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The Effect of Payment Delay on Construction Projects in Gaza Strip

تأثير الدفعات المتأخرة على المشاريع الإنشائية في قطاع غزة

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The Effect of Payment Delay on construction Projects in Gaza strip

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واللجنة إذ تمنحه هذه الدرجة فإنها توصيه بتقوى الله ولزوم طاعته وأن يسخر علمه في خدمة دينه ووطنه.

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إقـــــــرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

The Effect of Payment Delay on Construction Projects in Gaza Strip

تأثير الدفعات المتأخرة على المشاريع الإنشائية في قطاع غزة

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Dedication

This thesis is dedicated to my compassionate parents who supported me all the way, to my wife who encourage and help me, to my kids who were missing my direct care during my study, to my brothers and sisters for their sustainable support, to my friends and colleagues who stood beside me. I dedicate my research; hoping that I made all of them proud.

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ABSTRACT

Construction industry is considered an important sector for the development in Gaza Strip. Payment process is an important element of the construction industry. Payment delay to contractors is a common cause of disputes in Gaza Strip construction industry.

The aim of research is to identify the causes and the effects of payment delay, to determine the effective solutions that mitigate effects and risks of payment delay in Gaza Strip construction industry and to formulate a model to measure the risk of payment delays.

The objectives of the study were achieved through three approaches, the first one was a literature review about three main parts; causes of payment delay, effects of payment delay and effective solutions that mitigate effects of payment delay. The second one was a valid questionnaire that was obtained from Gaza Strip contractors, owners and consultants opinions, (140) questionnaires were distributed to contractors, owners and consultants. 113 (80.71%) questionnaires were received. The last one by developing Support Vector Machine (SVM) model to measure the risk of payment delays.

SPSS analysis was used to analyze the data collected. The factors that contribute to causes of payment delay in construction projects were divided to three groups. Results have shown that "contractor related factors" was the most important group. The factor "Failure to follow the certain procedures in claims" was in the first position at this group.

The effect and risk of payment delay on construction projects were divided to four groups. Results have shown that "Effects on contractor" was the most important group. The factor "Late payment of salaries" was in the first position at this group.

The top three effective solutions to mitigate effects and risks of payment delay in Gaza Strip according to this study were; contractors should submit timely accurate invoices with complete documents, contractors should chase payment due relentlessly and defined time frame for payment.

Developing support vector machine model SVM model passed through several steps started with choosing the nine ranked payment delay effects on contractors as input factors from the questionnaire results, and one output factor; total payment delay risk in $US. A hypothetical case study and structured interview with (31) contractors was used to build the model. The Neurosolution (5.07) program was selected to build the SVM model, the accuracy performance of the adopted model recorded (93.47%); where the model performed well.

This study recommended the contractors to have enough cash before beginning projects and to submit timely accurate invoices with complete documents. The owners are recommended to work within stipulated budget putting in bank account before starting the project execution and to pay progress payment to the contractors on time and to introduce payment bonds to contractors.

ملخص البحث

تعتبر صناعة الإنشاءات أحد أهم قطاعات التنمية في قطاع غزة, وتعتبر الدفعات المالية الخاصة بالمشاريع الإنشائية في مواعيدها المتفق عليها, عنصرا مهما لكي يستمر هذا القطاع بدون معوقات, كما أن تأخير صرف الدفعات المالية عن مواعيدها المحددة يؤدي إلى تعميق الخلافات بين أطراف المشاريع الإنشائية في قطاع غزة.

الأهداف الرئيسية لهذا البحث هي: 1- دراسة الأسباب التي تؤدي إلى تأخير الدفعات المالية في المشاريع الإنشائية, 2- دراسة الآثار المترتبة على تأخير الدفعات المالية، 3- تحديد الطرق الفعالة التي تعمل على تخفيف الآثار الناتجة عن تأخير الدفعات المالية, 4- تطوير نموذج يقيس الضرر الناتج عن تأخير الدفعات المالية في المشاريع الإنشائية.

وقد تم الوصول إلى أهداف الدراسة بثلاثة طرق : الأولى من خلال الدراسات السابقة التي تطرقت إلى أسباب تأخير الدفعات المالية, والآثار المترتبة على تأخير الدفعات المالية, والحلول المقترحة لتخفيف الآثار المترتبة على تأخير الدفعات. والثانية من خلال تصميم استبانة صالحة و توزيع (140) نسخة منها على المقاولين والملاك والاستشاريين, وقد تم جمع (113) استبانة فقط من مجموع الاستبيانات الموزعة بنسبة (80.71%). والطريقة الثالثة كانت من خلال تطوير نموذج SVM ليقيس الضرر الناتج عن تأخير الدفعات المالية.

تم تحليل الاستبيانات باستخدام برنامج التحليل الإحصائي SPSS. حيث أن الأسباب التي تؤدي إلى تأخير الدفعات المالية في المشاريع الإنشائية قسمت إلى ثلاث مجموعات، وقد أظهرت النتائج أن مجموعة "العوامل التي تعود إلى المقاول" كانت في المرتبة الأولى بين الثلاثة مجموعات, كما بينت النتائج أن العامل "عدم إتباع خطوات سليمة في إعداد المطالبات المالية" كان في صدارة هذه المجموعة.

كما أن الآثار والأضرار المترتبة على تأخير الدفعات المالية قسمت إلى أربع مجموعات. والنتائج أظهرت أن مجموعة "الضرر على المقاول" كانت في المرتبة الأولى بين المجموعات الأربع. كما بينت النتائج أن العامل "التأخر في دفع رواتب العاملين" كان في صدارة هذه المجموعة.

وقد تبين من النتائج أن أهم ثلاثة حلول مقترحة لتخفيف الآثار المترتبة على تأخير الدفعات هي: انه على المقاول تقديم مستخلص مالي دقيق في الوقت المناسب مع كامل الوثائق اللازمة، وكذلك عليه متابعة الدفعة المالية بجدية و بدون تقصير، ويجب أن يتم تحديد جدول زمني للدفع المالي.

تم تطوير نموذج SVM من خلال عدة خطوات بدأت باختيار أهم تسعة عوامل من مجموعة الأضرار المترتبة على المقاول والناتجة من تحليل الاستبانة، حيث تم استخدامها كبيانات مدخلة إلى المودل، وتم استخدام إجمالي الدفعات المتأخرة بالدولار الأمريكي كمخرجات من المودل، ولإعطاء هذه المدخلات والمخرجات أوزان وقيم قبل استخدامها في عملية بناء المودل تم عمل حالة دراسة افتراضية، وتم انجاز ذلك من خلال (31) مقابلة مع مجموعة من المقاولين. وقد تم استخدام برنامج نيروسوليوشن إصدار (5.07) لعملية بناء المودل. وكانت دقة أداء المودل (93.47%)، وهذا يدل على أن أداء المودل ممتاز.

كما أوصت الدراسة المقاولين بامتلاك رأس مال كافي قبل البدء بتنفيذ المشاريع الإنشائية، وأوصتهم بتقديم مستخلص مالي دقيق في الوقت المناسب مع كامل الوثائق اللازمة. كما أوصت الدراسة الملاك ألا يباشروا التنفيذ إلا بعد رصد قيمة تكلفة المشروع في حساب بنكي مخصص، كما وأوصتهم أن يقدموا جدول زمني يوضح آلية الدفعات المالية للمقاولين في الوقت المحدد وأن يقدموا ضمانات خاصة بالدفعات المالية للمقاولين قبل التنفيذ.

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List of Abbreviation

PNA	Palestinian National Authority
PCU	Palestinian Contractors Union
SPSS	Statistical Package for Social Science
SVM	Support Vector Machine
ANN	Artificial Neural Network
US$	United States Dollar
RI	Relative Index
CIDB	Construction Industry Development Board
FIDIC	The Fédération Internationale des Ingénieurs-Conseils; the international federation of consulting engineers
MAE	Mean Absolute Error
MSE	Mean Square Error
MAPE	Mean Absolute Percentage Error
AP	Accuracy Performance
UNRWA	United Nations Relief and Works Agency
UNDP	United Nations Development Program
ANOVA	Analysis of Variance

CHAPTER (1)

INTRODUCTION

1.1 Introduction

Causes and effects of payment delay in Gaza Strip considered as important topics that plague stakeholders in construction projects, this problem actually need to study in depth, to overcome these effects and to mitigate it in order to continue the process of construction execution in the Gaza Strip without hindrance.

Payment delay is defined as failure of a paymaster to pay within the period of honoring of certificates as provided in the contract (Harris and McCaffer, 2003). The parties involved in the process of payment claim such as client, contractor, superintending officer, architect, quantity surveyor, banker and other construction players may cause a payment to be delayed.

The construction industry plays an important role in any country's development process; it establishes buildings and infrastructure works required for social economic development which contribute to the overall economic growth. The success of economic development will further lead to an increase in disposal incomes, generating demand for additional construction activities. The industry also provides works for many ranging from professionals such as architects, engineers and surveyors to main contractors, subcontractors, suppliers and ultimately manual laborers who are employed by these contractors (Tony, 2006).

Lay (2010) stated that main construction industry players are extending from owners, developers, government, bankers, insurers, planners, consultants, main contractors, sub-contractors, suppliers, equipment, plant and machinery supplier … etc. These stakeholders are involved in the payment process.

Construction delay can be observed by several indication factors. One significant factor is owners' performance in making payment to contractors. The extra time required for payments is a clear evidence that company is in financial difficulties (Ayudhya, 2012).

Construction project risks can be classified as either objective or subjective. Risks that are analyzed by the actual observation or calculation of their occurrence and impact on a project are often described as objective risks. Objective risks are quantitative in nature, they involve experimental evidence, long term experience, or complicated analytical calculations that describe actual risks. Risks that are assessed based on beliefs recorded risk data are often referred to as subjective risks. Analyses of subjective risks are often qualitative and based on

the analyst's knowledge and experience of the risks and the process by which the analyst selects and organizes such knowledge and experiences. The majority of construction contract risks are subjective; there are often insufficient historical data to enable their objective analysis, so payment delay can be considered as subjective (Adams, 2008).

According to Abu Shaban, (2008) the most consultants and contractors stated that the projects suffered by the payment delay problems from the owner. In the Gaza Strip, payment delay from owner to contractor lead to delay of contractors' performance and cause time performance problem. This may also lead to disputes between owner and contractor. All of that will affect the overall performance of project which has been executed.

1.2 Problem statement

Payment has been said to be the important feeder of the construction industry. One of the important problems in the Gaza Strip construction industry is payment delay. It leads to delay in project completion, and difficulties to the contractor who spend a large daily money to cover the construction project process. This push many of researchers to study this phenomena when they study the causes of delay in construction, and the methods to reduce the delay. Payment delay occur in many of construction projects and the magnitude of payment delay considerably from project to project. So it is essential to study the impact of the payment delay and how to minimize the payment delay in construction, and also how to compensate the contractors for such delay.

1.3 Aim of the study

The aim of research is to improve the contractors ability to overcome the bad impact of payment delay.

1.4 Objectives of the study

1. To identify the factors that cause the payment delay in construction projects .
2. To identify the effects of the payment delay on construction projects.
3. To investigate how to mitigate the payment delay effect and risk in construction projects.
4. To formulate a model to measure the risk of payment delay.

1.5 Scope of the study

The scope of the study will cover the construction industry in Gaza Strip. This study is needed to evaluate the level of understanding and applying the delay concepts in planning, design and field operation. A questionnaire was distributed to the management team including project managers, supervisors, site engineers and others. The survey targeted the companies which work at building field, also it targeted private and public sectors.

1.6 Significance of research

The purpose of this research is to fulfill several of reasons which considered important to refer to the parties that were involved in construction. These significant involve:

First, to study the factors that cause payment delay in construction projects and produce the statistical result. The result of the study is the guideline to the parties that involve, so it will avoid any source that will happen in their projects.

Second, to study the effect of the payment delay in construction projects, the result of the study will gives a good information to the involved parties to prepare fulltime work and responsibilities to ensure every activities will be done according to the plan.

Third, to suggest several factors that can avoid the payment delay effects in construction projects. The factors can be studied for the parties that involved in construction to reduce the risk of payment delay in construction projects.

Forth, to formulate a model to measure the risk of payment delay in the construction projects. The model enhances the parties whom involved in construction to avoid the risk of payment delay in construction projects.

1.7 Justification

There are contractors who have to do loans with bank because of payment delay. Payment delay gives bad impacts to contractors, especially contractors with small capital. Not only that, it also creates a negative chain effect within the players in the construction industries such as to suppliers, subcontractors and end users as well. This study is important to help contractors when they face the payment delay problem (Nazir, 2006).

1.8 Research methodology

The methodology will explain how the objectives of this study can be achieved. The objectives are to study the effects of the payment delay in construction projects and to identify how we can mitigate the effects and risks of payment delay in construction. This study was carried out based on literature review and questionnaire survey. Then data collection from the questionnaire survey was analyzed using the statistical methods, and their results were presented. A model to measure the risk of payment delay was formulated and tested. Conclusion and recommendation were drawn up.

1.9 Summary of chapters

This dissertation is divided into six (6) chapters which discussed the effect of payment delay on construction projects in Gaza Strip.

Chapter One (1) discuss on the introduction, background, problem statement, aim of the study, objectives of the study, scope of the study, significance of research, justification and research methodology.

Chapter Two (2) discuss about the literature review.

Chapter Three (3) explains the methodology used in this study. The methodology used was considered based on the needs of the researcher to achieve the earlier mentioned objective. Chapter Four (4) describes and discuss the analysis of the data collected previously. The results of the analysis.

Chapter Five (5) discuss the modeling process, how to formulate the support vector machine model (SVM) model to measure the risk of payment.

Chapter Six (6) concludes the results from Chapters 4 &5. What had been determined here is then used to make certain recommendations to avoid the risk and effects of payment delay in Gaza Strip construction.

CHAPTER (2)

LITERATURE REVIEW

2.1 introduction

Before going through causes, effects and methods to mitigate payment delay risks, its necessary to understand payment process in construction industry. Payment is a sum of money paid to someone. In construction industry, payment is the sum of money paid to contractors after their works. Payment delay is the delay on paying these money by owners to contractors on time, this leads to risks that affect the project itself and all stakeholders. The literature review concentrates on causes, effects of payment delay, also it talks about methods to avoid payment delay effects and payment delay on construction in Gaza Strip in general.

2.2 Construction payments

Payment has been said to be the life-blood of the construction industry. Yet the industry knows payment default, specifically payment delay, remain a major problem (Ali, 2006).

Contract period refers to the duration for completing the construction project. When the contract period is delayed, it means the contract cannot be completed within the stipulated time. Payment delay will lead to: time overrun; delay in completion; termination of contract (Amoako, 2011).

One contributing reason for payment delays was the contractor's, tracking and his accounting system and the manual entry of data into this. The subcontractor would issue reminders for any outstanding payments. The Payment condition patterns are seen to differ between the public sector and the private sector, the payments in time are said to be a key element of a contractor's profitability performance, the impact on specialist contractors of payment delay, contractors were dissatisfied with the time lag to receiving payment, contractor non-payment as a cause of disputes escalating (Carmichael and Balatbat, 2010).

Danuri *et al.* (2006), focused on contractual payments from the employer (government or private) to the contractors. The main factors for late and non-payment in the construction industry identified from the study include: delay in certification, paymaster's poor financial management, local culture/attitude, paymaster's failure to implement good governance in business, underpayment of certified amounts by the paymaster and the use of 'pay when paid' clauses in contracts. The research findings show that late and non-payment can create cash flow problems, stress and financial hardship on the contractors and that some reactions to late and non-payment adopted by the contractors may have adverse effects on their own

businesses. Amongst the most appropriate solutions to overcome the problem of late and non-payment faced by local contractors include: a right to regular periodic payment, a right to a defined timeframe for payment and a right to a speedy dispute resolution mechanism.

Under the normal conditions of construction contracts, the owner is obliged to pay the contractor in monthly installments. The amount of each installment is based on the value of construction work actually produced in the previous month and forecasts are needed in advance of the likely value of these payments. A database is available of previously completed contracts and payments made, by the owners, to the contractors involved (Skitmore, 1998).

As stated by Kennedy (2005), 'Payment, not unexpectedly, has always been the main subject of disputes.' It is anticipated that conflict if unsettled will escalate into disputes which can also cause late and non-payment. Several relevant studies have been conducted in the United Kingdom which addressed the problems related to payment issues in the construction industry.

2.3 Pay when paid clauses

"Pay when paid" or also known as "back to back" method of payment is relevant especially in the case of nominated sub-contractor when the main contractor has not been paid by the employer. In most non-standard construction contracts encountered by researcher, this is also invariably the case. It may be worthwhile to note that in England, this type of provision in construction contracts have been rendered unenforceable (Nazir, 2006).

An additional risk is assumed when the subcontract does not define the timing of such payment by the general contractor other than that it will be after the owner has made payments. A study conducted by Artidi and Chotibhongs (2005) shows that this condition is commonly inserted in subcontracts drawn by general contractors in-house and that it gives no guarantee as to when payment is to be made. The general contractor uses these strategies for insulating itself from any liability to subcontractors at any time in the event of nonpayment by the owner. Standard forms of subcontract stipulate specific periods of time for payments to subcontractors arrived at by negotiation, but they are rarely used. As things currently stand, main contractors and sub-contractors would be victim, being squeezed in the middle when there are late payments. Usually, contractors seek ways out in courts or arbitration process.

This will not only take a long period to resolve but will affect the contractors reputation as well. He can claim for interest of sometimes if the breach be serious enough to 'shatter the confidence', he may rescind the contract and attempt to recover the necessary damages.

2.4 Payment and payment delay clauses in FIDIC (2006)

FIDIC means the Fédération Internationale des Ingénieurs Conseils; the international federation of consulting engineers.

2.4.1 Clause 14.7 payments

The employer shall pay to the contractor:

a. The first installment of the advance payment within 42 days after issuing the letter of acceptance or within 21 days after receiving the documents in accordance with sub-clause 4.2 [Performance security] and sub-clause 14.2 [Advance payment], whichever is later.

b. The amount certified in each interim payment certificate within 56 days after the engineer receives the statement and supporting documents; or, at a time when the bank's loan or credit (from which part of the payments to the contractor is being made) is suspended, the amount shown on any statement submitted by the contractor within 14 days after such statement is submitted, any discrepancy being rectified in the next payment to the contractor.

c. The amount certified in the final payment certificate within 56 days after the employer receives this payment certificate; or, at a time when the bank's loan or credit (from which part of the payments to the contractor is being made) is suspended, the undisputed amount shown in the final statement within 56 days after the date of notification of the suspension in accordance with sub- clause 16.2 [Termination by contractor].

Payment of the amount due in each currency shall be made into the bank account, nominated by the contractor, in the payment country (for this currency) specified in the contract.

2.4.2 Clause 14.8 delayed payment

If the contractor does not receive payment in accordance with sub-clause 14.7 [Payment], the contractor shall be entitled to receive financing charges compounded monthly on the amount unpaid during the period of delay. This period shall be deemed to commence on the date for payment specified in sub-clause 14.7 [Payment] irrespective (in the case of its sub-paragraph (b)) of the date on which any interim payment certificate is issued. Unless otherwise stated in the particular conditions, these financing charges shall be calculated at the annual rate of three percentage points above the discount rate of the central bank in the country of the currency of payment, or if not available, the interbank offered rate, and shall be paid in such currency. The contractor shall be entitled to this payment without formal notice or certification, and without prejudice to any other right or remedy.

2.5 Types of payment

According to Chen, *et al*., (2005), a regular disbursement of interim payment is a critical point for a contractor to keep them alive. Whether it's payment delay or not being paid in the amounts certified, it all literally means big problems to the contractors as cash flow will be effected. Some small construction companies would close business due to payment delay. The schemes for reimbursing the contractor for works done under a typical construction contract as varied as the types of such contract encountered in practice. In Malaysia however, the schemes have been reduced into the following principal categories.

2.5.1 Periodic schedule during contract period

During contract period, the most common method used is interim payments or the so called progress payments. In Standard Forms, the interim or progress payments are affected by the issuance of 'interim certificates'. Interim certificate is actually the periodic certification for the payment due to contractor. The failure of the certifier to issue the relevant 'interim' certificates in line with the stipulation of the contract can expose his employer to a possible claim of breach of contract by the contractor (Singh, 2003). The

frequency of periodic payment could be varied from fortnightly to monthly. The actual duration is normally the period as agreed in the contract conditions signed.

2.5.2 Phase payment

The term phase payment is used when the payments are made at specific phases of work. This mode of payment is often used in small lump sum contract without quantities where a proportion of the total sum is agreed to be paid over a number of phases. These proportions are fixed and do not depend upon any re-measurement of work. Nevertheless, the application, this mode of payments is also applied in Turnkey, Design & Build as well as contracts involving repetitive works (Amoako, 2011).

2.5.3 Advance payment

This is the sum of money paid to the contractor by the employer well before the work involved is executed. This practice is usually done in public work contracts. The main purpose of implementing this scheme is to help the contractor to start up and finance the contract without resorting to unnecessary external borrowings (Amoako, 2011).

2.5.4 Payment after completion or final payment

This is the method of payment to contractor triggered by the achievement of the contract milestone of practical or substantial completion and/or the so called handing over of the works to the employer. Hence, unless such stage is reached and certified by the contract administrator, the contractor is not entitled to any payment whatsoever. In using this method, the contractor is basically financing the works to a large degree, which costs would eventually build into the contract sum. The employer must also be prepared to shoulder this burden as well as be in a position to source and effect payment ultimately a sizeable lump sum amount upon the taking over of the works (Nazir, 2006).

2.5.5 Retention clause

The contracts are made provision of retention clause; the purpose of this retention money is to set-off the defects in the event that the contractor refuses to make good to the defect. The retention sum is often (10%) of the certified work. Therefore, the contractor must make allowance to this retained money in their cash flow planning (Lay, 2010).

2.6 The relationship between payment delay and delay of construction

Oppong (2003) research on ‘‘Causes of Construction Delays in Ghana” identify that payment delay to contractors for work done rank as number one cause of construction delay in Ghana, from the perspective of Clients, Contractors and Consultants.

Construction works involve huge amounts of money and most of the contractors' found it very difficult to bear the construction expenses when the payments are delayed. Payment delay for completed work lead to disputes between all project parties, the disputes, if not resolved amicably, can lead to arbitration or litigation (Sambasivan and Soon, 2007).

The owner has related a group of delay factors; it is mainly due to financing issues and owner interference (Odeh and Battaineh, 2002).

The speed of work depends largely to the efficiency and availability of workers. Most of contractors are using sub-contractors to do the construction work and when the payment delay to the sub-contractors, the sub-contractors have limited resource to work with and subsequently reduce the number of workers or stop work until they get payment from the contractors. Although there are abundant of workers in the construction sector, the reluctant of the contractors or sub-contractors to hire more workers contribute to shortage of site workers and then delay in the project period occurred (Abdullah *et al*., 2009).

2.7 Payment delay and cash flow relationship

Amoako (2011) defined the cash flow as the movement of cash into or out of a business, a project, or a financial product. It is usually measured during a specified, finite period of time. For a business to be successful, good cash flow is crucial. Cash flow is the primary indicator

of a business' financial health. It's the measure of your ability to pay your overheads such as rent, insurance and wages. Ultimately, effective cash flow is a key business skill and will help to protect the financial security of your business. Good cash flow forecasting is a balancing act, juggling your cash inputs and outputs. One of the reasons why many businesses fail is poor cash flow management.

As stated by Lip (2003) the construction payment blues have domino effects. A payment delay by one party may affect the whole supply chain of payment of a construction project. For instance, if an employer delays in making payment to the contractor, this in turn will result in contractor's delay in making payment to the sub-contractor. The further consequences of the negative chain effect will create cash flow problems. Lack of access to finance, both during pre-construction which disqualifies emerging contractors from meeting guarantee and performance bond requirements and during construction, which leads to cash-flow problems, incomplete work and even liquidation are financial constraints facing emerging contractors.

The payment predicament of the construction industry cannot be singly explained. All parties including the owners, consultants, contractors, subcontractors, suppliers and even public sector employers have an important role and must act in concert to take ownership of the problems and challenges. To this end, the industry as a whole must collaborate and focus on their synergies to eliminate as much as possible, poor, inefficient and outdated payment practices and smoothen cash flow supplies down the payment supply chain (Lip, 2006).

The payment delay from owners will affect the cash flow of the contractor and retain age with held by the owner will also create cash flow problem to the payment delay problem is interrelated with the cash flow problem. Cash flow in the construction industry is critical because of the relatively long duration of projects. Any deviation due to either project delays or cash flow delays can have major impact on the project (Mei Ye and Abdul Rahman, 2010).

Frimpongs *et al.*(2003) studied 26 factors that cause cost overruns in construction of ground water projects in Ghana. According to the contractors and consultants, monthly payments difficulties was the most important cost overruns factor.

2.8 Payment delay risk and claims

The owner should pay the contractor a risk premium for the risk of payment delays, since the money collected as part of the project mobilization fund is never returned to the government even if there is no payment delay (Adams, 2008).

Khosrowshahi (2000) identified other risk factors that impact on cash flow to include payment delay and difficulty in obtaining the right amount of funds at reasonable interest rates.

The contractor's payments are withholding throw corrective action from the contractor, if the contractor is not served a suitable notice on time either in the certified copy of the running bill or through a separate letter, owner is not in a position to levy liquidated damages in spite of an express provision in the contract. The other reason for withholding payment is that the owner being of poor means for the time being and defaults in making payment. Contractor in this case becomes suitable for the claims of interest charges on the payment delay (Iyer *et al.*, 2008).

Cross claim, not unexpectedly, has always been the main subject of dispute in relation payment in construction industry. Among the identified court cases, the most common employer's cross claim against the contractor's payment claim include: defective works, delay in completion i.e. liquidated and ascertained damages. The employer resisted the contractor's claim on the grounds that the work executed was defective and that other contractors had to be engaged for remedial works. Second, the contractor was late in completing the work despite the architect having granted to the contractor an extension of time in respect of this delay which was caused. The court allowed the employer's counterclaim for defective work which had been proved in evidence but rejected the employer's claim which the extension of time had been granted by the architect. The grant of an extension of time exonerated the contractor from liability for liquidated damages, as a landmark court case in relation to employer's right to cross claim, the Federal Court held that the employer could not refuse to pay an interim certificate issued by an architect except for permissible contractual deductions expressly provided such as liquidated damages, retention sum and etc. In the absence of the exercise of these relieves, the employer is obliged to make payment on the said certificates as a manner of law not withstanding that the interim payment certificate issued may include defective works (Tony, 2006).

Once a payment dispute arises, it is in everyone's interest to settle it as quickly as possible. It has been suggested that adjudication has become the dispute resolution method of choice for which, in time past would have gone to arbitration. Statutory adjudication tries to deal with payment problems by rapid adjudication processes that will quickly deal with obvious unreasonable failure to pay, while reserving more detailed processes for complex disputes (Gow, 2006).

2.9 Payment delay causes

National Construction Association of Sri Lanka (2008) classified the payment delay causes as:

1. A lack of capacity from the owner and consultant to manage adequately the project in all its stages and this lead to additional work.
2. Commencing works to suit the needs of politicians haphazardly and later finding it difficult to obtain the necessary funds.
3. Variation and extra works payment is paid only with the final payment of the contract.
4. The check and balance system, which is at core of the governments to manage their departments by limiting the consequences of injustice and incompetence.
5. Contractors for their part favor more balanced contracts which could help them to resist blackmails and to check the spreading of irresponsible incompetence.

Ayudhya (2012) had classified four main categories which were administration, financial, technical and inspection and other common and identified twenty-four causes of payment delay factors. The result showed that main contractors faced moderately severe impact from four main categories of delaying in payment. All the three groups of respondents generally agreed that the top five causes of delay in payment factors arranged in descending order of severity were owner financial problems, delay in work approval, major accidents, inaccurate bill of quantities and substandard workmanship.

The causes of payment delay according to (Abdul-Rahman *et al*., 2009) are the client's poor financial and business management, withhold of payment by client, contractor's invalid claim, delay in valuation and certification of interim payment by consultant, inaccuracy of valuation for work done, insufficient documentation and information for valuation, involvement of too many parties in the process of honoring certificates, heavy work load of consultant to do evaluation for work done, contractor's misinterpretation of client's requirement of variation order.

The causes of payment delay for contractors are delay in certification, paymaster's poor financial management, local culture, paymaster's failure to implement good governance in business, underpayment of certified amounts by the paymaster, the use of "pay when paid" clauses in contracts, disagreement on the valuation of work done, paymaster's wrongful withholding of payment, short of current year project budget, poor communication among parties involved, delay in submitting contractor's payment claim, conflict among parties involved, poor understanding of the contract (Munaaim, *et al*., 2006).

There is payment delay for the completed work due to bureaucracy in governments departments. Regular monthly payment to contractors for work done removed constraints which otherwise may have impeded project progress to cause delay and cost overruns (Frimpongs, *et al.*, 2003).

The study of Mei Ye and Abdul Rahman, (2010) found that respondents have highest ranked five significant variables out of a total of forty-one variables which can caused the payment delay problems: a) cash flow problems due to deficiencies in client's management capacity; b) client's ineffective utilization of funds; c) scarcity of capital to finance the project; d) clients failure to generate income from bank when sales of houses do not hit the targeted amount; and e) poor cash flow because of lack of proper process implementation, delay in releasing of the retention monies to contractor and delay in the evaluation and certification of interim and final payment.

2.10 The necessity of the payment in time

The objectives of atypical construction industry according to National Construction Association of Sri Lanka (2008) payment is necessary on time because:

1. Cash in hand is fuel to run the project without stopping.
2. The contractor's ability to tender and obtain new work.
3. It is very important to contractors to acquire a new technologies, machineries, management techniques and developments in the industry around the world.
4. Foreign contractors are able to make such investments because they receive huge financial support from their government with very low interest rates.
5. The contractor's perform their benevolent activities in their areas such as donating funds for charitable projects.
6. The development of contractor's enterprises is their aim as well as the country's aim which can be achieved if the contractors get their payments in time.
7. The construction industry is one of the most significant sources of employment to engineers, technicians, skilled labor and managers. When the monthly salary not paid on the set date the employee as well as his family faces difficulties.

Assaf and Hejji, (2006) recommended to pay progress payment to the contractor on time because it impairs the contractors ability to finance the work.

Odeyinka and Kaka (2005) showed that while contractors were satisfied with most of the contractual factors investigated under both procurement systems, they were dissatisfied with two of the factors, namely, time lag between entitlement to receive and actually receiving cash payment and percentage of contract sum retained. This dissatisfaction calls for action to consider devising alternative means of dealing with retention and payment delay.

2.11 The effect of payment delay on construction industry

Lip (2003) concluded that during the years, with the diminished volume of construction work, contractors are reeling under relentless pressure to tender with little or non-existent margins or as most aptly called 'suicide' bids just to sustain the flow of work orders. Payment to contactors or lack of it is a common cause of disputes in the construction industry. Timeliness of payments affects many contractors, for whom receiving payment delay from their owners is a cause of friction between the two parties.

Meng (2002) in his works stated that all problems in construction begin when payment is not received at the exact amount or date. Disagreements then leads to arguments as relationships sour, and the stage become a setting for conflict, blame, finger pointing and lawyers. Project exceed initial time and cost estimates and experienced extensive delays. But contractor are the one who suffers the most when things like this occur. This is the case especially when design and built construction contract are practiced more and more nowadays.

Payment delay never bring justice to contractors. Sub-contractors are very much the same, if not worse condition, because of payment delay (Artidi and Chotibongs, 2005).

The effects of payment delay according to contractors create cash flow problems, create stress on contractors creates financial hardship, creates negative chain effect on other parties, results in delay in completion of projects, creates negative social impacts, leads to abandonment of projects, results in formal dispute resolution (litigation / arbitration), leads to bankruptcy or liquidation (Munaaim, *et al*., 2006).

Statistics from South Africa (2005) shows that from 1995 to 2005, about (5,907) construction companies were formally liquidated. The Construction Industry Development Board (CIDB) states that much more than (90%) of the emerging black contractors survived the first five years. The CIDB further highlights that (1,400) construction companies were liquidated over the past three years. Emerging contractors feel that the banks are reluctant to deal with them unless exorbitant interest rates and through compulsory business management services. Complexity, risks involved in the construction industry have led to enormous failures especially in small contractors and those small emerging contractors harboring the wrong impression that there is quick money to be made are the mostly affected (Ngala, *et al*., 2005).

Wiguna and Scott (2005) studied the risks affecting construction delays and cost overruns in building projects in Surabaya and Indonesia. They identified the most critical factors as: high inflation/increased material price; design change by client; defective design; weather conditions; payment delay on contracts and defective construction work.

Amoako (2011) said that Sub-contractors are also affected by payment delay. Subcontractors are often paid late by main contractors because of pay-when-paid and pay-if-paid clauses included in most contract forms. The consequences of the subcontractors being paid late are grave. In such situations, some subcontractors tend to increase their quotations, which in turn increases total project cost, an undesirable condition for owners. It should be possible to improve subcontractor payment practice if developers pay main contractors on time, and in turn main contractors pay their sub-contractors right after completion of sub-contract work. Other than that, payment delay will also affect the contractor's performance. He can lose his workers. He wouldn't have sufficient funds for the construction.

The drive to maximize positive cash flow will continue to lead to disputes about payment. The disputes predominantly about payment issues are becoming larger and more complex. There are various methods of dispute resolution, which range from the less structured form of mediation to the rigid procedures found in court litigation. The prolonged and complicated procedures in arbitration is said to be the cause for the need for introducing statutory adjudication (Cheng, 2006).

2.12 Remedies for payment delay

One possible remedy to the payment delay problem by the employer in not paying in time is to allow for the contractor to claim for interest. This affords some relief to the contractor but this can be a double-edged sword for the contractor for it effectively allows the employer to suspend payment and not commit a breach of contract. Another remedy which contractors can resort to is to suspend further performance of his obligations under the contract. According to the understanding of the FIDIC, the contractor may either suspend work or reduce the rate of work, and even has the authority to terminate his employment under the contract after giving notice to the owner, with a copy to the engineer. This can be a safe position taken by the contractor and is in fact one routinely taken by the contractor when non-payment from the

employer ensues. But for late payment, this action might be too harsh and impose another problem at site such as illegal suspension of work by the contractor. There are persuasive writings arguing for remains that this is currently not the established law (Nazir, 2006).

It shall be established that in the event of the owner's or developer's failure to make a progress payment to the contractor within the time stated in the contract, by notifying the owner, the contractor may ask the client to effect a progress payment. If the client still fails to pay after receipt of the contractor's notice, the client may negotiate with the contractor for payment on deferred terms. If the client and the contractor come to an agreement, the client shall pay delayed interest. But if both of them do not come to an agreement and the contractor is unable to continue his work, the contractor may suspend work and the client shall bear the liability for breach of contract (Meng, 2002).

The remedial actions mentioned previously are usually for payment delay during the construction process. But what will happen if payment delay occurs after construction period? It must be noted that payment delay also occurs at the end on the construction process. In practice, clients often take over completed projects before making completion payment to contractors (Artidi and Chotibhongs, 2005).

The possible solutions according to contractors are the right to regular periodic payment, the right to a defined time frame for payment, the right to a speedy dispute resolution mechanism eg: adjudication, the right to interest due to payment delay, the mandatory creation of a trust account for retention sums, a right to suspend work, the restriction of the right to set-off or withhold sums due, the creation of a right to a lien, the prohibition of "pay when paid" clauses in contracts (Munaaim, *et al*., 2006).

Tony (2006) says that, perhaps the question which troubles a contractor most now is the question of non-payment or payment delay by the employer. The effecting of payment to the contractor in return for the performance of the works under the contract is one of the primary obligations of the employer. Default of which may result in breach of contract on part of the employer and with its attendant consequences. These may be either expressly stipulated in the contract itself or implied from the prevailing industry practice, although the tendency is, and has been, for express provisions to prevail. Should there be any default in disbursing the required sum; the contractor may then resort to his various remedies which include: under the express contractual provisions; repudiate the contract and attempt to recover the necessary

damages under common law principles. What does the contract provide? It is clear that the first place for an injured party to look for a description of his remedy in the event of breach must been the terms of his contract. Contractual remedies of payment default in Malaysian standard forms of building contract may include as follows: determination of employment; interest on the unpaid amount; suspension of the work.

Contractors and subcontractors indicated that payment bonds, direct payments and the use of trust accounts were preferred solutions to the payment problems experienced by industry (Ramachandra and Rotimi, 2012).

There is a necessity for such rights to be conferred statutorily. The right of suspension is an important remedy. The contractor has the right to stop work until the payment is made. It can be an effective means of securing overdue payment without the need to instigate other formal procedure such as arbitration and litigation. It is a 'self-help' remedy and can sometimes be used in parallel with these procedures (Pettigrew, 2005).

2.13 Payment delay in Gaza Strip construction industry

Making progress payments to contractors on time is critical. Expediting the reviewing and approving of design documents, shop drawings, and payments to contractor can reduce any delay or cost overruns at the projects in Gaza Strip (Enshassi, *et al.*, 2009).

Most consultants and contractors stated that the project was sometimes delay by payment delay from the owner. In the Gaza Strip, contractors usually suffer from this problem. Payment delay from owner to contractor lead to delay of contractors' performance and cause problem in time performance. This may also lead to disputes and claims between owner and contractor of project. All of that will affect the overall performance of project which has been implemented (Abu Shaban, 2008).

The financial difficulties are an effectual cause of construction disputes, because contractors always depend on the payments to be received on time in order to pay their obligations. the contractor tries to avoid failure by claiming the owner for payments that are not due yet. Because the Gaza Strip companies are of small size, any

payment delay or any design changes can affect the company's ability and might lead to disputes and claims (Abu Rass, 2006).

Most of projects in Palestinian National Authority are funded by donors. During Al-aqsa Intifada, construction companies have traditionally complained delay in collecting debts from donors as a direct impact of local business political environment. This cause is also directly related to cash flow management. With lack of capital and lack of financial resources, delay of collecting debts from donors makes the negative effect much worse (Al-Hallaq, 2003).

El Karriri (2008) study recommended the clients and consultants to minimize the due time of the payment not to be more than (20 days) from the submission of the payments request by the contractor. In addition, to simplify the payment policy at the contractors. This recommendation is expected to promote and enhance the bidders' decisions in the bidding process.

The respondents considered this item as one of the most factors that hamper constructability in terms of financial issues for their recognition that inadequate system of payment may lead to project interruption and disputes (El -Hourani, 2008).

Abo Mostafa (2003) stated that payment delay has high effect on labor productivity and ranked in position 6 among all factors negatively affecting labor productivity. This result is justified as payment delay has very bad effect on labor mood and consequently decreases its productivity.

2.14 Payment delay risks modeling

Adams (2008) presented an application of an expert elicitation model and Bayesian methods to the analysis of the risk of payment delays in international contracts set in a developing economy, and a determination of how differing perceptions about risks affect estimates about the risk. Expert opinions about the risk of payment delays in an international contract set in Ghana are transformed into prior distributions about the risk using the relative likelihood method and combined with sample information about the risk for a Bayesian analysis of the risk.

(Kwon, *et al.*, 2009) formulated a model enabled to examine how payment delay affects the supplier's optimal work rate, the manufacturer's optimal payment, the supplier's and the manufacturer's expected discounted profits, and the expected project completion time.

2.15 Types of models

According to Amer (2002) Models can be of several types, but common models are as under:

Iconic model: is a pictorial or visual representation of certain aspects of a system. In iconic models the relevant properties of the real thing are represented by the properties themselves, usually with a change of scale.

Analogue model: use one set of properties to represent another set of properties. They are more abstract than iconic models. Such models are easier to manipulate and can represent situation. Graphs representing time series, flow charts, demand curves, frequency graphs are examples of analogue models.

Symbolic or Mathematical model: in this model, the components of what is represented and their inter-relationships are given by symbols. These models use letters, numbers and other types of symbol s to represent variables and the relationship between them. Such models assume the form of equations or inequalities depicting the relationships amongst the variables of the system.

2.16 Chapter summary

Payment has been referred to as the lifeblood of the construction industry due to latter's inherent nature that takes relatively long durations and large amounts of money to complete. Payment delay will cause problems especially to contractors, payment delay issues are considered to affect many players in the local construction industry.

After studying many researches in this chapter; the factors that causing the payment delay problems in construction, the effects of payment delay on construction and the effective remedies of payment delay risks were identified. Payment delay issue in Gaza's construction industry was also discussed. Payment delay modeling and types of models were explained. Reference has been made to few works on this issue worldwide that highlighted the payment delay problems.

CHAPTER (3)

METHODOLOGY

3.1 Introduction

This research presents causes of the payment delay on construction projects; effects of payment delay and to determine the effective solutions to mitigate effects and risks of payment delay in Gaza Strip construction industry; to reduce their effects and to establish a model to measure the risk of payment delays.

The successful execution of construction projects and keeping them within estimated cost and prescribed schedule depend on a methodology that requires sound engineering judgment. Payment delay lead to delay in projects completion, nonconformance and safety problems as well as bankruptcy.

The methodology explain how the objectives of this research can be achieved. The objectives are: identifying the factors that cause the payment delay in construction projects; identifying the effects of the payment delay on construction projects; investigating how to mitigate the payment delay effect and risk in construction projects; formulating a model to measure the risk of payment delay.

This study was carried out based on literature review and questionnaire survey. Then data collection from the questionnaire survey was analyzed using the statistical methods, and their results were be presented.

The methodology based on subjective data; the subjective data were qualitative and based on the knowledge and experience of the respondents.

A model to measure the risk of payment delay was formulated and tested. Conclusion and recommendations were drawn up.

Figure (3.1) shows summary of methodology used in this research.

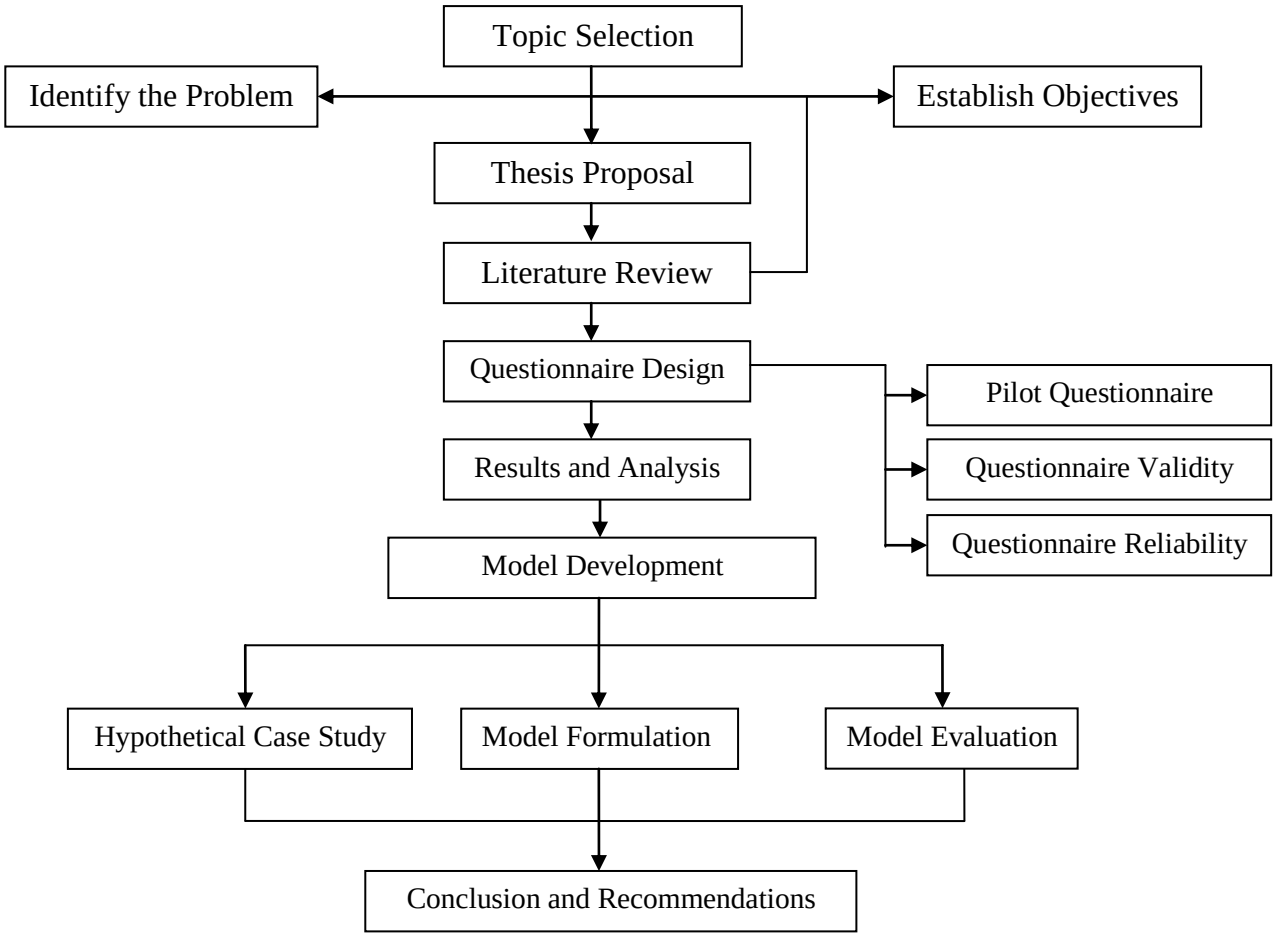

Figure (3.1) Summary of methodology used in this research

3.2 Research period

The study started in March 2012 when the initial proposal was approved. The literature review was completed on the end of November 2012. Questionnaire design, validity testing, piloting, questionnaire distribution and data collection took two months and completed on February 2013. The results analysis were completed on May 2013. Model development, conclusion and recommendation were completed from June till November 2013, so the total duration of the this study was twenty months.

3.3 Research location

The research was carried out in Gaza Strip, which consists of five governorates, the North Gaza, the Middle, Khan Younus and Rafah. These five governorates are considered the southern governorates of Palestinian National Authority (PNA).

3.4 Data collection

Data collection is the most critical part of the study since the accuracy of the data is related to the success or failure of the research. Data was obtained through questionnaires. Questionnaires were analyzed accordingly using appropriate analysis techniques. Then responses from questionnaires were compiled and analyzed. Data collected from different questions was gathered to answer different objectives. Analysis was done based on various categories by using the statistical methods.

3.5 Questionnaire design

The questionnaire was designed based on factors that were identified to contribute to the causes of payment delay. The effect of payment delay on construction projects, and to identify the effective remedy to the payment delay effects.

The questionnaire accompanied with a covering letter was delivered to respondents. The letter indicates the objectives of the research.

The questionnaire survey was developed to assess the views of contractors', clients' and consultants' engineers. The questionnaire was designed into four sections: section A, section B, section C and section D.

3.5.1 Section A: General information

This section is to obtain the information about the respondents. The questionnaire includes the following :

1. The type of respondent organization or company.

2. The respondent position in the organization/company.
3. The number of years that the respondent has experience in the construction industry.
4. The number of years that the respondent organization or company has experience in construction.
5. The number of constant employees at the respondent organization or company.
6. The type of project that the respondent has worked recently.
7. The respondent recently project price.

3.5.2 Section B: Factors that contribute to causes of payment delay

This section is focus to identify the major causes of payment delay in construction project on Gaza construction projects. The respondents were asked to rank the individual causes of payment delay on Gaza construction projects based on frequency of occurrence according to their own judgment and working experience.

This section was grouped into four major groups which are:

1. Owner related factors.
2. Consultant related factors.
3. Contractor related factors.

The questionnaire is mainly based on Linkert's scale of five ordinal measures from one (1) to five (5) according to level of frequency.

3.5.3 Section C: The effect and risk of payment delay

This section is focused to identify the frequent effect and risk of payment delay on Gaza construction projects. The respondents were asked to rank the individual effects and risk of payment delay on Gaza construction projects based on frequency of occurrence according to their own judgment and working experience.

This section was grouped into four major groups which are:

1. Effects on project characteristics.
2. Effects on owner.
3. Effects on consultant.
4. Effects on contractor.

The questionnaire is mainly based on Linkert's scale of five ordinal measures from one (1) to five (5) according to level of frequency.

3.5.4 Section D: The effective remedy to the payment delay

This section is to identify the effective remedy to the payment delay. The questionnaire is mainly based on Linkert's scale of five ordinal measures from one (1) to five (5) according to level of effectively.

3.6 Questionnaire distribution

The target groups in this study are owners, contractors and consultants. According to the Palestinian Contractors Union (PCU) in Gaza Strip interview on December 2012, there are 60 contracting companies are classified as first class (A and B) at the building field. According to Engineers' Syndicate in Gaza strip interview on December 2012, there are about 30 actual consultant offices. Number of owners is determined as 25 owners in Gaza Strip (Abu Shaban, 2008). The owners are governmental ministries, nongovernmental organizations and main municipalities.

Kish (1965) showed that the sample size can be calculated as following equation for 94% confidence level (Assaf *et al*., 2001).

$$n = n' / [1+(n'/N)]$$

Where:

N = total number of population

n= sample size from finite population

n' = sample size from infinite population = S^2/V^2; where S is the variance of the population elements and V is a standard error of sampling population. (Usually S= 0.5 and V = 0.06)

So, for 60 contractor building (First A and B classes) companies:

n= n'/ [1+(n'/N)]

n'= $S^2/V^2 = (0.5)^2/(0.06)^2$

= 69.44

N = 60

n= 69.44/ [1+(69.44 / 60)] = 32

This means that the questionnaire should be distributed to 32 contractor companies in order to achieve 94% confidence level.

So, for 30 consultant offices:

n= n'/ [1+(n'/N)]

n'= $S^2/V^2 = (0.5)^2/(0.06)^2$

= 69.44

N = 30

n= 69.44/ [1+(69.44 / 30)] = 21

This means that the questionnaire should be distributed to 21 consultant offices in order to achieve 94% confidence level For owners.

According to previous results of sample sizes, 140 questionnaires were distributed as follow: 55 to owner engineers, 25 to consultant engineers and 60 to contractor engineers. 113 questionnaires were received (80.71%) as follows: 49 (89%) from owners, 45 (75%) from consultants and 19 (76%) from contractors.

3.7 Data analysis

The procedure used in analysis of data was aimed at establishing the relative index. Average score obtained for each factor was used to determine the important factors.

Since Linkert's scale of (5) point was used which would result in the interval from (1) to (5) was distributed into (5) interval, each interval had a length of ((5-1)/5) = 0.8. Therefore for the average (mean) score the intervals were defined as :

Very low	1.00 to 1.79
Low	1.80 to 2.59
Medium	2.60 to 3.39
High	3.40 to 4.19
Very high	4.20 to 5.00

Factors scoring in average of 3.40 or more shall be considered as high importance (Ozen *et al*., 2012).

To achieve the research goal, researcher used the Statistical Package for the Social Science (SPSS) for manipulating and analyzing the data.

3.8 Data measurement

In this research, ordinal scales were used. Ordinal scale is a ranking or a rating data that normally uses integers in ascending or descending order. The numbers assigned to the high or low effect (1,2,3,4,5) do not indicate that the interval between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels. Based on Linkert's scale, Table (3.1) depict the used scale.

Table (3.1) Ordinal scale used for data measurement

Item	Very high	High	Medium	Low	Very low
Scale	5	4	3	2	1

3.9 Pilot study

These structured questionnaires should be based on a carefully prepared set of questions piloted and refined until the researcher is convinced of their validity. Therefore the pretesting is an important stage in the questionnaire design process, prior to finalizing the questionnaire. It involves administrating the questionnaire to a limited number of potential respondents and other knowledgeable individuals in order to identify and correct design flaws. The Arabic version of questionnaire was tested in order to make sure that the questions were easily understood. The test was made by distributing six drafts of the questionnaire, these questionnaires were distributed to expert engineers such as project manager, site engineer, office engineer and firm manager. In general, they agreed that the questionnaire is suitable to achieve the goals of the study. The following items are summary of the main results obtained from pilot study:

3.9.1 Section (B): The factors that contribute to causes of payment delay in construction projects

3.9.1.1 Group (1)

Item (1) 'Delay in certification' was modified to 'Taking over of the works certificate'.

Item (4) 'Failure to follow the certain procedures in claims' was modified to 'Evaluation of the contractor claims'.

Item (5) 'Bureaucracy in governments departments'; the Arabic translation to the item was modified to be represented with more clear meaning.

Item (6) 'Frequency of exchange rate of currencies' added.

3.9.1.2 Group (2)

Item (1) ' Underpaid claims' ; the Arabic translation to the item was modified to be represented with more clear meaning.

The items (5) 'Lack of technical and managerial skills of staff ' and (9) 'Less periodical meetings to address work problems' from section (C) were transferred to section (B) group (2) and became items (6) and (7) to this group.

3.9.1.3 Group (3)

The items (5) 'Willing to accept onerous payment term from clients due to difficulties in obtaining project' and (7) 'Failure to agree with the valuation of work'; the Arabic translation to the items were modified to be represented with more clear meaning.

3.9.2 Section (C): The effect and risk of payment delay on construction projects

3.9.2.1 Group (1)

Items (2) 'Delay in project completion' and (10) 'Abandonment of the project from contract parties' were deleted from this group because it was unclear.

3.9.2.2 Group (2)

Item (9) 'Compensations due to risk of payment delay' was modified to 'Cost overrun due to risk of payment delay'.

3.9.2.3 Group (3)

The items (5) 'Lack of technical and managerial skills of staff ' and (9) 'Less periodical meetings to address work problems' from section (C) were transferred to section (B) group (2) and became items (6) and (7) to this group.

Item (8) ' Waiting time for approval of tests' was modified to 'Waiting time for approval of samples '.

3.9.2.4 Group (4)

Item (6) 'Contractor's financial difficulties' was deleted from this group because it was repeated.

Item (7) 'High interest rate' was modified to 'High interest rate due to loans' and the item number became (6) after deleted item (6).

3.10 Validity of the research

This section presents test of validity of questionnaire according to the pilot study. The validity of an instrument is a determination of the extent to which the instrument actually reflects the abstract construct being examined. "Validity refers to the degree to which an instrument

measures what it is supposed to be measuring" (Pilot and Hungler, 1985). High validity is the absence of systematic errors in the measuring instrument. When an instrument is valid; it truly reflects the concept it is supposed to measure (Wood and Haber, 1998). Achieving good validity required the care in the research design and sample selection. The amended questionnaire was by the supervisor and six expertise to evaluate the procedure of questions. The expertise agreed that the questionnaire was valid and suitable enough to measure the purpose that the questionnaire designed for. Validity has a number of different aspects and assessment approaches.

3.10.1 Statistical validity of the questionnaire

To insure the validity of the questionnaire through the SPSS software, two statistical tests should be applied. The first test is Criterion-related validity test (Pearson test) which measure the correlation coefficient between each item in the field and the whole field. The second test is structure validity test (Pearson test) that used to test the validity of the questionnaire structure by testing the validity of each field and the validity of the whole questionnaire. It measures the correlation coefficient between one filed and all the fields of the questionnaire that have the same level of similar scale.

3.10.1.1 Criterion related validity test

Internal consistency of the questionnaire is measured by a scouting sample, through measuring the correlation coefficients between each paragraph in one field and the whole filed. Tables (3.2) to (3.4) at appendix (A) shows the correlation coefficient and P-value for each field items. As shown in the Table, P-values are less than 0.01, so the correlation coefficients of this field are significant at $\alpha = 0.01$. It can be said that the paragraphs of this field are consistent and valid to be measure what it was set for. The results of criterion-related validity test can be obtained with more details at appendix (A).

3.10.1.2 Structure validity test

Structure validity is the second statistical test that used to test the validity of the questionnaire structure by testing the validity of each field and the validity of the whole questionnaire. It measures the correlation coefficient between one filed and all the fields of the questionnaire that have the same level of Linkert's scale.

As shown in Table (3.5), the P-values (significance) are less than (0.01), so the correlation coefficients of all the fields are significant at $\alpha = 0.01$, so it can be said that the fields are valid to be measured what it was set for to achieve the main aim of the study.

Table (3.5) Structure validity of the questionnaire

Section	Title of section	Pearson correlation coefficient	P-value
Section B	The factors that contribute to causes of payment delay in construction projects	0.751	0.000
Section C	The effect and risk of payment delay on construction projects	0.958	0.000
Section D	The effective remedy to the payment delay	0.786	0.000

3.11 Reliability of the questionnaire

Reliability of an instrument is the degree of consistency with which it measures the attribute it is supposed to be measuring. The test is repeated to the same sample of people on two occasions and then compares the scores obtained by computing a reliability coefficient (Polit and Hunger, 1985). For the most purposes reliability coefficient above (0.7) are considered satisfactory. Period of two weeks to a month is recommended between two tests. Due to complicated conditions that the sample is facing at the time being, it was too difficult to ask them to responds to our questionnaire twice within short period. The statistician's explained that, overcoming the distribution of the questionnaire twice to measure the reliability can be achieved by using half split method and Cronbach's coefficient alpha through the SPSS software.

3.11.1 Half split method

This method depends on finding Pearson correlation coefficient between the means of odd rank questions and even rank questions of each field of the questionnaire. Then, correcting the Pearson correlation coefficients can be done by using Spearman Brown correlation coefficient of correction. The corrected correlation coefficient (consistency coefficient) is computed according to the following equation :

Consistency coefficient = $2r/(r+1)$, where r is the Pearson correlation coefficient (Burns and Grove, 1987).

The normal range of corrected correlation coefficient 2r/(r+1) is between (0.0 and + 1.0) as shown in Table (3.6), the general reliability for all items equal (0.8936), and the significant α is less than (0.05) so all the corrected correlation coefficients are significance at α = (0.05). The results obtained from Table (3.6) that illustrate half split method showed that the value is ranged from (0.7 to 0.9) which reflect very good results.

Table (3.6) Split-Half coefficient method

Section	Title of section	Person-correlation	Spearman-Brown coefficient	P-value
Section B	The factors that contribute to causes of payment delay in construction projects	0.8317	0.9081	0.0000
Section C	The effect and risk of payment delay on construction projects	0.7928	0.8844	0.0000
Section D	The effective remedy to the payment delay	0.7829	0.8782	0.0000
	Average	0.8076	0.8936	0.0000

3.11.2 Cronbach's coefficient alpha

This method is used to measure the reliability of the questionnaire between each field and the mean of the whole fields of the questionnaire. The normal range of Cronbach's coefficient alpha value between (0.0) and (+1.0), and the higher values reflects a higher degree of internal consistency. As shown in Table (3.7) the Cronbach's coefficient alpha was calculated and the general reliability for all items equal (0.9076). This range is considered high; the result ensures the reliability of the questionnaire.

Table (3.7) Cronbach's coefficient alpha

Section	Title of section	Cronbach's Alpha
Section B	The factors that contribute to causes of payment delay in construction projects	0.9267
Section C	The effect and risk of payment delay on construction projects	0.8991
Section D	The effective remedy to the payment delay	0.8978
	Average	0.9076

3.12 Statistical manipulation

To achieve the research goal, the Statistical Package for the Social Science (SPSS) was used for manipulating and analyzing the data.

One Sample K-S Test

One Sample K-S (The Kolmogorov-Smirnov) test was used to identify if the data follow normal distribution or not, this test is considered necessary in case testing hypotheses as most parametric test stipulate data to be normality distributed and this test used when the size of the sample are greater than (50).

Results test as shown in Table (3.8), clarifies that the calculated P-value is greater than the significant level which is equal (0.05), P-value > (0.05), this in turn denotes that data follows normal distribution and so parametric tests must be used.

Table (3.8) One sample K-S

Section	Title of section	Statistic	P-value
Section B	The factors that contribute to causes of payment delay in construction projects	0.659	0.778
Section C	The effect and risk of payment delay on construction projects	0.951	0.326
Section D	The effective remedy to the payment delay	0.895	0.400
	Average	0.681	0.742

3.13 Data processing and analysis

The collected raw data was first sorted, edited, coded and then entered into computer software using SPSS software. Appropriate graphical representations and tables were obtained to understand and analyze the questions. The ordinal scale was used in the analysis process. The ordinal scale is a ranking or rating data which normally uses integers in a seconding or descending order. The Relative Index (RI) was used in the analysis in addition to other approaches such as the T-test and frequencies and percentiles.

Linkert's scale was used for ranking questions that have an agreement levels. The respondents were asked to give their perceptions in group of questions on five-point scale 1 for the strongly disagree to 5 for the strongly agree, which reflects their assessment

regarding the factors affecting bidding process. The relative index was computed using the following equation:

$$\text{Formula Relative Index} = \frac{\sum W}{AN} = \frac{5n_5+4n_4+3n_3+2n_2+1n_1}{5N}$$

Where W is the weighting given to each factor by the respondent, ranging from 1 to 5, (n_1 = number of respondents for strongly disagree, n_2 = number of respondents for disagree, n_3 = number of respondents for neutral, n_4 = number of respondents for agree, n_5 = number of respondents for strongly agree). A is the highest weight (i.e. 5) and N is the total number of samples. The relative index ranges from 0 to 1 (Cheung *et al*., 2004).

3.14 Development of the research model

In order to develop a models to measure the risk of payment delay on construction projects, the identified (9) significant risk factors were used as the independent variables; late payment of salaries, time overrun of project, cash flow problems, slow down the progress until payment is received, difficult to procure material and services, difficult to tender for new projects, sub-contractor refuse to continue works on the project, bad reputation of the contractor, high interest rate due to loans.

The developed model was formulated and evaluated to realize the effectiveness and practicality to use for measuring the risk of payment delay on construction projects in Gaza Strip.

3.15 Chapter summary

The whole chapter explain the methodology used in this study step by step. The methodology used was considered to achieve the earlier mentioned objective. For better understanding, the methodology in this research has been simplified into a flow chart diagram as shown in Figure (3.1). The figure explains briefly the steps from the initial stage of identifying problem to discussing the method of analyzing data.

CHAPTER (4)

RESULTS AND ANALYSIS

4.1 Introduction

This chapter contains the results of the research questionnaire. It discusses the results that have been deduced from a field survey of (113) questionnaires. Section one present general information about the respondents. Section two was designed to achieve the objectives of this research. These objectives intend to study the effect of payment delay on construction projects in Gaza Strip.

4.2 Part one: Section (A) general information

This part mainly is designed to provide general information about the respondents in terms of the type of respondent organization or company, respondent position in the organization /company, number of years that the respondent has experience in the construction industry, number of years that the respondent organization or company has experience in construction, number of fixed employees at the respondent organization or company, the type of project that the respondent has worked recently and respondent recently project price.

4.2.1 Type of respondents organization or company

Table (4.1) shows that the frequency and percent of each type of organization or company, where the response rate for owners was (43.4%) from the sample size, the response rate for contractors was (39.8%) from the sample size and the response rate for consultants was (16.8%) from the sample size. This means that the majority of respondents were from owners, who represented governmental ministries, United Nations Relief and Works Agency (UNRWA), United Nations Development Program (UNDP), municipalities and a another associations spread in Gaza Strip.

Table (4.1) Type of respondent organization / company

Type of your organization / company	Frequency	Percentages (%)
Owner	49	43.4
Contractor	45	39.8
Consultant	19	16.8
Total	**113**	**100.0**

4.2.2 Respondent position in the organization/company

Table (4.2) shows that the frequency and percent of each position in the organization or company. Where the response rate for project manager was (36.3%) from the sample size, response rate for site engineer was (31.9%) from the sample size, response rate for office engineer was (15.9%) from the sample size and response rate for others was (15.9%) from the sample size. As seen more than 35 % of the respondents have key positions that insure quality information.

Table (4.2) Respondent position in the organization/company

Position in the organization/company	Frequency	Percentages (%)
Project Manager	41	36.3
Site Engineer	36	31.9
Office Engineer	18	15.9
Others	18	15.9
Total	**113**	**100.0**

4.2.3 Number of years that respondent has experience in the construction industry

Table (4.3) shows that the frequency and percent of each respondent's experience in the construction industry, where the response rate for "1 - 5 years" was (26.5%) from the sample size, response rate for "6 – 10 years " was (31.0%) from the sample size, response rate for "10 – 15 years " was (13.3%) from the sample size and response rate for " More than 15 years " was (29.2 %) from the sample size. It is clear that about a third of the respondents have experience more than 10 years, this gives strength to the data collected.

Table (4.3) Respondent's years of experience

Experience in the construction industry	Frequency	Percentages (%)
1 - 5 years	30	26.5
6 - 10 years	35	31.0
10 - 15years	15	13.3
More than 15 years	33	29.2
Total	**113**	**100.0**

4.2.4 Respondent organization years of experience

Table (4.4) shows that the frequency and percent of each respondent's organization or company experience years in the construction industry, where the response rate for "1 – 5 years" was (15.0%) from the sample size, response rate for "6 - 10 years " was (12.4%) from the sample size, response rate for "10 - 15 years " was (10.6%) from the sample size and response rate for " More than 15 years " was (61.9 %) from the sample size. The fact that more than (61.0%) of the respondent's organization or company have more than 15 years experience was reflected in the level of consistency and precision of the information provided, and provides further validity for the survey results.

Table (4.4) Respondent organization or company experience years

Organization or company have experience in construction	Frequency	Percentages (%)
1 - 5 years	17	15.0
6 - 10 years	14	12.4
10 - 15years	12	10.6
More than 15 years	70	61.9
Total	**113**	**100.0**

4.2.5 Number of fixed employees at the respondent organization or company

Table (4.5) shows that the frequency and percent of each respondent organization or company fixed number of employees, where the response rate for less than 5 employees was (8.0%) from the sample size, response rate for 5 - 10 employees was (22.1%) from the sample size, response rate for 11 - 15 employees was (7.1%) from the sample size and response rate for more than 15 employees was (62.8%) from the sample size. (30.10%) of the them have an average (1-10) employees while (69.9%) have more than 10 employees. The result indicate that most of sample size organizations were governmental, or municipalities and large companies compared with those in the Gaza Strip.

Table (4.5) Number of fixed employees at the respondent organization or company

Number of fixed employees at your organization / company	Frequency	Percentages (%)
Less than 5 employees	9	8.0
5 - 10 employees	25	22.1
11 - 15 employees	8	7.1
More than 15 employees	71	62.8
Total	**113**	**100.0**

4.2.6 Type of project that the respondent has executed recently

Table (4.6) shows that the frequency and percent of each project type that the respondent has executed recently, where the response rate for school buildings was (22.1%) from the sample size, response rate for medical buildings (hospitals) was (3.5%) from the sample size, response rate for infrastructure was (25.7%) from the sample size, response rate for residential buildings was (31.0%) from the sample size and response rate for other type of projects was (17.7%) from the sample size**.**

It's clear that more than (50%) of the respondent's organization or company were working in building fields and this was provided further quality for the results.

The infrastructure type refers to the type that respondent executed recently not to the type of contracting company, where the field of contracting companies was a building field.

Table (4.6) Type of project that respondent has executed recently

Type of project that respondent has executed recently	Frequency	Percentages (%)
School buildings	25	22.1
Medical buildings (Hospitals)	4	3.5
Infrastructure	29	25.7
Residential buildings	35	31.0
Others	20	17.7
Total	**113**	**100.0**

4.2.7 Respondent recently project price

Table (4.7) shows that the frequency and percent cost of each project that the respondent has executed recently, where the response rate for (US$) "Below 1 million" was (63.7%) from the sample size, response rate for (US$) "1 - 2 million" was (10.6%) from the sample size, response rate for (US$) "2 - 3 million" was (8.0%) from the sample size and response rate for (US$) "More than 3 million" was (17.7%) from the sample size. It's concluded that most organizational construction are considered as large organization in regard to the project sizes in Gaza Strip. It illustrate that (60%) of organizations have completed projects of value less than 1 million dollars during that period. This may be another example of small size organizations and economic weakness.

Table (4.7) Recently project price (US$)

Recently project price (US$)	Frequency	Percentages (%)
Below 1 million	72	63.7
1 – 2 million	12	10.6
2 – 3 million	9	8.0
More than 3 million	20	17.7
Total	**113**	**100.0**

4.3 Part two: The effect of payment delay on construction projects in Gaza Strip

This part consist of results and discussion of the effect of payment delay on construction projects in Gaza Strip. This part was divided into three sections. These sections are; the factors that contribute to causes of payment delay in construction projects, the effect and risk of payment delay on construction projects and the effective remedy to the payment delay.

4.3.1 Section (B): The factors that contribute to causes of payment delay in construction projects

Table (4.8) shows the relative index and ranks of factors that contribute to causes of payment delay in construction projects. This section contains three groups; group (1) contains six factors, group (2) contains seven factors and group (3) contains ten factors. In this section, only the most important factors and the least important factors will be discussed.

Table (4.8) The factors that contribute to causes of payment delay in construction

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
Group (1) owner related factors							
5	Bureaucracy in governments departments	66.53	1	43.33	1	71.58	1
4	Evaluation of the contractor claims	59.18	2	38.61	2	63.16	2
2	Taking over of the works certificate	53.88	4	38.33	3	61.05	3
1	Poor financial management	56.33	3	36.11	4	57.89	4
3	Failure to agree to the valuation of work	51.84	5	33.89	5	57.89	5
6	Frequency of exchange rate of currencies	44.08	6	28.06	6	47.37	6
Average		**55.31**		**36.39**		**59.82**	
Group (2) consultant related factors							
4	Slow processing of final accounts	61.63	2	44.72	1	71.58	1
3	Slow processing of variation orders	62.45	1	42.78	2	66.32	2
7	Less periodical meetings to address work problems	58.78	4	40.28	3	64.21	3
5	Inaccurate bill of quantities	56.33	5	38.33	4	60.00	4
2	The quality of quantity surveyor management system	59.59	3	32.78	6	57.89	5
1	Underpaid claims	48.16	7	25.28	7	50.53	6
6	Lack of technical and managerial skills of staff	56.33	6	34.17	5	45.26	7
Average		**57.61**		**36.90**		**59.40**	

Complement of Table (4.8)

No.	Factors	Owner		Contractor		Consultant	
		Relative index	Rank	Relative index	Rank	Relative index	Rank
Group (3) contractor related factors							
8	Failure to do work based on bill of quantity	66.12	3	37.50	4	78.95	1
4	Failure to follow the certain procedures in claims	68.98	1	42.22	1	72.22	2
10	Labor productivity	58.37	9	38.61	2	71.58	3
6	Poor quality of work	62.04	7	37.22	4	71.58	3
5	Willing to accept onerous payment term from clients due to difficulties in obtaining project	59.18	8	35.56	6	70.53	4
1	Capital lock up	67.76	2	35.00	7	70.53	4
9	Failure to understand the contract agreement	63.27	5	37.78	3	69.47	5
3	Delay in submitting claims	65.71	4	38.61	2	68.42	6
7	Failure to agree with the valuation of work	62.86	6	37.22	5	68.42	6
2	Submit claims with mistakes	68.98	1	35.83	5	68.42	6
Average		**64.33**		**37.56**		**71.02**	

Table (4.9) shows the relative index and ranks of factors that contribute to causes of payment delay in construction projects. The groups are factors related to owners, contractors and consultants. In this table the factors related to contractor has the high relative index (R.I = 64.33%, 37.56% and 71.02%) respectively, these results reflect the same agreement between the respondents, which indicates that the contractor is the main player in the payment delay causes.

Table (4.9) The factors that contribute to causes of payment delay in construction projects

G.	Factors related	Owner		Contractor		Consultant	
		Relative index	Rank	Relative index	Rank	Relative index	Rank
3	Contractor	64.33	1	37.56	1	71.02	1
1	Owner	55.31	3	36.39	3	59.82	2
2	Consultant	57.61	2	36.90	2	59.40	3
Average		**59.93**		**37.05**		**64.56**	

4.3.1.1 Group (1) owner related factors

Table (4.10) shows the relative index and ranks of owner related factors that contribute to causes of payment delay in construction projects. This table contains six factors. In this table, only the most important factors and the least important factors will be discussed.

Table (4.10) Group (1) owner related factors

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
5	Bureaucracy in governments departments	66.53	1	43.33	1	71.58	1
4	Evaluation of the contractor claims	59.18	2	38.61	2	63.16	2
2	Taking over of the works certificate	53.88	4	38.33	3	61.05	3
1	Poor financial management	56.33	3	36.11	4	57.89	4
3	Failure to agree to the valuation of work	51.84	5	33.89	5	57.89	5
6	Frequency of exchange rate of currencies	44.08	6	28.06	6	47.37	6
Average		**55.31**		**36.39**		**59.82**	

All views (Owners, contractors and consultants)

Table (4.10) shows that the respondents owners, contractors and consultants ranked "Bureaucracy in governments departments" in the first position with relative index (R.I = 66.53%, 43.33% and 71.58%) respectively. These results reflect the same agreement between the respondents, which indicates there is payment delay due to bureaucracy in governments departments. Regular monthly payment to contractors for work done removed constraints which otherwise may have impeded project progress to cause delay and cost overruns (Frimpongs, *et al.*, 2003).

The second factor cause payment delay in this group was "Evaluation of the contractor claims" with relative index (R.I = 59.18% , 38.61% and 63.16 %) respectively. These results reflect the same agreement between the respondents, which indicates that some reactions to payment delay taken by the contractors may have adverse effects on their own businesses. For instance, contractors may not be able to justify their claims (Danuri *et al.*, 2006).

The respondents ranked the "Frequency of exchange rate of currencies" with relative index (R.I = 44.08 %, 28.06% and 47.37) respectively as the last factor because there are no Palestinian special currency, so there is a poor culture in the field of currency changes.

Table (4.11) shows the opinion of the respondents about the owner related factors and ranked according to the relative index from high to down, the two higher R.I items as follows:

1. "Bureaucracy in governments departments" with relative index (68.50%), and P-value equal (0.0), and ranked the 1st on the overall ranking.
2. "Evaluation of the contractor claims" with relative index (60.88%), and P-value equal (0.634), and ranked the 2nd on the overall ranking.

and the two lowest R.I items as follows:

1. "Failure to agree to the valuation of work" with relative index (53.81%), and P-value equal (0.006), and ranked the 5th on the overall ranking.
2. "Frequency of exchange rate of currencies" with relative index (44.96%), and P-value equal (0.0), and ranked the 6th on the overall ranking.

For general the relative index for the opinion of the respondents about owner related factors is (57.23%) which is less than (60%), and the P-value equal (0.020) which is less than the level of significance (0.05), and the absolute value of T test equal (2.352) which is greater than the critical value which is equal (1.98) that mean the respondents views are (Negative) to the factors of this groups; where the respondents were not agree with this group factors, it may be not a suitable factors.

Table (4.11) Group (1) owner related factors

No.	Factors	Mean (5)	Standard Deviation	Relative index	T test	P-value	Rank
5	Bureaucracy in governments departments	3.42	1.108	68.50	4.074	0.000	1
4	Evaluation of the contractor claims	3.04	0.986	60.88	0.477	0.634	2
2	Taking over of the works certificate	2.90	1.077	58.05	-0.961	0.339	3
1	Poor financial management	2.86	1.093	57.17	-1.377	0.171	4
3	Failure to agree to the valuation of work	2.69	1.181	53.81	-2.788	0.006	5
6	Frequency of exchange rate of currencies	2.25	1.114	44.96	-7.176	0.000	6
Average		**2.86**	**0.627**	**57.23**	**-2.352**	**0.020**	

Critical value of t at df (112) and significance level (0.05) equal (1.98)

4.3.1.2 Group (2) Consultant related factors

Table (4.12) shows the relative index and ranks of consultant related factors that contribute to causes of payment delay in construction projects. This table contains seven factors. In this table, only the most important factors and the least important factors will be discussed**.**

Table (4.12) Group (2) consultant related factors

		Owner		Contractor		Consultant	
No.	Factors	Relative index	Rank	Relative index	Rank	Relative index	Rank
4	Slow processing of final accounts	61.63	2	44.72	1	71.58	1
3	Slow processing of variation orders	62.45	1	42.78	2	66.32	2
7	Less periodical meetings to address work problems	58.78	4	40.28	3	64.21	3
5	Inaccurate bill of quantities	56.33	5	38.33	4	60.00	4
2	The quality of quantity surveyor management system	59.59	3	32.78	6	57.89	5
1	Underpaid claims	48.16	7	25.28	7	50.53	6
6	Lack of technical and managerial skills of staff	56.33	6	34.17	5	45.26	7
Average		**57.61**		**36.90**		**59.40**	

Owners view

Table (4.12) shows that the respondents owners ranked "Slow processing of variation orders" in the first position with relative index (R.I = 62.45%). The delay in making payment to the contractor is further escalated if there is a dispute or disagreement about the value of work done or variation order (Amoako, 2011).

The respondents owners ranked the "Underpaid claims" with relative index (R.I = 48.16 %) as the last factor because the project contracts and agreements in Gaza Strip include items which give the consultant this right when the delay occurred from another parties.

Contractors and consultants view

Table (4.12) shows that the respondents contractors and consultants ranked "Slow processing of final accounts" in the first position with relative index (R.I = 44.72% and 71.58%) respectively, these results reflect the same agreement between the respondents, which indicates there is payment delay due to slow processing of final accounts by the consultants (Mei Ye and Abdul Rahman, 2010) and contractors.

The second factor cause payment delay in this group was "Slow processing of variation orders" with relative index (R.I = 42.78 % and 66.32 %) respectively. The delay in making payment to the contractor is further escalated if there is a dispute or disagreement about the value of work done or variation order (Amoako, 2011).

Table (4.13) shows the opinion of the respondents about the consultant related factors and ranked according to the relative index from high to down, the two higher R.I items as follows:

1. "Slow processing of final accounts" with relative index (67.26%), and P-value equal (0.0), and ranked the 1st on the overall ranking.
2. "Slow processing of variation orders" with relative index (65.49%), and P-value equal (0.005), and ranked the 2nd on the overall ranking.

and the two lowest R.I items as follows:

1. "Lack of technical and managerial skills of staff" with relative index (53.81%), and P-value equal " 0.007", and ranked the 6th on the overall ranking.
2. "Underpaid claims" with relative index (45.49%) , and P-value equal (0.0), and ranked the 7th on the overall ranking.

Its noted that, the relative index for clearly view of the received responses about consultant related factors is R.I = (58.48%) which is less than (60%), the P-value equal (0.207) which is greater than (0.05), the value of T test equal (1.269) which is less than the critical value which is equal (1.98). That means the respondents views are (Neutral) to consultant related factors and the consultant not a key party in payment delay causes.

Table (4.13) Group (2) consultant related factors

No.	Factors	Mean (5)	Standard Deviation	Relative index	T test	P-value	Rank
4	Slow processing of final accounts	3.36	1.044	67.26	3.694	0.000	1
3	Slow processing of variation orders	3.27	1.029	65.49	2.835	0.005	2
7	Less periodical meetings to address work problems	3.10	1.026	61.95	1.008	0.315	3
5	Inaccurate bill of quantities	2.95	1.133	58.94	-0.498	0.619	4
2	The quality of quantity surveyor management system	2.82	1.011	56.46	-1.861	0.065	5
6	Lack of technical and managerial skills of staff	2.69	1.196	53.81	-2.753	0.007	6
1	Underpaid claims	2.27	1.037	45.49	-7.437	0.000	7
Average		**2.92**	**0.635**	**58.48**	**-1.269**	**0.207**	

Critical value of t at df (112) and significance level (0.05) equal (1.98)

4.3.1.3 Group (3) contractor related factors

Table (4.14) shows the relative index and ranks of contractor related factors that contribute to causes of payment delay in construction projects. This table contains ten factors. In this table, only the most important factors and the least important factors were discussed.

Table (4.14) Group (3) contractor related factors

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
8	Failure to do work based on bill of quantity	66.12	3	37.50	4	78.95	1
4	Failure to follow the certain procedures in claims	68.98	1	42.22	1	72.22	2
10	Labor productivity	58.37	9	38.61	2	71.58	3
6	Poor quality of work	62.04	7	37.22	4	71.58	3
5	Willing to accept onerous payment term from clients due to difficulties in obtaining project	59.18	8	35.56	6	70.53	4
1	Capital lock up	67.76	2	35.00	7	70.53	4
9	Failure to understand the contract agreement	63.27	5	37.78	3	69.47	5
3	Delay in submitting claims	65.71	4	38.61	2	68.42	6
7	Failure to agree with the valuation of work	62.86	6	37.22	5	68.42	6
2	Submit claims with mistakes	68.98	1	35.83	5	68.42	6
Average		**64.33**		**37.56**		**71.02**	

Owners view

Table (4.14) shows that the respondents owners ranked "Failure to follow the certain procedures in claims" in the first position with relative index (R.I = 68.98 %). That indicates the clear and systematic procedure in preparing claims by the contractor lead to fast the payments. Also "Submit claims with mistakes" ranked in the first position with relative index (R.I = 68.98%). That indicates that right, soundness and accurate claims which has done according compliance of parties views lead to fast the payment.

The second factor cause payment delay in this group was "Capital lock up" with relative index (R.I = 67.76 %). According to Mei Ye and Abdul Rahman (2010) contractor's capital lockup consider as a one of the payment delay causes.

The respondents owners ranked the "Labor productivity" with relative index (R.I = 58.37 %) as the last factor, that may be according to owners views because the contractors in Gaza Strip projects depend on the subcontractors where they implement the most of building works.

Contractors view

Table (4.14) shows that the respondents contractors ranked "Failure to follow the certain procedures in claims" in the first position with relative index (R.I = 42.22 %). That indicates the clear and systematic procedure in preparing claims by the contractor lead to fast the payments.

The second factor cause payment delay in this group was "Labor productivity" with relative index (R.I = 38.61 %). According to Abo Mostafa (2003) there is a high relationship between the payment delay and the labor productivity. Also "Delay in submitting claims" ranked in the second position with relative index (R.I = 38.61 %). That indicates that accurate claims on time lead to fast the payment.

The respondents contractors ranked the "Capital lock up" with relative index (R.I = 35.00 %) as the last factor because the contractors in Gaza Strip projects depend on the series of payments from the owner according to this view.

Consultants view

Table (4.14) shows that the respondents consultants ranked "Failure to do work based on bill of quantity" in the first position with relative index (R.I = 78.95 %). According to Mei Ye and Abdul Rahman (2010) this item consider as a cause of payment delay.

The second factor cause payment delay in this group was "Failure to follow the certain procedures in claims" with relative index (R.I = 72.22%). That indicates the clear and systematic procedure in preparing claims by the contractor lead to fast the payments.

Table (4.15) shows the opinion of the respondents about the contractor related factors and ranked according to the relative index from high to down, and the two higher R.I items as follows:

1. "Failure to follow the certain procedures in claims" with relative index (68.93%) , and P-value equal (0.0), and ranked 1st on the overall ranking.
2. "Failure to do work based on bill of quantity" with relative index (65.84%) , and P-value equal (0.017), and ranked 2nd on the overall ranking.

and the two lowest R.I items as follows:

1. "Labor productivity" with relative index (61.95%), and P-value equal (0.357), and ranked 9th on the overall ranking.
2. "Willing to accept onerous payment term from clients due to difficulties in obtaining project" with relative index (60.18%), and P-value equal (0.929), and ranked 10th on the overall ranking.

We can say that, relative index for the point views of the participants about contractor related factors is (63.76%) which is greater than (60%), the P-value equal (0.022) which is less than (0.05), the value of T test equal (2.330) which is greater than the critical value which is equal (1.98). That indicates the participants opinions are (Positive) to the factors of this group and the contractor plays the main role in these causes.

Table (4.15) Group (3) contractor related factors

No.	Factors	Mean (5)	Standard Deviation	Relative index	T test	P-value	Rank
4	Failure to follow the certain procedures in claims	3.45	1.030	68.93	4.589	0.000	1
8	Failure to do work based on bill of quantity	3.29	1.280	65.84	2.426	0.017	2
3	Delay in submitting claims	3.23	1.157	64.60	2.113	0.037	3
2	Submit claims with mistakes	3.21	1.137	64.25	1.985	0.050	4
1	Capital lock up	3.18	1.189	63.54	1.582	0.117	5
9	Failure to understand the contract agreement	3.16	1.229	63.19	1.378	0.171	6
6	Poor quality of work	3.13	1.199	62.65	1.177	0.242	7
7	Failure to agree with the valuation of work	3.12	1.240	62.48	1.062	0.291	8
10	Labor productivity	3.10	1.118	61.95	0.926	0.357	9
5	Willing to accept onerous payment term from clients due to difficulties in obtaining project	3.01	1.056	60.18	0.089	0.929	10
Average		**3.19**	**0.859**	**63.76**	**2.330**	**0.022**	

Critical value of t at df (112) and significance level (0.05) equal (1.98)

4.3.2 Section (C): The effect and risk of payment delay on construction projects

Table (4.16) shows the relative index and ranks of the effect and risk of payment delay on construction projects. This section contains four groups; group (1) contains thirteen effects, group (2) contains ten effects, group (3) contains eight effects and group (4) contains eighteen effects. In this section, only the most important factors and the least important factors will be discussed.

Table (4.16) The effect and risk of payment delay on construction projects

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
Group (1) effects on project characteristics							
1	Delay in project progress	73.06	2	50.83	1	76.84	1
3	Extension of project time	76.73	1	50.00	2	74.74	2
7	Suspension of work by owner or contractor	71.02	4	39.17	8	74.74	2
4	Rise of project cost	68.98	6	43.33	5	73.68	3
9	Creates negative chain effect on other parties	71.84	3	45.56	3	71.58	3
2	Scheduling of works or program	66.53	9	43.33	5	71.58	3
10	Creates negative chain effect on other parties	68.16	8	44.72	4	67.37	4
11	May result in disputes e.g. litigation/ arbitration	70.20	5	41.11	6	67.37	4
5	Low quality works	68.16	7	39.44	7	63.16	5
6	Poor site safety	60.82	12	35.00	12	60.00	6
13	Problems with neighbors	56.33	13	36.11	10	57.89	7
8	Termination of contract by owner or contractor	65.31	10	35.83	11	57.89	7
12	Creates negative social impacts	61.63	11	38.33	9	55.79	8
Average		**67.60**		**41.75**		**67.13**	

Complement of Table (4.16)

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
Group (2) effects on owner							
3	Delay in completion of project by the contractor	74.29	1	48.33	1	81.05	1
10	Bad reputation of the owner	61.63	7	42.78	3	70.53	2
4	Delay in having the expected benefit of property	68.57	3	41.94	4	70.53	2
9	Cost overrun due to risk of payment delay	71.02	2	41.11	5	70.53	2
2	Payment of interest on delayed payment	60.00	9	39.44	7	70.53	2
5	Leads to suspension of works	66.12	4	38.61	8	70.53	2
8	Contract modifications (replacement and addition of – new work to the project and change in specifications)	65.71	5	39.72	6	67.37	6
1	Most projects were unplanned	65.31	6	46.39	2	66.32	4
7	Leads to poor quality	61.22	8	37.78	9	66.32	4
6	Leads to contract termination	54.29	10	32.22	10	57.89	5
Average		**64.86**		**40.83**		**69.16**	
Group (3) effects on consultant							
3	Consultants spend longer time than planned	65.71	3	43.06	3	73.68	1
4	Absence of consultant's site staff	66.94	1	40.83	4	71.58	2
5	Slowness in giving instruction	64.08	4	38.06	6	71.58	3
2	Slow down of the works	62.86	5	46.39	1	65.26	4
8	Bad reputation of the consultant	57.96	8	37.50	7	65.26	4
1	Cost of consultancy services increased	66.53	2	43.33	2	63.16	5
7	Waiting time for approval of sample sizes	59.59	7	36.94	8	63.16	5
6	Lack of quality control	62.04	6	39.44	5	61.05	6
Average		**63.21**		**40.69**		**66.84**	

Complement of Table (4.16)

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
Group (4) effects on contractor							
10	Late payment of salaries	75.10	1	53.89	1	83.16	1
5	Difficult to procure material and services	74.69	2	47.78	10	83.16	1
3	Time overrun of project	73.06	4	53.06	2	80.00	2
13	Slow down the progress until payment is received	73.06	4	50.00	7	80.00	2
2	Forced to borrow from financial institutions	66.12	11	46.11	11	80.00	2
1	Cash flow problems	74.29	3	51.39	3	78.95	3
6	High interest rate due to loans	67.76	9	48.06	9	78.95	3
12	Difficult to tender for new projects	68.57	8	51.11	4	77.89	4
11	Bad reputation of the contractor	66.94	10	50.83	5	77.89	4
18	Sub-contractor refuse to continue works on the project	71.02	6	50.28	6	72.63	5
4	Cost overrun of project	71.43	5	49.44	8	71.58	6
17	Continue to submit a claim	69.80	7	45.56	12	71.58	6
9	Low productivity of labor	66.12	11	39.72	14	71.58	6
7	Difficult to maintain equipment	60.41	15	39.17	15	67.37	7
14	Suspend the work until payment is received	65.31	12	37.50	16	66.32	8
8	Shortage of equipment	62.86	13	40.83	13	65.26	9
16	Interpret the contract document on payment issue and seek legal advice	61.63	14	36.11	17	63.16	10
15	Contract termination	57.14	16	32.22	18	57.89	11
Average		**68.07**		**45.73**		**73.74**	

Table (4.17) shows the relative index and ranks of the effect and risk of payment delay on construction projects. The groups are effects on project characteristics, owners, consultants and contractors. In this table the effect on contractor has the high relative index (R.I = 68.07 %, 45.73 % and 73.74 %) respectively, these results reflect the same agreement between the respondents, which indicates that the contractor is the most affected part by the payment delay.

Table (4.17) The effect and risk of payment delay on construction projects

		Owner		Contractor		Consultant	
Group	**Effects**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
4	Effects on contractor	68.07	1	45.73	1	73.74	1
2	Effects on owner	64.86	3	40.83	3	69.16	2
1	Effects on project characteristics	67.60	2	41.75	2	67.13	3
3	Effects on consultant	63.21	4	40.69	4	66.84	4
Average		**66.50**		**42.85**		**69.92**	

4.3.2.1 Group (1) Effects on project characteristics

Table (4.18) shows the relative index and ranks of effects on project characteristics that results from payment delay in construction projects. This table contains thirteen effects. In this table, only the most important factors and the least important factors will be discussed.

Table (4.18) Group (1) effects on project characteristics

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
1	Delay in project progress	73.06	2	50.83	1	76.84	1
3	Extension of project time	76.73	1	50.00	2	74.74	2
7	Suspension of work by owner or contractor	71.02	4	39.17	8	74.74	2
4	Rise of project cost	68.98	6	43.33	5	73.68	3
9	Creates negative chain effect on other parties	71.84	3	45.56	3	71.58	3
2	Scheduling of works or program	66.53	9	43.33	5	71.58	3
10	Creates negative chain effect on other parties	68.16	8	44.72	4	67.37	4
11	May result in disputes e.g. litigation/ arbitration	70.20	5	41.11	6	67.37	4
5	Low quality works	68.16	7	39.44	7	63.16	5
6	Poor site safety	60.82	12	35.00	12	60.00	6
13	Problems with neighbors	56.33	13	36.11	10	57.89	7
8	Termination of contract by owner or contractor	65.31	10	35.83	11	57.89	7
12	Creates negative social impacts	61.63	11	38.33	9	55.79	8
Average		**67.60**		**41.75**		**67.13**	

Owners view

Table (4.18) shows that the respondents owners ranked "Extension of project time" in the first position with relative index (R.I = 76.73 %). Meng (2002) stated that all problems in construction begin when payment is not received at the exact amount or date. Disagreements then leads to arguments as relationships sour, and the stage become a setting for conflict, blame, finger pointing and lawyers. Project exceed initial time and cost estimates and experienced extensive delays.

The second effect was "Delay in project progress" with relative index (R.I = 73.06 %). It has the same meaning of "Extension of project time" in the first position. This indicates that the respondents views were neutral and close to some extent. Payment delay on the part of the employer would cause cash flow problems for the contractor which could affect the overall progress of works (Amoako, 2011).

The respondents owners ranked the "Problems with neighbors" with relative index (R.I = 56.33 %) as the last effect, that may be according to owners views because the good social relationship between neighbors in Gaza Strip, that's lead to the patience of neighbors on each other. So there was a weak relationship between the payment delay and the problems with neighbors.

Contractors view

Table (4.18) shows that the respondents contractors ranked "Delay in project progress" in the first position with relative index (R.I = 50.83%). That indicates the contractors see that delay in project progress is one of payment delay effects.

The second factor cause payment delay in this group was "Extension of project time" with relative index (R.I = 50.00 %). That indicates the contractors see that extension of project time is one of payment delay effects.

The respondents contractors ranked the "Poor site safety" with relative index (R.I = 35.00%) as the last factor because the contractors in Gaza Strip till now didn't realize the great importance of maintaining the safety in site.

Consultants view

Table (4.18) shows that the respondents consultants ranked "Delay in project progress" in the first position with relative index (R.I = 76.84 %). Also according to the previous reasons consultants see that the delay in project progress is a result of payment delay in construction projects and occupies a high position.

The respondents consultants ranked the "Creates negative social impacts" with relative index (R.I = 55.79 %) as the last factor. The consultants may see that social relationships aren't considered as payment delay effect.

Table (4.19) shows the opinion of the respondents about the and effects on project characteristics ranked according to the relative index from high to down, and the two higher R.I items as follows:

1. "Extension of project time" with relative index (77.70%), and P-value equal (0.0), and ranked 1st on the overall ranking.
2. "Delay in project progress" with relative index (76.99%), and P-value equal (0.0), and ranked 2nd on the overall ranking.

and the two lowest R.I items as follows:

1. "Poor site safety" with relative index (58.76%), and P-value equal (0.543), and ranked 12th on the overall ranking.
2. "Problems with neighbors" with relative index (57.17%), and P-value equal (0.190), and ranked 13th on the overall ranking.

For general the relative index for the opinion of the respondents about effects on project characteristics is (67.20%) which is less than (60%), and the P-value equal (0.0) which is less than (0.05), and the value of T test equal (6.225) which is greater than the critical value which is equal (1.98) that mean the respondents views are (Positive) to the effects of this group. This indicates that the effects on project characteristics which result from payment delay in construction projects are important effects and the project parties should cooperate to mitigate or avoid these effects of payment delay.

Table (4.19) Group (1) effects on project characteristics

No.	Factors	Mean (5)	Standard Deviation	Relative index	T test	P-value	Rank
3	Extension of project time	3.88	0.943	77.70	9.980	0.000	1
1	Delay in project progress	3.85	0.984	76.99	9.178	0.000	2
9	Creates negative chain effect on other parties	3.61	1.089	72.21	5.960	0.000	3
4	Rise of project cost	3.50	1.103	69.91	4.776	0.000	4
10	Creates negative chain effect on other parties	3.47	1.001	69.38	4.983	0.000	5
2	Scheduling of works or program	3.42	0.884	68.50	5.105	0.000	6
7	Suspension of work by owner or contractor	3.42	1.155	68.32	3.828	0.000	7
11	May result in disputes e.g. litigation/ arbitration	3.40	1.154	67.96	3.669	0.000	8
5	Low quality works	3.27	1.118	65.31	2.524	0.013	9
8	Termination of contract by owner or contractor	3.04	1.256	60.88	0.374	0.709	10
12	Creates negative social impacts	3.03	1.056	60.53	0.267	0.790	11
6	Poor site safety	2.94	1.080	58.76	-0.610	0.543	12
13	Problems with neighbors	2.86	1.141	57.17	-1.319	0.190	13
Average		**3.36**	**0.615**	**67.20**	**6.225**	**0.000**	

Critical value of t at df (112) and significance level (0.05) equal (1.98)

4.3.2.2 Group (2) effects on owner

Table (4.20) shows the relative index and ranks of effects on owner that results from payment delay in construction projects. This table contains ten effects. In this table, only the most important factors and the least important factors will be discussed.

Table (4.20) Group (2) effects on owner

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
3	Delay in completion of project by the contractor	74.29	1	48.33	1	81.05	1
10	Bad reputation of the owner	61.63	7	42.78	3	70.53	2
4	Delay in having the expected benefit of property	68.57	3	41.94	4	70.53	2
9	Cost overrun due to risk of payment delay	71.02	2	41.11	5	70.53	2
2	Payment of interest on delayed payment	60.00	9	39.44	7	70.53	2
5	Leads to suspension of works	66.12	4	38.61	8	70.53	2
8	Contract modifications (replacement and addition of – new work to the project and change in specifications)	65.71	5	39.72	6	67.37	6
1	Most projects were unplanned	65.31	6	46.39	2	66.32	4
7	Leads to poor quality	61.22	8	37.78	9	66.32	4
6	Leads to contract termination	54.29	10	32.22	10	57.89	5
Average		**64.86**		**40.83**		**69.16**	

Owners view

Table (4.20) shows that the respondents owners ranked "Delay in completion of project by the contractor " in the first position with relative index (R.I = 74.29 %). Payment delay from owner to contractor lead to delay of contractors' performance and cause problem in time performance. This may also lead to disputes and claims between owner and contractor of project (Abu Shaban, 2008).

The second effect was "Cost overrun due to risk of payment delay" with relative index (R.I = 71.02%). Making progress payments to contractors on time is critical. Expediting the reviewing and approving of design documents, shop drawings, and payments to contractor can reduce any delay or cost overruns at the projects in Gaza Strip (Enshassi, *et al.*, 2009).

The respondents owners ranked the "Leads to contract termination" with relative index (R.I = 54.29 %) as the last effect, that may be according to their views considered away the contract termination as an effect of payment delay.

Contractors view

Table (4.20) shows that the respondents contractors ranked "Delay in completion of project by the contractor" in the first position with relative index (R.I = 48.33%). That indicates the contractors see that delay in completion of project by the contractor is one of payment delay effects.

The second factor cause payment delay in this group was "Most projects were unplanned" with relative index (R.I = 46.39 %). The contractor see that a confusion may be happen as a result of payment delay, which leads to a mess in his budget and planning.

The respondents contractors ranked the "Leads to contract termination" with relative index (R.I = 32.22%) as the last factor because the contractors in Gaza Strip considered away the contract termination as an effect of payment delay.

Consultants view

Table (4.20) shows that the respondents consultants ranked "Delay in completion of project by the contractor " in the first position with relative index (R.I = 81.05 %). That indicates the consultants see that delay in completion of project by the contractor is one of payment delay effects. The respondents consultants ranked the "Contract modifications (replacement and addition of new work to the project and change in specifications)" with relative index (R.I = 67.37%) as the last factor. The consultants may see that contract modifications aren't considered as payment delay effect.

Table (4.21) shows the opinion of the respondents about the effects on owner ranked according to the relative index from high to down, and the two higher R.I items as follows:

1. "Delay in completion of project by the contractor" with relative index (76.64%), and P-value equal (0.0), and ranked 1st on the overall ranking.
2. "Most projects were unplanned" with relative index (69.03%), and P-value equal (0.0), and ranked 2nd on the overall ranking.

and the two lowest R.I items as follows:

1. "Leads to poor quality" with relative index (61.77%), and P-value equal (0.426), and ranked 8th on the overall ranking.

2. "Leads to contract termination" with relative index (53.81%), and P-value equal (0.002), and ranked 9th on the overall ranking.

At last, the relative index of effects on owner group is R.I = (65.77%) which is greater than (60%), the P-value equal (0.0) which is less than (0.05), the value of T test equal (4.591) which is greater than the critical value which is equal (1.98). That indicates the participants opinions are (Positive) to effects on owner, where the owner is affected by the payment delay risks and he considered as a key party in construction projects.

Table (4.21) Group (2) effects on owner

No.	Factors	Mean (5)	Standard Deviation	Relative index	T test	P-value	Rank
3	Delay in completion of project by the contractor	3.83	0.990	76.64	8.931	0.000	1
1	Most projects were unplanned	3.45	1.069	69.03	4.488	0.000	2
9	Cost overrun due to risk of payment delay	3.44	1.069	68.85	4.402	0.000	3
4	Delay in having the expected benefit of property	3.42	1.075	68.32	4.113	0.000	4
10	Bad reputation of the owner	3.29	1.237	65.84	2.510	0.014	5
5	Leads to suspension of works	3.26	1.016	65.13	2.686	0.008	6
8	Contract modifications (replacement and addition of – new work to the project and change in specifications)	3.26	0.989	65.13	2.758	0.007	6
2	Payment of interest on delayed payment	3.15	1.117	63.04	1.438	0.153	7
7	Leads to poor quality	3.09	1.177	61.77	0.799	0.426	8
6	Leads to contract termination	2.69	1.061	53.81	-3.102	0.002	9
Average		**3.29**	**0.668**	**65.77**	**4.591**	**0.000**	

Critical value of t at df (112) and significance level (0.05) equal (1.98)

4.3.2.3 Group (3) effects on consultant

Table (4.22) shows the relative index and ranks of effects on consultant that results from payment delay in construction projects. This table contains eight effects. In this table, only the most important factors and the least important factors will be discussed.

Table (4.22) Group (3) effects on consultant

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
3	Consultants spend longer time than planned	65.71	3	43.06	3	73.68	1
4	Absence of consultant's site staff	66.94	1	40.83	4	71.58	2
5	Slowness in giving instruction	64.08	4	38.06	6	71.58	3
2	Slow down of the works	62.86	5	46.39	1	65.26	4
8	Bad reputation of the consultant	57.96	8	37.50	7	65.26	4
1	Cost of consultancy services increased	66.53	2	43.33	2	63.16	5
7	Waiting time for approval of sample sizes	59.59	7	36.94	8	63.16	5
6	Lack of quality control	62.04	6	39.44	5	61.05	6
Average		**63.21**		**40.69**		**66.84**	

Owners view

Table (4.22) shows that the respondents owners ranked "Absence of consultant's site staff " in the first position with relative index (R.I = 66.94%). Consultant sharing in the responsibility of time and cost overruns specially when the consultant delay the payments of contractor. Also the absence of consultant staff affect on the progress of work. Consultant should find a method to put replacement staff at site (Al-Najjar, 2008).

The second effect was "Cost of consultancy services increased" with relative index (R.I = 66.53%). The implications of payment default on the consultants from the contractors identified were slow pace of the works, reduction of consultants activities, increased cost of consultancy services, morals requirement of consultants weaken and also consultants spending longer time than planned (Amoako, 2011).

The respondents owners ranked the "Bad reputation of the consultant" with relative index (R.I = 57.96 %) as the last effect, that may be according to their views it considered away the bad reputation of the consultant as an effect of payment delay.

Contractors view

Table (4.22) shows that the respondents contractors ranked " Slow down of the works " in the first position with relative index (R.I = 46.39 %). Slow down the execution of the work is one of the payment delay effects; where the contractors can't pay to material suppliers and their team salaries.

The second factor cause payment delay in this group was "Cost of consultancy services increased " with relative index (R.I = 43.33 %). The contractor see that the cost overrun of consultancy services consider as an effect of payment delay.

The respondents contractors ranked the "Waiting time for approval of sample sizes" with relative index (R.I = 36.94 %) as the last factor; where the contractors in Gaza Strip considered this effect as a weak one.

Consultants view

Table (4.22) shows that the respondents consultants ranked "Consultants spend longer time than planned" in the first position with relative index (R.I = 73.68 %). Amoako (2011) states that the implications of payment default on the consultants from the contractors identified were: slow pace of the works, reduction of consultants' activities, increased cost of consultancy services, morals requirement of consultants weaken and also consultants spending longer time than planned. The respondents consultants ranked the "Lack of quality control" with relative index (R.I = 61.05 %) as the last factor. The consultants may see that lack of quality control isn't considered as payment delay effect.

Table (4.23) shows the opinion of the respondents about the effects on consultant ranked according to the relative index from high to down, and the two higher R.I items as follows:

1. "Consultants spend longer time than planned" with relative index (68.32%), and P-value equal (0.0), and ranked 1st on the overall ranking.

2. "Slow down of the works" with relative index (67.79%), and P-value equal (0.0), and ranked 2nd on the overall ranking.

and the two lowest R.I items as follows:

1. "Waiting time for approval of sample sizes" with relative index (60.00%), and P-value equal (1.00), and ranked 6th on the overall ranking.

2. "Bad reputation of the consultant" with relative index (60.00%) , and P-value equal (1.00), and ranked 6th on the overall ranking.

The results illustrated that the relative index of effects on consultant is (64.58%) which is greater than (60%), the P-value equal (0.001) which is less than (0.05), the value of T test equal (3.475) which is greater than the critical value which is equal (1.98). So the respondents views are (Positive) to the effects on consultant. This indicates that the consultant affected by the payment delay risks and he should do hardly to avoid payment delay.

Table (4.23) Group (3) effects on consultant

No.	Factors	Mean (5)	Standard Deviation	Relative index	T test	P-value	Rank
3	Consultants spend longer time than planned	3.42	0.989	68.32	4.473	0.000	1
2	Slow down of the works	3.39	0.986	67.79	4.198	0.000	2
1	Cost of consultancy services increased	3.35	1.017	67.08	3.700	0.000	3
4	Absence of consultant's site staff	3.35	0.954	67.08	3.946	0.000	3
5	Slowness in giving instruction	3.20	1.036	64.07	2.088	0.039	4
6	Lack of quality control	3.12	1.067	62.30	1.146	0.254	5
7	Waiting time for approval of sample	3.00	1.134	60.00	0.000	1.000	6
8	Bad reputation of the consultant	3.00	1.150	60.00	0.000	1.000	6
Average		**3.23**	**0.701**	**64.58**	**3.475**	**0.001**	

Critical value of t at df (112) and significance level (0.05) equal (1.98)

4.3.2.4 Group (4) effects on contractor

Table (4.24) shows the relative index and ranks of effects on contractor that results from payment delay in construction projects. This table contains eighteen effects. In this table, only the most important factors and the least important factors will be discussed.

Table (4.24) Group (4) effects on contractor

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
10	Late payment of salaries	75.10	1	53.89	1	83.16	1
5	Difficult to procure material and services	74.69	2	47.78	10	83.16	1
3	Time overrun of project	73.06	4	53.06	2	80.00	2
13	Slow down the progress until payment is received	73.06	4	50.00	7	80.00	2
2	Forced to borrow from financial institutions	66.12	11	46.11	11	80.00	2
1	Cash flow problems	74.29	3	51.39	3	78.95	3
6	High interest rate due to loans	67.76	9	48.06	9	78.95	3
12	Difficult to tender for new projects	68.57	8	51.11	4	77.89	4
11	Bad reputation of the contractor	66.94	10	50.83	5	77.89	4
18	Sub-contractor refuse to continue works on the project	71.02	6	50.28	6	72.63	5
4	Cost overrun of project	71.43	5	49.44	8	71.58	6
17	Continue to submit a claim	69.80	7	45.56	12	71.58	6
9	Low productivity of labor	66.12	11	39.72	14	71.58	6
7	Difficult to maintain equipment	60.41	15	39.17	15	67.37	7
14	Suspend the work until payment is received	65.31	12	37.50	16	66.32	8
8	Shortage of equipment	62.86	13	40.83	13	65.26	9
16	Interpret the contract document on payment issue and seek legal advice	61.63	14	36.11	17	63.16	10
15	Contract termination	57.14	16	32.22	18	57.89	11
Average		**68.07**		**45.73**		**73.74**	

Owners view

Table (4.24) shows that the respondents owners ranked "Late payment of salaries" in the first position with relative index (R.I = 75.10 %). According to National Construction Association of Sri Lanka (2008) payment is necessary on time because the construction industry is one of the most significant sources of employment to engineers, technicians, skilled labor and managers. When the monthly salary not paid on the set date the employee as well as his family faces difficulties.

The second effect was "Difficult to procure material and services" with relative index (R.I = 74.69 %). Construction firms often look out for suppliers and manufacturers who provide discount facilities to trade with. This serves as an incentive for firms as they could purchase large volume of materials. Sometimes, suppliers give discount to contractors who make purchase above a certain quantities of materials whilst long term relationship with suppliers can help give discount facilities to contracts (Amoako, 2011).

The respondents owners ranked the "Contract termination" with relative index (R.I = 57.14 %) as the last effect, that may be according to their views it considered away the Contract termination as an effect of payment delay.

Contractors view

Table (4.24) shows that the respondents contractors ranked "Late payment of salaries" in the first position with relative index (R.I = 53.89 %). Also its important effect as explained previously in the owner view.

The second factor cause payment delay in this group was "Time overrun of project" with relative index (R.I = 53.06 %). The major implications of payment default from the contractors perspective identified were: contractors cash flow forecast affected, increase in construction cost, extension of intended completion date, payment of interest on delayed payment does not off-set contractors liabilities, scheduling of works or program distracted and leads to bankruptcy or liquidation (Nazir, 2006).

The respondents contractors ranked the "Contract termination" with relative index (R.I = 32.22 %) as the last factor ; where the contractors in Gaza Strip considered this effect as a weak one.

Consultants view

Table (4.24) shows that the respondents consultants ranked "Late payment of salaries" and "Difficult to procure material and services" in the first position with relative index (R.I = 83.16 %). Also these were important effects as explained previously in the owner view.

The respondents consultants ranked the "Contract termination" with relative index (R.I = 57.89 %) as the last factor. The consultants may see that contract termination isn't considered as payment delay effect.

Table (4.25) shows the opinion of the respondents about the and effects on contractor ranked according to the relative index from high to down, and the two higher R.I items as follows:

1. "Late payment of salaries" with relative index (80.88%), and P-value equal (0.0), and ranked 1st on the overall ranking.
2. "Time overrun of project" with relative index (78.94%), and P-value equal (0.0), and ranked 2nd on the overall ranking.

and the two lowest R.I items as follows:

1. "Interpret the contract document on payment issue and seek legal advice" with relative index (60.35%), and P-value equal (0.872), and ranked 16th on the overall ranking.
2. "Contract termination" with relative index (55.04%), and P-value equal (0.056), and ranked 17th on the overall ranking.

Its noted that, relative index about effects on contractor is R.I = (71.05%) which is greater than (60%), the P-value equal (0.0) which is less than (0.05), and the value of T test equal (8.919) which is greater than the critical value which is equal (1.98). That indicates the participants opinions are (Positive) to the effects of this group and the contractor should use all of his effort to mitigate the payment delay effects.

Table (4.25) Group (4) effects on contractor

No.	Factors	Mean (5)	Standard Deviation	Relative index	T test	P-value	Rank
10	Late payment of salaries	4.04	0.976	80.88	11.369	0.000	1
3	Time overrun of project	3.95	0.943	78.94	10.670	0.000	2
1	Cash flow problems	3.91	1.090	78.23	8.888	0.000	3
13	Slow down the progress until payment is received	3.85	0.984	76.99	9.178	0.000	4
5	Difficult to procure material and services	3.84	0.996	76.81	8.972	0.000	5
12	Difficult to tender for new projects	3.77	1.126	75.40	7.268	0.000	6
18	Sub-contractor refuse to continue works on the project	3.75	1.005	75.04	7.958	0.000	7
4	Cost overrun of project	3.73	1.063	74.51	7.258	0.000	8
11	Bad reputation of the contractor	3.73	1.219	74.51	6.327	0.000	8
6	High interest rate due to loans	3.66	1.107	73.27	6.374	0.000	9
2	Forced to borrow from financial institutions	3.58	1.171	71.50	5.221	0.000	10
17	Continue to submit a claim	3.57	0.925	71.33	6.511	0.000	11
9	Low productivity of labor	3.30	1.133	66.02	2.823	0.006	12
8	Shortage of equipment	3.21	1.004	64.25	2.249	0.026	13
14	Suspend the work until payment is received	3.17	1.217	63.36	1.469	0.145	14
7	Difficult to maintain equipment	3.12	1.028	62.48	1.282	0.203	15
16	Interpret the contract document on payment issue and seek legal advice	3.02	1.165	60.35	0.162	0.872	16
15	Contract termination	2.75	1.366	55.04	-1.928	(0.05)6	17
Average		**3.55**	**0.659**	**71.05**	**8.919**	**0.000**	

Critical value of t at df (112) and significance level (0.05) equal (1.98)

4.3.2.5 Analysis of the effect and risk of payment delay on construction projects

Table (4.26) show the opinion of the respondents about the effect and risk of payment delay on construction projects, the relative index of the effects on contractor group equal

R.I = (67.90%), and it ranked in the 1st position. That indicates the contractor is the most affected party by payment delay risks.

Table (4.26) Analysis of the effect and risk of payment delay on construction projects

Group	Factors	Mean (5)	Standard Deviation	Relative index	T test	P-value	Rank
4	Effects on contractor	3.55	0.659	71.05	8.919	0.000	1
1	Effects on project characteristics	3.36	0.615	67.20	6.225	0.000	2
2	Effects on owner	3.29	0.668	65.77	4.591	0.000	3
3	Effects on consultant	3.23	0.701	64.58	3.475	0.001	4
Average		**3.39**	**0.570**	**67.90**	**7.361**	**0.000**	

Critical value of t at df (112) and significance level (0.05) equal (1.98)

4.3.3 Section (D): The effective remedy to the payment delay

Table (4.27) shows the relative index and ranks of factors that identify the effective remedy to the payment delay effects. This section contains fifteen factors. In this section, only the most important factors and the least important factors will be discussed.

Table (4.27) The effective remedy to the payment delay

		Owner		Contractor		Consultant	
No.	**Factors**	**Relative index**	**Rank**	**Relative index**	**Rank**	**Relative index**	**Rank**
2	Defined time frame for payment	73.88	3	49.72	3	78.95	1
6	Employer work within stipulated budget	71.84	4	48.06	5	77.89	2
3	Contractors should submit timely accurate invoices with complete documents	77.14	1	53.89	1	76.84	3
4	Contractors should chase payment due relentlessly	75.10	2	50.28	2	75.79	4
5	Requires the owner to provide the owner's payment guarantee or bond	63.67	7	43.33	8	75.79	5
7	Charging interest on late payment amount	60.00	8	41.19	9	71.58	6
1	Negotiate payment terms with the owner to facilitate a healthy cash flow	71.84	4	46.94	6	70.53	7
8	Understand and study the payment requirement of each individual project	68.57	5	48.33	4	69.47	8
15	Absence of bureaucracy	65.31	6	44.44	7	63.16	9
12	Sending notice letter trough contractor's lawyer	58.78	9	34.72	11	56.84	10
14	Just ignore and continue with next month's claim	51.02	12	35.83	10	49.47	11
9	Apply term loan from bank to cover the consequences of late payment	51.43	11	31.67	13	49.47	11
13	Initiate arbitration or litigation	52.24	10	32.22	12	48.42	12
10	Allow the contractor to slow down the work until payment is received	51.43	11	29.72	14	47.37	13
11	Allow the contractor to suspend the work until payment is received	46.94	13	26.67	15	42.11	14
Average		**62.61**		**41.13**		**63.58**	

Owners and contractors views

Table (4.27) shows that the respondents owners and contractors ranked "Contractors should submit timely accurate invoices with complete documents" in the first position with relative index (R.I = 77.14 % and 53.89 %) respectively. According to Mei Ye and Abdul Rahman, (2010) the contractors should submit timely accurate invoices with complete documents to mitigate the payment delay effects.

Also in Gaza Strip construction projects, contractors should submit all necessary documents such as: shopdrawing details, quantity calculation sheet, tax invoice, and sometimes full report about the project progress to reduce the effect of payment delay.

The second effect was "Contractors should chase payment due relentlessly" with relative index (R.I = 75.10 % and 50.28 %) respectively. According to Mei Ye and Abdul Rahman, (2010) contractors should follow up their payments seriously with contractors to avoid payment delay effects.

In Gaza Strip, most of projects are funding from international associations; so the payment process take time at many projects, that's force the contractor to follow up his payment seriously.

The respondents owners and contractors ranked the "Allow the contractor to suspend the work until payment is received" with relative index (R.I = 46.94 % and 29.72 %) respectively as the last effect.

In Gaza Strip projects, owners don't prefer the choice of work suspension, where suspension lead to more difficult and complexity.

Consultants view

Table (4.27) shows that the respondents consultants ranked "Defined time frame for payment" and "Difficult to procure material and services" in the first position with relative index (R.I = 78.95%). Amoako, (2011) considered the remedy factor "Defined time frame for payment" as a one of strategic methods to eliminate payment delay effects.

The second effect was "Employer work within stipulated budget" with relative index (R.I = 77.89 %) respectively. So it's necessary that employers work within budget and don't make extra works or variation orders.

The respondents consultants ranked the "Allow the contractor to suspend the work until payment is received" with relative index (R.I = 42.11%) as the last factor. As owners and

contractors, also the consultants saw that work suspension isn't considered as payment delay remedy.

Table (4.28) shows the opinion of the respondents about the effective remedy to the payment delay and ranked according to the relative index from high to down, and the two higher R.I items as follows:

1. "Contractors should submit timely accurate invoices with complete documents" with relative index (80.71%), and P-value equal (0.0), and ranked 1st on the overall ranking.
2. "Contractors should chase payment due relentlessly" with relative index (77.35%), and P-value equal (0.0), and ranked 2nd on the overall ranking.

and the two lowest R.I items as follows:

1. "Allow the contractor to slow down the work until payment is received" with relative index (49.20%), and P-value equal (0.0), and ranked 14th on the overall ranking.
2. "Allow the contractor to suspend the work until payment is received" with relative index (44.42%), and P-value equal (0.0), and ranked 15th on the overall ranking.

The results show that, the relative index for the participants view points about the effective remedy to the payment delay is R.I = (64.05%) which is greater than (60%), the P-value equal (0.0) which is less than (0.05), the value of T test equal (4.106) which is greater than the critical value which is equal (1.98). That indicates the respondents views are (Positive) to factors of effective remedy to the payment delay effects and the project parties should take in care these factors to mitigate the payment delay effects.

Table (4.28) The effective remedy to the payment delay

No.	Factors	Mean (5)	Standard Deviation	Relative index	T test	P-value	Rank
3	Contractors should submit timely accurate invoices with complete documents	4.04	0.954	80.71	11.541	0.000	1
4	Contractors should chase payment due relentlessly	3.87	0.901	77.35	10.227	0.000	2
2	Defined time frame for payment	3.85	0.984	76.99	9.178	0.000	3
6	Employer work within stipulated budget	3.74	0.971	74.87	8.140	0.000	4
1	Negotiate payment terms with the owner to facilitate a healthy cash flow	3.65	0.981	72.92	6.998	0.000	5
8	Understand and study the payment requirement of each individual project	3.61	1.013	72.21	6.409	0.000	6
5	Requires the owner to provide the owner's payment guarantee or bond	3.40	1.065	67.96	3.974	0.000	7
15	Absence of bureaucracy	3.36	1.181	67.26	3.267	0.001	8
7	Charging interest on late payment amount	3.21	1.166	64.29	1.945	(0.05)4	9
12	Sending notice letter trough contractor's lawyer	2.86	1.133	57.17	-1.329	0.187	10
14	Just ignore and continue with next month's claim	2.66	1.099	53.27	-3.253	0.002	11
13	Initiate arbitration or litigation	2.57	1.164	51.33	-3.960	0.000	12
9	Apply term loan from bank to cover the consequences of late payment	2.54	1.061	50.80	-4.611	0.000	13
10	Allow the contractor to slow down the work until payment is received	2.46	1.086	49.20	-5.284	0.000	14
11	Allow the contractor to suspend the work until payment is received	2.22	1.108	44.42	-7.472	0.000	15
	Average	**3.20**	**0.524**	**64.05**	**4.106**	**0.000**	

Critical value of t at df (112) and significance level (0.05) equal (1.98)

4.3.4 Analysis of part two: The effect of payment delay on construction projects in Gaza Strip

Table (4.29) shows the opinion of the respondents about the all sections (The effect of payment delay on construction projects in Gaza Strip) and ranked according to the relative index from high to down, and for general the relative index for the opinion of the sample size equal (65.26%) which is greater than (60%), and the P-value equal (0.0) which is less than (0.05), and the value of T test equal (5.763) which is greater than the critical value which is equal (1.98). That mean the respondents views are (Positive) to all sections, and this indicates that there is a general satisfaction of the parties toward the factors that contribute to causes of payment delay in construction projects, the effect and risk of payment delay on construction projects and the effective remedy to the payment delay, that suggested in this research.

Table (4.29) All sections

Section	Factors	Mean (5)	Standard Deviation	Relative index	T test	P-value	Rank
C	The effect and risk of payment delay on construction projects	3.39	0.570	67.90	7.361	0.000	1
D	The effective remedy to the payment delay	3.20	0.524	64.05	4.106	0.000	2
B	The factors that contribute to causes of payment delay in construction projects	3.02	0.598	60.45	0.401	0.690	3
Average		**3.26**	**0.486**	**65.26**	**5.763**	**0.000**	

Critical value of t at df (112) and significance level (0.05) equal (1.98)

4.4 One way analysis of variance (ANOVA)

4.4.1 The factors that contribute to causes of payment delay in construction projects

1. There is a significant differences about owner related factors due to type of organization (Owner, contractor and consultant) levels at significant level $\alpha = (0.05)$. To test the hypothesis we use the one way ANOVA and the result illustrated in Table

(4.30) which show that the P-value equal (0.327) which is greater than (0.05) and the value of F test equal (1.128) which is less than the value of critical value which is equal (3.08), that's means there are no statistical differences about the owner related factors due to type of organization (Owner, contractor and consultant) at significant level $\alpha = (0.05)$.

Table (4.30) One way ANOVA test for difference in point of view up to the owner related factors due to type of organization

Field	Source	Sum of Squares	df	Mean Square	F value	P-Value
Owner related factors	Between groups	0.884	2	0.442	1.128	0.327
	Within groups	43.111	110	0.392		
	Total	43.995	112			

Critical value of F at df (2,110) and significance level (0.05) equal (3.08)

2. There is a significant differences about consultant related factors due to type of organization (Owner, contractor and consultant) levels at significant level $\alpha = (0.05)$. To test the hypothesis we use the one way ANOVA and the result illustrated in Table (4.31) which show that the P-value equal (0.814) which is greater than (0.05) and the value of F test equal (0.207) which is less than the value of critical value which is equal (3.08), that's means there are no statistical differences about the consultant related factors due to type of organization (Owner, contractor and consultant) at significant level $\alpha = (0.05)$.

Table (4.31) One way ANOVA test for difference in point of view up to the consultant related factors due to type of organization

Field	Source	Sum of Squares	df	Mean Square	F value	P-Value
Consultant related factors	Between groups	0.169	2	0.085	0.207	0.814
	Within groups	45.058	110	0.410		
	Total	45.227	112			

Critical value of F at df (2,110) and significance level (0.05) equal (3.08)

3. There is a significant differences about contractor related factors due to type of organization (Owner, contractor and consultant) levels at significant level α = (0.05). To test the hypothesis we use the one way ANOVA and the result illustrated in Table (4.32) which show that the P-value equal (0.063) which is greater than (0.05) and the value of F test equal (2.841) which is less than the value of critical value which is equal (3.08), that's means there are no statistical differences about the contractor related factors due to type of organization (Owner, contractor and consultant) at significant level α = (0.05).

Table (4.32) One way ANOVA test for difference in point of view up to the contractor related factors due to type of organization

Field	Source	Sum of Squares	df	Mean Square	F value	P-Value
Contractor related factors	Between groups	4.057	2	2.029	2.841	0.063
	Within groups	78.545	110	0.714		
	Total	82.602	112			

Critical value of F at df (2,110) and significance level (0.05) equal (3.08)

4.4.2 The effect and risk of payment delay on construction projects

1. There is a significant differences about effects on project characteristics due to type of organization (Owner, contractor and consultant) levels at significant level α = (0.05). To test the hypothesis we use the one way ANOVA and the result illustrated in Table (4.33) which show that the P-value equal (0.953) which is greater than (0.05) and the value of F test equal (0.049) which is less than the value of critical value which is equal (3.08), that's means there are no statistical differences about the effects on project characteristics due to type of organization (Owner, contractor and consultant) at significant level α = (0.05).

Table (4.33) One way ANOVA test for difference in point of view up to the effects on project characteristics due to type of organization

Field	Source	Sum of Squares	df	Mean Square	F value	P-Value
Effects on project characteristics	Between groups	0.037	2	0.019	0.049	0.953
	Within groups	42.321	110	0.385		
	Total	42.358	112			

Critical value of F at df (2,110) and significance level (0.05) equal (3.08)

2. There is a significant differences about the effects on owner due to type of organization (Owner, contractor and consultant) levels at significant level $\alpha = (0.05)$. To test the hypothesis we use the one way ANOVA and the result illustrated in Table (4.34) which show that the P-value equal (0.477) which is greater than (0.05) and the value of F test equal (0.746) which is less than the value of critical value which is equal (3.08), that's means there are no statistical differences about the effects on owner due to type of organization (Owner, contractor and consultant) at significant level $\alpha = (0.05)$.

Table (4.34) One way ANOVA test for difference in point of view up to the effects on owner due to type of organization

Field	Source	Sum of Squares	df	Mean Square	F value	P-Value
Effects on owner	Between groups	0.669	2	0.334	0.746	0.477
	Within groups	49.306	110	0.448		
	Total	49.975	112			

Critical value of F at df (2,110) and significance level (0.05) equal (3.08)

3. There is a significant differences about the effects on consultant due to type of organization (Owner, contractor and consultant) levels at significant level $\alpha = (0.05)$. To test the hypothesis we use the one way ANOVA and the result illustrated in Table (4.35) which show that the P-value equal (0.603) which is greater than (0.05) and the value of F test equal (0.508) which is less than the value of critical value which is equal (3.08), that's means there are no statistical differences about the effects on

consultant due to type of organization (Owner, contractor and consultant) at significant level α = (0.05).

Table (4.35) One way ANOVA test for difference in point of view up to the effects on consultant due to type of organization

Field	Source	Sum of Squares	df	Mean Square	F value	P-Value
Effects on consultant	Between groups	0.503	2	0.252	0.508	0.603
	Within groups	54.462	110	0.495		
	Total	54.966	112			

Critical value of F at df (2,110) and significance level (0.05) equal (3.08)

4. There is a significant differences about the effects on contractor due to type of organization (Owner, contractor and consultant) levels at significant level α = (0.05). To test the hypothesis we use the one way ANOVA and the result illustrated in Table (4.36) which show that the P-value equal (0.107) which is greater than (0.05) and the value of F test equal (2.277) which is less than the value of critical value which is equal (3.08), that's means there are no statistical differences about the effects on contractor due to type of organization (Owner, contractor and consultant) at significant level α = (0.05).

Table (4.36) One way ANOVA test for difference in point of view up to the effects on contractor due to type of organization

Field	Source	Sum of Squares	df	Mean Square	F value	P-Value
Effects on contractor	Between groups	1.931	2	0.966	2.277	0.107
	Within groups	46.648	110	0.424		
	Total	48.579	112			

Critical value of F at df (2,110) and significance level (0.05) equal (3.08)

4.4.3 The effective remedy to the payment delay

There is a significant differences about the effective remedy to the payment delay due to type of organization (Owner, contractor and consultant) levels at significant level α = (0.05). To test the hypothesis we use the one way ANOVA and the result illustrated in Table (4.37) which show that the P-value equal (0.331) which is greater than (0.05) and the value of F test equal (1.116) which is less than the value of critical value which is equal (3.08), that's means there are no statistical differences about the effective remedy to the payment delay due to type of organization (Owner, contractor and consultant) at significant level α = (0.05).

Table (4.37) One way ANOVA test for difference in point of view up to the effective remedy to the payment delay due to type of organization

Field	Source	Sum of Squares	df	Mean Square	F value	P-Value
The effective remedy to the payment delay	Between groups	0.611	2	0.306	1.116	0.331
	Within groups	30.135	110	0.274		
	Total	30.746	112			

Critical value of F at df (2,110) and significance level (0.05) equal (3.08)

4.5 Chapter summary

In this chapter, the results of this study were generated from all the responses received. The structured data are summarized by calculating frequencies, percentage, relative index, standard deviation, mean, and ranks. It was based on questionnaire sections in the results analysis and discussion.

1. Section (A) general information

This part mainly is designed to provide general information about the respondents in terms of the type of respondent organization or company, respondent position in the organization/company, number of years that the respondent has experience in the construction industry, number of years that the respondent organization or company has experience in construction, number of fixed employees at the respondent organization or company, the type of project that the respondent has worked recently and respondent recently project price.

2. Section (B): The factors that contribute to causes of payment delay in construction projects

Table (4.8) shows the relative index and ranks of factors that contribute to causes of payment delay in construction projects. This section contains three groups; group (1) contains six factors, group (2) contains seven factors and group (3) contains ten factors. In this section, the factors related to contractor has the high relative index.

3. Section (C): The effect and risk of payment delay on construction projects

Table (4.16) shows the relative index and ranks of the effect and risk of payment delay on construction projects. This section contains four groups; group (1) contains thirteen effects, group (2) contains ten effects, group (3) contains eight effects and group (4) contains eighteen effects. In this section, the contractor is the most affected party by payment delay.

4. Section (D): The effective remedy to the payment delay

The results derived from the data analysis indicated that the highest three ranking actions that have been taken by respondents to mitigate payment delay risks were; contractors should submit timely accurate invoices with complete documents, contractors should chase payment due relentlessly and defined time frame for payment.

CHAPTER (5)

SUPPORT VECTOR MACHINES MODEL

5.1 Introduction

There is a consensus among researchers and industry experts that one of the principal barriers to promote improvement in construction projects is the payment delay risks. Through this research, a model formulated to measure the risk of payment delay of construction projects in Gaza Strip.

A Neural Network training program, NeuroSolution, was used as a standalone environment for support-vector machines (SVM) development and training. Moreover, for verifying this work the plentiful trial and error process was performed to obtain the best model architecture.

The following sections present the steps performed to design the support-vector machines (SVM) model and finally the analysis and discussion of results.

5.2 Support vector machines (SVM)

The support-vector network is a new learning machine for two-group classification problems. The machine conceptually implements the following idea: input vectors are non-linearly mapped to a very high dimension feature space. In this feature space a linear decision surface is constructed. Special properties of the decision surface ensures high generalization ability of the learning machine. The idea behind the support-vector network was previously implemented for the restricted case where the training data can be separated without errors (Cortes and Vapnik, 1995).

The theory that underlies support vector machines (SVM) represents a new statistical technique that has drawn much attention in recent years. This learning theory may be seen as an alternative training technique for polynomial, radial basis function and multi-layer percept classifiers. SVM are based on the structural risk minimization (SRM) induction principle (Lin, 2004).

The SVM deals with classification and regression problems by mapping the input data into high-dimensional feature spaces. Its central feature is that the regression surface can be determined by a subset of points or support-vectors (SV); all other points are not important in determining the surface of the regression (Chen and Shih, 2006).

5.3 Support vector machines (SVM) and artificial neural network (ANN)

According to Chen and Shih (2006) the SVM, which originated as an implementation of Vapnik's Structural Risk Minimization (SRM) principle, is now being used to solve a variety of learning, classification and prediction problems. In many ways, a SVM performs the same function as artificial neural network (ANN). For example, when both the input and output data are available (supervised learning in ANN), the SVM can perform classification and regression; but when only the input data are available, it can perform clustering, density estimation and principle component analysis. The SVM is more than just another algorithm. It has the following advantages over an ANN:

1. It can obtain the global optimum.
2. The over fitting problem can be easily controlled.
3. Empirical testing has shown that the performance of SVMs is better than ANNs in classification (Cai and Lin, 2002; Morris and Autret, 2001) and in regression (Tay and Cao, 2011).

5.4 The using of support vector machines in construction

There are plenty of learning approaches for applications in the engineering fields. Scholars have utilized approaches such as neural networks, case based reasoning, and self-organizing feature map based optimization to deal with practical construction problems. SVM is one popular type of learning approach which has been utilized in the engineering fields, especially for pattern classification. Recently this approach has also been adapted for the construction industry, for example, for the solving of cost estimates, contract risk, and construction safety problems. Construction material suppliers are usually exposed to financial risks as a consequence of a high debt capital structure and the nature of the material import business. There is demand for a tool that is able to predict whether such a material supplier, based on its financial status, should use derivatives to hedge financial risks. a prediction model using the Support Vector Machine (SVM) was developed to determine whether employing risk hedging based on derivatives usage would be beneficial. The SVM prediction model, based on the kernel radial basis function and normalized data, yields a prediction accuracy rate of 80.65%. The evaluation, using logistics and small sets of data. A ten financial determinates are proven candidates for financial risk hedging. SVM prediction model appeared feasible for construction material suppliers to apply the model (Chen and Lin, 2010).

5.5 SVM prediction model

The data sample sizes are taken from interview reports of expert engineers who working in contracting companies which conduct business related to construction in Gaza Strip. Considering accessibility of data, this research includes interview with (31) construction companies.

5.6 The data collection to build the SVM model

The data collection techniques employed may be various and are likely to be used in combination. They may include, for example, interviews, observation, documentary analysis, if you are using a case study strategy you are likely need to use and triangulate multiple sources of data (Saunders, *et al*., 2009).

- *Triangulation* refers to the use of different data collection techniques within one study in order to ensure that the data are telling you what you think they are telling you. For example, qualitative data collected using semi-structured group interviews may be a valuable way of triangulating quantitative data collected by other means such as a questionnaire (Saunders, *et al*., 2009).

  A structured interview is sometimes called a standardized interview. The same questions are asked of all respondents. Corbetta (2003) states that structured interviews are interviews in which all respondents are asked the same questions with the same wording and in the same sequence. According to David and Sutton (2004) strength of structured interviews is prompting can be included with the questions and if a question is inappropriate, data on why no response was made can be recorded. Furthermore, non-verbal cues, such as facial expressions, gestures can be recorded.
- *The Case Study* is an empirical inquiry that investigates a contemporary phenomenon in depth and within a real life context, especially when the boundaries between phenomenon and context are not clearly evident or when there is a lack of relevant information. They should aim to focus on relationships, structure and processes in a natural setting and discover interconnections and interrelationships between the various parts. Thus case studies tend to be holistic rather than dealing with isolated factors. A case study can provide the opportunity to find out more than just the outcomes, i.e. it can explain why certain outcomes might occur. They should illustrate, explain and provide more detail or expand on qualitative findings whilst facilitating conceptualization and the development of theory (Yin, 2003).

Robson (2002) defines case study as a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence. Strengths of case studies is to give psychological researchers the possibility to investigate cases, which could not possibly be engineered in research laboratories. For example, the money case study (McLeod, 2008).

- *A structured interview in addition to a hypothetical case study*

  To build the SVM model, thirty one (31) interviews were done with contractors, the contractors were chosen because they were the most hurters due to the effects of payment delay, which were discussed previously in chapter (4), where through results and analysis eighteen (18) effects were ranked according to their mean and relative index (R.I.), the highest nine (9) effects were chosen to estimate the financial loss percentages or weights of each effect as a result of payment delay. Table (5.1) shows the highest ranked effects of payment delay on contractor according to mean above (3.66) and relative index (R.I.) above (73.27%) from the 1st to the 9th, that resulted previously and illustrated in Table (4.25).

Table (5.1) Effects of payment delay on contractor

No.	Effects of payment delay on contractor	Mean	Relative index
1.	Late payment of salaries	4.04	80.88
2.	Time overrun of project	3.95	78.94
3.	Cash flow problems	3.91	78.23
4.	Slow down the progress until payment is	3.85	76.99
5.	Difficult to procure material and services	3.84	76.81
6.	Difficult to tender for new projects	3.77	75.40
7.	Sub-contractor refuse to continue works on	3.75	75.04
8.	Bad reputation of the contractor	3.73	74.51
9.	High interest rate due to loans	3.66	73.27

Note: the ranked 8th item (cost overrun of project) as an effect of payment delay on contractor in Table (4.5) was excluded, where the contractors consider this item as a total loss and

include all mentioned nine items in Table (5.1), if cost overrun item remains it will taken the weight (100 %) of total loss; so it was excluded to prevent dispersion of the final results.

These nine effects of payment delay were included in a suggested hypothetical case study, to be polled by the contractors opinions, this hypothetical case study was designed by counseling and sharing the experts engineers.

Whereas hypothetical case study was used because there is no actual case study concerns payment delay disputes in Gaza Strip construction documented till now by the competent forces.

Where a hypothetical case study suggested was as follow:

1. The company executed a building construction project with total grand cost (US$1million), twelve months period, number of invoice payments were twelve, i.e. one payment every month, and the value of each payment was ($75 thousands) except final payment its value was ($175 thousands) because it included the retention amounts.
2. A payment delay occurred in the last five payments, the payment delay was extend to two months for each invoice payment.

The aim of the contractors iterviews was to collect data of financial loss, that resulted due to the payment delay effects on contractors, as a percentage or a weight of financial loss for the nine items based on experts contractors accounting information, also to estimate the total financial loss in ($US) of this hypothetical case study according to contractors points of view.

Finally the collected data used in building the model which was designed to measure the effect of payment delay on construction in Gaza Strip, where the total financial loss in ($US) used as output data in the model formation process and the wights of nine factors affecteing the financial loss were used as input data.

The formulated SVM model only valid for cases that simulate the mentioned hypothetical case study in; project grand total value and project period, payment ivoice value and payment schedule time, payment delay value and payment delay period. If any change is happen, a new model will be modified to befit the new case.

5.7 Data encoding

Support vector machines as artificial neural network only deal with numeric input data. Therefore, the raw data should be converted from the external environment (Kshirsagar, 2012). This may be challenging because there are many ways to do it. In this research data were converted to numeric form as shown in Table (5.2), where the data collected through the triangulation technique (hypothetical case study and structured interview); which were the weights of the contractors payment delay effects of nine (9) items, based on experts contractors accounting information , also to estimate the total financial loss in ($US) of this hypothetical case study according to contractors points of view, where the total financial loss in ($US) used as output data in the model formation process and the wights of the nine items used as input data.

Table (5.2) Encoding the effects of payment delay on contractors estimation cost (US$)

company	Factor									Total loss ($US)
	1	2	3	4	5	6	7	8	9	
	Late payment of salaries (weight)	Time overrun of project (weight)	Cash flow problems (weight)	Slow down the progress until payment is received (weight)	Difficult to procure material and services (weight)	Difficult to tender for new projects (weight)	Sub-contractor refuse to continue works on the project (weight)	Bad reputation of the contractor (weight)	High interest rate due to loans (weight)	
1st	0.07	0.07	0.1	0.07	0.3	0.15	0.1	0.07	0.07	27500
2nd	0.04	0.08	0.03	0.06	0.08	0.04	0.06	0.04	0.57	25000
3rd	0.1	0.05	0.05	0.05	0.3	0.3	0.05	0.05	0.05	26000
4th	0.01	0.25	0.2	0.15	0.25	0.05	0.02	0.05	0.02	30000
5th	0.05	0.05	0.1	0.1	0.2	0.3	0.05	0.05	0.1	30400
6th	0.05	0.1	0.1	0.15	0.15	0.25	0.1	0.05	0.05	30300
7th	0.1	0.1	0.15	0.05	0.25	0.05	0.15	0.1	0.05	27000
8th	0.1	0.15	0.17	0.07	0.08	0.11	0.09	0.2	0.03	30500
9th	0.09	0.18	0.05	0.16	0.14	0.12	0.09	0.1	0.07	26500
10th	0.1	0.15	0.05	0.1	0.25	0.1	0.15	0.05	0.05	34500
11th	0.1	0.05	0.1	0.15	0.25	0.1	0.05	0.05	0.15	31000
12th	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.12	26300
13th	0.17	0.15	0.19	0.09	0.18	0.02	0.07	0.02	0.11	25500
14th	0.05	0.15	0.2	0.2	0.2	0.05	0.05	0.05	0.05	30700
15th	0.1	0.05	0.05	0.1	0.2	0.1	0.1	0.1	0.2	28500
16th	0.1	0.1	0.15	0.15	0.1	0.2	0.1	0.05	0.05	28000
17th	0.05	0.05	0.15	0.15	0.2	0.15	0.1	0.05	0.1	25700
18th	0.05	0.09	0.13	0.1	0.12	0.2	0.05	0.06	0.2	29500
19th	0.03	0.07	0.1	0.11	0.15	0.21	0.07	0.07	0.19	27200
20th	0.1	0.01	0.01	0.05	0.6	0.01	0.2	0.01	0.01	28300
21st	0.07	0.12	0.06	0.11	0.06	0.32	0.12	0.07	0.07	34700
22nd	0.1	0.1	0.05	0.07	0.11	0.12	0.23	0.12	0.1	27700
23rd	0.06	0.09	0.09	0.15	0.15	0.11	0.11	0.11	0.13	30100
24th	0.05	0.2	0.1	0.05	0.3	0.05	0.1	0.02	0.13	27500
25th	0.1	0.05	0.15	0.15	0.2	0.05	0.05	0.1	0.15	29400
26th	0.1	0.14	0.09	0.14	0.14	0.18	0.06	0.05	0.1	33500
27th	0.05	0.15	0.15	0.15	0.15	0.05	0.15	0.1	0.05	30600
28th	0.05	0.1	0.1	0.2	0.1	0.1	0.2	0.05	0.1	25800
29th	0.09	0.02	0.04	0.13	0.13	0.19	0.13	0.08	0.19	33000
30th	0.3	0.1	0.1	0.15	0.05	0.02	0.08	0.1	0.1	28900
31st	0.1	0.1	0.25	0.15	0.05	0.05	0.1	0.1	0.1	26700

5.8 Model formulation

There are several types of (SVM) software that used to predict the future values based on the past data like SPSS, MATLAB, NeuroSolution …etc.

The developed model in this research is based on NeuroSolution for Excel program. NeuroSolutions has been used for its ease of use, speed of training, flexibility of building and executing the SVM model. The research depended on the flexibility to specify SVM type, learning rate, momentum, activation functions and graphical interpretation of the results. It also has multiple criteria for training and testing the model.

In NeuroSolutions, Support Vector Machines (SVMs) are implemented using the kernel Adatron algorithm. The kernel Adatron maps inputs to a high-dimensional feature space, and then optimally separates data into their respective classes by isolating those inputs that fall close to the data boundaries. Therefore, the kernel Adatron is especially effective in separating sets of data that share complex boundaries.

NeuroSolutions constructs adaptive systems in a Lego style, that is component by component. The components are chosen from palettes. This object-oriented methodology allows for the simple creation of adaptive systems by simply dragging and dropping components, connecting them, and then adjusting their parameters.

As shown in Figure (5.1) neural builder is opened and contains several types of neural networks.

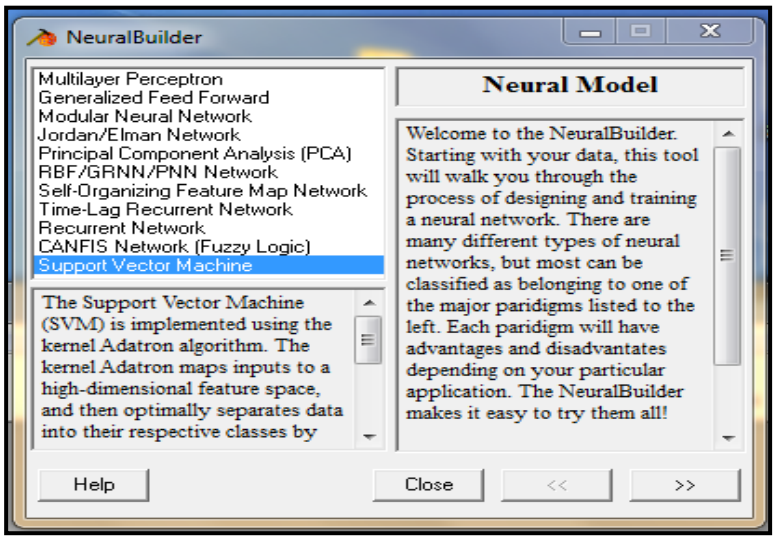

Figure (5.1) Neural network types in neurosolution program

5.9 Data organization

The first step in implementing the support vector machines model in NeuroSolution application is to organize the Neurosolution Excel spreadsheet by specifying the input factors that have been already encoded, which consist of (9) factors; late payment of salaries, time overrun of project, cash flow problems, slow down the progress until payment is received, difficult to procure material and services, difficult to tender for new projects, sub-contractor refuse to continue works on the project, bad reputation of the contractor, high interest rate due to loans. Figures (5.2) and (5.3) show the procedure of selecting the input and output factors in the application program.

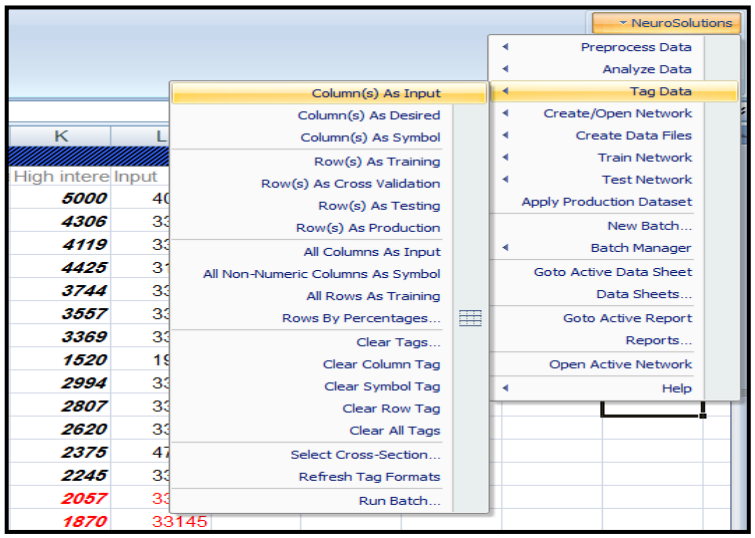

Figure (5.2) Tag column of data as input parameter

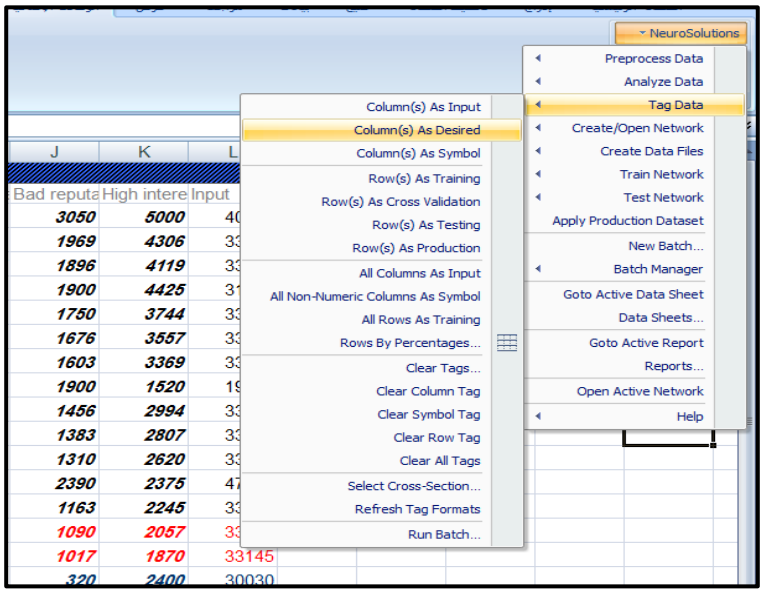

Figure (5.3) Tag column of data as desired parameter

5.10 Data set

The available data were divided into three sets namely; training set, cross-validation set and test set. Training and cross validation sets are used in learning the model through utilizing training set in modifying the network weights to minimize the network error, and monitoring this error by cross validation set during the training process. However, test set does not enter the training process and it hasn't any effect on the training process, where it is used for measuring the generalization ability of the network, and evaluated network performance (Arafa and AL-Qedra, 2011).

In the present study, the total available data is (31) exemplars (Interviews results) that are divided logical randomly into three sets with the following ratio:

- Training set (includes 15 exemplars ≈ 48%).
- Cross validation set (includes 8 exemplars ≈ 26%).
- Test set (includes 8 exemplar ≈ 26%).

As shown in Figure (5.4), assigning the three sets of model building using tag option in Neurosolution program.

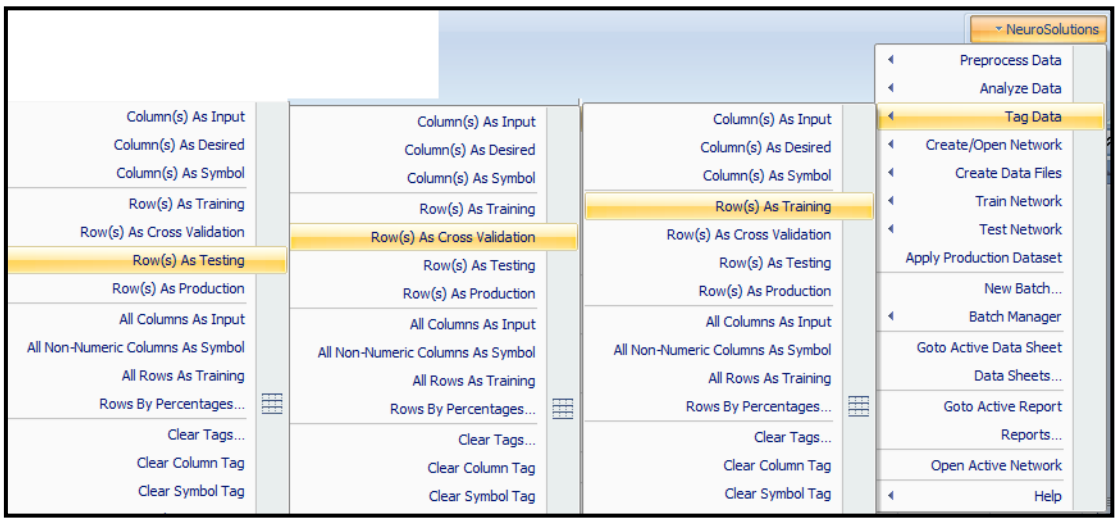

Figure (5.4) Sets of model building

5.11 Building network

The building steps for SVM as an example are explained in the following Figures. Figure (5.5) describes the first pace in creating network type from add-ins tool in Excel.

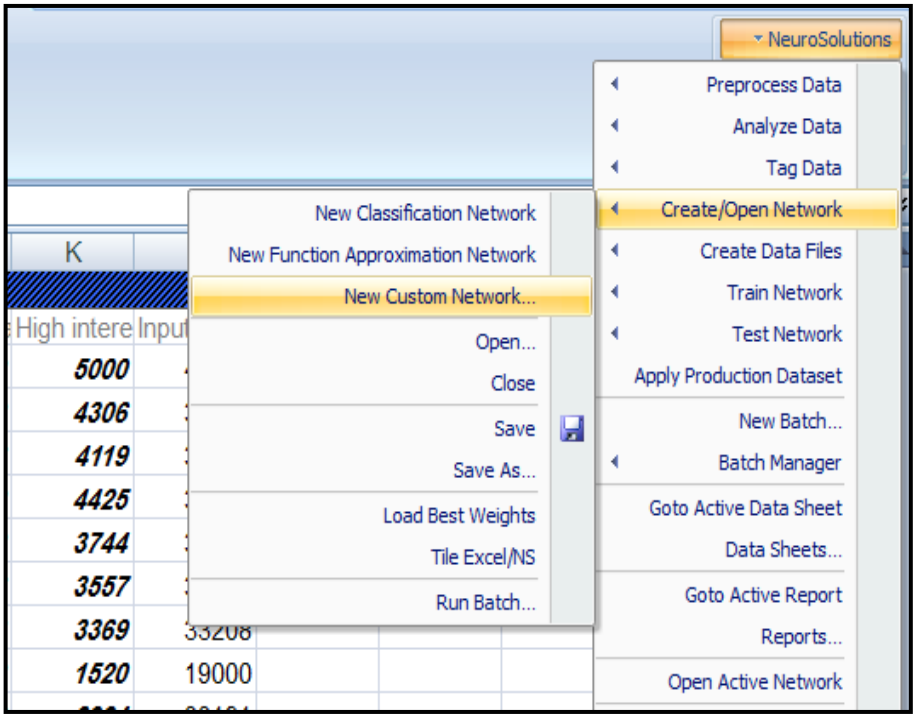

Figure (5.5) Building initial network

The support vector machine was built by selecting the type of network, number of epochs. Figure (5.6) presents the initial network of support vector machine (SVM) network.

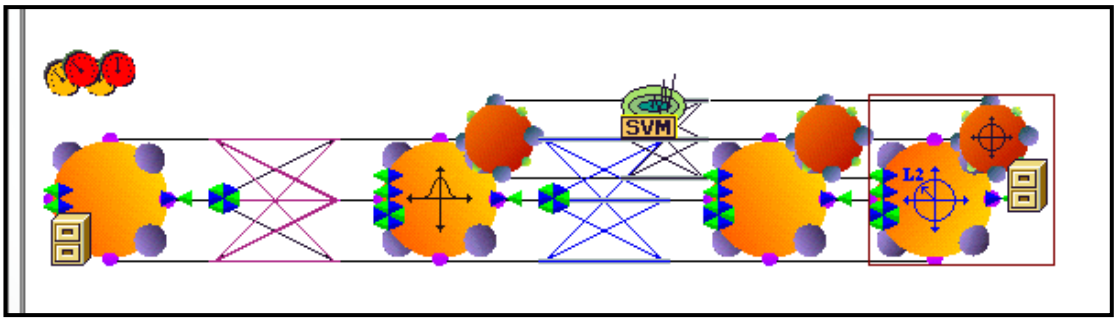

Figure (5.6) Support vector machine (SVM) network

Before starting the training phase, the normalization of training data is recognized to improve the performance of trained networks by Neurosolution program as shown in Figure (5.7) which ranging from (0 to 1).

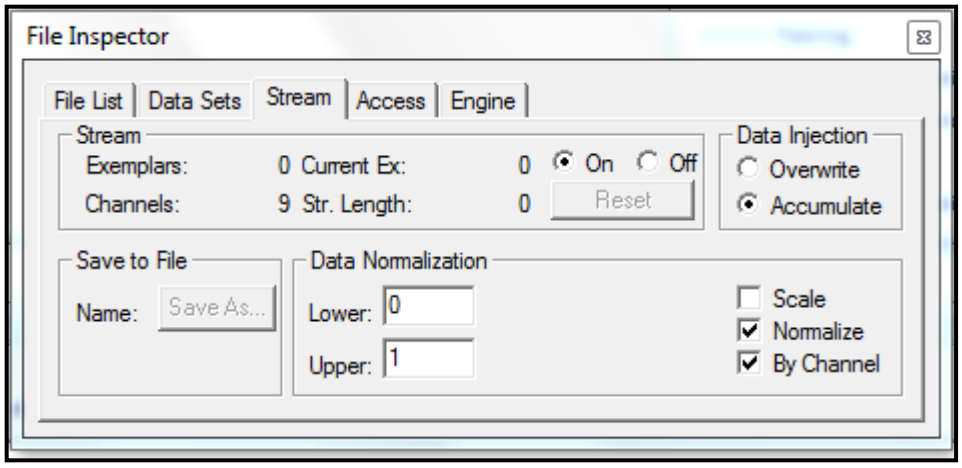

Figure (5.7) Selecting the normalization limits of data

5.12 Model training

The objective of training support vector machine (SVM) networks is the same objective of training the neural network.

Where the objective of training a neural network is to adjust the neural network weights to bring its output closer to the desired output, where the weights after training contain meaningful information, whereas before training, they are random and have no meaning.

This process of changing or adapting the connection weights in some orderly fashion using a suitable learning method is referred to as the learning rule of the network (Dogan, 2005).

The first step in training process is to initialize the weight of parameters that randomly assigned to the links between nodes. The output of the neural network is compared with desired values, and an error is calculated by learning algorithm then the weights associated with each link are adjusted in an attempt to minimize the network's mean square error. The input values are run through the network with the adjusted weights and the process restarts from the beginning. The process is repeated for the predetermined number of epochs. An epoch represents one cycle of the training process (Dowler, 2008). When the training reaches a satisfactory level, the network holds the weights constant and uses the trained network to make decisions, or define associations in new input data sets not used to train it (Dogan, 2005).

The model training starts with selecting the (SVM) network type also a thousand epochs and ten runs were limited. Figure (5.8) clarifies training variables for one trial.

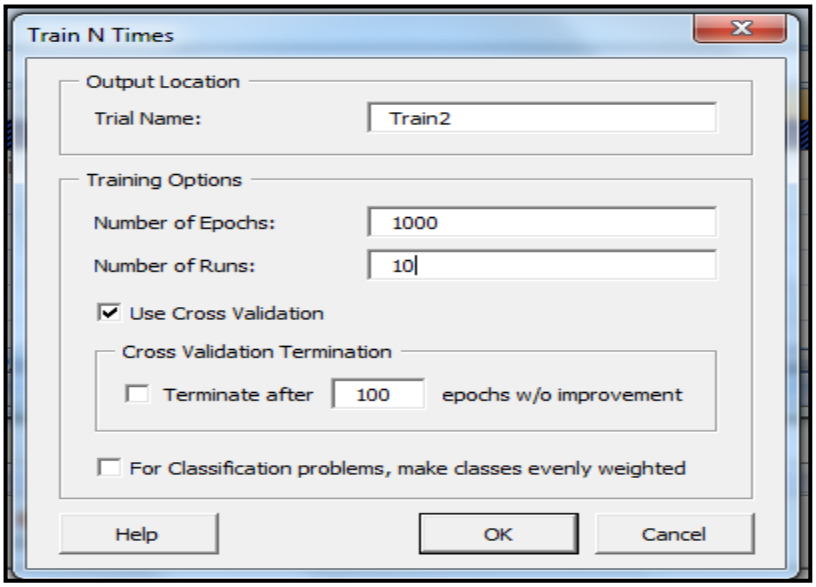

Figure (5.8) Training options in Neurosolution

Ten runs in each one 3000 epochs were applied, where a run is a complete presentation of 3000 epochs, each epoch is a one complete presentation of all of the data (Principe *et al*., 2010). However, in each run, new weights were applied in the first epoch and then the weights were adjusted to minimize the percentage of error in other epochs.

To avoid overtraining for the network during the training process, an option of using cross-validation was selected, which computes the error in a cross validation set at the same time that the network is being trained with the training set.

5.13 Model cross-validation

The cross-validation data is used during the training but for monitoring not to train the network, instead to check the learning of the network during the training; and the testing data is used to validate the training network after finishing training process (Edara, 2003).

Cross validation uses its own data set to monitor the neural network's ability to produce generalized cost estimates; this is done by training many networks on a training set and comparing the errors of the networks on the validation set. The networks that performed best on the validation data set are then selected (Dindar, 2004).

5.14 Model testing

The testing data is totally a different set of data that the network is unaware of; after finishing the training process testing data is used for validation and generalization of the trained network. If the network is able to generalize rather precisely the output for this testing data, then it means that the neural network is able to predict the output correctly for new data and hence the network is validated. Moreover, the amount of data that is to be used for training and testing purposes is depending on the availability of the data, but in general the training data is 2/3rd of the full data and the remaining is used for testing purposes. The cross-validation data can be 1/10th of the training data (Edara, 2003).

5.15 Results and analysis

As mentioned above, the purpose of testing phase of SVM model is to ensure that the developed model was successfully trained and generalization is adequately achieved. The best model that provided more accurate payment delay risk estimation without being overly complex was structured of (SVM) includes nine input factors; late payment of salaries, time

overrun of project, cash flow problems, slow down the progress until payment is received, difficult to procure material and services, difficult to tender for new projects, sub-contractor refuse to continue works on the project, bad reputation of the contractor, high interest rate due to loans. And one output (Total payment delay risk in $US).

The training data set was used to get network weights to bring its output closer to the desired output, where the weights after training contain meaningful information, whereas before training, they are random and have no meaning. Data from (15) contracting companies interviews were used for training purposes. A Neurosolution train tool was used for training the adopted model accordingly to the weights adopted.

The cross validation data set was used to monitor the network, instead to check the learning of the network during the training. Data from eight (8) contracting companies interviews were used for cross validation purposes.

The testing data set was used for generalization that is to produce better output for unseen examples. Data from eight (8) contracting companies interviews were used for testing purposes. A Neurosolution test tool was used for testing the adopted model accordingly to the weights adopted. Table (5.3) presents the results of these (8) contracting companies interviews with comparing the actual risk in ($US) of tested interviews with estimated risk in ($US) from support vector machine (SVM) model, and an absolute error with both price and percentage are also presented.

Table (5.3) Results of SVM network model for testing sample sizes

Interview No.	Actual Risk ($)	Estimated Risk ($)	Absolute Error (AE) ($)	Absolute Percentage Error (APE) %
24th	27,500	28,974.56	1,474.56	5.36
25th	29,400	29,679.26	279.26	0.95
26th	33,500	30,091.04	3,408.96	10.18
27th	30,600	29,353.83	1,246.17	4.07
28th	25,800	28,264.77	2,464.77	9.55
29th	33,000	29,300.5	3,699.50	11.21
30th	28,900	27,507.37	1,392.63	4.82
31st	26,700	28,337.89	1,637.89	6.13
		Average	**1,950.47**	**6.53**

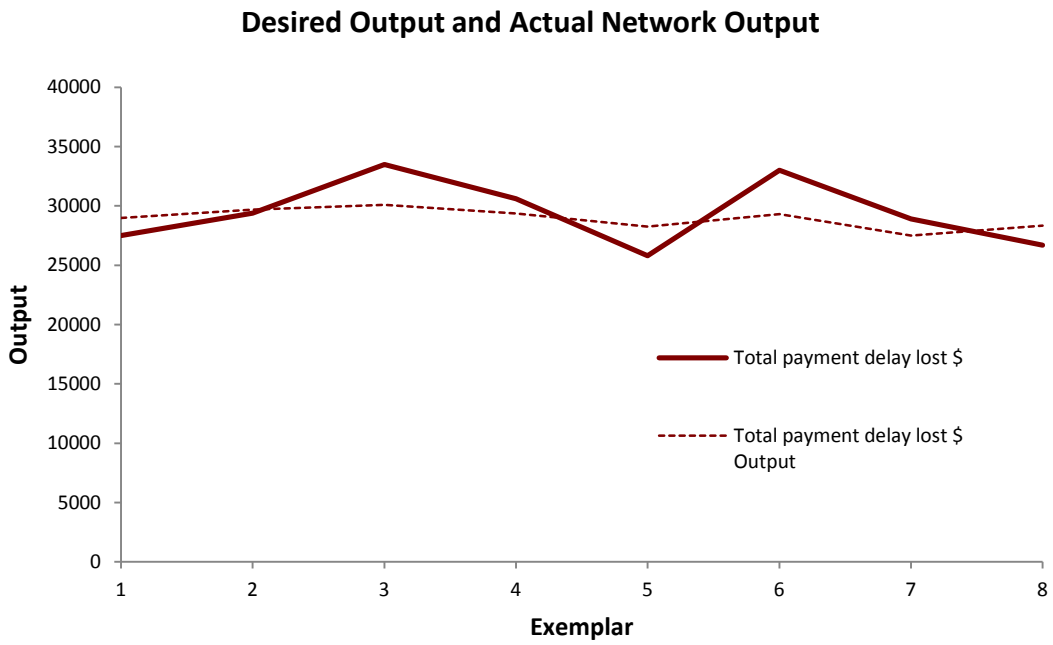

Figure (5.9) Comparison between actual and estimated payment delay risk for test set

Figure (5.9) describes the actual payment delay risk comparing with estimated payment delay risk for test set. It is noted that there is a convergence between two lines.

5.16 Model evaluation

The most common evaluation approaches have been utilized to determine the estimation accuracy in testing phase are:

- Mean Absolute Error (MAE).
- Mean Absolute Percentage Error (MAPE).
- Correlation Coefficient (r).

5.16.1 Mean Absolute Error (MAE)

It is one of many ways to quantify the difference between an estimated and the actual value of the projects being estimated. According to Willmott and Matsuura (2005) the MAE is relatively simple; It involves summing the magnitudes (absolute values) of the errors to obtain the 'total error' and then dividing the total error by n, it can be defined by the following formula:

$$MAE = \frac{\sum_{j=0}^{P}\sum_{i=0}^{N}|dy_{ij}-dd_{ij}|}{N\,P} \qquad \textbf{Eq. (5.1)}$$

Where: P= number of output PEs.

N= number of exemplars in the data set.

dy_{ij}= denormalized network output for exemplar i at PE j.

dd_{ij}= denormalized desired output for exemplar i at PE j.

Table (5.3) shows the MAE for the selected model, and to calculate the (MAE) for testing set, the following procedure (Eq. 5.1) is followed.

$$\textbf{MAE} = \frac{1474.56+279.26+3408.96+1246.17+2464.77+3699.50+1392.63+1637.89}{8} = \textbf{1950.47}$$

The mean absolute error (MAE) equals (US$ 1,950.47), it is acceptable for projects worth one million dollars. However, it is not a significant indicator for the model performance because it proceeds in one direction for the hypothetical case study that supposed for this model, where the mentioned error may be small if the total cost of the project is over one million.

5.16.2 Mean Absolute Percentage Error (MAPE)

The mean absolute Percentage error is a quantity used to measure how close forecasts or predictions are to the eventual outcomes, according to Principe *et al*., (2010) The MAPE is defined by the following formula:

$$\textbf{MAPE} = \frac{100}{N\,P}\sum_{j=0}^{P}\sum_{i=0}^{N}\frac{|dy_{ij}-dd_{ij}|}{dd_{ij}} \qquad \textbf{Eq. (5.2)}$$

Where:

P= number of output PEs.

N= number of exemplars in the data set.

dy_{ij}= denormalized network output for exemplar i at PE j.

dd_{ij}= denormalized desired output for exemplar i at PE j.

Note that this value can easily be misleading. For example, say that your output data is in the range of 0 to 100. For one exemplar your desired output is 0.1 and your actual output is 0.2. Even though the two values are quite close, the percent error for this exemplar is 100 (Principe *et al*., 2010).

Table (5.3) shows the (MAPE) for the selected model, and to calculate the (MAPE) for testing set, the following procedure (Eq. 5.2) is followed.

$$\textbf{MAPE} = \frac{5.36+0.95+10.18+4.07+9.55+11.21+4.82+6.13}{8} = \textbf{6.53}$$

The mean absolute Percentage error (MAPE) for the test results which equals (6.53%), this result can be expressed in another way by accuracy performance (AP) according to Wilmot and Mei (2005) which is defined as (100−MAPE) %.

AP= 100% - 6.53% = 93.47%

That means the accuracy of adopted model for payment delay risk in building projects is (93.47%). The result is acceptable for projects worth one million dollars.

5.16.3 Correlation coefficient (r)

According to Principe *et al.* (2010) the size of the mean square error (MSE) can be used to determine how well the network output fits the desired output, but it doesn't necessarily reflect whether the two sets of data move in the same direction. For instance, by simply scaling the network output, we can change the MSE without changing the directionality of the data. The correlation coefficient (*r*) solves this problem. By definition, the correlation coefficient between a network output *x* and a desired output *d* is:

$$r = \frac{\frac{\sum_i (x_i-\bar{x})(d_i-\bar{d})}{N}}{\sqrt{\frac{\sum_i (d_i-\bar{d})^2}{N}}\sqrt{\frac{\sum_i (x_i-\bar{x})^2}{N}}} \qquad \textbf{Eq. (5.3)}$$

The correlation coefficient is confined to the range [-1,1].

Regression analysis was used to ascertain the relationship between the estimated payment delay risk and the actual payment delay risk. The results of linear regression are illustrated graphically in Figure (5.10). The correlation coefficient R is (0.672) for testing set, indicating

that; there is a good linear correlation between the actual and the estimated risk of payment delay.

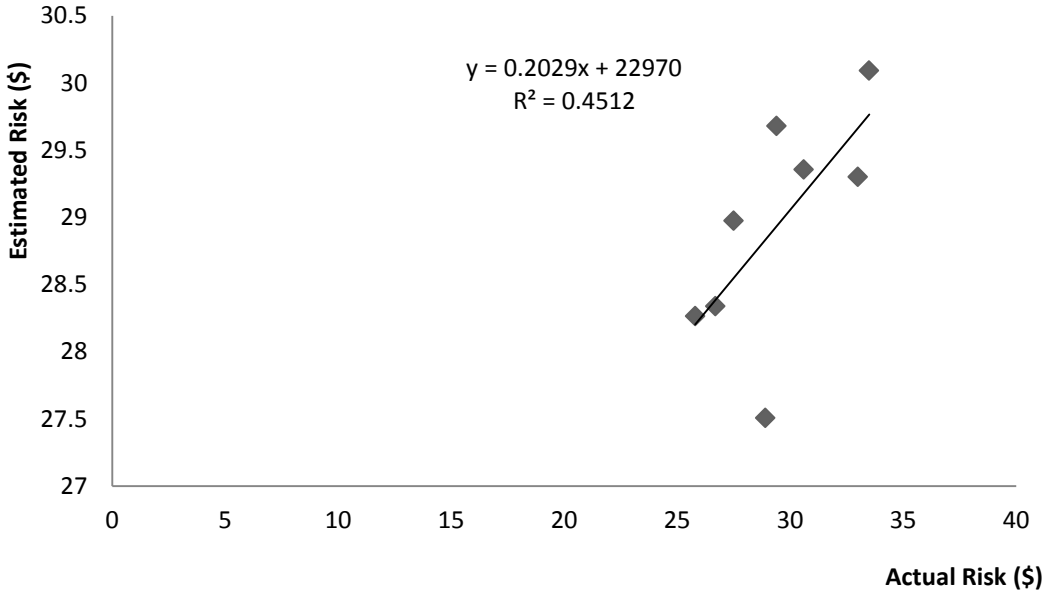

Figure (5.10) Linear regression of actual and estimated risk of payment

The results of performance measures are presented in Table (5.4), where the accuracy performance of adopted model is (93.47 %). In which the average error is (6.53%).

Table (5.4) Results of performance measurements

	MAE	MAPE	AP	r
SVM Model	US$ 1,950.47	%6.53	%93.47	0.672

Figure (5.11) describes the actual payment delay risk comparing with estimated payment delay risk for all (31) contracting companies interviews. It is noted that there is a convergence between two lines.

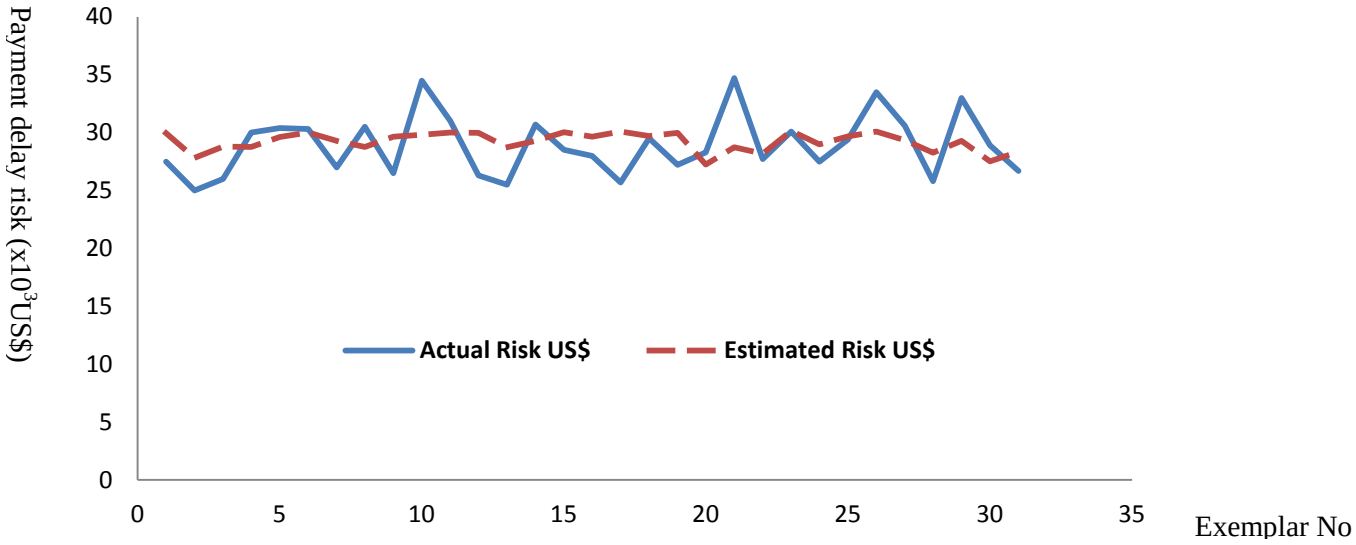

Figure (5.11) Comparison between actual and estimated payment delay risk (x10^3 US$)

5.17 Chapter summary

SVM model formulating passed through several steps started with choosing the nine input factors; late payment of salaries, time overrun of project, cash flow problems, slow down the progress until payment is received, difficult to procure material and services, difficult to tender for new projects, sub-contractor refuse to continue works on the project, bad reputation of the contractor, high interest rate due to loans. And one output factor; total payment delay risk in $US.

The technique of data collection (hypothetical case study and structured interview) with (31) Gaza contracting companies was used in building the model. The Neurosolution 5.07 program was selected to formulate the model.

In order to ensure the validity of the model in measuring the effect of payment delay, many statistical performance measures were conducted i.e.; Mean Absolute Error (MAE) = (US$ 1,950.47), Mean Absolute Percentage Error (MAPE) = (6.53%), Accuracy Performance (AP) = (93.47%) and Correlation Coefficient (r) = (0.672).

CHAPTER (6)

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

Payment to contractors on time must be a main priority the owners do must set, since payment delay leads to cost overrun to the project in terms of interest and delays the entire project completion.

This chapter summarizes the findings from the previous chapters and draws conclusion for this research. It illustrates the conformance to the objectives and aim of the study.
The first objective of this study was to identify factors that cause payment delay. The second objective was to identify the effect of payment delay on construction projects. Identify the effective remedy to the payment delay effects was the third objective, and the last one was to formulate a model to measure the risk of payment delays.

6.2 Conclusion

This part of the thesis concludes the main findings as following:

The factors that contribute to causes of payment delay in construction projects were divided to three groups; group (1) contains six factors, group (2) contains seven factors and group (3) contains ten factors. Results have shown that "contractor related factors" is the most important group. This indicates that the contractor relationship in payment delay causes is important and that he plays the main role in these causes. Results of contractor related factors have indicated that "Failure to follow the certain procedures in claims" is the most important factor. This result indicates the clear and systematic procedure in preparing claims by the contractor lead to fast the payments.

The effect and risk of payment delay on construction projects were divided to four groups; group (1) contains thirteen effects, group (2) contains ten effects, group (3) contains eight effects and group (4) contains eighteen effects. Results have shown that "Effects on contractor" group has been ranked in the first position. This indicated that the contractor is the most affected party by payment delay. Results indicated that the effect "Late payment of salaries" in the first position at effects on contractor group. This indicated that salaries as a result due to payment delay will lead to productivity reduction and thus increase project duration and cost. The top nine effects that resulted in this group have been used in the technique of data collection (hypothetical case study and structured interview) with (31)

Gaza contracting companies, in order to build the SVM model, through the estimation of the financial loss percentage of each effect as a result of payment delay.

The top three effective solutions to mitigate effects and risks of payment delay in Gaza Strip according to this study were; contractors should submit timely accurate invoices with complete documents, contractors should chase payment due relentlessly and defined time frame for payment.

The SVM model was structured nine input factors; late payment of salaries, time overrun of project, cash flow problems, slow down the progress until payment is received, difficult to procure material and services, difficult to tender for new projects, sub-contractor refuse to continue works on the project, bad reputation of the contractor, high interest rate due to loans. One output factor was used; total payment delay risk in $US.

The accuracy performance of the adopted SVM model recorded (93.47%) where the model performed well and no significant difference was discerned between the estimated output and the actual payment delay value. The average percentage error of this model is (6.53%).

In order to ensure the validity of the model in measuring the effect of payment delay, many statistical performance measures were conducted i.e.; Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), Accuracy Performance (AP) and Correlation Coefficient (r).

6.3 Recommendations

Some recommendations should be presented for decision makers in the construction sector to support the results of this study:

1. The owners or donors should work within stipulated budget putting in bank account before starting the project execution.
2. The owners should introduce payment bonds to enable contractors to obtain bonds and guarantees. Also owners should pay progress payment to the contractor on time because it impairs the contractors ability to finance the work.
3. Owners are recommended to revise the bid documents such as technical specifications, drawings, bill of quantities and the design of the project in a good way. This is to avoid disputes and so payment delay may occur.
4. Government, adjudication, Contractors Union and arbitration center at Engineering Syndicate are recommended to establish a database and documentation system for executed projects and disputes between project parties due to payment delay risks for researchers to develop a mitigation methods for payment delay effects and risks.
5. Contractors are recommended to have enough cash before beginning in any project to avoid the financial problems.
6. Contractors should submit timely accurate invoices with complete documents and chase payment due relentlessly.
7. Contractors are recommended to use the developed SVM model to evaluate their competitiveness strength and intern their chances to win the contracts.
8. Consultants should review and approve design documents, shop drawings, and the payments schedule of contractor to avoid any delay or cost overruns at the project.
9. The stakeholders should establish a unified legislative constriction act, to regulate the relationship between all project parties in the construction industry in Palestine, and get rid of the different systems that used now in Gaza, where every party or association has its special system. This lead to confuse contractors, especially when they implement several projects in the same time.
10. It is necessary to give the contractor the right to stop or suspend the work until the payment is made. It can be an effective means to mitigate payment delay without the need to instigate other formal procedure such arbitration and litigation.

11. The recovery of interest on payment delay can often be vital for those in business, the depend on bank financing, lead to a bad effect on the profitability of construction companies.

6.4 Further recommended studies

1. Its suggested that the boundaries of the study widened to include West Bank.
2. Studies for legal issues associated with recovery of payment in construction industry through arbitration and adjudication are suggested.
3. Its recommended to increase the sample size and use real case studies to build up a new model.

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Appendix (A)

The correlation coefficient

Table (3.2)

The correlation coefficient between each paragraph in the field and the whole field SECTION (B) The factors that contribute to causes of payment delay in construction projects

No.	Question	Pearson coefficient	P-value	Sig. level
Group (1) Owner related factors				
1	Poor financial management	0.442	0.014	*
2	Taking over of the works certificate	0.639	0.000	**
3	Failure to agree to the valuation of work	0.584	0.001	**
4	Evaluation of the contractor claims	0.515	0.004	**
5	Bureaucracy in governments departments	0.666	0.000	**
6	Frequency of exchange rate of currencies	0.524	0.003	**
	Group (2) Consultant related factors			
1	Underpaid claims	0.464	0.010	**
2	The quality of quantity surveyor management system	0.719	0.000	**
3	Slow processing of variation orders	0.667	0.000	**
4	Slow processing of final accounts	0.725	0.000	**
5	Inaccurate bill of quantities	0.667	0.000	**
6	Lack of technical and managerial skills of staff	0.674	0.000	**
7	Less periodical meetings to address work problems	0.623	0.000	**
	Group (3) Contractor related factors			
1	Capital lock up	0.634	0.000	**
2	Submit claims with mistakes	0.668	0.000	**
3	Delay in submitting claims	0.659	0.000	**
4	Failure to follow the certain procedures in claims	0.585	0.001	**
5	Willing to accept onerous payment term from clients due to difficulties in obtaining project	0.508	0.004	**
6	Poor quality of work	0.642	0.000	**
7	Failure to agree with the valuation of work	0.862	0.000	**
8	Failure to do work based on bill of quantity	0.698	0.000	**
9	Failure to understand the contract agreement	0.650	0.000	**
10	Labor productivity	0.473	0.008	**

** Correlation coefficient is significant at the $\alpha = 0.01$

* Correlation coefficient is significant at the $\alpha = (0.05)$

Table (3.3)

The correlation coefficient between each paragraph in the field and the whole field

SECTION (C) The effect and risk of payment delay on construction projects

No.	Question	Pearson coefficient	P-value	Sig. level
	Group (1) Effects on project characteristics			
1	Delay in project progress	0.689	0.000	**
2	Scheduling of works or program	0.566	0.001	**
3	Extension of project time	0.539	0.002	**
4	Rise of project cost	0.431	0.017	*
5	Low quality works	0.571	0.001	**
6	Poor site safety	0.679	0.000	**
7	Suspension of work by owner or contractor	0.407	0.026	*
8	Termination of contract by owner or contractor	0.575	0.001	**
9	Creates negative chain effect on other parties	0.711	0.000	**
10	Creates negative chain effect on other parties	0.695	0.000	**
11	May result in disputes e.g. litigation/ arbitration	0.802	0.000	**
12	Creates negative social impacts	0.432	0.017	*
13	Problems with neighbors	0.616	0.000	**
	Group (2) Effects on owner			
1	Most projects were unplanned	0.706	0.000	**
2	Payment of interest on delayed payment	0.718	0.000	**
3	Delay in completion of project by the contractor	0.610	0.000	**
4	Delay in having the expected benefit of property	0.702	0.000	**
5	Leads to suspension of works	0.755	0.000	**
6	Leads to contract termination	0.657	0.000	**
7	Leads to poor quality	0.740	0.000	**
8	Contract modifications (replacement and addition of – new work to the project and change in specifications)	0.552	0.002	**
9	Cost overrun due to risk of payment delay	0.542	0.002	**
10	Bad reputation of the owner	0.600	0.000	**
	Group (3) Effects on consultant			
1	Cost of consultancy services increased	0.398	0.030	*
2	Slow down of the works	0.660	0.000	**
3	Consultants spend longer time than planned	0.447	0.013	**
4	Absence of consultant's site staff	0.505	0.004	**
5	Slowness in giving instruction	0.462	0.010	**
6	Lack of quality control	0.577	0.001	**
7	Waiting time for approval of sample sizes	0.676	0.000	**
8	Bad reputation of the consultant	0.500	0.005	**

	Group (4) Effects on contractor			
1	Cash flow problems	0.755	0.000	**
2	Forced to borrow from financial institutions	0.571	0.001	**
3	Time overrun of project	0.601	0.000	**
4	Cost overrun of project	0.580	0.001	**
5	Difficult to procure material and services	0.542	0.002	**
6	High interest rate due to loans	0.501	0.005	**
7	Difficult to maintain equipment	0.578	0.001	**
8	Shortage of equipment	0.522	0.003	**
9	Low productivity of labor	0.638	0.000	**
10	Late payment of salaries	0.735	0.000	**
11	Bad reputation of the contractor	0.683	0.000	**
12	Difficult to tender for new projects	0.766	0.000	**
13	Slow down the progress until payment is received	0.634	0.000	**
14	Suspend the work until payment is received	0.551	0.002	**
15	Contract termination	0.589	0.001	**
16	Interpret the contract document on payment issue and seek legal advice	0.625	0.000	**
17	Continue to submit a claim	0.612	0.000	**
18	Sub-contractor refuse to continue works on the project	0.687	0.000	**

* * Correlation coefficient is significant at the $\alpha = 0.01$

Table (3.4)

The correlation coefficient between each paragraph in the field and the whole field SECTION (D) The effective remedy to the payment delay

No.	Question	Pearson coefficient	P-value	Sig. level
1	Negotiate payment terms with the owner to facilitate a healthy cash flow	0.559	0.001	**
2	Defined time frame for payment	0.750	0.000	**
3	Contractors should submit timely accurate invoices with complete documents	0.641	0.000	**
4	Contractors should chase payment due relentlessly	0.705	0.000	**
5	Requires the owner to provide the owner's payment guarantee or bond	0.697	0.000	**
6	Employer work within stipulated budget	0.619	0.000	**
7	Charging interest on late payment amount	0.582	0.001	**
8	Understand and study the payment requirement of each individual project	0.662	0.000	**
9	Apply term loan from bank to cover the consequences of late payment	0.521	0.003	**
10	Allow the contractor to slow down the work until payment is received	0.621	0.000	**
11	Allow the contractor to suspend the work until payment is received	0.681	0.000	**
12	Sending notice letter trough contractor's lawyer	0.719	0.000	**
13	Initiate arbitration or litigation	0.624	0.000	**
14	Just ignore and continue with next month's claim	0.556	0.001	**
15	Absence of bureaucracy	0.734	0.000	**

** Correlation coefficient is significant at the $\alpha = 0.01$

Appendix (B)

Interview with contracting companies to build a model to measure the effect of payment delay on construction in Gaza Strip.

Company Name: _____

Interviewee Name: _____

First : the fixed hypothesis to achieve different viewpoints:

1. The company executed a building construction project with total grand cost ($ 1 million) , twelve months period , number of invoice payments were twelve, i.e. one payment every month, and the value of each payment was ($75 thousands) except final payment its value was ($175 thousands) because it included the retention amounts.
2. A payment delay occurred in the last five payments , the delay was two months for each invoice payment due to special reasons.

Second: Please calculate the total cost estimation to the loss in the mentioned project as a result of payment delay : ($) _____

Third: If we assume that the effect of payment delay, as mentioned in the table, what is the weight percentage of each effect of payment delay:

No.	Effects of payment delay on contractor	Relative index (%)
1.	Late payment of salaries	
2.	Time overrun of project	
3.	Cash flow problems	
4.	Slow down the progress until payment is received	
5.	Difficult to procure material and services	
6.	Difficult to tender for new projects	
7.	Sub-contractor refuse to continue works on the project	
8.	Bad reputation of the contractor	
9.	High interest rate due to loans	

THANK YOU !!

Researcher: Abedelsalam Nasser

مقابلة مع شركات مقاولات بخصوص عمل Model لقياس تأثير الدفعات المتأخرة على المشاريع الإنشائية في قطاع غزة:

اسم الشركة:_____

اسم وصفة صاحب المقابلة:_____

أولا: فرضيات ثابتة للحصول على أراء مختلفة:

1. الشركة نفذت مشروع إنشاء مبنى , وقيمته 1 مليون دولار , ومدته 12 شهر , وعدد مستخلصات الدفعات = 12 بواقع واحد لكل شهر , وقيمة كل مستخلص 75 ألف دولار عدا آخر مستخلص (الختامي) فقيمته 175 دولار لأنه يشمل المبالغ المحجوزة .
2. حدث تأخير في آخر الدفعات الخمس الأخيرة بواقع شهرين لكل دفعة لأسباب معينة.

ثانيا: نرجو منكم عمل حساب تقريبي وتقديري للخسارة بالدولار في المشروع المذكور نتيجة تأخير الدفعات :_____($)

ثالثا: لو فرضنا أن أثر تأخير الدفعات كان على النحو المذكور في الجدول , فما هو الوزن بالنسبة المئوية لكل أثر من الآثار التالية نتيجة تأخير الدفعات المالية:

الرقم	تأثير وخطر الدفعات المتأخرة على المقاولين في المشاريع الإنشائية	الوزن (%)
.1	تأخير صرف رواتب العاملين	
.2	زيادة في مدة المشروع	
.3	خلل في التدفق المالي (cash flow)	
.4	إبطاء سير العمل حتى يتم تلقي دفعة مالية	
.5	صعوبة في شراء المواد وتوفير الخدمات	
.6	صعوبة المشاركة في مناقصات مشاريع جديدة	
.7	رفض مقاولي الباطن الاستمرار في العمل	
.8	تشويه سمعة المقاول	
.9	ارتفاع معدل الفائدة نتيجة القروض المالية	

ولكم جزيل الشكر

الباحث

م. عبد السلام هاني نصر

Appendix (C)

THE ISLAMIC UNIVERSITY – GAZA

DEANERY OF HIGHER EDUCATION

ENGINEERING PROJECTS MANAGEMENT

Master Program in Engineering Projects Management

(Questionnaire)

In fulfillment of Msc thesis requirement

The Effect of Payment Delay on Construction Projects in Gaza Strip

Researcher

Abedelsalam H. Nasser

Supervisor

Dr. Nabil I. El Sawalhi

2012

Introduction

This questionnaire is a part of MSc thesis requirement in engineering projects management program in The Islamic University of Gaza.

It is required to be filled with exact relevant facts as much as possible. All data included in this questionnaire will be used only for academic research and will be strictly confidential. After the collection and analysis of all questionnaires, interested participants of this study will be given feedback on the overall research results.

Research Topic

" The effect of payment delay on construction projects in Gaza Strip"

The Aim and Objectives

This research aims to identify the causes of payment delay, and to identify the effect of payment delay and to determine the effective solutions to mitigate risks of payment delay in Gaza Strip construction industry, to reduce their effects and to establish a model to measure the risk of payment delays.

Considering your practical experience in the engineering projects management sector, I have the honor to collaborate with me as one of the experts to fill this questionnaire.

Your data and information is vital to make this research successful. Your kind cooperation is most appreciated.

Yours faithfully,

Eng. Abedelsalam H. Nasser

Questionnaire For MSc Thesis

Please add (√) as appropriate

SECTION (A) General Information

1. Name of your organization / company (optional) ……
2. Type of your organization / company.

   ☐ Owner ☐ Contractor

   ☐ Consultant ☐ others, please specify ……

3. Position in the organization/company.

   ☐ Project Manager ☐ Site Engineer

   ☐ Office Engineer ☐ others, please specify……

4. Experience in the construction industry.

   ☐ 1 - 5 years ☐ 6 – 10 years

   ☐ 10- 15years ☐ More than 15 years

5. Organization / company have experience in construction.

   ☐ 1 - 5 years ☐ 6 – 10 years

   ☐ 10- 15years ☐ More than 15 years

6. No. of fixed employees at your organization / company.

   ☐ Less than 5 ☐ 5 - 10 ☐ 11 - 15 ☐ More than 15

7. Type of project that you have executed recently.

   ☐ School buildings ☐ Medical buildings (Hospitals)

   ☐ Infrastructure ☐ Residential buildings

   ☐ Others, please specify ……

8. Recent project cost (US$)

   ☐ Below 1 million ☐ 1 – 2 million ☐ 2 – 3 million ☐ More than 3 million

SECTION (B) The factors that contribute to causes of payment delay in construction projects.

Each scale represents the following rating

(5) = Very high. (4) = High. (3) = Moderate. (2) = Low. (1) = Very low.

Please indicate the factors that contribute to causes of payment delay.

No		1	2	3	4	5
	Group (1) Owner related factors					
1.	Poor financial management					
2.	Taking over of the works certificate					
3.	Failure to agree to the valuation of work					
4.	Evaluation of the contractor claims					
5.	Bureaucracy in governments departments					
6.	Frequency of exchange rate of currencies					
	Group (2) Consultant related factors					
1.	Underpaid claims					
2.	The quality of quantity surveyor management system					
3.	Slow processing of variation orders					
4.	Slow processing of final accounts					
5.	Inaccurate bill of quantities					
6.	Lack of technical and managerial skills of staff					
7.	Less periodical meetings to address work problems					
	Group (3) Contractor related factors					
1.	Capital lock up					
2.	Submit claims with mistakes					
3.	Delay in submitting claims					
4.	Failure to follow the certain procedures in claims					
5.	Willing to accept onerous payment term from clients due to difficulties in obtaining project					
6.	Poor quality of work					
7.	Failure to agree with the valuation of work					
8.	Failure to do work based on bill of quantity					
9.	Failure to understand the contract agreement					
10.	Labor productivity					

SECTION (C) The effect and risk of payment delay on construction projects.

Each scale represents the following rating

(5) = Very high. (4) = High. (3) = Moderate. (2) = Low. (1) = Very low.

Please indicate the payment delay effect and risk on the Gaza Strip projects.

No		1	2	3	4	5
	Group (1) Effects on project characteristics					
1.	Delay in project progress					
2.	Scheduling of works or program					
3.	Extension of project time					
4.	Rise of project cost					
5.	Low quality works					
6.	Poor site safety					
7.	Suspension of work by owner or contractor					
8.	Termination of contract by owner or contractor					
9.	Creates negative chain effect on other parties					
10.	Creates negative chain effect on other parties					
11.	May result in disputes e.g. litigation/ arbitration					
12.	Creates negative social impacts					
13.	Problems with neighbors					
	Group (2) Effects on owner					
1.	Most projects were unplanned					
2.	Payment of interest on delayed payment					
3.	Delay in completion of project by the contractor					
4.	Delay in having the expected benefit of property					
5.	Leads to suspension of works					
6.	Leads to contract termination					
7.	Leads to poor quality					
8.	Contract modifications (replacement and addition of – new work to the project and change in specifications)					
9.	Cost overrun due to risk of payment delay					
10.	Bad reputation of the owner					

The effect and risk of payment delay on construction projects.

No		1	2	3	4	5
	Group (3) Effects on consultant					
1.	Cost of consultancy services increased					
2.	Slow down of the works					
3.	Consultants spend longer time than planned					
4.	Absence of consultant's site staff					
5.	Slowness in giving instruction					
6.	Lack of quality control					
7.	Waiting time for approval of sample sizes					
8.	Bad reputation of the consultant					
	Group (4) Effects on contractor					
1.	Cash flow problems					
2.	Forced to borrow from financial institutions					
3.	Time overrun of project					
4.	Cost overrun of project					
5.	Difficult to procure material and services					
6.	High interest rate due to loans					
7.	Difficult to maintain equipment					
8.	Shortage of equipment					
9.	Low productivity of labor					
10.	Late payment of salaries					
11.	Bad reputation of the contractor					
12.	Difficult to tender for new projects					
13.	Slow down the progress until payment is received					
14.	Suspend the work until payment is received					
15.	Contract termination					
16.	Interpret the contract document on payment issue and seek legal advice					
17.	Continue to submit a claim					
18.	Sub-contractor refuse to continue works on the project					

SECTION (D) The effective remedy to the payment delay

Each scale represents the following rating

(5) = Very high effective. (4) = High effective. (3) = Moderate effective.

(2) = Low effective. (1) = Very low effective.

Please indicate the possible solutions to mitigate the payment delay effect and risk on the Gaza Strip projects.

No		1	2	3	4	5
1.	Negotiate payment terms with the owner to facilitate a healthy cash flow					
2.	Defined time frame for payment					
3.	Contractors should submit timely accurate invoices with complete documents					
4.	Contractors should chase payment due relentlessly					
5.	Requires the owner to provide the owner's payment guarantee or bond					
6.	Employer work within stipulated budget					
7.	Charging interest on late payment amount					
8.	Understand and study the payment requirement of each individual project					
9.	Apply term loan from bank to cover the consequences of late payment					
10.	Allow the contractor to slow down the work until payment is received					
11.	Allow the contractor to suspend the work until payment is received					
12.	Sending notice letter trough contractor's lawyer					
13.	Initiate arbitration or litigation					
14.	Just ignore and continue with next month's claim					
15.	Absence of bureaucracy					

THANK YOU !!

الجامعـة الإسلاميـة – غـزة

كليـــة الدراســـات العليـــا

إدارة المشـروعات الهندسيـة

استبيان حول

" تأثير الدفعات المتأخرة على المشاريع الإنشائية في قطاع غزة "

وذلك جزء من البحث التكميلي لنيل درجة الماجستير في إدارة المشروعات الهندسية

الباحث / م. عبد السلام هاني نصر

المشرف / د. نبيـــل الصوالحـــي

2012 م / 1433 هـ

الأخوة / المهندسون العاملون في قطاع المشروعات الإنشائية بقطاع غزة ,,,,,,,,,

السلام عليكم ورحمة الله وبركاته ,,,,,,,,,

الموضوع / استبانة حول دراسة بعنوان " تأثير الدفعات المتأخرة على المشاريع الإنشائية في قطاع غزة "

تعتبر صناعة الإنشاءات إحدى أهم المجالات التي ساهمت في النمو الاقتصادي بقطاع غزة مؤخرا , وعلى الرغم من صغر مساحة قطاع غزة إلا أنه وبعد توقيع معاهدة أوسلو شهد تطورا وانتعاشا كبيرا في مجال صناعة الإنشاءات , نظرا للمشاريع المتعددة التي عكفت الدول المانحة والمؤسسات الدولية المختلفة على تمويلها , وتنفيذها بالتعاون مع القطاع الحكومي ومختلف الجهات المالكة لهذه المشاريع.

ولكن هذا التطور في صناعة الإنشاءات تبعه العديد من المشاكل , ولعل من أهم هذه المشاكل تأخر بعض الملاك أو المانحين في تسديد المستحقات المالية للمقاولين , والتي يوجد عوامل متعددة تسبب تأخيرها , كما ونجم تأثيرات و ترتب مخاطر عديدة على تأخرها , لذلك تم اختيار هذا البحث لدراسة العوامل المسببة لتأخير الدفعات , والتأثيرات والمخاطر المترتبة عليها , ووضع أفضل الحلول والتوصيات التي تقلص هذه المشكلة .

كما وأنوه أن هذه الاستبانة يعتبر جزء من رسالة الماجستير التي أسعى لنيلها في إدارة المشروعات الهندسية بالجامعة الإسلامية – غزة , وينقسم إلى أربعة أقسام وهي :

1. معلومات عامة.
2. العوامل التي تساهم في أسباب تأخير الدفعات المالية في المشاريع الإنشائية.
3. تأثير ومخاطر تأخير الدفعات المالية على المشاريع الإنشائية.
4. طرق المعالجة الفعالة لتقليص تأثيرات ومخاطر الدفعات المتأخرة على المشاريع الإنشائية.

لذلك نرجو منكم أن تتعاونوا معنا لإنجاح هذا البحث بمشاركتكم في تعبئة هذه الاستبانة بشفافية وأمانة , علماً بأن هذه المعلومات سيتم المحافظة عليها وستكون فقط لغرض البحث العلمي.

م. عبد السلام هاني نصر

استبانة

يرجى وضع علامة (√) عند الإجابة المناسبة

القسم الأول / معلومات عامة.

1. **اسم الشركة أو المؤسسة التي تعمل بها (اختياري)** .....
2. **نوع الشركة أو المؤسسة التي تعمل بها.**

☐ مالك ☐ مقاول

☐ استشاري ☐ أخرى , وضح .....

3. **وظيفتك في المؤسسة أو الشركة.**

☐ مدير مشروع ☐ مهندس موقع

☐ مهندس مكتب ☐ أخرى , وضح .....

4. **خبرتك في مجال الإنشاءات.**

☐ 1– 5 سنوات ☐ 6 – 10 سنوات

☐ 11 – 15 سنة ☐ أكثر من 15 سنة

5. **خبرة المؤسسة أو الشركة التي تعمل بها في مجال الإنشاءات.**

☐ 1– 5 سنوات ☐ 6 – 10 سنوات

☐ 11 – 15 سنة ☐ أكثر من 15 سنة

6. **عدد العاملين الثابتين في المؤسسة أو الشركة التي تعمل بها.**

☐ أقل من 5 ☐ من 5 – 10

☐ من 11– 15 ☐ أكثر من 15

7. **نوع المشروع الذي عملت به مؤخرا.**

☐ مباني تعليمية ☐ مباني صحية

☐ مباني سكنية ☐ بنية تحتية ☐ أخرى , وضح .....

8. **تكلفة آخر مشروع بالدولار الأمريكي.**

☐ أقل من 1 مليون ☐ 1 – 2 مليون

☐ 1 – 3 مليون ☐ أكثر من 3 مليون

القسم الثاني / العوامل التي تساهم في أسباب الدفعات المتأخرة في المشاريع الإنشائية.

يرجى وضع علامة (√) عند المقياس المناسب.

		1	2	3	4	5
الرقم	العوامل التي تساهم في أسباب الدفعات المتأخرة في المشاريع الإنشائية	بشكل منخفض جداً	بشكل منخفض	بشكل متوسط	بشكل مرتفع	بشكل مرتفع جدا
المجموعة رقم (1) عوامل لها علاقة بالمالك						
.1	ضعف الإدارة المالية					
.2	التأخر في إصدار شهادة تسليم الأعمال					
.3	عدم الدقة في حساب الأعمال المنجزة					
.4	تقييم المطالبات المالية للمقاول (Claims)					
.5	الطابع البيروقراطي التسلطي في الإدارات الحكومية					
.6	التغير في أسعار العملات					
المجموعة رقم (2) عوامل لها علاقة بالاستشاري						
.1	تقاضي أجر مقابل تدقيق المطالبات المالية (claims)					
.2	جودة إدارة حساب الكميات					
.3	البطء في اعتماد الأوامر التغيرية					
.4	البطء في اعتماد المستخلص الختامي					
.5	وجود أخطاء في جدول الكميات					
.6	ندرة المهارات الفنية والإدارية لدى فريق الاستشاري					
.7	ندرة الاجتماعات الدورية والتي تناقش مشاكل المشروع					
المجموعة رقم (3) عوامل لها علاقة بالمقاول						
.1	تجميد رأس المال أو جمود رأس المال					
.2	تقديم مطالبات مالية (claims) تحتوي أخطاء					
.3	التأخر في تقديم المطالبات المالية (claims)					
.4	عدم إتباع خطوات سليمة في إعداد المطالبات المالية (claims)					
.5	قبول نظام الدفعات المالية المتأخرة لدى المالك بسبب صعوبة الحصول على مشاريع					
.6	ضعف جودة العمل					
.7	عدم الدقة في حساب الأعمال المنجزة					
.8	القصور في تنفيذ العمل وفقا لجدول الكميات					
.9	سوء فهم بنود العقد					
.10	إنتاجية العمال (Productivity)					

القسم الثالث / تأثير وخطر الدفعات المتأخرة على المشاريع الإنشائية.

يرجى وضع علامة (√) عند المقياس المناسب.

الرقم	تأثير وخطر الدفعات المتأخرة على المشاريع الإنشائية	1 بشكل منخفض جداً	2 بشكل منخفض	3 بشكل متوسط	4 بشكل مرتفع	5 بشكل مرتفع جدا
المجموعة رقم (1) تأثيرات على خصائص المشروع						
.1	تأخير التقدم أو الانجاز في المشروع					
.2	جدولة الأعمال أو البرامج					
.3	زيادة في مدة المشروع					
.4	ارتفاع في تكلفة المشروع					
.5	انخفاض في جودة العمل					
.6	انخفاض عوامل الأمان في موقع العمل					
.7	تعليق العمل من قبل المالك أو المقاول					
.8	فسخ العقد من قبل المالك أو المقاول					
.9	خلق علاقة سلبية بين أطراف المشروع					
.10	خلق تأثير سلبي على سلسلة الأطراف الأخرى					
.11	قد يؤدي إلى نزاعات على سبيل المثال القضاء / التحكيم					
.12	يؤدي إلى آثار سلبية على المجتمع					
.13	يؤدي إلى مشاكل مع جيران المشروع					
المجموعة رقم (2) تأثيرات على المالك						
.1	تخبط في وضع خطط للمشاريع					
.2	دفع فوائد مالية على القروض نتيجة الدفعات المتأخرة					
.3	تأخر انتهاء المشروع عن موعده					
.4	تأخير في الفائدة المتوقعة من الممتلكات					
.5	يؤدي إلى تعليق مؤقت العمل					
.6	يؤدي إلى فسخ العقد					
.7	يؤدي إلى انخفاض جودة العمل					
.8	يؤدي إلى حدوث تعديلات وإضافات على العقد					
.9	زيادة العبء المالي على المالك					
.10	تشويه سمعة المالك					

تابع القسم الثالث / تأثير وخطر الدفعات المتأخرة على المشاريع الإنشائية.

الرقم	تأثير وخطر الدفعات المتأخرة على المشاريع الإنشائية	1 بشكل منخفض جداً	2 بشكل منخفض	3 بشكل متوسط	4 بشكل مرتفع	5 بشكل مرتفع جدا
المجموعة رقم (3) تأثيرات على الاستشاري						
.1	زيادة تكاليف الخدمات الاستشارية					
.2	بطء في انجاز العمل					
.3	الاستشاري يقضي وقت أطول من المخطط له					
.4	غياب فريق الاستشاري عن موقع العمل					
.5	بطء في إعطاء تعليمات العمل					
.6	ضعف التحكم في الجودة					
.7	انتظار وقت طويل في اعتماد العينات					
.8	تشويه سمعة الاستشاري					
المجموعة رقم (4) تأثيرات على المقاول						
.1	خلل في التدفق المالي (cash flow)					
.2	الاضطرار للاقتراض من المؤسسات المالية (البنوك)					
.3	زيادة في مدة المشروع					
.4	زيادة في تكلفة المشروع					
.5	صعوبة في شراء المواد وتوفير الخدمات					
.6	ارتفاع معدل الفائدة نتيجة القروض المالية					
.7	صعوبة صيانة المعدات					
.8	نقص في المعدات					
.9	انخفاض إنتاجية العمال					
.10	تأخير صرف رواتب العاملين					
.11	تشويه سمعة المقاول					
.12	صعوبة المشاركة في مناقصات مشاريع جديدة					
.13	إبطاء سير العمل حتى يتم تلقي دفعة مالية					
.14	تعليق العمل حتى يتم تلقي دفعة مالية					
.15	فسخ العقد					
.16	تفسير قضايا الدفعات المالية في وثيقة العقد وطلب مشورة قانونية					
.17	تقديم مطالبة مالية (claim)					
.18	رفض مقاولي الباطن الاستمرار في العمل					

القسم الرابع / طرق المعالجة الفعالة لتقليص تأثيرات ومخاطر الدفعات المتأخرة على المشاريع الإنشائية.

يرجى وضع علامة (√) عند المقياس المناسب.

		1	2	3	4	5
الرقم	**طرق المعالجة الفعالة لتقليص تأثيرات ومخاطر الدفعات المتأخرة على المشاريع الإنشائية**	**بشكل منخفض جداً**	**بشكل منخفض**	**بشكل متوسط**	**بشكل مرتفع**	**بشكل مرتفع جدا**
.1	التفاوض على شروط الدفع المالي مع المالك لتسهيل التدفق النقدي (cash flow)					
.2	تحديد جدول زمني للدفع المالي					
.3	على المقاول تقديم مستخلص مالي دقيق في الوقت المناسب مع كامل الوثائق اللازمة					
.4	على المقاول متابعة الدفعة المالية بجدية و بدون تقصير					
.5	مطالبة المالك تقديم ضمان أو كفالة تخص الدفعة المالية					
.6	أن يعمل المالك ضمن الميزانية المرصودة					
.7	فرض فوائد على قيمة الدفعة المالية المتأخرة					
.8	فهم ودراسة متطلبات وآليات الدفعة المالية لكل مشروع على حدة					
.9	أخذ قرض من البنك لتغطية الأضرار المترتبة على تأخير الدفعة المالية					
.10	السماح للمقاول بإبطاء العمل حتى يتلقي دفعة مالية					
.11	السماح للمقاول بتعليق العمل حتى يتم يتلقي دفعة مالية					
.12	إرسال رسالة تنبيه بواسطة محامي المقاول					
.13	البدء في التحكيم أو اللجوء للقضاء					
.14	فقط التجاهل ومتابعة عمل مطالبة مالية (claim) الشهر المقبل					
.15	تغييب البيروقراطية (التسلط)					

شكرا لتعاونكم معنا