CASH FLOW DEFINING THE CONSTRUCTION INDUSTRY

A Thesis

by

SHALINI NAIR

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Chair of Committee,	John M. Nichols
Committee Members,	Edelmiro Escamilla
	Kevin T. Glowacki
Head of Department,	Joseph P. Horlen

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ABSTRACT

Cash flow is one of the most critical aspects in the proper management of any company or industry. Success or failure in proper cash flow management ultimately plays a huge role in determining the success or failure of the company or industry as a whole. Cash flow exists at three levels, the company management level, at an individual manager level and at the individual level in terms of productivity. Cash flow can be observed as a series of transactions in a game. The interesting feature in the game is that the state of no-move by one player, as in a failure to pay, may lead to a game-ending move for another player. Cash flow is not like productivity, it is not completely controlled by factors in the company's control, and even the best-managed companies may experience liquidity problems from time to time. This research develops the game and the game rules to study cash flow at a microeconomic level. The game represents a real life scenario; the decisions are taken based on input data and prior knowledge. The game result is a cash flow model. The cash flow model provides input data for a statistical analysis of the output data. Most cash flow decisions are made by a manager with limited autonomy and often no real control occurs at the financial management level. The personal responsibility levels are moderate and the returns based on the decisions made are sometimes hard to determine. The developed game rules model such a situation, providing a Superintendent with a scenario to control cash flow for a theoretical site and contract. The game output will provide a data set to review the Superintendent's performance in managing the cash flow presented in the game. Further research will use the game to study individual players and compare the results.

DEDICATION

To my parents and brother for always believing in me and always supporting me in all my endeavors. To my friends for always standing by me, and helping make this journey so far in United States fruitful.

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I would like to thank my committee chair, Dr. Nichols, and my committee members, Dr. Escamilla and Professor Glowacki, for their guidance and support throughout the course of this research. I express my gratitude, as it would not have been possible without them.

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NOMENCLATURE

Cash Flow	is movement of money in to or outside of the project, company or business. A period of extended cash flow out of a project or company can results in the need to declare bankruptcy
Net Cash Flow	is difference between a company's cash flowing in to the project and cash flowing out of the project in a given period, in other terms where revenue is higher than the expenses. Three types of cash flow exist, positive, neutral and negative. Neutral cash flow is rarely common, but it may occur for brief periods
Positive Cash Flow	where the cash floating in is higher than the cash floating out of the project. Positive cash flow is the preferred arrangement. Often contract writers frustrate the development of positive cash flows with withheld amounts
Negative Cash Flow	where the cash floating out of the project is greater than cash floating in to the project, in other terms where expenses are more than revenues. Negative cash flow requires sufficient liquidity in the firm to weather the negative cash flow periods

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

CHAPTER I

INTRODUCTION

Background

Despite the considerable amount of literature existing on the problem of company failure due to poor management of cash flow in the construction industry and other volatile industries, challenges on implementing efficient cash flow continue to plague the construction industry (Birchall, 1991; Huang, 2009; Lennox, 1999; Ogawa, 2015; Wan & Zhu, 2011). Cash flow is important in the construction industry, as it is in all industries. Recent research at TAMU has looked at using Game Theory to study the problems and opportunities associated with Reverse Auction Bidding (van Vleet, 2004). This Reverse Auction Bidding research provided the conceptual idea for this study into cash flow in the construction industry. Reverse Auction Bidding case studies using a simple game showed the dominant influence of personality type on the returns. The long-term goal of this research is to investigate the performance of trained construction specialists in controlling a standard cash flow situation. The statistical properties of the construction scientist's performance can be measured and the factors influencing the performance investigated in future case studies.

Cash flow control occurs at three levels, the company management team, at the individual manager level and as a productivity measure for the individuals. Cash flow management at the company level is a well-understood process, but at the individual superintendent level, there is room to study the performance of individuals in making

decisions that affect the company cash flows. This problem is one of microeconomics (Lennox, 1999), the cash flow must in the end be positive for job success.

The thesis provides

- Chapter II Literature Review, where the basic problem concepts are outlined in some detail
- Chapter III Game Method, provides the conceptual idea for the development of the game and game rules
- Chapter IV Game Development, outlines a summary of the game play and intended analysis methods
- Chapter V Conclusions provides conclusions and recommendations for the use of the game
- Appendix A provides the game sheets

Problem Statement

A game is proposed and developed to measure cash flow control performance. New knowledge will be sought in future case studies to understand how the various factors influence each other in measuring the performance of the cash flow equation at the lowest element for a new field superintendent.

Research Objectives

The major research objectives are:

- Create the rules for a game that allows the study of individual performance in the management of cash flow at the superintendent entry level in a construction company, the new field superintendent

- Outline the game development and methods

Assumptions of the Study

This study will be focused on the factors of construction Industry in United States. The study assumptions are:

- Limited to a simple game
- Game play is expected to model real world scenarios
- Limited to one player at a time
- The players act in an honest and fair manner

CHAPTER II

LITERATURE REVIEW

Introduction

This literature review outlines:

- Construction
- Cash flow basics
- Other factors
- Various financial factors
- Past research studies
- Industry survival
- Various determinants
- Risk factors

Construction

Construction is the lifeblood of the economy along with agriculture. The construction industry is one of the most significant contributors to the U.S economy and is one of the riskiest businesses in the market (Eisdorfer, 2007; Wong & Ng, 2010). The development of US assets ranges from the simplest house to the most complex government project related to national security. Figure 1 shows a typical small home constructed in the 1920s on the east coast of the USA. Little has changed in the way of construction since that time and the average home builder would be quite comfortable building this home in the modern era, although the fittings may change and the boiler room provided could be used for other things.

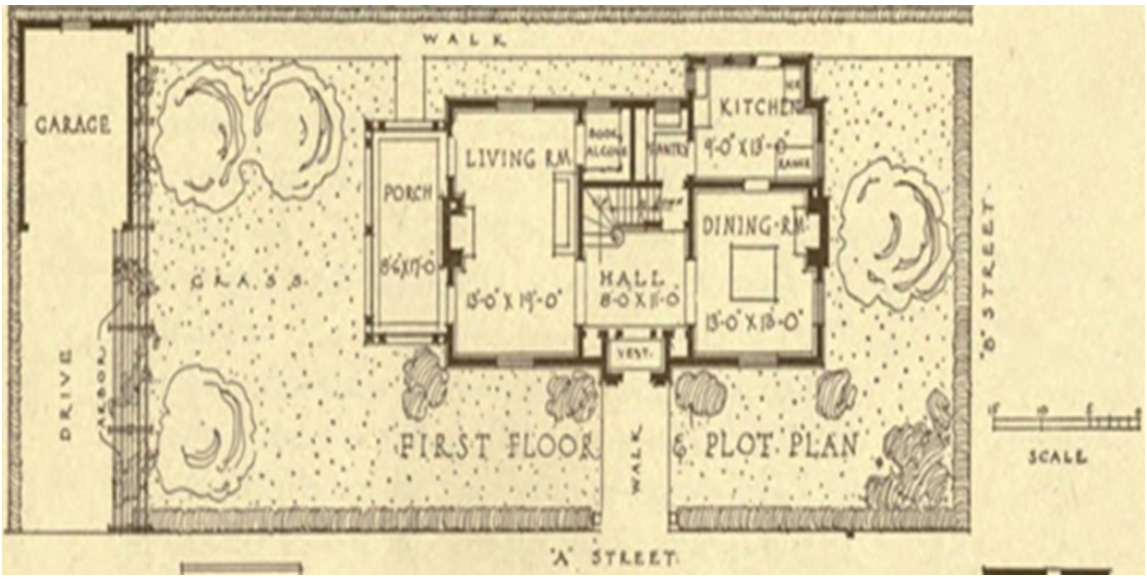

Figure 1. Dises House – 1921

This home represents the quintessential dream of the average US family throughout the 20th century. It represents the major investment in their life and their hope for the future of their children, being seen as an asset for their retirement and for the children. The house needs to be constructed in an efficient and economical manner to achieve two clear objectives for the two parties to the construction contract, an cost effective and well-built house for the owner and maximized returns for the builder. There is nothing unethical in any of these objectives and the efficient management of cash flow is one aspect of this construction. The game is built around the construction of such a building.

Cash Flow Basics

Only about half of startup businesses remain operational after the first four years of operation. Although this may not always be due to cash issues, cash flow is a significant

problem. Eisdorfer (2007) clearly showed that questions were raised at the position of the company in the market, once it was observed to have a cash flow problem. Cash flow problems can be accounted for in the various reasons for failure. Problems can start from the failure to convince creditors and possible lenders of money that this inadequacy is only temporary and would not result in bankruptcy. Therefore, forecasting cash requirements is essential in order to make provisions for difficult times in the future (McCaffer & Harris, 2001). Many factors account for the discrepancies in the cash flow. Some of different categories of failure can be broken into financial issues, supplier problems, subcontractor issues, and communication throughout the whole project (Al-Issa & Zayed, 2007). Cash flow is a communication issue; the delay to cash flow can have a serious impact on the project and in time the reputation of the entity with the communication problem.

The construction industry is often considered a one of a kind industry and is unique for both small scale as well as large-scale industries, but in reality, it is a manufacturer of unit items, and the difficulty with unit item manufacture is the failure to learn from repeated work. Repeated work brings efficiency and improved productivity, construction uses the concepts of subcontractor and unique suppliers to provide a small step in the path to multiple unit manufacture, but the continual shuffling of the contract types, players, sites and clients means that the simple learning in multiple units has to be relearned, time after time. Figure 1 shows a house that may have been built several hundred times in the USA in the 1920's, but each time is likely to be the first for the construction crew.

If planned properly, company profits can provide an excellent return on investment, but this requires an effective cash flow control procedure. The company has to fund the work for the period from start until the first payment and so:

- assuming invoices submitted monthly at the end of the month
- the average cost item is not billed for 15 days
- assuming a 30-day account settlement
- the average payment period is 45 days
- assuming a ten percent reduction on the amount as withholding,
- the amount settled is 90%
- the remaining ten percent is not obtained until the end of the contract payments.

If the company operates on a ten percent profit, then the company is in a neutral at best cash flow from the first payments. The best method to fund this type of contract is to delay payments to sub-contractors for as long as possible, which often leads to the contract terms requiring settlement of all subcontractor accounts prior to invoice settlement. This is in reality a game of cat and mouse involving the movement of money, and it is the velocity of money that is an important indicator of economic vitality (Ogawa, 2015).

Research shows that only ten percent of companies that earn $10 million or less forecast their cash flow, which contributes to the excessive failure rates (Strugs, 2015). Complexity and construction projects go hand in hand. Even the most profitable company in the construction industry can collapse if cash flow management is not

effective (Central Computer and Telecommunication Agency., 1993; Liu, Zayed, & Li, 2009).

Cash flow is defined by Cooke . B. and Jepsen (1986) as the movement of money flowing in and out of the business. Positive cash flow is the money flowing in to the business whereas money flowing out of the business is negative cash flow. The difference between the positive and negative cash flow is called net cash flow. Additionally Cooke . B. and Jepsen (1986) referred positive cash flow as the money received in the form of monthly payment whereas negative cash flow is something money spent on materials, wages, and overheads during the course of work as shown in the following equation:

$$i - o = n \tag{1.1}$$

Where, i, inflow cash flow, 0, outflow cash flow and n is the net cash flow. Cash flow is a simple cycle and this thus amenable to study using game theory. The interest is in maximizing the return to the builder, whilst maintaining a legal contract. The input and output functions are time based, with a Dirichlet Delta Function form, which is amenable to game play.

Other Factors

Many other factors can affect a company and cause issues with cash flow. These factors include:

- The indirect costs often exceed the direct costs (Wong & Ng, 2010) and control over indirect costs can be difficult in a time of market volatility

- More than 80% of company failures are due to budgetary and macroeconomic issues within the construction industry (Arditi, Koksal, & Kale, 2000)
- The construction industry is a very competitive industry, and during periods of intense competition, control of cash flow can be critical

There is thus a need for effective management of cash flow to survive and sustain in the end (Liu et al., 2009). One of the major problems causing failures in construction projects is a lack of liquidity (Al-Issa & Zayed, 2007; Argenti, 1976). According to various surveys conducted, financial and budgetary factors are the leading causes of failures among others in the construction industry (Kivrak & Arslan, 2008).

Poor financial management, inadequate attention to cash flow management in particular is the main reason behind why the construction industry suffers the largest number of bankruptcy of any sector of the economy(A. Boussabaine & Kaka, 1998; Calvert, 1986; McCaffer & Harris, 2001).

Additionally, Strugs (2015).states that for a company to succeed, clear understanding of profit and loss is necessary whether it is in strategy, leverage or logistics. Unfortunately, poor cash flow and ineffective management are plaguing the construction industry. Most of the construction company failures are accounted due to poor financial management. The major problem with this industry is that client payment usually gets cleared in 45 days after billing, whereas vendors are required to be paid usually within 30 days of work, whereas employees are supposed to be paid much earlier resulting in negative cash flow. This without proper financial resources often results in disastrous capital outflow. The secondary is that in a downturn, if the workload falls to

71 % of the peak workload and the average returns fall to 71% of the peak prices, then the company has to subsist on 50% of the previous income, which requires drastic remedial action to realign the company assets, personal and costs. One of the most important tools in the construction industry is financial management. The construction industry is marred by the largest rates of insolvency in the economic sector. Moreover, an accurate cash flow prediction will help solve any unexpected financial requirements, as decision making would become easier if we know the source of cash as well as the structure of its flow within the company (El Din Hosny & El Beheri, 2014).

Financial planning is one of the most important necessities for a construction industry to survive, as a lack of funds has been seen as the biggest reason for failed projects in the past. Al-Issa and Zayed (2007) states that it is impossible for a contractor to survive in the construction industry without proper cash flow management, as is the case for all industries as well as individual entities.

The purpose of the capital system is to provide sufficient equity forms to a company to allow it to commence and survive. Cash flow ensures that the capital equity market receives sufficient returns to allow its business to borrow. Failures and defects are considered to be a common phenomenon in the construction industry as it can impact the cost and duration of the project considerably. If the necessary precautions are not taken it can lead to serious problems in near future (Ahzahar, Karim, Hassan, & Eman, 2011).

Various Financial Factors

There are various financial performance models that can be seen in the literature to study failures in the construction industry. Most of them use financial ratios through a statistical search (Kangari, Farid, & Elgharib, 1992). However, it has been argued that these financial ratios are not accurate in identifying the causes of failure and cannot be relied upon (Argenti, 1976). The factors enumerated are:

1. Budgetary Issues

   Compared to larger firms, smaller firms pay less attention to financial ratios (Storey, 1994; Storey, Keasey, Wynarczyk, & Watson, 1987). As compared to small firms, large firms face fewer challenges with cash flow and payment issues as they have a better chance of receiving support from financial institutions. Additionally, it has been seen that insufficient capital, burdensome institutional debt and heavy operating expenses besides the typical procedures of monthly payments are affecting cash flow of a construction company by owner or contractor (Arditi et al., 2000).

2. Human/Organizational Capital Issues

   According to Arditi et al. (2000) lack of commitment, managerial experience, fraud and poor working habits amount to 7.54% of the overall failure factors. Argenti (1976) describes a lack of managerial experience as the cause for one man rule or an unbalanced top team, and financial functions to be weak. It is more evident in small firms where there is a lesser scope for interaction among team members and the firm is dominated by a chief executive or one leader. According to Adizes (1989) for infant organizations a high level of commitment is the key to survive. Additionally

Adizes (1989) highlighted that young organizations will break up if they are not more commitment focused and action oriented. It takes some measure of sound financial and human resource planning to translate a group of people into a construction company able to handle even moderately sized projects. The high failure rate can be attributed to some of these factors, but essentially it is a lack of planning and often poor communication that seals a company.

Past Studies

In mid 1980s, The Business Roundtable, an organization of large industrial construction owners, conducted a research study for why construction costs are more than its actual worth. Every facet, which is involved in the construction process, was critically examined and explicit recommendations to the participants in the industry were made. Some of the factors suggested were quality awareness, smooth labor relations, effective project management and access to highly complex procurement systems for the contractors to be familiar with the needed tools to survive (Business Round Table., 1983).

A company can be pushed to a higher level of risk with financial debt because of overexpansion that eventually increases its chances of failure. Failure can be accounted to too many projects, which a company sometimes cannot afford either because of employing too many people without an appropriate financial structure in place (Arditi et al., 2000).

Three distinct control entities exist in a company. The budget developed by the owner or developer typically in some form of a contract, the equity partners in the

company and the workforce of the company. The workforce has the least control of all of the entities, except in some exceptional circumstances, such as in Germany. This in itself is a major issue because the workforce often has a significant unseen capital investment with the foregone wages. An employer might have worked for a week, fortnight or month before receiving a paycheck. The company is selling the products of the labor in that period and so can develop a cash flow. This point to some of the injustice in the existing capitol system, which poorly defines capital and provides excessive rewards for some forms of capitol and not others. After all the worker is risking a wage check, a not insignificant amount of money. Construction industry is used as a regulator of the economy by the government. A UK Government White paper by Emerson (1962) is one of the first studies to document the consequences of this practice by government. Such regulation can come at a price for small companies, who may not survive an economic squeeze, as the government tries to control the entire economy. There has been a distinct movement to a freer market since WW2.

Industry Survival

Survival of an organization is highly dependent on successfully transforming the inputs acquired by the environment to an output. These are influenced by strategic choices made by the organization or an individual and also on the environment and context in which these decisions are made and implemented (Boyle & Desai, 1991). Success and prosperity of the organization depends on the smooth flow of all the resources. This concept eludes in part to the corporate culture, whether the company is new and growing or old and potentially stagnant. The capital market provides mechanisms for the former

to be turned into the latter, as the world's economy grows. The recent growth of Apple provides one example of the growth potential if the cash flow is maintained and the company mystic is embraced by world's people, or one can be old, boring and moribund like IBM, although one can still be profitable.

The construction industry is a fluctuating industry characterized by the constant changes in its construction market landscape. The health of the economy and business conditions often determine the value of these investments affecting interest rates and growth prospects among others. Platt and Platt (1994) indicate that it is this cyclic behavior of the economy that could cause failures in businesses. Many studies have been conducted so far to increase productivity and performance at the company or project level, but there is very limited data reporting on business failures in construction industry (Koksal & Arditi, 2004). In 1997, the total value of liability failure in the construction industry constituted about 5% of the total value of failure liabilities in the US and amounted to approximately $2 million. Additionally the failure rate per 10,000 firms in the construction industry was 116 in 1997 (Dun & Bradstreet Corporation., 1997). The researchers have described causes of the failure in different ways ranging from managerial aspects to the incompetency of the CEO's (Argenti, 1976; Storey, 1994). However, when it comes to the construction industry, failures due to organizational and managerial aspects are barely touched upon in the research literature (Koksal & Arditi, 2004).

Arditi et al. (2000) conducted a study on business failures which was based on events which are under management control (internal factors) and which are beyond management control (external factors), and the responses are generated by the administrative system and strategic planning groups. Furthermore, factors like business and market adaptation issues, organizational and financial capital factors and business and market adaptation issues were found to be the direct driving force of failures.

Various Determinants

There are various determinants identified in the literature that can account for company failure. *Figure 2* shows company failure modes from a study by Arditi and Koksal (2000).

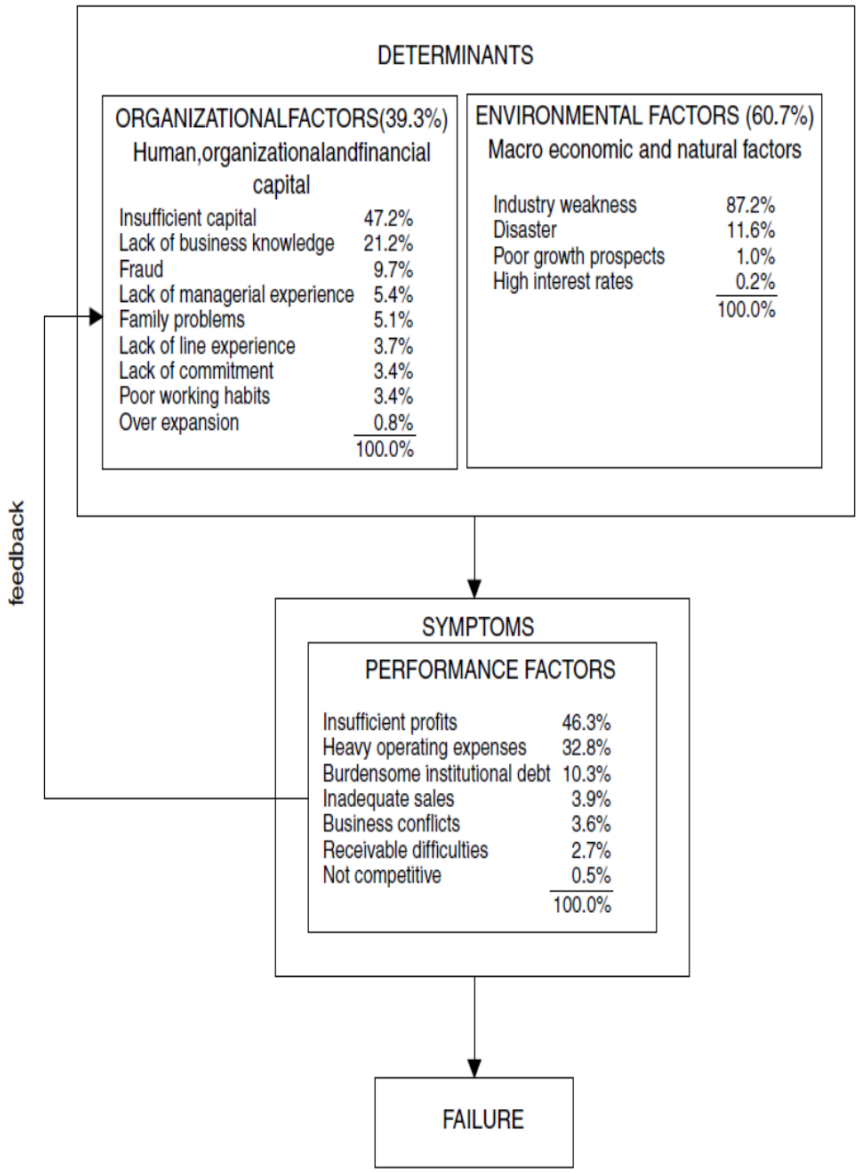

Figure 2. Company failure mode, from Arditi and Koksal (2000)

Figure 3 shows a survival model for companies developed by Arditi and Koksal (2000).

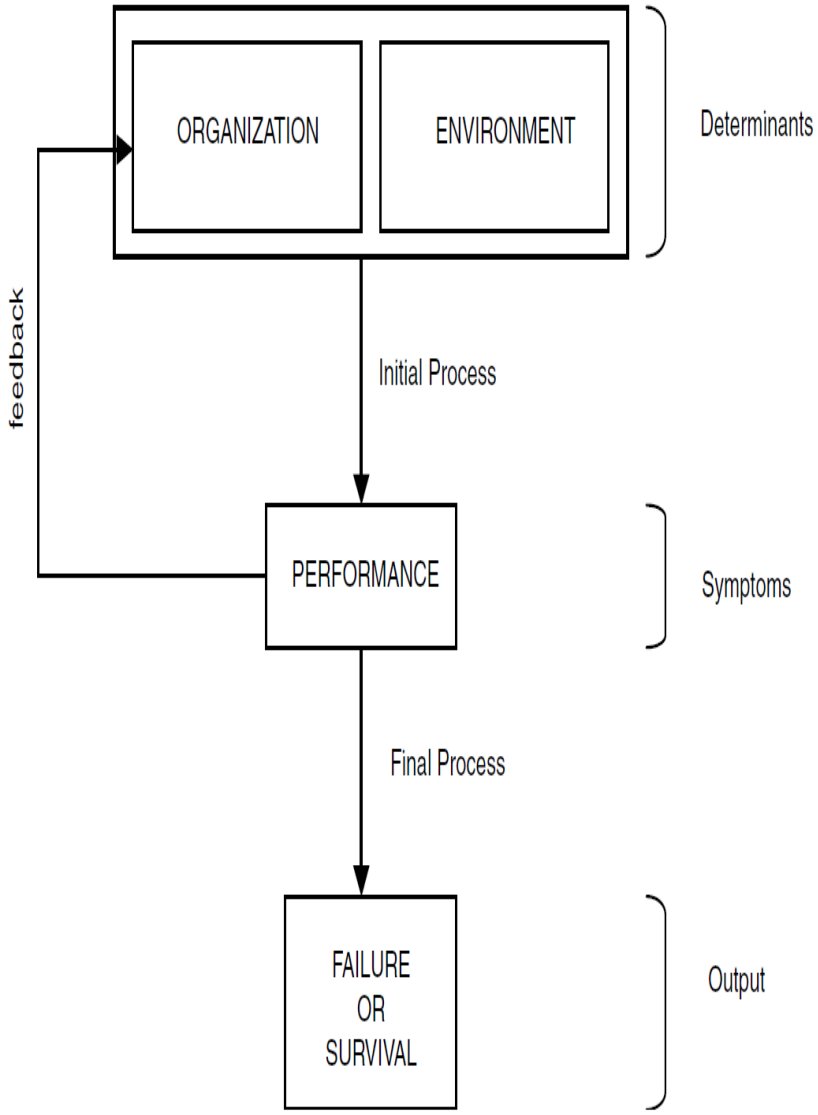

Figure 3. Survival model, from Arditi and Koksal (2000)

Usually when a company moves towards insolvency, both adverse financial and managerial fiascos can be observed. To identify a problem along with the balance sheet, past managerial records are necessary (Abidali & Harris, 1995).

Management characteristics of failed companies found in the literature are:

1. Autocratic Chief Executive: it is usually a dominating style and is indicated as a position of sole authority and negligible team play. Often this way of governance fails when the second or even third generation take over the company and may lack the driving force and vision of the original founder or the new owners may decide to cash out their interest in the company
2. The same person as both CEO and Chairperson: most failed company models possess the characteristic of appointing a single person for both the roles. Generally, a chairperson should have the power of removing an incompetent CEO. However, if a single person is playing both the roles, the possibility of removing an incompetent CEO is ruled out and this can be unfortunate for a company and can lead to eventual company failure.
3. The Company Boards: A company can fail if too many directors not contributing to a project are appointed. Boards in the US and Europe are often overlapping entities with limited oversight, time and skill.
4. Lack of Engineering Skills: If the engineering experience of the people working in a company is not strong enough, it pushes the company towards failure. The western world in particular the USA has deskilled the population with the emphasis being more on liberal education and not on the important skills of math and science. While the drive from the 1950's for liberal education is understandable in part, this overtly liberal form of education in the USA could hurt the economy in the long run except for the input of migrant engineers and

doctors.

5. Lack of a Strong Financial Director: Failed companies have had financial directors with shared responsibilities for financial decision-making. Financial direction is important to ensure the cash flow, but a strong feedback mechanism is also important to ensure that all participants in the process are aware of the costs and issues in construction.
6. Defective Managerial Skills: The factors accounting for companies failing under this category include the following: poor people skills, inefficient marketing and legal skills, defective financial controls.
7. Poor Marketing Skills: Many failed companies have shown the trend of not noticing the change in their respective business markets or were too late to respond to it. In case of the construction market, one of the companies had heavily invested in land and property when the market was at its peak, but when the market crashed and prices slowed down and heavy losses were incurred. A classic example of this is IBM and their desire to maintain the business model with large mainframes and a rental model for the use of the machines. The issue here was often seen on campuses where the walking distance and time drove the development of the dumb terminal and ultimately led to the personal computer – everyone has one, of course this drives the need for IT personal who come to replace the mainframe maintenance with a continuing cycle of PC maintenance. The issue was however morphed with the development of the so called Cloud Computing where the dumb terminal is on each desk and the raw computing

power is located at a remote server farm. The recent movement in Revit to use a cloud based Structural Analysis package is one such example. The point here is to only use and pay for the needed resources and not to require a million people for maintenance of a relatively simple program, such as a structural analysis package.

Past managerial errors in decision-making can be a result of various reasons but few of them reported in the literature are:

1. Over reliance on short term loans: Companies that failed because of this allowed leverage of loans to such a level at which their futures were placed in jeopardy (Abidali & Harris, 1995). Further it was illustrated by Argenti (1976) that companies not constrained by strong financial directors, are the ones that were run by ambitious autocrats and are more liable to make such blunders. This can be viewed as a form of gambling, my return in all future years will be sufficient to overcome the high cost of short-term loans and the lack of real equity in the firm. Like all probability statistics, the coin can land on the reverse face even when not expected. Fisher's rather famous comment on this type of event is particularly true here.
2. Losses in projects: Companies involved in large projects have an excessive inventory and when the obligations are not met in terms of a running project, they face heavy losses. This can also be seen in companies that carry excessive investment in equipment and the return on the investment is below an acceptable target level. The move to large rental companies for equipment can be seen in

construction and in the movement to the use of rental equipment. Rental equipment has the advantages:

- No downtime if it is not being used and the equipment can be returned
- Pay for the usage at the time of usage
- Cost per hour will need to cover owners return

However, it can have the disadvantages of

- Not being available when required
- If breaks down requires fixing by others
- Cannot modify equipment

Risk Factors

In complex construction projects the uncertainty is at a very higher level and it is difficult to predict the impact of unexpected changes on the ongoing project and subsequently on the cash flow (A. H. Boussabaine & Elhag, 1999). The real issue is the differences inherent in any building and the inability to undertake truly repetitive task and make use of the Deming cycle of productivity improvements. Productivity improvements is a healthy sign for a growing economy, but there has been scant productivity improvements in dry wall installation in the last fifty years. It is labor intensive and hard.

The uncertainty in construction projects cannot just be restricted to project related problems but it is also accounted to economic and technological factors (Laufer & Cohenca, 1990). Technological factors are changing some aspects of construction most notably the development of BIM, but the real step forward will be with the computer

control of all construction activities so that the inherent advantages of the Deming cycle can be achieved in a single cycle and through repetitive learning. This was shown recently at Cornell with the manufacture of a Hummer Frame.

Although many researchers have made attempts in the past to model construction cash flow but eventually failed due to the uncertainties in the industry (Odeyinka, Lowe, & Kaka, 2008). Despite various attempts over the past three decades to model construction cash flow, an accurate forecast had been a difficult task (Odeyinka et al., 2008). Flanagan and Norman (1993) states there can be three stages certainty risk and uncertainty in the environment where decision-making takes place. Additionally they mentioned certainty is a stage where one is aware exactly what will happen during the period when the decision is made. Which is not a common scenario in the construction industry. Bennett and Ormerod (1984) also concluded that illusions of certainty can be one of the important causes of bad decision. They believed uncertainty to be widespread and should be explicitly identified by personnel's in the construction industry. Risk has been accounted as the chance of exposure for the unfavorable consequences of the events happening in future (Central Computer and Telecommunication Agency (CCTA). 1883; Healy, 1982; Perry & Hayes, 1985). Healy (1982) stated risk as factor of economic loss in the construction process. Risk has been related as a variable in the construction projects, which eventually results in uncertainty in final cost, duration and quality (Bufaied, 1987). Additionally, Lockyer and Gordon (1996) state these factors include slippage of the project tasks because of delays in schedule, technological issues, people oriented issues, financing issues, and managerial issues. Flanagan and Norman

(1993) stated situation of uncertainty arises when there are no historic data or previous history accounting to the current situation involved for decision-making. Additionally they stated risk is viewed more relevant in the building industry when more thought is given to it. Perry and Hayes (1985) added even though distinction between risk and uncertainty is viewed in the construction industry but it is unhelpful when it comes to delivering a project. The development of new technology can be limited by the skills of the team players and the scientific knowledge required to achieve the technology breakthrough. The recent work by Intel on the 14 nm chips and the delay in delivery of the processor shows the very real problem of technological change (Cunningham, 2015). Intel is clearly the world leader in chip technology and even given that level of leadership, it can be subject to significant delays. The other issue is the technological barrier implicit in the size of the atom and the current size of the transistor. Moore's Law in its current form will become impractical without a change in technology not just an iteration in chip manufacturing process. Even multi-unit manufacture is subject to delays and significant cost overruns.

Factors accounted for the variation in cash flow of a project according to Lowe (1987) can be grouped under five categories of contractual, programming, pricing, economic factors and valuation. Contractual factors incorporate delay in settling of the claims, delay in payment from client, interim certificates delay and delay in retention release. Programming factors identified by Lowe (1987) mentions changes in initial design, act of god, production target delay, civil disturbances and labor strike. Further pricing factors identified by Lowe (1987) is estimation errors. Economic factors which

are identified by Lowe (1987) include inflation, subcontractor's insolvency, changes in interest rates, subcontractor's insolvency and changes in currency exchange. This list does not include the common mistakes in bidding and price estimation, more than one firm has been driven into bankruptcy by underestimating the cost of work, rock removal is a classic case of not identifying an issue clearly and then underpricing the work. Khosrowshahi (2000) also recognized risk factors that influence cash flow from payment delay and difficulty in attaining funds at rational interest rates. Kenley and Wilson (1986) added that variation in cash flow during a project phase can be caused by multiple factors and it is hard to capture a great majority in a sample data.

Adequate availability of fund when required and deployment of additional fund for a more constructive use is very crucial in construction industry (Odeyinka et al., 2008). Construction industry deals with the largest number of bankruptcy accounting to poor financial management and inadequate desired attention to cash flow management (A. Boussabaine & Kaka, 1998; Calvert, 1986; McCaffer & Harris, 2001). Insufficiency in cash resources is accounted for one of the final causes of bankruptcy whereas failure in convincing the creditors is just temporary (McCaffer & Harris, 2001).

Decision-making is affected by uncertainty in the information. This uncertainty can be related to many factors varying from project related factors to economic and technological factors (El Din Hosny & El Beheri, 2014). Additionally they stated a reliable prediction of the cash flow can help in overcoming the obstacles. An interesting issue is the common practice of part payment; often a contract includes a retention clause as a guarantee for the owner that the work progress is acceptable. This payment

often represents the profit margin for the contractor who has a delay in the profit realization. The second issue is liquidated damages, the owner requires a form of a payment to prevent or minimize the risk of late performance. The purely rational economic viewpoint is it is worth a 1 million if it is a day late, it should be worth a million if it is a day early, but contract writers rarely consider this point as they usually work for the owner or developer. This is a matter that will ultimately be dealt with in the courts and the development of future case law.

Chapman (2012) states, “at the beginning of any construction project a detailed schedule is prepared. To avoid any material related delays they are purchased in advance before the start of a project. To avoid any further delays every aspect has to be taken in to consideration starting from project schedule during the planning phase to everyday work schedule of the project managers, every effort has to be made to avoid any possible delays. To make sure everything is under control these methods has to be employed since the inception of any construction project. Additionally, in order to efficiently manage the cash flow in construction project, companies need to ensure the expenditure and the cash floating in for a project are well utilized. By doing so it will allow the company to avoid unnecessary delay due to cash flow and make the company prepared to take a setback of any economic storm more effectively. Risk level is associated with this cash flow problem”. Equipment purchase is a critical item in a contract, the problem is if you purchase too early it needs to be stored and in some contracts not paid for until it is installed and if you purchase too late it may not arrive. The third issue is being lost in transit, which Nichols (2015) identified as an issue in a pumping station contract for

Gunnedah Shire Council in the late 1980s. This type of loss can be problematic depending on the form of the contracts and the reason for the delay.

There are various factors, which lead to cash flow problems, some of the major problems include:

1. Labor-intensive work: construction projects can be unpredictable and there can be times where labor costs are inflated eventually increasing the cost of the project and effecting the smooth cash flow. There is a more significant issue in the United States that of the exempt and non-exempt employee. An exempt employee is expected to perform certain work for a set pay, the hours are irrelevant to a large degree, and the non-exempt employee is paid by the hour. An economic system to work best needs to know the true costs of all activities and make sure that they are efficiently accounted for in the great scheme of things. So a company that regularly works the exempt employees for 60 hours as its corporate culture, but pays at the same rate as a company that maintains a 40 hour work week is economically inefficient and should be tagged as such. The US practice results in high turnover compared to some countries and this has led to complaints about the current generation entering the workforce jumping ship quickly. One can view this quite simply as a reaction to the Baby Boomer generation allowing for the inflation of education costs to their advantage and the Baby Boomers desire for zero increase in taxation rates. Generational differences are not often studied in construction, but they are real and significant.
2. Payments to suppliers and subcontractors: to keep a project on track and schedule

without any major delays it is sometimes required to make payments to suppliers and contractors before the money is actually received for that particular work in the project, although often companies can delay payments to subcontractors to use the subcontractor as a pseudo bank. Again, this is economically inefficient and clearly unethical behavior in terms of any decent code of ethics; of course one of the real issues is the lack of a governing body for builders to enforce a decent code of ethics.

3. Retainage: Money held by your client can delay your payment to the subcontractors eventually hindering the smooth cash flow
4. Slow paying customers: can eventually affect your smooth cash flow cycle in a project tying a project in debt
5. Slow billing: cash flow is affected by the billing cycle as well. The longer the time taken to pay bills for a completed activity longer it takes in smooth flowing of cash in a project
6. Unplanned cash expenditures: many unplanned events can sometimes take a toll on the cash flow strategy for example unfavorable legal disputes and tax penalty can take away the working capital from project operations

Moreover, Chapman (2012) states "the most important aspect in any industry for managing cash flow is to address them as early as possible once they have been identified."

Cash flow is seen as the blood line of the construction industry. Due to inefficient management of cash, around 10%-15% of the construction company exit the

construction business every year (Ismail, 2014). Sometimes it is so unexpected that a contractor who may be profitable and has a positive income on the financial statement but lack of cash can lead him to bankruptcy. It is almost impossible for a contractor to survive in a very competitive construction industry without proper cash flow management, and lack of liquidity is the major problem accounted for construction project failure (Al-Issa & Zayed, 2007). It has been stated by Navon (1996), that a company can still survive with low profitability or even with temporary loss but fails miserably if there is not enough cash to operate the project. One of the leading reasons of failure of a construction business is working capital and inadequate capitalization of construction contractors (Kamshad, 1993; Navon, 1996; Singh & Lakanathan, 1992). Further the company failure can be a result of environment dependent and strategic dependent factors also (Arditi et al., 2000). Although various factors are investigated and many are under investigation but budgetary and human capital related issues have taken first slot, issues of adaptation to market condition have filled second slot, followed by characteristics of managers and business conflicts and subsequently natural forces and macroeconomics conditions (Ismail, 2014). Additionally a group of authors (Arditi, Akan, & Gurdamar, 1985; Arditi et al., 2000), found out major factors that are leading when it comes to failure in construction industry are divided in to five categories. Together which can be accounted as insufficient profits (26.71%), industry weakness (22.73%), heavy operating expenses (17.80%), insufficient capital (8.29%), and burdensome institutional debt (5.93%). Four of these factors are short term and budgetary which are further classified as internal administrative and last factor which is

beyond the company's scope of immediate action is “industry weakness” which is an environmental factor.

Failure can also be related to the complexity of the process in the construction industry rather than relating it to one single factor (Wong & Ng, 2010). Poor accounting, estimating that is lack of managerial experience and inadequate capital are the factors among others which can lead to company failure (Schaufelberger, 2003). Cash flow is the ever changing process and its complexity of transactions dependent on time, events and prior cost (Lucko & Cooper, 2010). Smooth cash flow can also be affected by changes in costs of the product (Navon, 1996). Time delays, cost overruns, change orders, and changes of cost plan capital additionally increase the expenses and can be the elements involved in affecting smooth transition of cash flow (Bennett & Ormerod, 1984)

For any project to run cash is the most important element in the construction industry (Hwee & Tiong, 2002). Therefore lacking this source can lead to failure on the construction project (Lucko & Cooper, 2010).

Summary

The relationship between business failures has been studied by many researchers as outlined in this literature review. However using a game to study the performance of specialist construction scientists is a new research area and is yet to be explored. In this chapter, failure factors are analyzed in depth and based on those factors game model rules are structured which can be further used for game model development.

CHAPTER III

GAME METHODS

Introduction

This chapter outlines the methods and background used in the study. The concept for the game is simple:

- A builder has a new Superintendent who needs to be trained in the company cash flow methods
- The company builds a limited range of houses in a small market and has a chief financial officer (CFO) who is rigid in control of money and schedule, and has kept the company profitable for the last 30 years
- The new Superintendents are always trained on the same house to allow the CFO to ensure that the person can manage a cash flow effectively, if not the CFO can retrain or de-hire the Superintendent
- The company provides the following information to the Superintendent as part of the training
    - Schedule of each item, but not overall schedule
    - Plans
    - Costs for each item
    - A start day that ensures the games are not simple and repeatable
    - Sheets for the recording of decisions by the participant

- The CFO ensures that the data is recorded on a set of sheets so that they can be reviewed and to ensure that the Superintendent has effectively learnt all of the standard company techniques
- Game play is condensed to provide a reasonable limit on the time required from the participants, limited to 4 hours
- The object of the game is to maximize the return to the company from the cash flow in the form of:
    - Minimize delay between payment and invoice
    - Minimize total outlay at any one time
    - Maximize company profit
    - Minimize borrowing costs

The basic goal is the development of a simple game rules that provides an insight into the methods and problems with a new field superintendent controlling a simple residential cash flow.

The sections include:

- Company Data
- Building and Construction Details
- Game outline

Company Data

The company, Scotia Homes, has an annual turnover of $60,000,000 in construction work mainly related to single-family homes in the price range of $300,000 to $600,000

per house. The graph of the company turnover in the last twenty years is shown in Figure 4.

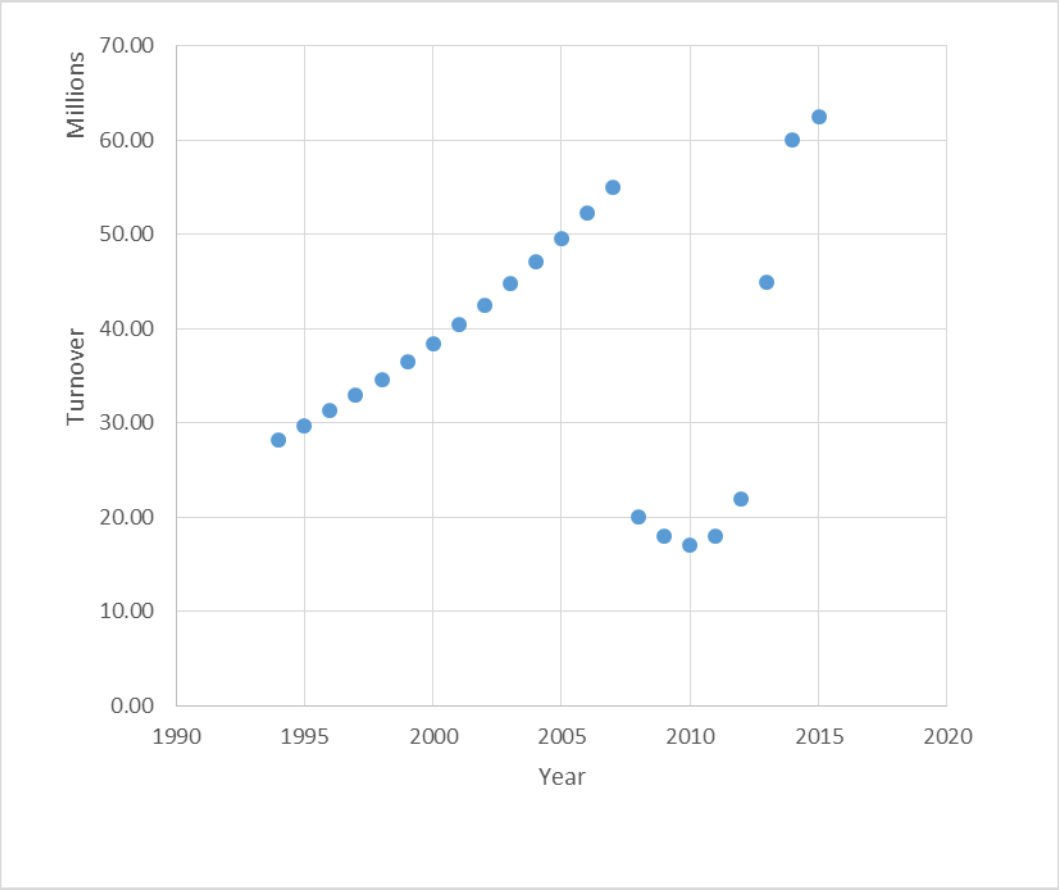

Figure 4. Company income - 1994-2015

The company went through a sharp downturn in work during the economic recession of 2007 to 2011 in line with all construction in the USA. The company has rebounded from the recession and is in line to move back to a similar turnover as in the prerecession days.

The Scotia home is based in Dallas and has a headquarters in Highland Park, on Mockingbird Lane. The company has a set of display homes on the site. Figure 5 shows the company headquarters location from Google earth.

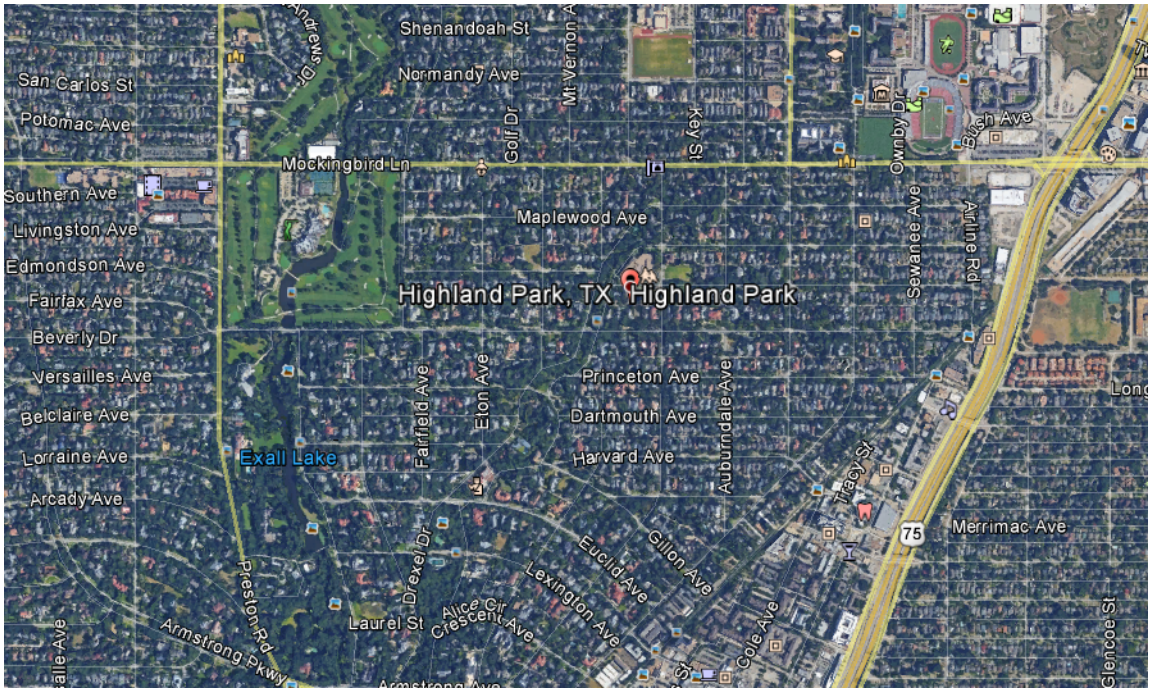

Figure 5. Highland Park location (from Google Earth, 2015)

Building and Construction Details

The building used by the CFO to train new superintendents is from a house design competition (Building Plan Holding Corporation, 1921). The house is simple and easy to build, it reflects a trend in the recent market towards a colonial themed dwelling. Scotia Homes sells about three of these per month and they are their most popular small home.

Figure 6 shows the perspective view of the small house. The house is termed the *Dise Plan* for the purposes of this study. The plan, whilst for a wooden house, would be easily recast in stone or masonry.

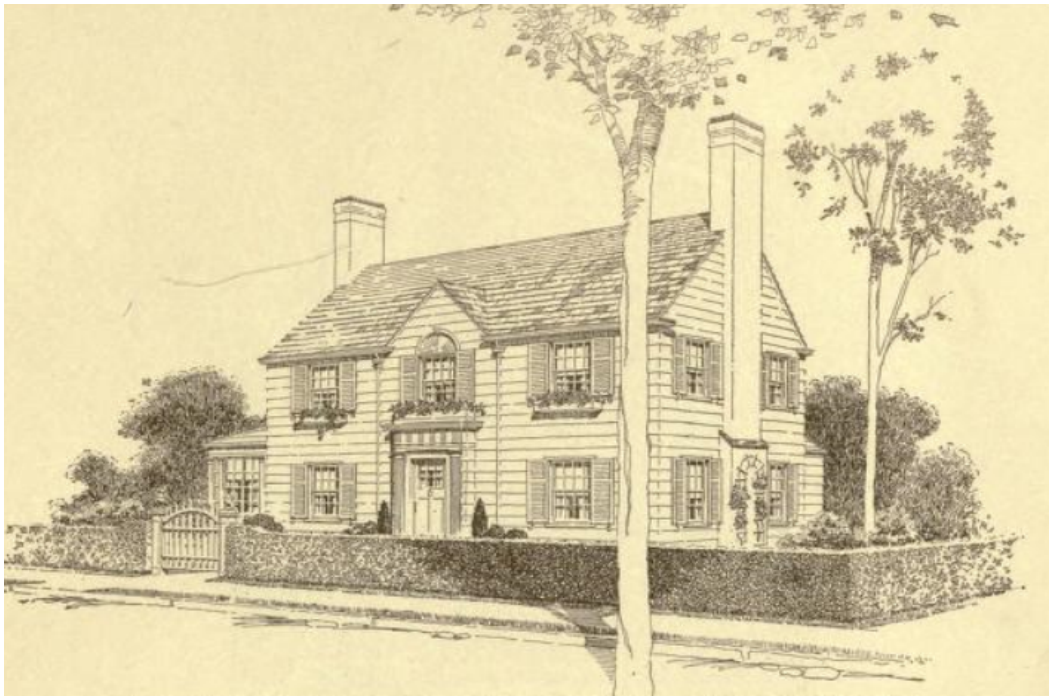

Figure 6. Perspective View of the Typical Small House

In 1921, the total US income was 63 billion dollars. (National Bureau of Economic Research Inc., 1926). The current average income is 53,819 dollars a ratio of about 40. The estimated cost of the house in 1921 dollars is $9500, when the average income was $1357. The change in house value based on the 40 ratio is $380,000. Median sales price in the USA in 2014 was $280,000. The house is still in the typical range assuming the relative increase is applied. *Figure 7* shows this typical small house plan with the room dimensions.

Figure 8 shows a larger scale plan for the house.

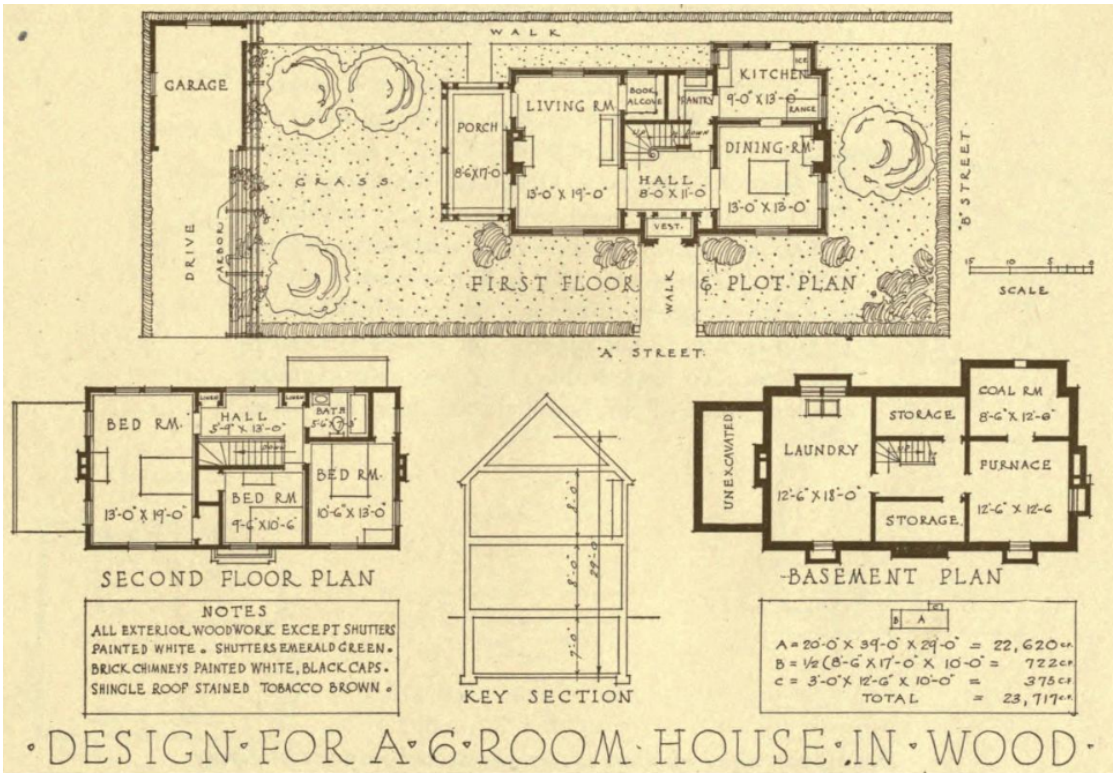

Figure 7. Small House Floor Plan

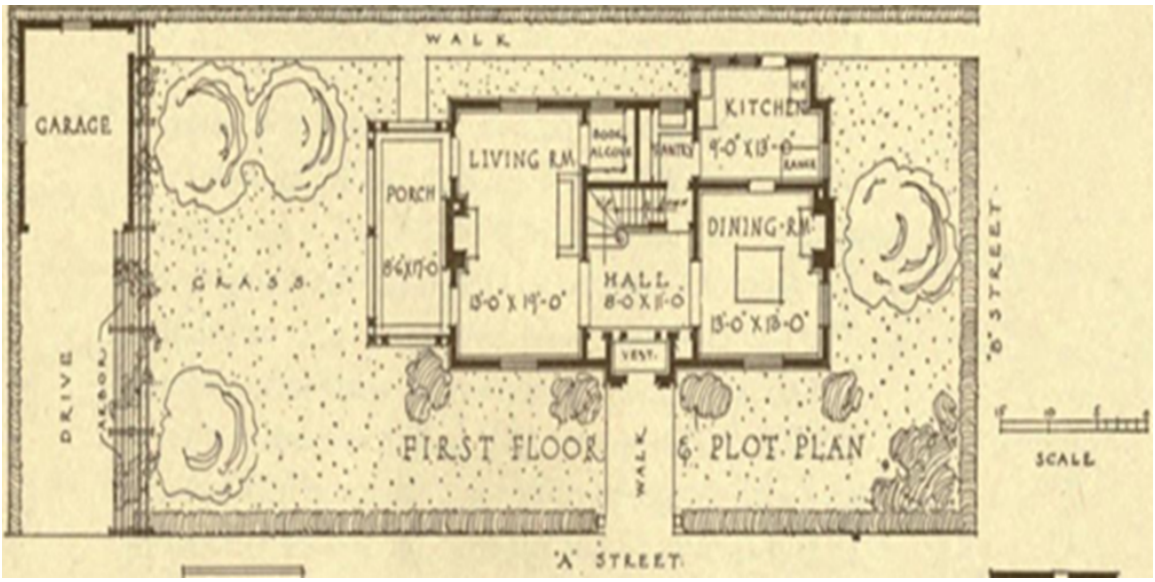

Figure 8. Building used for game play

Table 1 lists the dimensions, areas, and volumes for the first floor of the Dises home.

Table 1.

Dises Home - First Floor Dimensions, Areas, and Volumes

Rooms	Depth	Length	Area	Height	Volume
Porch	8.5	17	144.5	8	1156
Living Room	13	19	247	8	1976
Hall + Stairs+ Entry	13.5	11	148.5	8	1188
Dining Room	13	13	169	8	1352
Kitchen	9	13	117	8	936
Pantry	5	5	25	8	200
Books	5	5	25	8	200
Total			876		7008

Figure 9 shows the Revit model for the house.

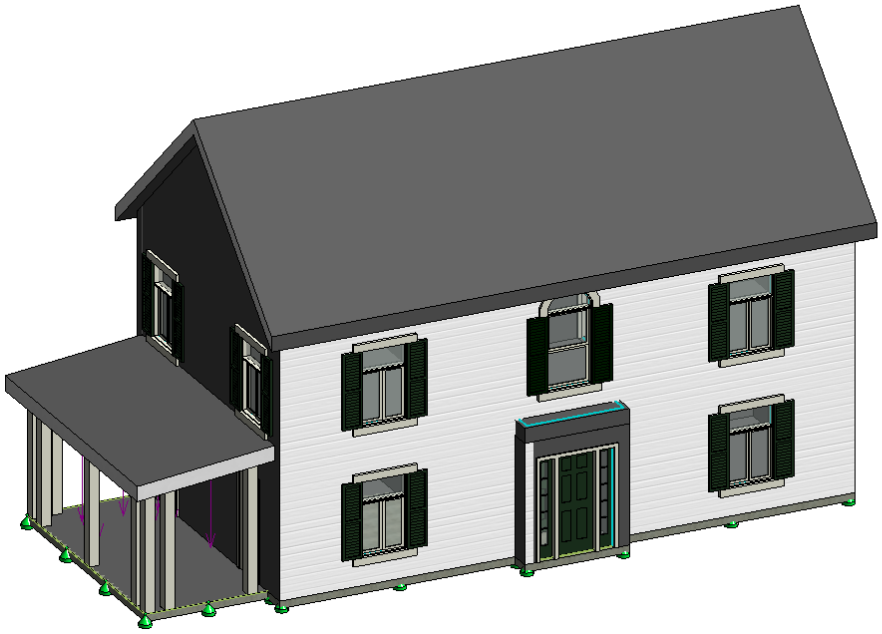

Figure 9. Revit model of the Dises house

Table 2 shows the construction costs and the program says for each component of the construction.

Table 2.

Cost and Construction Schedule Data

Cost Breakdown	Average Cost	Program Days
Building permit	$9,500	3
Impact Fee	$6,200	1
Water and Sewer Inspection	$7,000	3
Excavation	$10,000	6
Foundation	$12,000	21
Pouring Basement Walls	$10,000	4
Back Fill	$8,000	2
Foundation Sill Plate	$6,200	2
First Floor Joist and Decking	$10,000	3
First Floor Stud Walls	$17,000	6
Roof Truss Installation	$56,000	7
Exterior Sheathing Installation	$8,000	3
Vapor Barrier Installation	$4,500	2
Plumbing	$20,000	3
Utilities	$8,000	2
HVAC	$40,000	4
Garage Fit out	$19,200	3
Cabinets and Countertops	$26,000	3
Interior Doors	$6,400	3
Painting	$15,000	3
Wood Deck or Patio	$6,000	6
Total	$304,500	90

Figure 10 includes the cost for each major item in graphical form. The graph highlights the major cost items that the new Superintendent will need to pay attention to if they are going to meet the CFO goals for the return on each house.

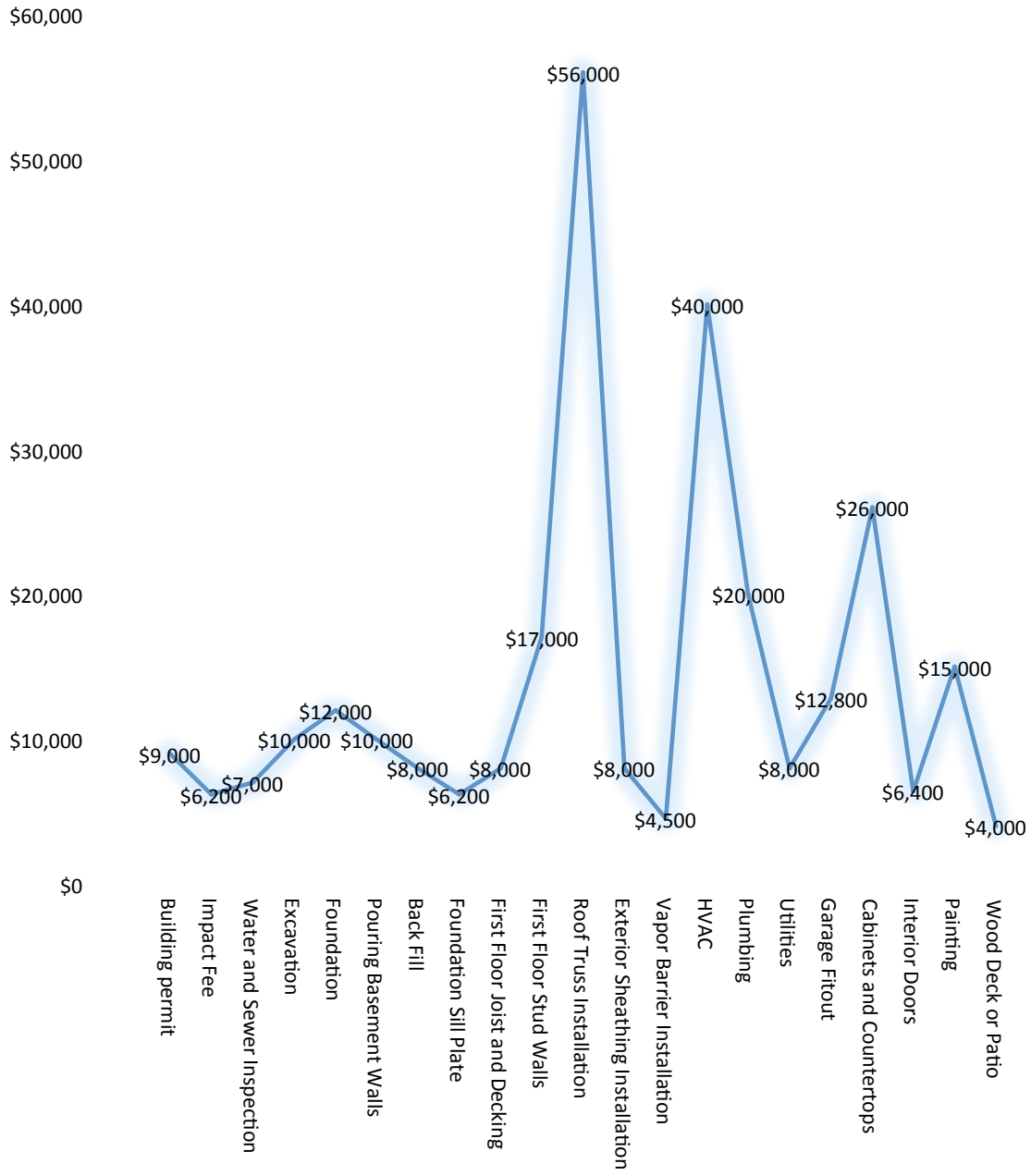

Figure 10. Costs for each item

Table 3 shows the material delivery time from the date of placement of the order with the vendor.

Table 3.

Material Purchase Delivery Times

Material Purchase	Time Taken (Days)
Foundation Precast	3
Basement materials	2
Joist and Decking	2
Stud Walls	2
Roof Truss Installation	5
Exterior Sheathing material	2
Vapor Barrier Installation material	3
Electric	6
HVAC	7
Plumbing	6
Garage Fit out	2
Cabinets and Countertops	3
Interior Doors	3
Painting	3
Wood Deck or Patio	3

Figure 11 shows the time for delivery for the major purchases on the house.

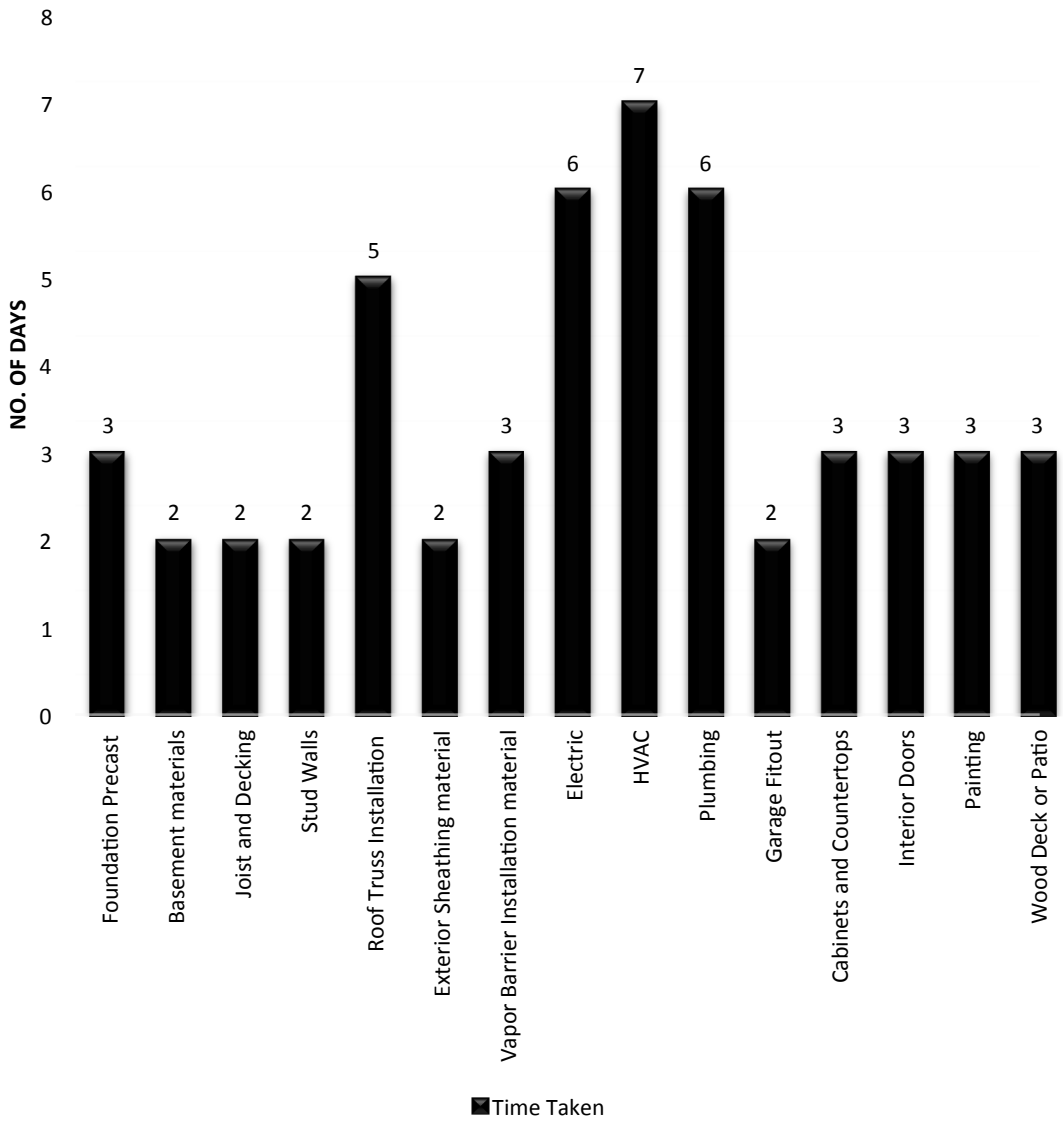

Figure 11. Material Purchase Delivery Time

Company Accounting Rules

The company has a simple set of rules to follow:

Rule 1. all payments are made at 30 days.

Rule 2. all payments are expected at 30 days and interest at the rate of 10% is charged on all accounts outstanding at 30 days – interest calculations start at the time of issue of the invoice if unpaid

Rule 3. the company builds six homes and will only vary the paint color, the brick type, bathroom fixtures and the kitchen unit

Rule 4. All cost control occurs in a special program supplied by the management consultants and which tracks costs on a daily basis

Rule 5. Each house has been studied and a program, schedule and construction order has been established along with a manual for construction that provides details on nail quantities as an example.

Rule 6. The employee who monitors the progress of each house is termed the House Superintendent (HS).

Rule 1 is used to provide sufficient capital exists for our vendors. Rule 2 establishes that the Scotia Homes is not acting as a bank, without the return of a bank at an appropriate risk level. Rule 3 is used to simplify construction. If a homebuyer wants a specialist plan then there are plenty of bespoke builders.

Rule 4 provides rapid control of issues with cash flow. Rule 5 provides the standard conditions for control of a job. Rule 6 provides for a single point of control for all, in accordance with good management technique.

Summary

The information supplied in this chapter is designed to provide a competent field superintendent with the necessary information to plan and execute the house. The CFO has deliberately provided raw data rather than a finished schedule so that the CFO can observe the skill set applied by the new worker.

CHAPTER IIII

GAME DEVELOPMENT

Study Design

Cash flow is the critical item in ensuring the financial health of a company or even an individual under most circumstances. Negative cash flow can be sustained for a time, but not forever. This chapter outlines the development of the Cash Flow Game (CFG), enumerates the rules for the game and provides a set of models for the game proper.

The purpose of the CFG is to develop a methodology to study human behavior in relation to management of a cash flow for a theoretical company.

Game Design

The game design components are:

- The house plan
- The new superintendent
- The schedule
- The game
- The game rules
- Game scoring

The House Plan

Each house has a complete order catalog so that all parts are uniquely numbered and ordered by a central clerk based on the master schedule for each house. The Superintendent has to decide when to order the materials.

The New Superintendent

A new employee is provided with the simplest house that the company builds and their work is followed daily by the senior superintendent to see that the work is completed to the company standard, in accordance with the company rules and to the accepted program for each specific house.

The Schedule

Once the house's earthworks are completed the company works to a schedule set by the scheduling clerk based on forward workload and available staff, the company self performs all work except septic tank installation. Each specialty has a crew chief who assigns work personal based on the schedule requirements supplied by the scheduling clerk. The company preferences is teams of two – one junior and one senior in each work team. The n Superintendent has to request the work teams in advance so they can be scheduled by the scheduling clerk.

The Game

You are the newest house Superintendent and have been given the company one week introduction course, you graduated from TAMU with a Construction Science Degree.

You meet with the Main Superintendent (MS) every morning at 7am for 20 minutes and then you travel to the job site, once you have completed one house you will not have to meet with the MS and you will be given 3 homes, ultimately rising to 6 homes after 2 years. The intent is to provide long-term training so you meet the company standards for quality and progress. Each day you will need to review the work completed and issue the necessary requests for the performance of the next stages of the work.

Game Rules

The game rules are:

1. The activity breakdown for construction is provided in the earlier chapter
2. The total cost and days required to complete each activity has been determined
3. The superintendent taking part in a completion of a project with the company will be determined and assigned at the start of the work
    a. Once the superintendent is on site, determine the scheduling and cost invoices to be sent each month
    b. Once the task has been allotted to them, the task completed by them will be matched with the predetermined task outlined in the task schedule. The goal of the superintendent is to maximize the return to the company in terms of minimize delays between work and billing
    c. Activities handout which will be provided to team members as set out in Appendix A
    d. Handouts are at the start of play

Game Scoring

At the completion of the game, the sheets are used to determine a score in relation to:

1. Lost money or gained money from the standard schedule in terms of dollar days saved
2. Period to compete the contract
3. Deviation from the standard program

CHAPTER V

CONCLUSIONS

Cash flow is important to any business. It means in the end the survival or the loss of the company. This study develops a theoretical game to study construction specialists managing a theoretical cash flow for a simple house construction. The game provides a straight schedule to build a two-story house, along with costs, and estimated times for construction. Each participant will be given a set of sheets outlining the tasks, required schedule, costs and plan for the house. The purpose of the game is to compare the performance of future participants against each other in terms of maximizing the company return, minimizing the needed ban loans and billing as soon as possible.

The scoring system for the game will compare the three areas of schedule, money gained or lost against the standard schedule developed by the research team and the billing errors. The objective is to determine if participants can minimize the company loan requirements and show an understanding of cash flow basics.

Further research will require the use of case studies to build a data set of performance results. The participants will be masters students enrolled at Texas A&M University in the Construction Science program. Each has training in an undergraduate topic such as civil engineering or architecture. The intent is to determine how they perform on a simple task and what defects exist in their knowledge.

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APPENDIX A

GAME SHEETS

Introduction

The initial game has been developed using paper sheets to allow the main superintendent to write the summary of the tasks performed.

Game Sheets

A total of twenty game sheets provide the mechanism to capture the moves by the participant in the game.

Figure 12 shows the building permit sheet. Each sheet provides the places for the participant to enter the required data and for the game scoring. The job description for the building permit) is:

- It is a license which grants a legal permission to start a building construction
- Usually it should not take more than a week or 10 days to get the permit once the paperwork is submitted
- The player will have to record the start date as of when he filed the paper to actually getting the permit

Player Initials: _____

Game Sheet No 1.

Item: Building Permit

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____
Days Impact _____
Critical mistake _____

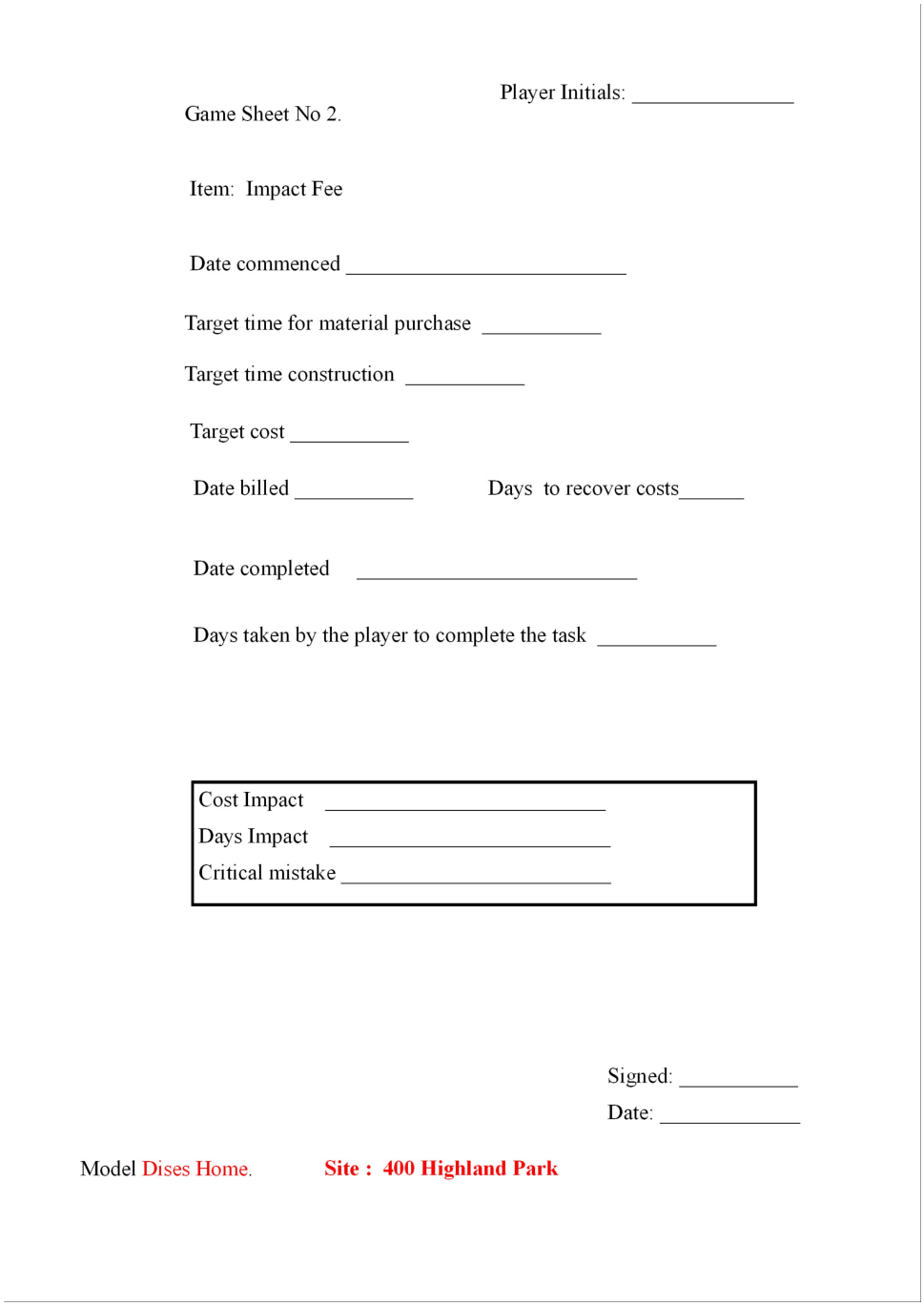
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 12. Game sheet 1 - Building Permit

Figure 13 shows the game sheet for the impact fee. The impact fee is the payment to the local government authority for permission to build the house.



Player Initials: _____

Game Sheet No 2.

Item: Impact Fee

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

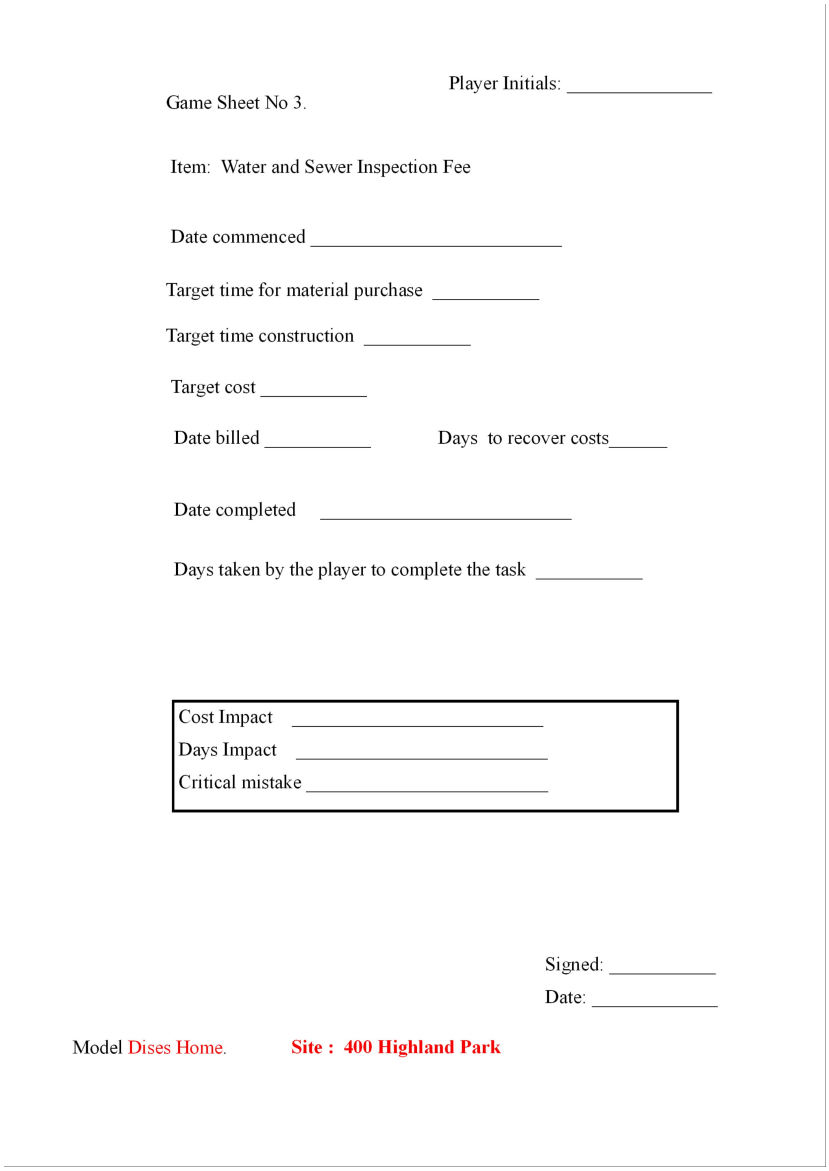
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 13. Game sheet 2 – Impact Fee

Figure 14 shows the game sheet for the water and sewer inspection fee. This fee covers the local government authorities' costs to connect the water and sewer. An allowance need to be made to four days to connect water and a week to connect the sewer.



Player Initials: _____

Game Sheet No 3.

Item: Water and Sewer Inspection Fee

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 14. Game sheet 3 – Water and Sewer Inspection Fees

Figure 15 shows the worksheet for the excavation.

Player Initials: _____

Game Sheet No 4.

Item: Excavation

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____
Days Impact _____
Critical mistake _____

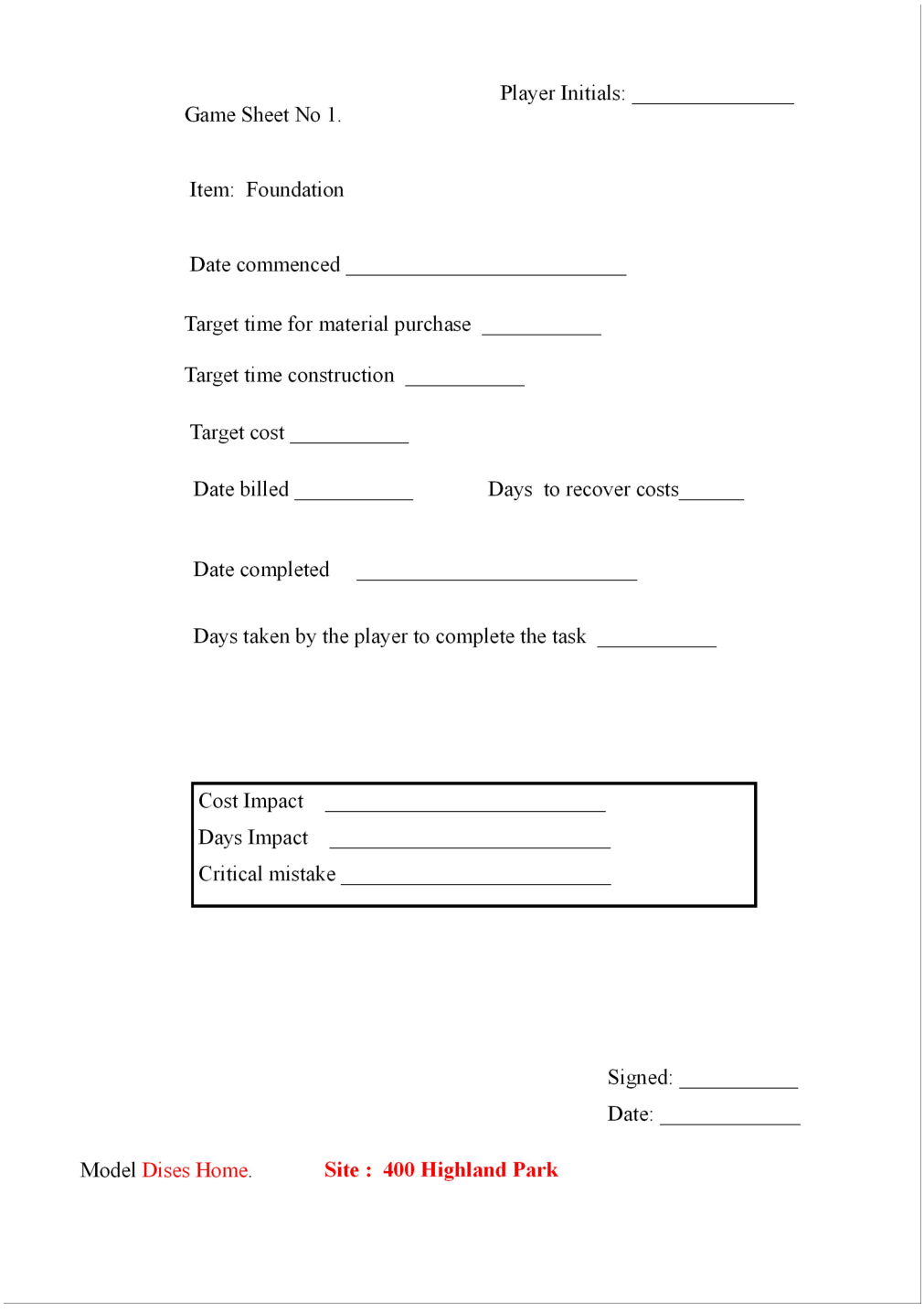
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 15. Game sheet 4 – Excavation

Figure 16 shows the worksheet for the foundation.



Player Initials: _____

Game Sheet No 1.

Item: Foundation

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

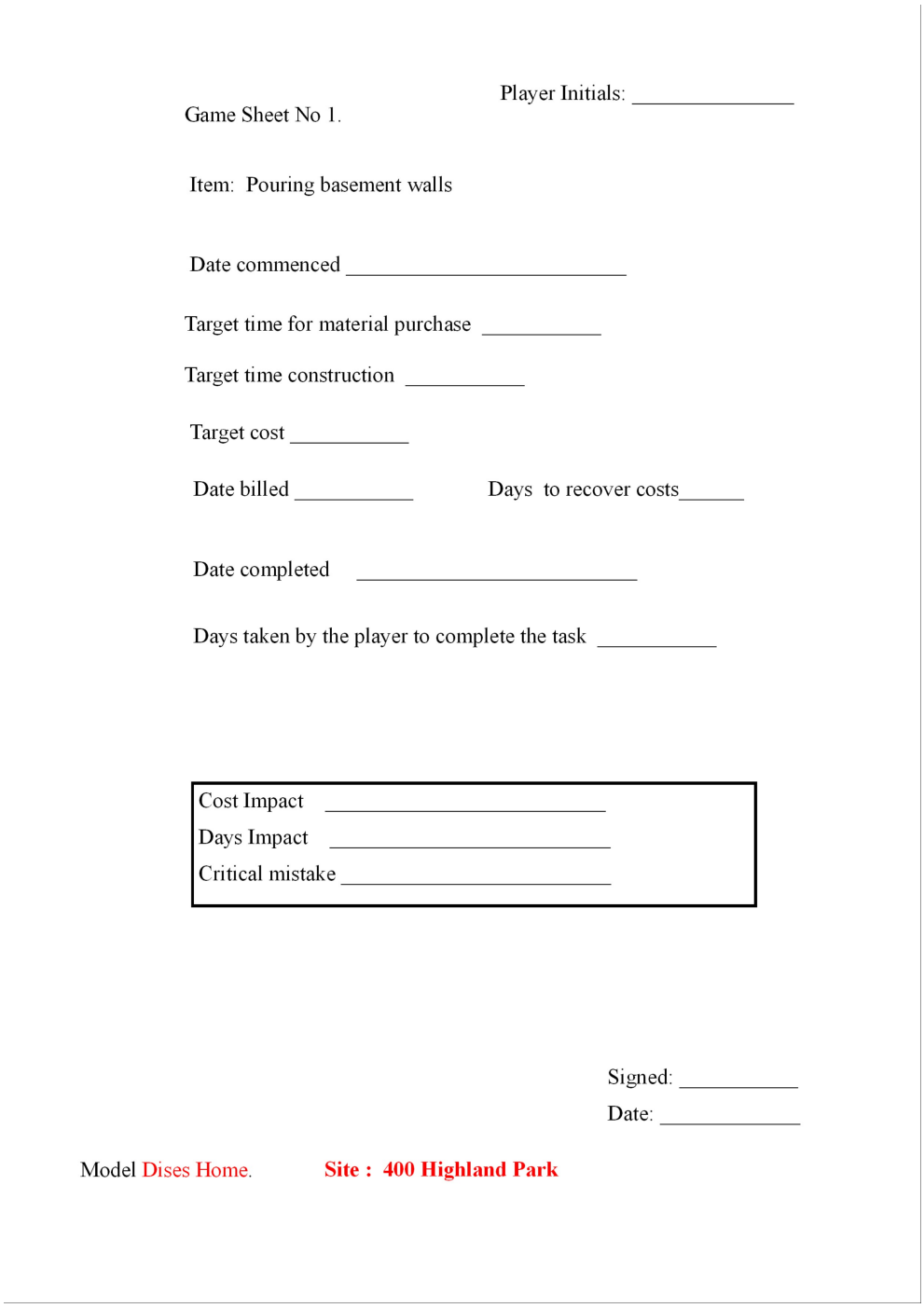
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 16. Game sheet 5 – Foundation

Figure 17 shows the worksheet for pouring the basement walls.



Player Initials: _____

Game Sheet No 1.

Item: Pouring basement walls

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

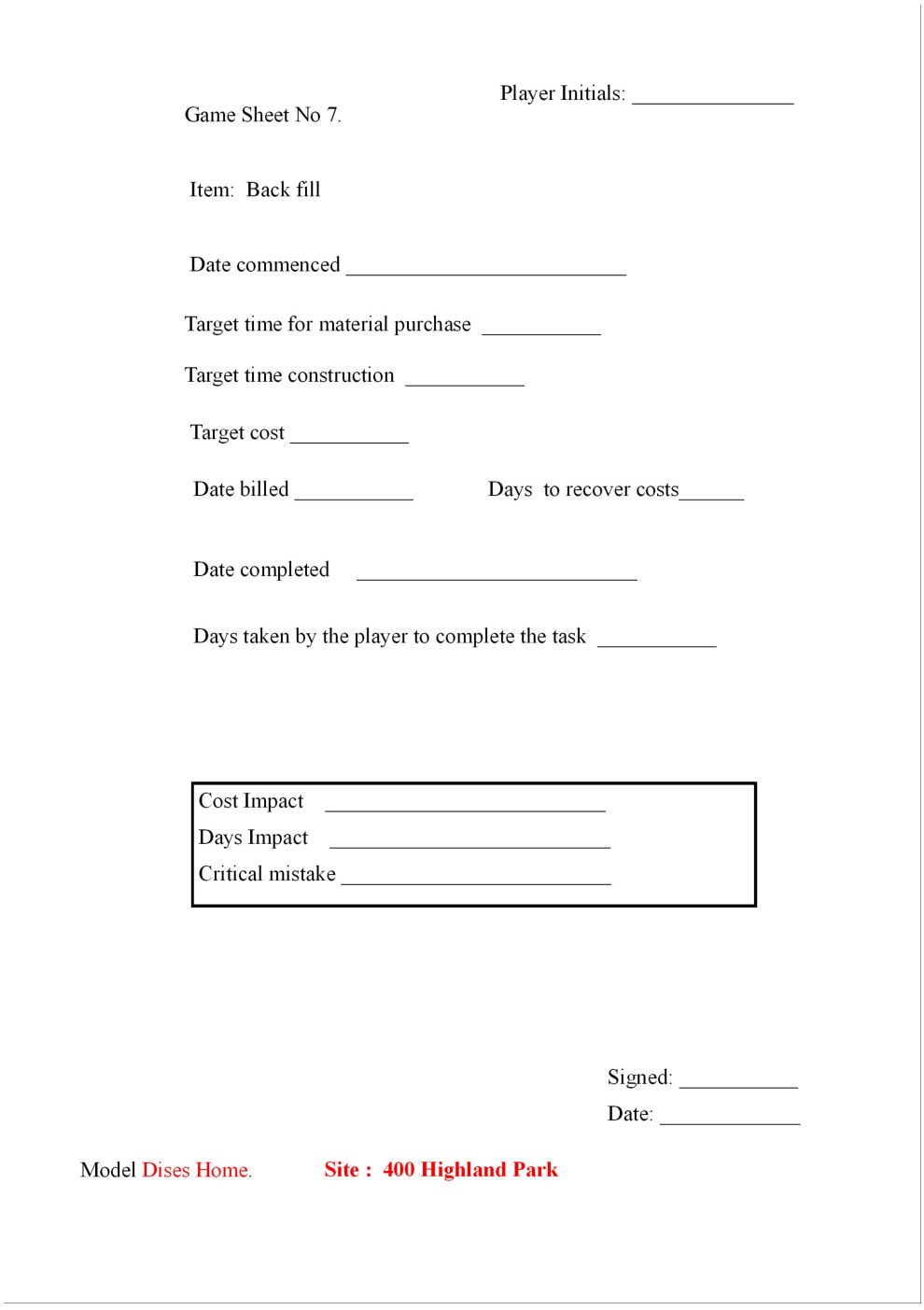
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 17. Game sheet 6 – Pouring Basement Walls

Figure 18 shows the worksheet for the back fill for the house.



Player Initials: _____

Game Sheet No 7.

Item: Back fill

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

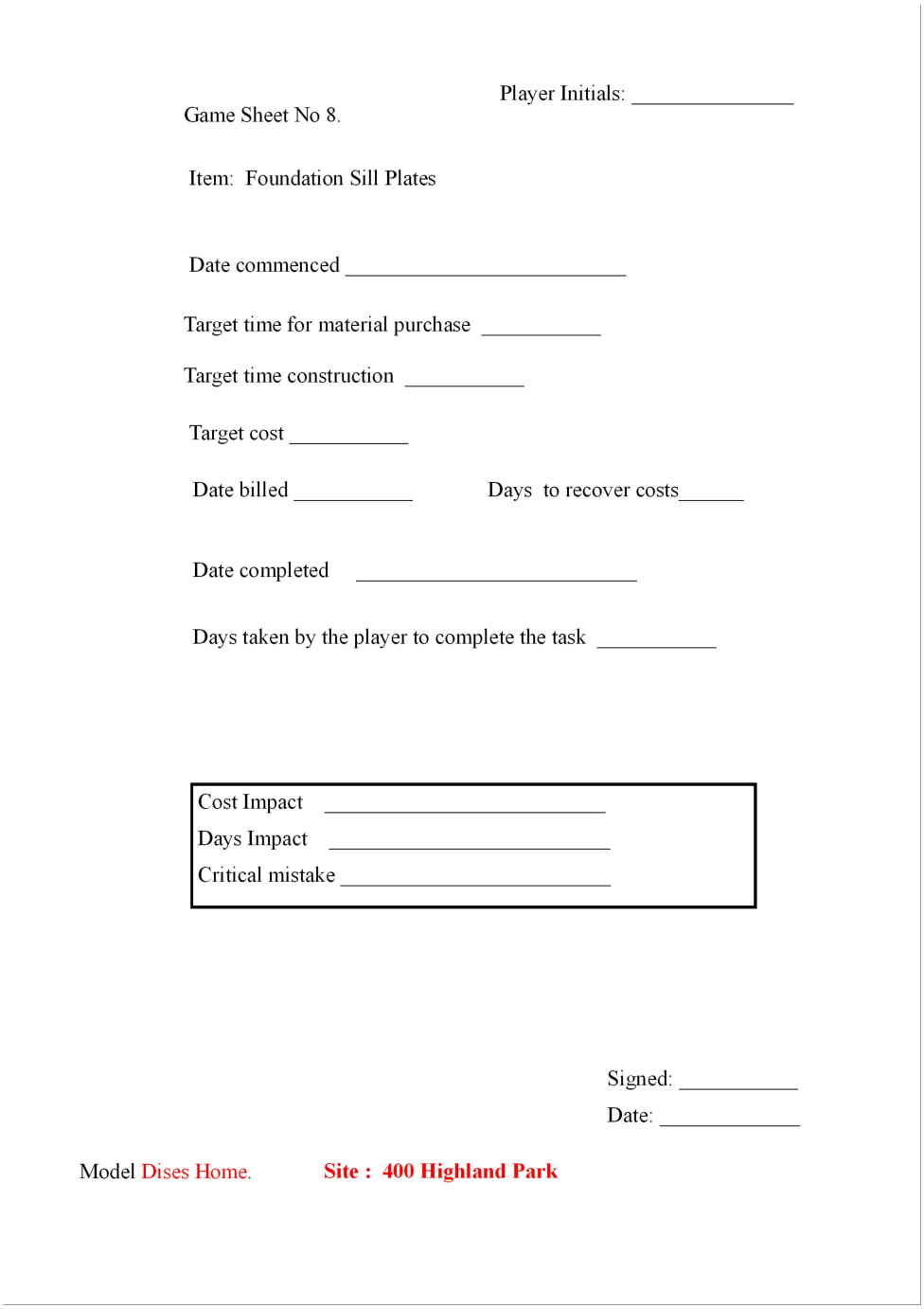
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 18. Game sheet 7 – Back Fill

Figure 19 shows the worksheet for the foundation sill plate.



Player Initials: _____

Game Sheet No 8.

Item: Foundation Sill Plates

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

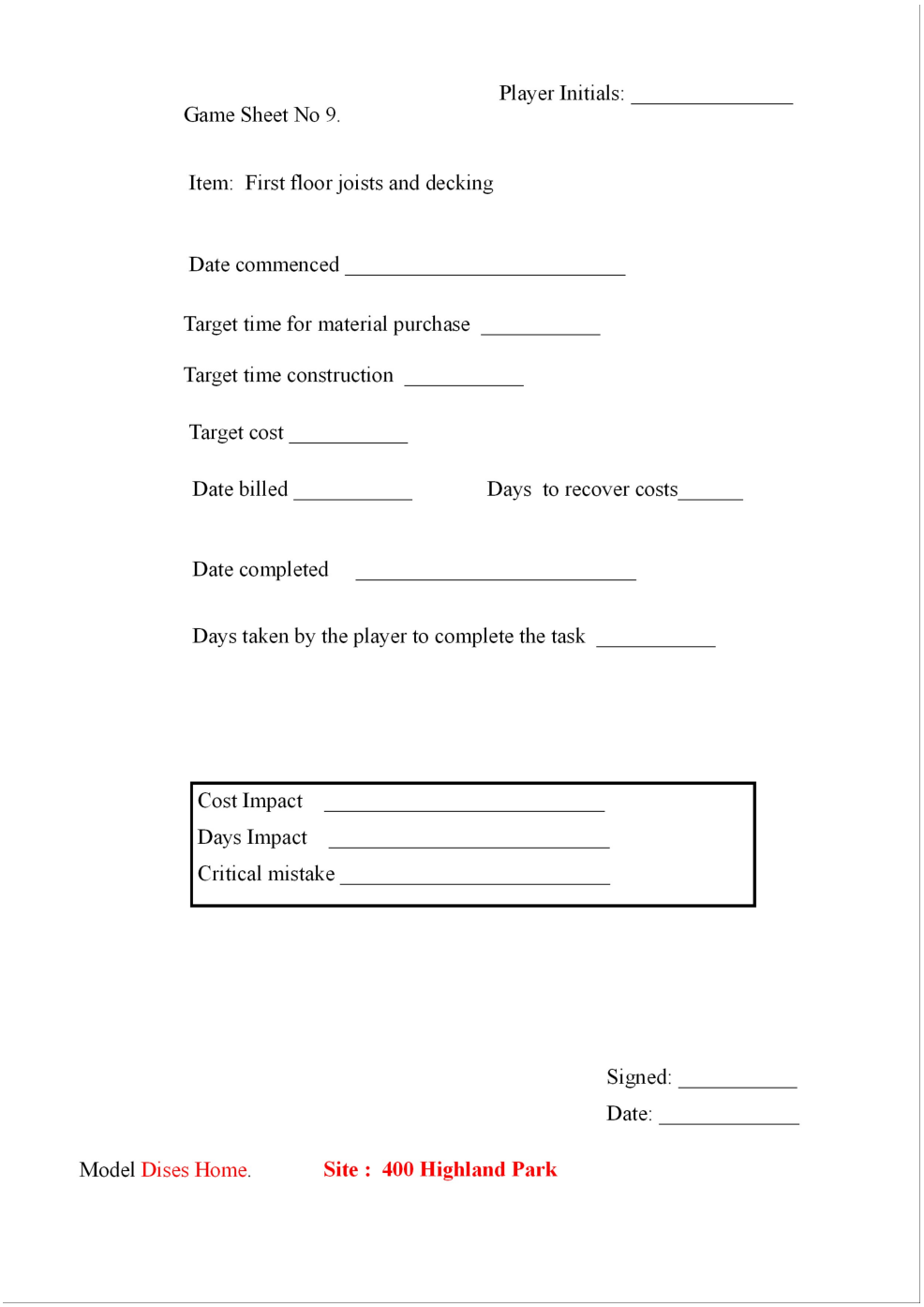
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 19. Game sheet 8 – Foundation Sill Plates

Figure 20 shows the work sheet for the first floor joists and decking.



Player Initials: _____

Game Sheet No 9.

Item: First floor joists and decking

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 20. Game sheet 9 – First Floor Joists and Decking

Figure 21 shows the worksheet for the first floor framing.

Player Initials: _____

Game Sheet No 10.

Item: First floor framing

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

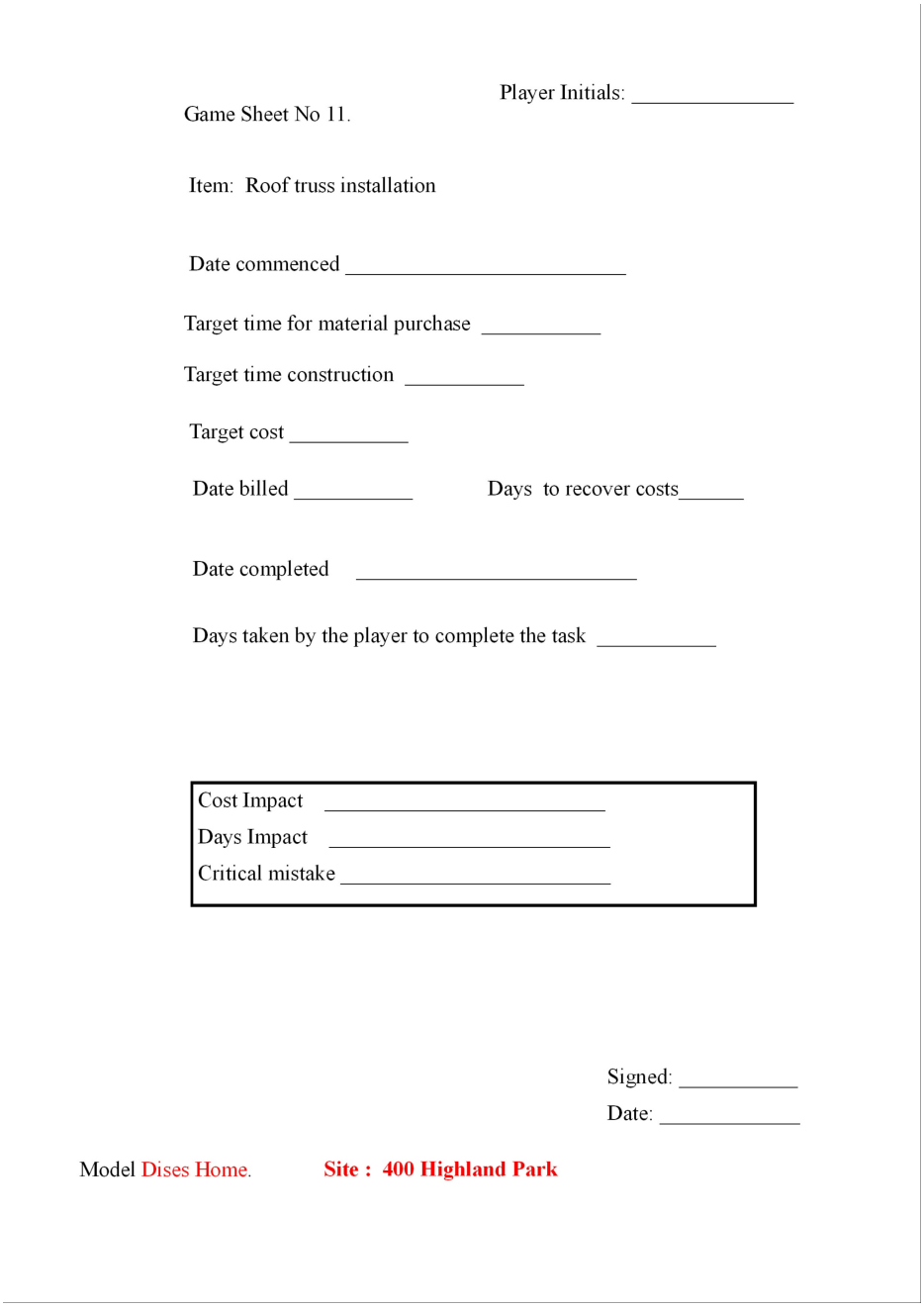
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 21. Game sheet 10 – First Floor Framing

Figure 22 shows the worksheet for the roof truss installation.



Player Initials: _____

Game Sheet No 11.

Item: Roof truss installation

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

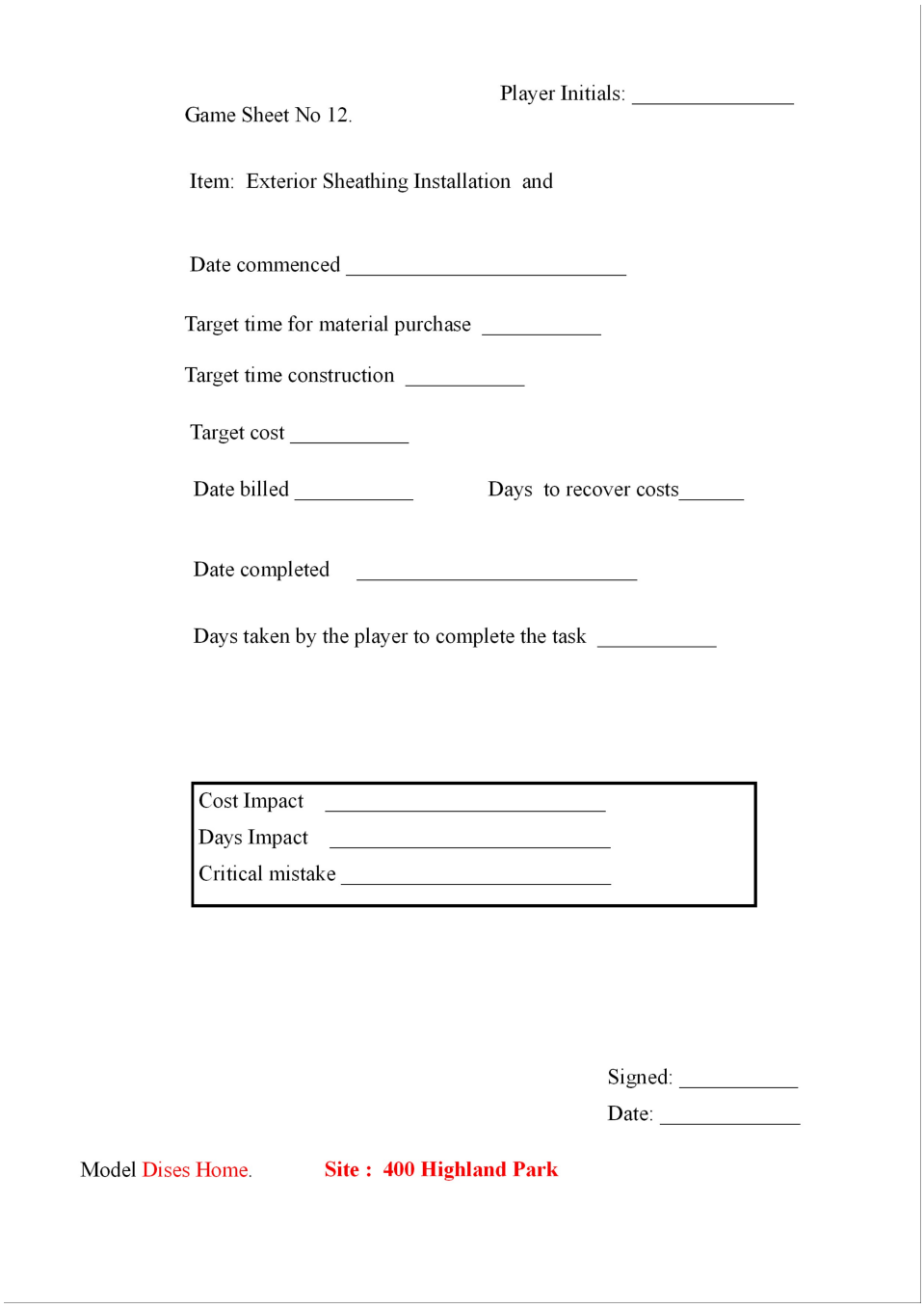
Cost Impact _____
Days Impact _____
Critical mistake _____

Signed: _____
Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 22. Game sheet 11 – Roof Truss Installation

Figure 23 shows the work sheet for exterior sheathing and sheetrock.



Player Initials: _____

Game Sheet No 12.

Item: Exterior Sheathing Installation and

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

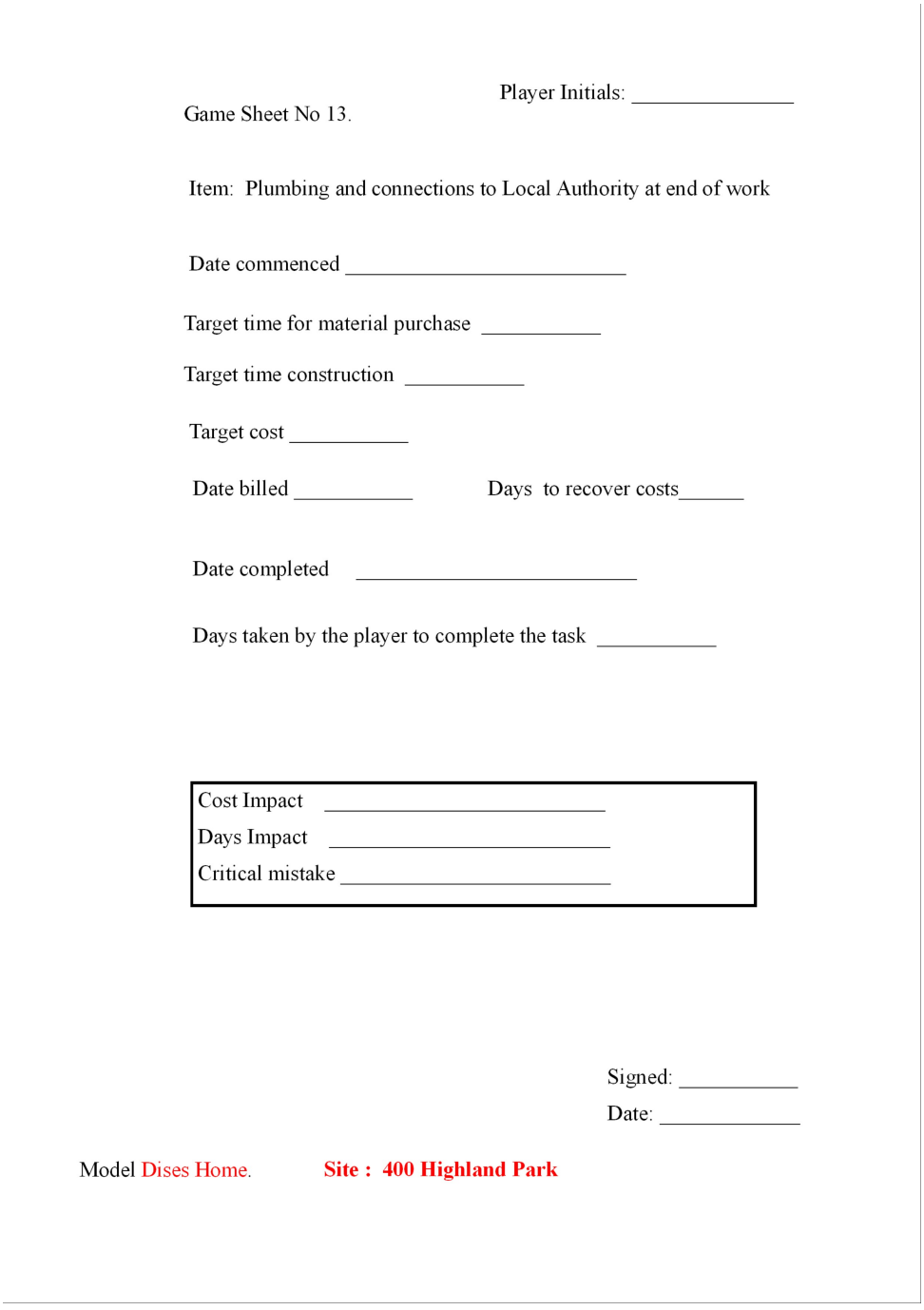
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 23. Game sheet 12 – Exterior Sheathing and Sheetrock

Figure 24 shows the work sheet for plumbing.



Player Initials: _____

Game Sheet No 13.

Item: Plumbing and connections to Local Authority at end of work

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

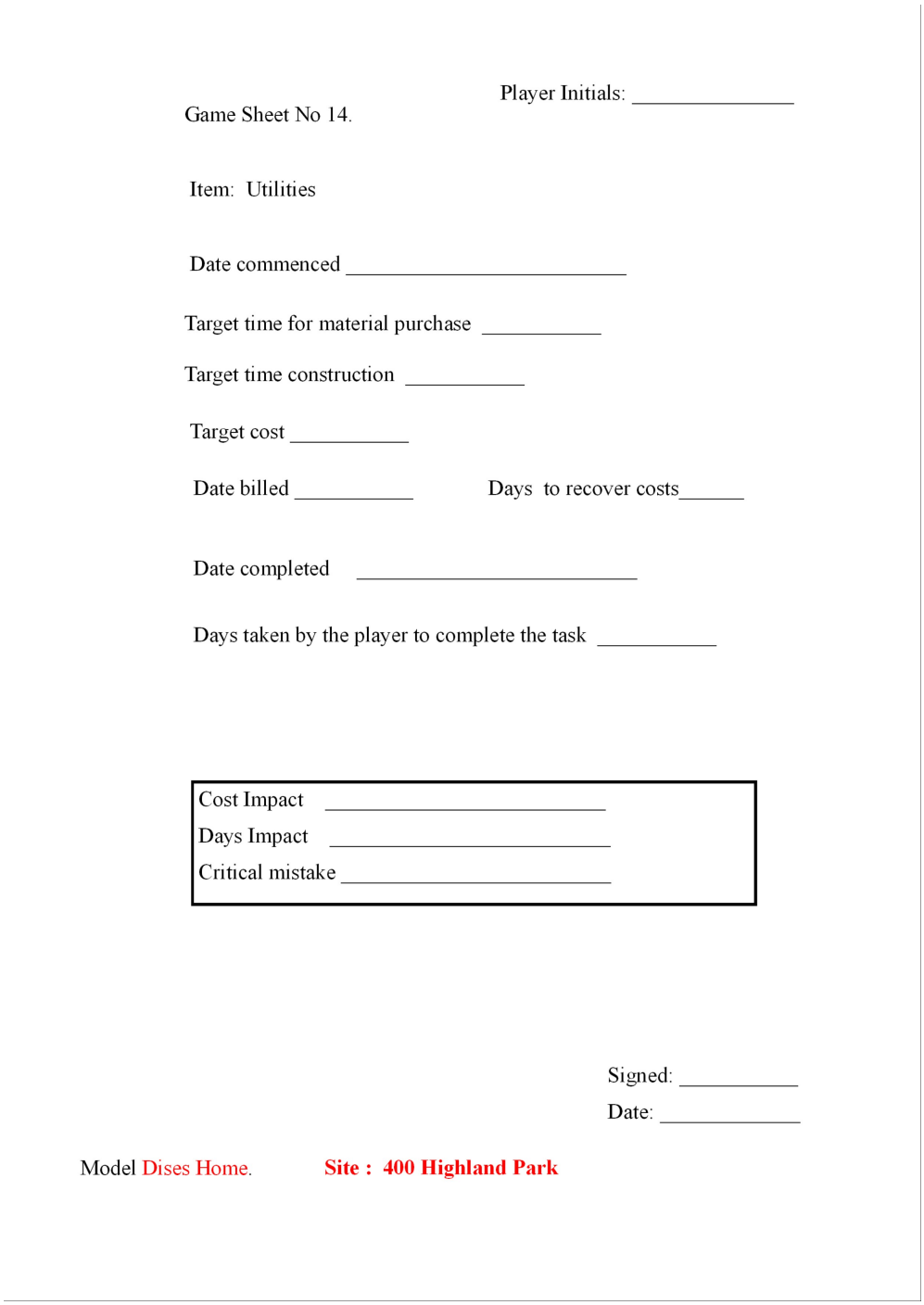
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 24. Game sheet 13 – Plumbing

Figure 25 shows the game sheet for utilities.



Player Initials: _____

Game Sheet No 14.

Item: Utilities

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

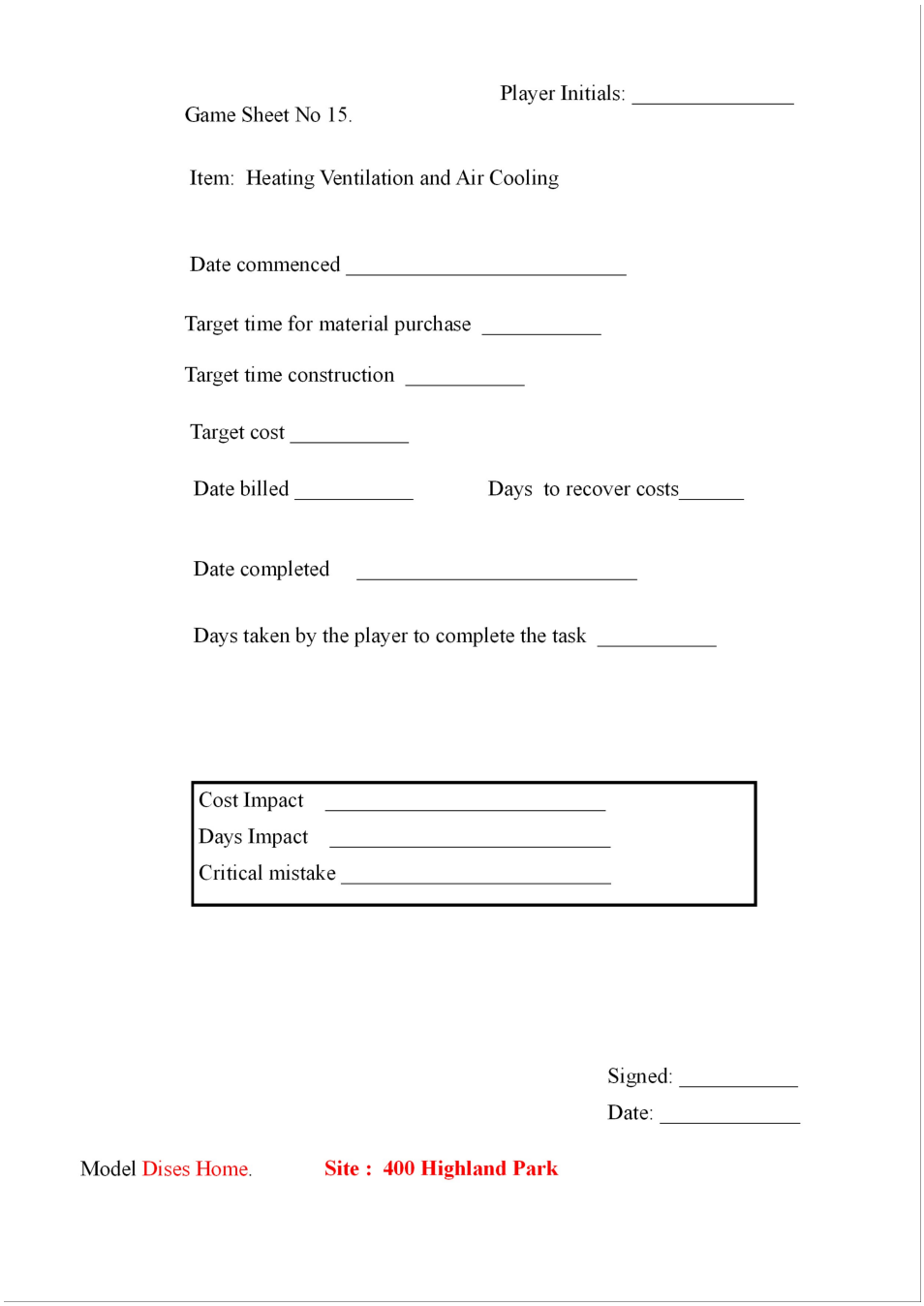
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 25. Game sheet 14 – Utilities

Figure 26 shows the worksheet for heating, ventilation and air conditioning for the house.



Player Initials: _____

Game Sheet No 15.

Item: Heating Ventilation and Air Cooling

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

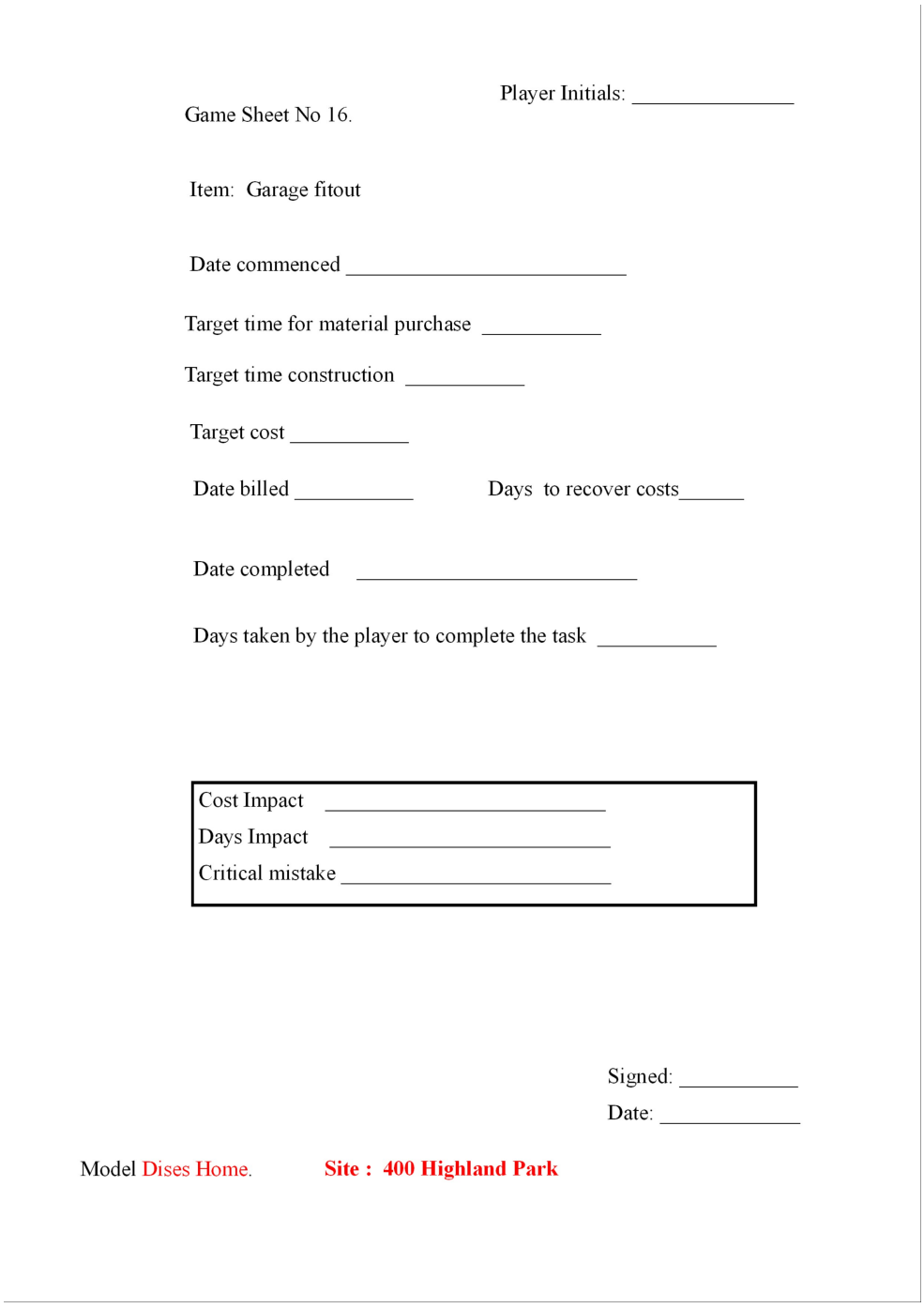
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 26. Game sheet 15 – Heating, Ventilation, and Air Conditioning

Figure 27 shows the garage fit out for the house.



Player Initials: _____

Game Sheet No 16.

Item: Garage fitout

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

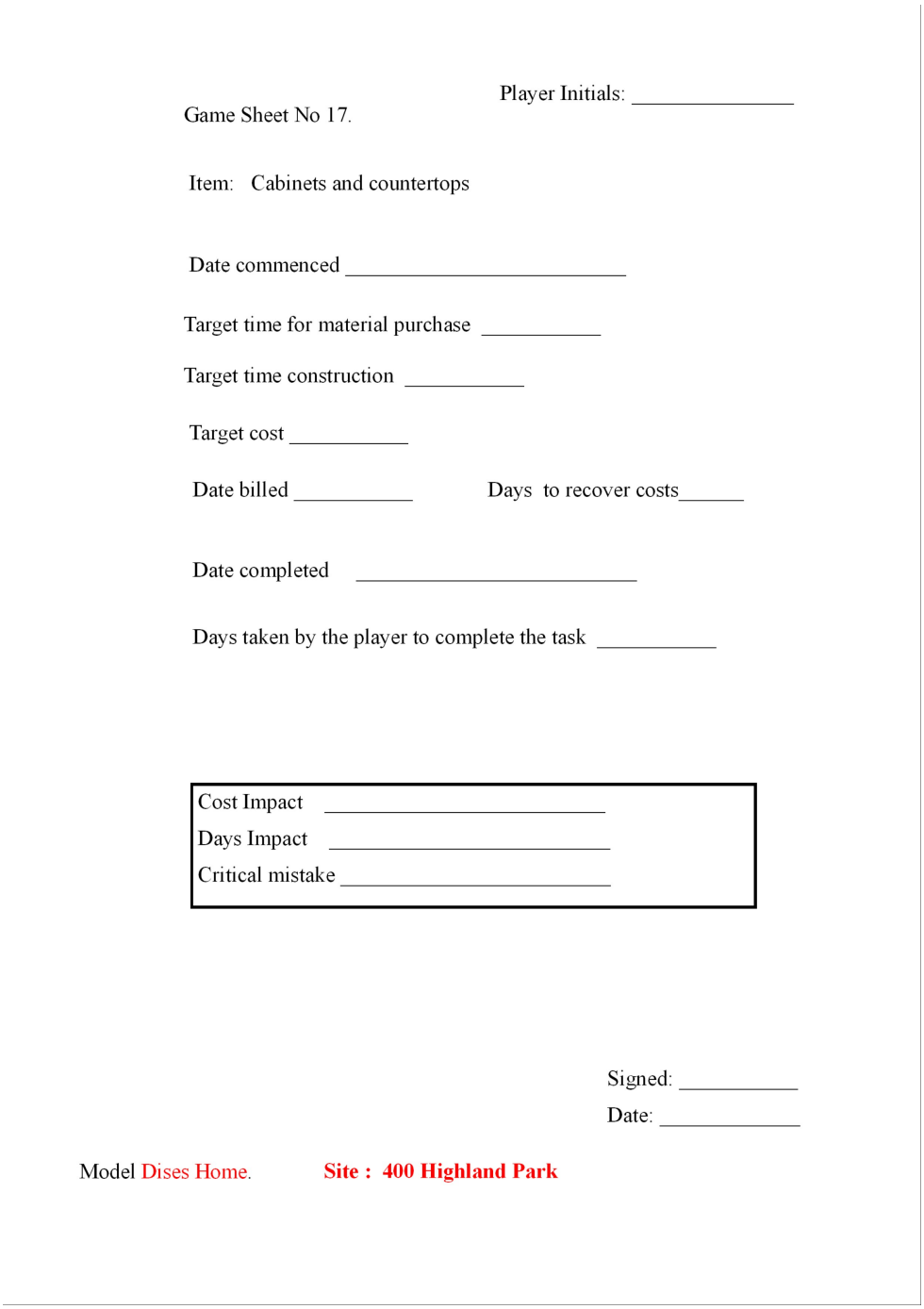
Cost Impact _____
Days Impact _____
Critical mistake _____

Signed: _____
Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 27. Game sheet 16 – Garage Fit Out

Figure 28 shows the worksheet for cabinets and countertops.



Player Initials: _____

Game Sheet No 17.

Item: Cabinets and countertops

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

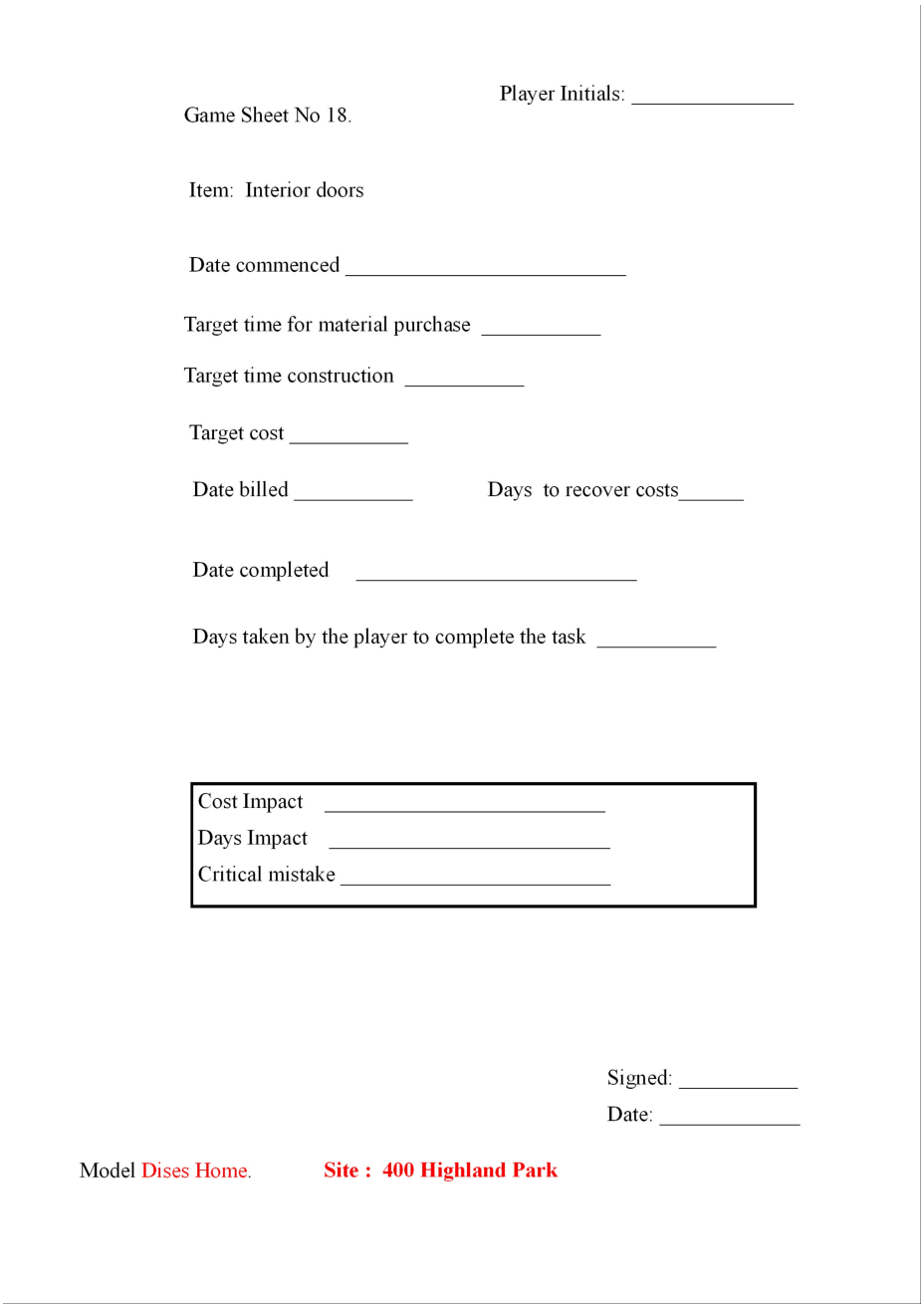
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 28. Game sheet 17 – Cabinets and Countertops

Figure 29 shows the work sheet for the interior doors, of course one adds the exterior doors at this stage.



Player Initials: _____

Game Sheet No 18.

Item: Interior doors

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

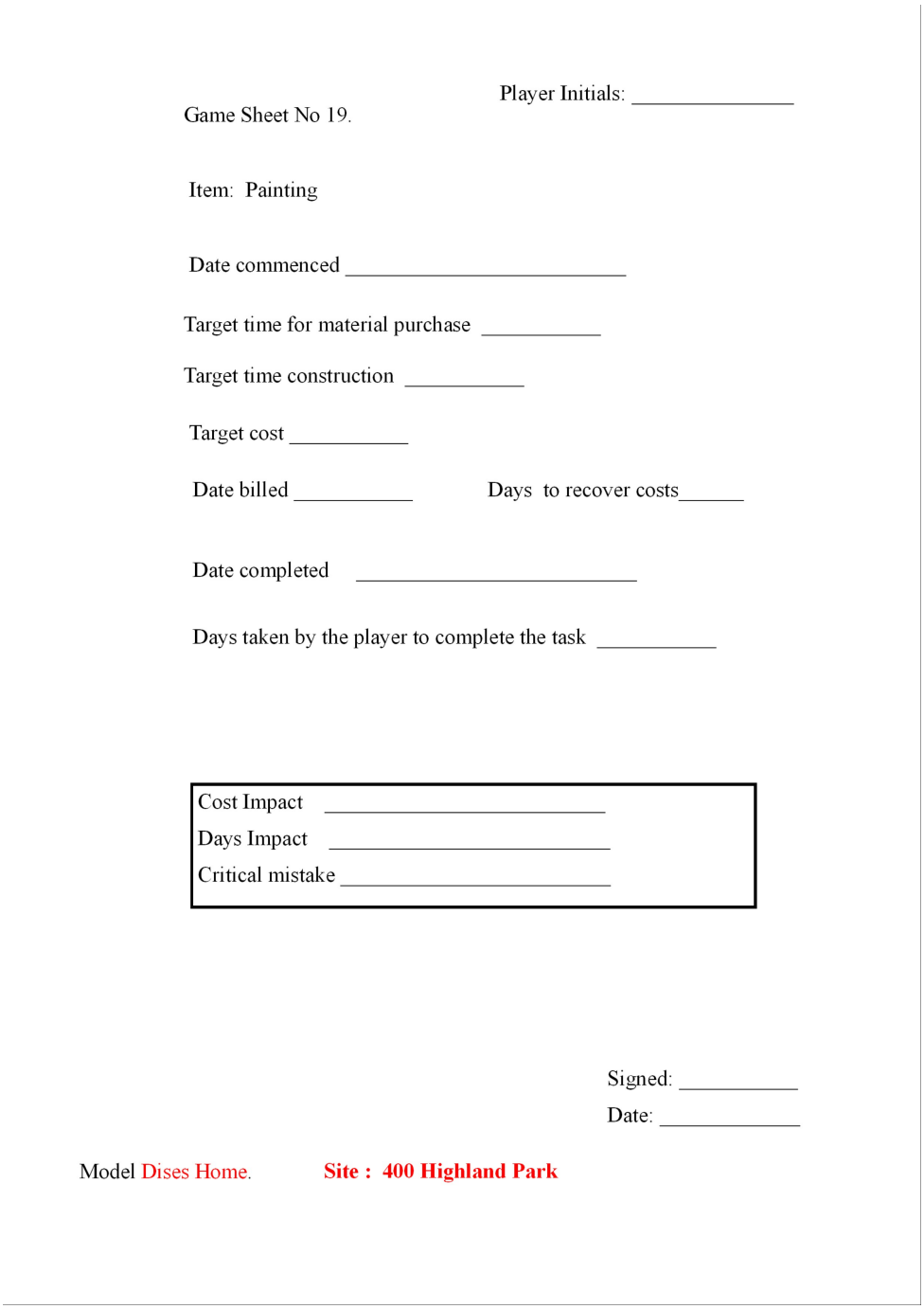
Cost Impact _____
Days Impact _____
Critical mistake _____

Signed: _____
Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 29. Game sheet 18 – Interior Doors

Figure 30 shows the work sheet for painting for the house.



Player Initials: _____

Game Sheet No 19.

Item: Painting

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

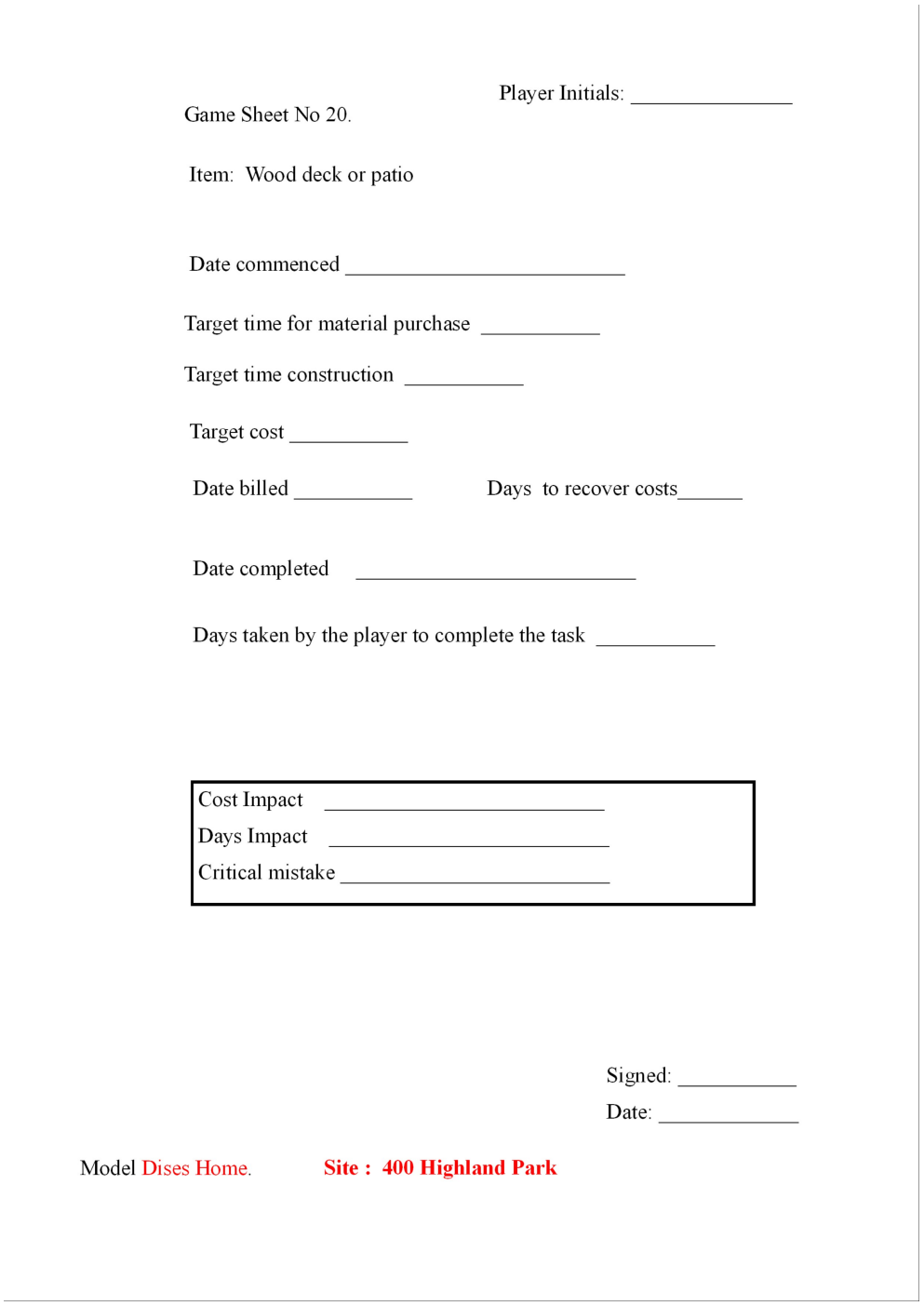
Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 30. Game sheet 19 – Painting

Figure 31 shows the game sheet for the wood deck or patio for the house.



Player Initials: _____

Game Sheet No 20.

Item: Wood deck or patio

Date commenced _____

Target time for material purchase _____

Target time construction _____

Target cost _____

Date billed _____ Days to recover costs_____

Date completed _____

Days taken by the player to complete the task _____

Cost Impact _____

Days Impact _____

Critical mistake _____

Signed: _____

Date: _____

Model Dises Home. **Site : 400 Highland Park**

Figure 31. Game sheet 20 – Wood Deck or Patio