. Then these factors are decreased to eleven according to experts' opinion who are conversant with IT projects. In this section, eleven factors that affect IT project success are explained in detail.

## 3.1 PROJECT SIZE

All projects have different sizes, IT projects as well. Hence, in some cases IT teams must manage relatively smaller projects in limited time and using less resources, in other cases they must deal with relatively large projects that require more resources and a long period of time. These relatively large projects, which are more vulnerable for success than their smaller counterparts, must be planned and managed more carefully. Accordingly, related literature illustrates that, the size of a project has a direct effect on the complexity of the problem (Tukel and Rom 1998; Ewusi-Mensah 2003; Wallace et al. 2004). For instance, the research led by Standish Group illustrates that large projects tend to fail than their smaller counterparts (The Standish Group International 1999) due to their size and complexity (Taimour 2005).

Related research usually measures IT project size by four components; effort, duration, team size and budget. With respect to a research by Sauer et al. (2007), failure risk of projects increases with effort. They found that 24 person-month or less projects have a 25% probability of underperforming, while the risk is doubled for 500-1000 person-month projects. Similarly, while underperformance possibility is %25 for three to six months projects, it is doubled for 18-month projects. In a similar context probability of low performance increases with team size and budget. Finally, the authors found that enlargement in size of a project means higher risk and this is not dependent on the experience of project manager.

## 3.2 COMPLEXITY OF IT PROJECTS

Technology complexity is defined as “technology that has links with other systems and/or immature technology” (Wallace et al. 2004). Since IT projects usually incur more technology than other engineering projects (Ahmad et al. 2009), the concept of complexity becomes more important in IT projects. Even though, Kappelman et al. (2008) found that technological complexity is an important issue for IT project failure and Nelson’s (2007) empirical survey illustrates that solely 4% of the top ten failures show technology as a leading failure factor, there exist numerous academic studies that have empirically proven that complexity is a major issue in IT project failure rate (White and Fortune 2002; Huang et al. 2004; Crawford et al. 2006; Shwalbe 2007).

## 3.3 ORGANIZATIONAL CULTURE

Organizational culture is formed in shared values, practices examined, symbols, assumptions and appropriate behaviour (Schein 2000). Hence, this culture serves as a base for the management of systems and processes (Denison 1990). In this context knowledge creation and transfer within the organization, which are vital for successful project management, depends on organizational culture (Ajmal and Koskinen 2008).

Organizational culture is shaped by external forces such as national, regional or industrial culture. Academic studies in related literature also consider cultural perspective as a factor to project success or failure (Rees-Caldwell and Pinnington 2012). For instance, according to Tilmann and Weinberger (2004), the most ordinary reasons for IT Project failure are embedded in the process of IT Project management process and alignment of IT with organizational culture.

## 3.4 POOR PLANNING

Projects do not have a predefined procedure to follow and in case of a poor planning, all effort of project team can lead unexpected objectives or results. Considering that none of the projects have unlimited resources, managers have to plan their projects in advance before they start. While the size and complexity of projects increase, the ability to plan the project decreases.

In some cases, IT Project managers are not given a chance to plan the project due to pressures from top management. However, even they have a chance to plan the Project beforehand they might fail due to the unknown risks brought by IT projects (Pinto and Kharbanda 1996). Hence, cannot guarantee that planning will lead project success, but poor planning will surely guarantee the failure (Dvir et al. 2003).

### 3.5 UNCLEAR GOALS AND OBJECTIVES

Identifying goals and objectives are the mostly cited failure factors in IT project management literature. Because all projects are unique, and they have their own specific objectives which must be finished within a defined time period and budget. In addition, software projects are mostly invisible. Hence, project managers must make the product and the project visible by defining goals, requirements, plans, risks, individual responsibilities (Jurison 1999). These visible objectives provide over-all direction for the project.

However, defining clear goals for IT projects requires a lot time and communication (Taimour 2005). Even project team is given the time and opportunity to define goals and objectives, the customer/sponsor might lack the experience for describing what they want (Fichter and Cervone 2003). Hence, ambiguous goals and unclear vision leads to failure (Yeo 2002) in time, cost and quality of the Project (Schmidt et al. 2001; Ahmad et al. 2009). In addition to that, narrow and conflicting goals (Lyytinen 1987) and/or lack of stakeholder agreement (Ewusi-Mensah 2003) might result in Project failure.

### 3.6 CHANGING OBJECTIVES DURING THE PROCESS

Many IT projects suffer from changing requirements (Wallace et al. 2004). Even the Project team and the customer clearly defined all goals and objectives in advance, they might change due to uncontrolled and unexpected inputs or changes which cause a shift in scope or on agreed features of the project (Taimour 2005). Scope shift causes loss of controlled and expected changes in user requirements, while feature shift is more related to uncontrolled additional features to the system (Fichter and Cervone 2003). This shift might be either related to unexpected changes in business conditions and technologies during the project or related to changing customer needs during the process.

Unexpected changes in business landscape became more and more important with the increasing speed of knowledge creation and innovation. Today, the speed of innovation is increased enormously, and in many cases, innovations introduced by rivals or from other industries make a product obsolete or even change the rules of an entire industry (Chesbrough 2006). Hence, shift in scope of IT projects became very common and important particularly for projects that are bigger in size and duration.

## 3.7 UNREALISTIC TIME AND COST ESTIMATES

Unrealistic management expectations are one of the failure reasons in IT projects (Evans et al. 2002). The most common errors related to the time and resource estimate of IT projects emerge from the using time on task to forecast timetable (Fichter and Cervone 2003) or using linear approximation when forecasting timetable (Grossman 2003). First, the time on task is not equal to actual duration of each task because it does not consider interruptions. Second, increasing the resources does not yield a decrease in schedule to same degree. For instance, doubling the human resource does not result in a decrease in time to same degree (Grossman 2005).

Hence, many IT projects overrun due to poor estimates. Trevor and McManus (2003) suggest staying away from project rather than committing unrealistic time and budgets. Related literature illustrates that there are two reasons for unrealistic time and budget estimates. First one is known as ignorance, in which project manager or team members do not know what they do not have. Second one is known as unrealistic optimism, which arises from being unaware of the problems they may face or oversimplifying what it will take to achieve intended results (Evans et al. 2002).

## 3.8 LACK OF MANAGEMENT SUPPORT

Management help and dedication are critical for IT Project success. For instance, Biehl (2007) and Bradley (2008) agreed that management support is an important factor for IT project success. Furthermore, some research even argued that it is a direct predictor of project success (Liang et al. 2007; Young and Jordan 2008; Young et al. 2011).

According to Dwivedi et al. (2013), failure can still appear due to missing management support particularly if management is not clear about the objectives of the project. Hence, top management must understand the needs to support project management team. In this context, top management support comprises three critical components (Dong et al. 2009; Jarvenpaa and Ives 1991; Subramanian and Lacity 1997).

i. resource provisioning,
ii. participation,
iii. involvement.

## 3.9 ORGANIZATIONAL STRUCTURE

Organizational structure is also considered as an important factor to avoid IT project failure. Because many organizations, due to their structure, resist to change and keep on a hierarchical model (Morgan 1989). Even smaller project teams in these organizations has a strict hierarchical structure in which decision-makers are different from the employees doing the real work. In these organizations, the structure may ignore the authority of project manager, who should control all resources required to overcome project needs. In this context, Belassi and Tukel (1996) argue that a useful and well working organizational structure other than that a simple project or matrix structure enables better resource sharing.

A research conducted by General Dynamics Systems Integration Management Office illustrate that 75% of project managers are not happy with the form of their organization. And they declared that they use their personal relationships with colleagues from other supporting departments to get the job done and finalize their project with success (Soraya and NetoAlvarez 2003).

### 3.10 INAPPROPRIATE SKILLS

IT project often require a diverse set of skills. However, due to the challenge brought by global competition, increasing speed of knowledge and innovation, and also continuous changes in technological landscape make it really hard to predict required set of skills that a project need. In addition, most IT projects require a wide variety of skills (Taimour 2005) and the breadth and depth of required skills are even higher in large IT projects (Glaser 2004). However, many project teams and/or organizations lack required skill breadth and depth (Fichter and Cervone 2003) and unfortunately only a few of them are equipped with the right experience, education and discipline for completing IT projects successfully (Ahmad et al. 2009).

### 3.11 IGNORING BEST PRACTICES AND LESSONS LEARNED

According to Ackoff (1994), "a mistake is an indicator of a gap in one's knowledge and learning takes place when this mistake is identified and corrected". According to McConnell (1996), people tend to make some mistakes more than others because these mistakes have a seductive appeal. For instance, if the project is behind schedule we add more people, or we cut testing to speed up development process (McConnell 1996). Similar mistakes are not avoidable however they might be a part of learning process and used as a reference to improve following projects. In this context, Field (1997) argued that managers ignorance of best practices and lessons learned is another factor in IT project failures. As Lingberg (1999) stated "if you lose with an IT project, do not lose the lesson and especially if lessons can be learned and applied". Thus, understanding why projects failed, might be a delay or budget overrun, can help the organization and the team to correct the problem in the future (Lytinen and Robey 1999).

# 4. METHODOLOGY AND CASE STUDY

## 4.1 METHODOLOGY

This research is underlining mostly considered eleven IT failure factors, each has independent and depended effects on success of IT projects. Methodology used in this study is an integrated approach that consists of Interpretative Structural Modelling (ISM) which provides whole overview of the problem by considering direct and indirect relationships among factors rather than considering each factor individually. ISM was applied to intuitively explain the interrelationships within these factors (Ravi & Mahamaya 2017).

Interpretive Structural Modelling (ISM) is a deep-scaled methodology to identify connection among certain factors, which describe a problem or a subject matter (Jharkharia & Shankar 2015). For any complex case that is under consideration, many different factors might cause of an issue or problem. On the other hand, the direct and indirect connections between the factors define the case better than the individual factor evaluated separately. For that reason, ISM develops a realization on joint understanding of these relationships between factors.

ISM, was evolved by Warfield in 1970’s, is a methodology of systemic structural modelling, which is being thoroughly applied during identification and summarization of relationships between factors. Methodology is an interactive discovery process in which a set of genuine, related and connected factors are redesigned into a generic systemic model introduced as a hierarchy diagram. ISM maintains a guideline that someone can synthesize an objective hierarchy of the factors by mathematical conclusion, given the one to one relations between the factors (Warfield 1974; Sage 1977).

The steps followed according to the methodology for analysing relationship between factors are described below (Ravi & Shankar 2005):

i. *Step 1:* A group of factors that have influence upon the system to be specified. The relevant factors to be taken into account in analysis that are constituted by brainstorming, literature investigation, face to face discussion, or other research tools.
ii. *Step 2:* According to the situation and selected the factors, a contextual relationship to be structured based on "leads to" decision and an adjacency matrix to be constructed.
iii. *Step 3:* Structural Self-Interaction Matrix (SSIM) to be developed according to the survey results which points out a pair wise relationship among variables of the system under investigation.
iv. *Step 4:* By using SSIM, an initial reachability matrix to be developed and transitivity checked to be performed for generating final reachability matrix. The transitivity of the contextual relationships is a fundamental guess made in ISM. It remarks that if factor A has relation with factor B and factor B has relation with factor C, then factor A necessarily has related with factor C.
v. *Step 5:* The reachability matrix to be partitioned into different planes that is provided in Step 4.
vi. *Step 6:* Factors to be classified as "autonomous, dependent, linkage and independent" variables.
vii. *Step 7:* A directed chart, according to the contextual relationships in the final reachability matrix, to be drawn and finally the transitive links to be removed.
viii. *Step 8:* Finally, the diagraph to be transformed into an ISM by changing variable nodes with declarations.

## 4.2 CASE STUDY

ISM methodology proposes using expert opinions based on different management practices, in example brainstorming, interview, nominal group technique, for generating the contextual relationship among the variables (Attri et al. 2013).

Advise of experts should be consulted in considered industry and academia for identifying the structure of contextual relationship among the factors. Experts and academicians must be well practised with the case. To examine the factor relationship, ‘leads to’ or ‘influences’ type must be chosen for pairwise evaluation. That means, factor A has impact on factor B. Based on this, contextual relationship between the specifically identified factors is clarified.

In order to analyse these factors, a questionnaire is prepared and performed a mixture of interview and survey method with help of total 23 experts, consisting of 6 academicians and 17 experts in IT industry located in Turkey.

### 4.2.1 Identifying the System Factors Set

The factors in this study are generated mainly by using literature review and summarized by considering expert opinion via brainstorming.

### 4.2.2 Adjacency Matrix

A survey has been generated for identifying contextual relationship between factors and an adjacency matrix is developed.

### 4.2.3 Structural Self-Interaction Matrix (SSIM)

According to the results of the survey, SSIM is developed by using following four letters which points out the direction of relationship between two factors, abbreviation of i and j.

V- Factor i will lead to factor j;

A- Factor j will lead to factor i;

X- Factor i and j will lead to each other;

O- Factor i and j are unrelated

SSIM developed according to the contextual relationships among factors and is illustrated in Table 4.1. As known there are two cells in a matrix for every pair of factors. Since the letters used in the matrix provide information on both directions, only upper side of the matrix is filled. The lower part, shown in grey, as well as the diagonal is ready to be filled in the next section by decoding letters into binary numbers, according to the selected methodology.

**Table 4.1: Structural Self Interaction Matrix**

| S.N | Factors affecting IT Project Success | Factor Number | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | Project Size | - | A | O | A | A | A | X | O | A | O | O |
| 2 | Complexity of IT Projects | | - | O | A | A | X | V | O | O | A | A |
| 3 | Organizational Culture | | | - | V | V | V | V | X | X | O | V |
| 4 | Poor Planning | | | | - | A | V | V | A | A | A | A |
| 5 | Unclear goals and objectives | | | | | - | V | V | A | A | A | O |
| 6 | Changing objectives during the process | | | | | | - | X | A | A | A | A |
| 7 | Unrealistic time and cost estimates | | | | | | | - | A | O | A | A |
| 8 | Lack of management support | | | | | | | | - | A | V | O |
| 9 | Organizational Structure | | | | | | | | | - | V | O |
| 10 | Inappropriate skill | | | | | | | | | | - | V |
| 11 | Ignoring best practices and lessons learned | | | | | | | | | | | - |

### 4.2.4 Reachability Matrix

Following step in the ISM methodology is conversion of the SSIM into a binary matrix. Diagonal values are "1" (one), which means that single factor is affected by itself as well, and V, A, X, O are substituted by "1" (one) and "0" (zero) as per each of the case and resulting matrix will be named as Initial Reachability Matrix. The guideline for the substitution of V, A, X, O to "1"s and "0"s are given below:

i. V value of (i, j) cell in the SSIM is replaced by 1; (j, i) entry is filled with 0.
ii. A value of (i, j) cell in the SSIM is replaced by 0; (j, i) entry is filled with 1
iii. X value of (i, j) cell in the SSIM is replaced by 1; (j, i) entry is filled with 1.
iv. O value of (i, j) cell in the SSIM is replaced by 0; (j, i) entry is filled with 0.

#### 4.2.4.1 Initial reachability matrix

**Table 4.2: Initial Reachability Matrix**

| **S.N** | **Factors affecting IT Project Success** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Project Size | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 2 | Complexity of IT Projects | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 3 | Organizational Culture | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 4 | Poor Planning | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 5 | Unclear goals and objectives | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 6 | Changing objectives during the process | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 7 | Unrealistic time and cost estimates | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 8 | Lack of management support | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| 9 | Organizational Structure | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| 10 | Inappropriate skill | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 11 | Ignoring best practices and lessons learned | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |

After initial reachability matrix is generated, transitivity check is conducted in order to provide Final Reachability Matrix. Transitivity check means that if factor A leads to B and factor B leads to C than factor A necessarily leads to C. Thus, “0” values between factor A and factor C are replaced with “1”. Final reachability matrix, which is obtained after transitivity check is illustrated in Table 4.3 and converted binary numbers after transitivity check are marked.

#### 4.2.4.2 Final reachability matrix

**Table 4.3: Final Reachability Matrix**

| S.N | Factors affecting IT Project Success | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Driving Power |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Project Size | 1 | 0 | 0 | 0 | 0 | 1* | 1 | 0 | 0 | 0 | 0 | 3 |
| 2 | Complexity of IT Projects | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 4 |
| 3 | Organizational Culture | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1* | 1 | 9 |
| 4 | Poor Planning | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 5 |
| 5 | Unclear goals and objectives | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 6 |
| 6 | Changing objectives during the process | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 4 |
| 7 | Unrealistic time and cost estimates | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 3 |
| 8 | Lack of management support | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1* | 8 |
| 9 | Organizational Structure | 1 | 0 | 1 | 1 | 1 | 1 | 1* | 1 | 1 | 1 | 1* | 10 |
| 10 | Inappropriate skill | 1* | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 8 |
| 11 | Ignoring best practices and lessons learned | 1* | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 6 |
| **Dependence Power** | | 9 | 6 | 3 | 7 | 5 | 11 | 11 | 3 | 2 | 4 | 5 | |

*value after applying transitivity (these are 0(zero) in Initial Reachability Matrix)

As seen in Table 4.3, final reachability matrix also includes driving and dependence power of all factors that affect IT Project success. Driving power of an item is the total number of items (including itself) that help to achieve other factors. Dependence power, on the other hand, total number of items (including itself) that help other factors to achieve it. Accordingly, organizational structure has a driving power of 10, highest driving power, which makes the factor a strong nominee to emerge at the bottom level of the hierarchy in final ISM model. Organizational structure is followed by organizational culture having driving power of 9. On the other hand, our survey resulted in a driving power of 3 for project size and unrealistic time and cost estimates, which probably emerge at the top of hierarchy that have less effect on project success.

Consistently, changing objectives during the process and unrealistic time and cost estimates has the highest dependence power. These factors are nominated to emerge at the top levels of final ISM model. Finally, organizational culture, organizational structure, lack of management support and inappropriate skills have the lowest dependence power, higher driving power on the other hand.

### 4.2.5 Level of Partitions

The reachability matrix is partitioned into different levels. The reachability sequence (R) and the antecedent sequence (A) are extracted from the final reachability matrix. The reachability sequence is formed by the factor itself and others that it may impact, while the antecedent sequence is formed by the factor itself and the others that may impact it. The intersection of the sequences, R ∩ A, is extracted for all the factors. If R ∩ A = R, the factor in R will fit in the top layer and taken out from evaluation during next iterations. This process is performed again to obtain the factors for extracting the next level and then iteration is applied so long as all selected factors have been partitioned and placed in hierarchical levels.

Looking to Iteration-1 given in Table 4.4, project size, changing objectives during process and unrealistic time and cost estimates are top items of the hierarchy, means that there is no other item above these and would not help achieve any other items in the system and are going to be removed during next iteration.

**Table 4.4: Iteration 1**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Reachability | Antecedent | Intersection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | **1,6,7** | 1,2,4,5,6,7,9,10,11 | **1,6,7** | **I** |
| 2 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1,2,6,7 | 2,4,5,6,10,11 | 2,6 | |
| 3 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3,4,5,6,7,8,9,10,11 | 3,8,9 | 3,8,9 | |
| 4 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1,2,4,6,7 | 3,4,5,8,9,10,11 | 4 | |
| 5 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1,2,4,5,6,7 | 3,5,8,9,10 | 5 | |
| 6 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | **1,2,6,7** | 1,2,3,4,5,6,7,8,9,10,11 | **1,2,6,7** | **I** |
| 7 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | **1,6,7** | 1,2,3,4,5,6,7,8,9,10,11 | **1,6,7** | **I** |
| 8 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 3,4,5,6,7,8,10,11 | 3,8,9 | 3,8 | |
| 9 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1,3,4,5,6,7,8,9,10,11 | 3,9 | 3,9 | |
| 10 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1,2,4,5,6,7,10,11 | 3,8,9,10 | 10 | |
| 11 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1,2,4,6,7,11 | 3,8,9,10,11 | 11 | |

After identifying and removing the top-level factors as well as from Reachability and Antecedent set of other factors for the following iteration, the same process is conducted to find the factors in next step. The results of second iteration is shown in Table 4.5. According to the results, complexity of IT projects is placed on second level of the hierarchy.

**Table 4.5: Iteration 2**

| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | Reachability | Antecedent | Intersection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | **2** | 2,4,5,10,11 | **2** | **II** |
| 3 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3,4,5,8,9,10,11 | 3,8,9 | 3,8,9 | |
| 4 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2,4 | 3,4,5,8,9,10,11 | 4 | |
| 5 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 2,4,5 | 3,5,8,9,10 | 5 | |
| 8 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 3,4,5,8,10,11 | 3,8,9 | 3,8 | |
| 9 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3,4,5,8,9,10,11 | 3,9 | 3,9 | |
| 10 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 2,4,5,10,11 | 3,8,9,10 | 10 | |
| 11 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 2,4,11 | 3,8,9,10,11 | 11 | |

In the next iteration, complexity of IT projects is removed from the list and reachability and intersections sets are checked again. According to the results illustrated in Table 4.6, poor planning is found as third level factor.

**Table 4.6: Iteration 3**

| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | Reachability | Antecedent | Intersection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3,4,5,8,9,10,11 | 3,8,9 | 3,8,9 | |
| 4 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | **4** | 3,4,5,8,9,10,11 | **4** | **III** |
| 5 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4,5 | 3,5,8,9,10 | 5 | |
| 8 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 3,4,5,8,10,11 | 3,8,9 | 3,8 | |
| 9 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3,4,5,8,9,10,11 | 3,9 | 3,9 | |
| 10 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 4,5,10,11 | 3,8,9,10 | 10 | |
| 11 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 4,11 | 3,8,9,10,11 | 11 | |

Same steps are followed during next iterations until the bottom level factors are identified. The results of iterations are illustrated in Table 4.7-10. According to the results, unclear goals and objectives and ignoring best practices and lessons learned are fourth level factors, inappropriate skills emerged as fifth, organizational culture and lack of management support is emerged as sixth level and finally organizational structure is located as seventh (bottom) level of the hierarchy.

**Table 4.7: Iteration 4**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Reachability | Antecedent | Intersection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3,5,8,9,10,11 | 3,8,9 | 3,8,9 | |
| 5 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | **5** | 3,5,8,9,10 | **5** | **IV** |
| 8 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 3,5,8,10,11 | 3,8,9 | 3,8 | |
| 9 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3,5,8,9,10,11 | 3,9 | 3,9 | |
| 10 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 5,10,11 | 3,8,9,10 | 10 | |
| 11 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | **11** | 3,8,9,10,11 | **11** | **IV** |

**Table 4.8: Iteration 5**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Reachability | Antecedent | Intersection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3,8,9,10 | 3,8,9 | 3,8,9 | |
| 8 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 3,8,10 | 3,8,9 | 3,8 | |
| 9 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3,8,9,10 | 3,9 | 3,9 | |
| 10 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | **10** | 3,8,9,10 | **10** | **V** |

**Table 4.9: Iteration 6**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Reachability | Antecedent | Intersection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | **3,8,9** | 3,8,9 | **3,8,9** | **VI** |
| 8 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | **3,8** | 3,8,9 | **3,8** | **VI** |
| 9 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3,8,9 | 3,9 | 3,9 | |

**Table 4.10: Iteration 7**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Reachability | Antecedent | Intersection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | **3,9** | 3,9 | **3,9** | **VII** |

### 4.2.6 Factor Classification

In this step, already identified 11 factors that affect IT project success are classified into four cluster. These clusters are; “autonomous, dependent, linkage and independent” variables. For instance, variable 1 (project size) has driving power “3” and dependence power “9” is positioned at a cell corresponding to driving power “3” and dependence power “9” in Figure 4.1 given below. In a similar context, all other variables are positioned into their corresponding cells according to their driving and dependence power.

**Figure 4.1: Driving Power and Dependence Power Diagram**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Driving Power | **11** | | | | | | | | | | | |
| | **10** | | 9 | | | | | | | | | |
| | **9** | | | 3 | | | | | | | | |
| | **8** | | | 8 | 10 | | | | | | | |
| | **7** | | IV.INDEPENDENT | | | | | III.LINKAGE | | | | |
| | **6** | | | | | 5,11 | | | | | | |
| | **5** | | | | | | | 4 | | | | |
| | **4** | | | | | | | | | 2 | | 6 |
| | **3** | | | | | | | | | 1 | | 7 |
| | **2** | | I. AUTONOMOUS | | | | | II.DEPENDENT | | | | |
| | **1** | | | | | | | | | | | |
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| | Dependence Power | | | | | | | | | | | |

According to the ISM methodology, the first cluster is called autonomous factors having weak dependence and weak driving power. Autonomous factors, which are illustrated at the bottom left of Figure 4.1, are comparatively unrelated from the system, meaning that they have only a couple of links that are usually not so strong. As seen in Figure 4.1, there is no autonomous factors in our final model.

The second cluster, dependent factors, consists of factors that with strong dependence but weak driving power. These factors usually position close to the top of the final ISM model, means that they are dependent on other factors but drive only a few ones. In our model, project size, complexity of IT projects, poor planning, changing objectives during the process and unrealistic time and cost estimates are emerged as dependent factors. These factors are placed at the bottom right corner of Figure 4.1.

Third cluster illustrated in top right corner of Figure 4.1, consist of linkage factors that both have strong driving power and strong dependence power. These factors are unstable and any change on them will influence others and also will have a feedback on themselves. Managers should pay more attention during managing linkage variables. According to our findings, there are no linkage variables in our model.

Finally, the fourth cluster consist of independent factors. These factors, which have weak dependence and strong driving power always lies at the bottom levels of hierarchy. As illustrated at the top left corner of Figure 4.1, organizational structure, organizational culture, unclear goals and objectives, lack of management support, inappropriate skills and ignoring best practices and lessons learned are emerged as independent factors.

### 4.2.7 Directed Graph

After all levels are identified, levels are summarized in the Table 4.11 in importance sequence.

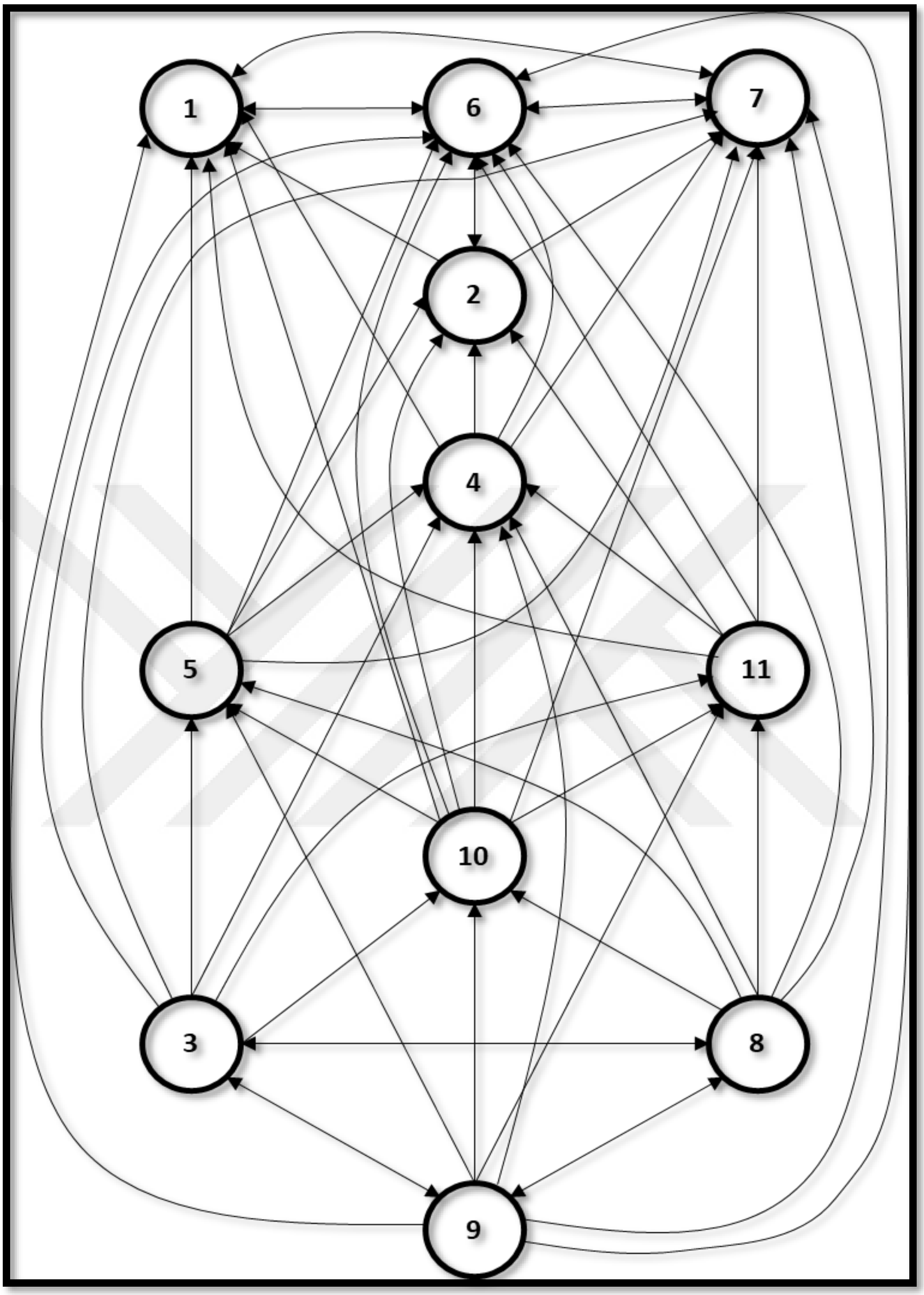
**Table 4.11: Summary of IT Project Success Failure Factors**

| Importance Level | Factors that affect IT project success |
|---|---|
| 1 | Organizational structure |
| 2 | Organizational culture |
| | Lack of management support |
| 3 | Inappropriate skills |
| 4 | Unclear goals and objectives |
| | Ignoring best practices and lessons learned |
| 5 | Poor planning |
| 6 | Complexity of IT projects |
| 7 | Project size |
| | Changing objectives during the process |
| | Unrealistic time and cost estimates |

The top-level factors which are emerged during iteration process are placed at the top of the hierarchy and following level factors are placed just below the top level. This process is repeated by considering disconnected factors in iteration process and these factors are placed in sequence through bottom level in the hierarchy.

Based on the final reachability matrix (Table 4.3), the structural model is generated by means of corners or nodes and border lines (Jharkharia & Shankar 2005). This graph is named as digraph as shown in Figure 4.2 and illustrates the hierarchical relationships among these factors. Factors are connected by a line with direction and a final graph is developed after checking all pairwise relations.

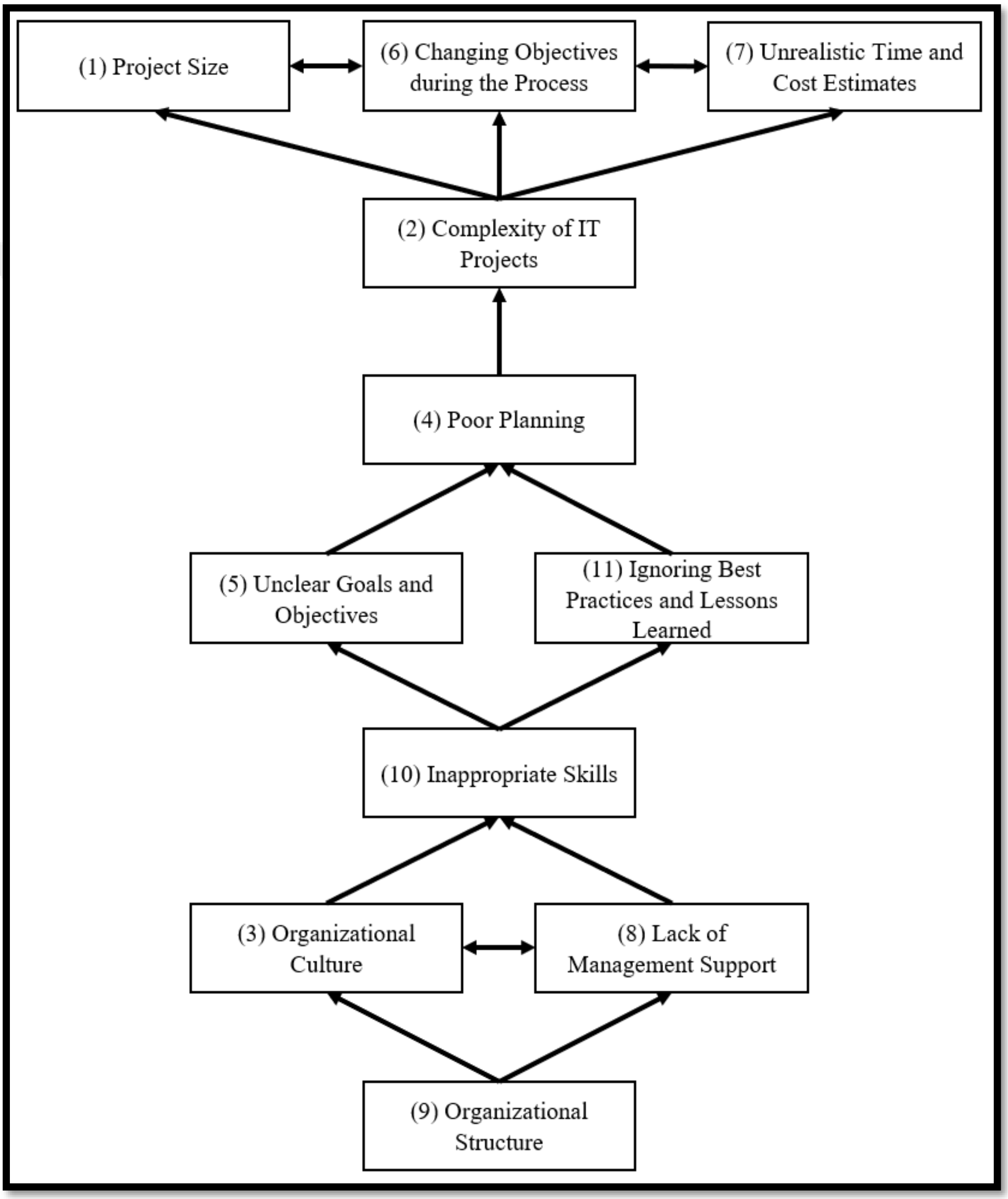
**Figure 4.2: Diagraph of Factors that affect IT Project Success**



### 4.2.8 Final ISM Model

After the transitivity links are removed, the Final ISM Based Model of Factors affecting IT Project Success is obtained as shown in Figure 4.3.

**Figure 4.3: Final ISM Based Model**



# 5. RESULTS

Our results indicate that organizational structure, which have high driving power but low dependence power, lies at the bottom of hierarchy. This factor has a direct effect on organizational culture and lack of management support. Organizational structure has been viewed as a factor that has an impact on resource sharing, while organizational culture consists of shared values, practices, symbols, assumptions and appropriate behaviour (Schein 2000). Consistently, related research offers a functional organizational structure as well as an organizational culture that does not resist to change and does not stick to a hierarchical model (Morgan 1989). Lack of management support, on the other hand, is known as a critical factor for IT project success (Bradley 2008) according to the related literature. In our final model this factor with organizational culture lies right at the top of organizational structure. Hence it is affected by organizational structure right below its position in the hierarchy and also by organizational culture which is placed at the same level.

Then, both organizational culture and lack of management support do have a direct effect on inappropriate skills. Hence, this factor is not independent from others that lie below its position on final hierarchical model and has a direct affect both on unclear goals and objectives and ignoring best practices and lessons learned. Meaning that if the project team or management don not have appropriate skills for the project, they probably will ignore best practices and lessons learned and could not be able to identify main and sub duties as well as interrelations among them. According to our final model these two failures will consequently lead to poor planning, which is another highly mentioned failure factor for IT projects.

According to our final model, poor planning has a direct effect on complexity of IT projects. Meaning that a failure in planning might consequently increase the complexity of projects. In addition, complexity of IT projects lies right below project size, changing objectives during the process and unrealistic time and cost estimates. Meaning that the more the complex an IT project will lead increasement of possible objective changes during the process. In addition, the complexity makes the project more vulnerable to unrealistic time and cost estimates.

Finally, these three factors, project size, changing objectives during the process and unrealistic time and cost estimates, lie at the top of ISM hierarchy. Meaning that they do not drive any factors but mainly driven by other factors. On the other hand, these three dependent factors are interrelated, meaning that they drive and driven by each other. Thus, our final model illustrates that changing objectives during the process as well as unrealistic time and cost estimates have a direct effect on project size. Put differently, defining the project's size correctly depends on realistic time and cost estimates as well as on correct planning. Without them, the project size cannot be estimated and identified, which consequently have a negative influence on project success. In addition, changing objectives during the process and unrealistic time and cost estimates are also interrelated.

# 6. DISCUSSION

The main purpose of this thesis is developing a hierarchy of factors that have a direct or indirect effect on IT project success and finding the root cause(s) of failure. In order to develop the hierarchy, an ISM based methodology, which gives the opportunity to illustrate complex relationships between factors in a simple way, is used. First of all, based on an extant literature review we identified the most important factors that affect IT project success. The number of factors is than narrowed down to eleven after getting expert opinions. Next, a questionnaire is developed to obtain expert opinions on the relationship between these factors. After getting survey results we conducted steps according to the selected methodology and finally developed final digraph that illustrate the relationship between factors affecting IT Project success.

In this context, this paper makes several contributions to IT Project management literature. First, we found that the first and most important factors that affect IT Project success are organizational structure, organizational culture and lack of management support. Hence, managers need to focus on these factors before other that are placing on other levels of hierarchy. That finding of our research is supported by previous researches in IT project management literature. Since knowledge and resource sharing is an important factor in IT project success, organizational structure needs to be developed to facilitate communication and sharing (Soraya and Neto Alvarez 2003). On the other hand, organizational structure that does not allow project managers involve in decision making process may undermine the authority of project manager and subsequently may result in loss of control on resources required to satisfy project needs. Hence, organizational structure should provide a comfortable zone for project manager both for involving in decision making process and for having control on required resources.

Organizational culture, which appeared at the top of organizational structure, is also seen as a very important factor in IT project failure. For instance, Tilmann and Weinberger (2004) argued that the most common reason for IT project failure is the misalignment of IT project management with organizational culture. More specifically, Koskinen and

Ajmal (2008) argued that knowledge creation and transfer within organization, that are very important for IT project success depends on organizational culture.

Similarly, Dong et al (2009) argues that management help consists of three important items; resource provisioning, lead participation and involvement. Hence, we argue that if there exist an appropriate organizational structure that facilitate the involvement of managers and resource allocation in IT projects and an organizational culture that facilitate management participation, IT projects does not suffer from management support.

Next, we found that lack of management support and organizational culture lead to inappropriate skills. In order to avoid narrow and conflicting goals (Lyytinen 1987) the project team must be equipped with appropriate skills. As indicated by Ahmad et al. (2009), project team needs to be equipped with right education and discipline to successfully complete the IT projects. It is known that this could only be supported by management. Thus, related literature provides consistent findings aligned with final findings of our ISM model.

Our next finding is inappropriate skills lead to unclear goals and objectives as well as ignoring best practices and lessons learned. Inappropriate skills might probably result in misunderstanding of project needs and failure in defining project goals and objectives (Glaser 2004). In this context, we argue that project team needs to have appropriate skills to be able to define goals and objectives. In addition, teams equipped with appropriate skills will consider best practices and lessons learned by using their previous experiences.

Then, our final model illustrates that unclear goals and objectives as well as ignoring best practices and lessons learned both have a direct effect poor planning. Since all IT projects have their own unique and specific objectives and these objectives provide overall direction for the project (Jurison 1999), it is reasonable to argue that unclear goals and objectives affect project planning. On the other hand, ignoring best practices and lessons learned will lead to failures caused by similar mistakes done in earlier projects.

Another finding of this study is the direct effect of poor planning on complexity of IT projects, which is seen as one of the main issues in IT project failure (Shwalbe 2007). Meredith and Mantel (2002) argue that problems related to project planning, particularly those dealing with defining project are the main cause of failure especially in complex projects. Hence, the poorer the planning the more complex a project is.

On the other hand, we found that more complex projects are more subject to unrealistic time and cost estimates. This finding is also supported by related literature. For instance, Murray (2001) argued that unrealistic time and cost estimates are usual characteristics of complex IT projects. In addition, Ewusi-Mensah (2003) argued that unrealistic goals, schedules and budgets are risk associated with complex IT projects.

Next, we found that changing objectives during the process is directly affected by complexity of IT projects. Even though the planning stage precedes the project process, any changes in project objectives make the planning as well as time and budget estimates outdated. However, the changes in scope of projects is unavoidable in today’s rapid changing business environment and the probability of these changes increases with the complexity of projects. Hence, top management and IT project management need to be aware of the need to update project planning and time and budget in case of any change in objectives.

Finally, we found that complexity of IT projects has a direct effect on project size. Even though the size of an IT project depends on customer needs, planning the project and dividing into appropriate sub-projects will overcome problems associated with the size and complexity of IT projects.

In summary, this paper provides an extensive model that include both direct and indirect effects of factors that cause IT project success. We believe that a better understanding of interrelations between these factors will result in a better management of IT projects which already have a higher failure rate than any other projects in different industries.

Since the findings of this study is based on expert opinion, they need empirical proof. In this context, we suggest further studies to empirically prove the findings of this study by using real project management data. Another interesting study might be conducting empirical survey in order to find bilateral relationships between two factors, which are found to have a direct relationship.

Finally, no study is without limitations. Hence, this study has some limitations. First, our final digraph is developed based on expert opinions. Even though our experts composed of both academicians and practitioners who are conversant with IT project management, our final model is shaped according to only 23 experts' opinion. On the other hand, all experts involved in factor identification and survey processes are working and living in a single country. Involvement of experts from different countries and different cultures might result in different findings.

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