Chapter 2

2.0 LITERATURE REVIEW ON RISK MANAGEMENT

2.1 Introduction
This chapter offers an overview of risk management practices in the construction industry as delineated in the existing literature. It focuses mainly on the emerging aspects of risk management associated with the different phases of a construction project as outlined in the literature.

The chapter begins with a discussion of the current perceptions and understanding of risk and uncertainty in the construction industry and how they affect existing risk management practices in construction projects. It will then describe strategies which can be adopted to tackle risk and undertake an exhaustive review of current risk management processes. The chapter will then engage in a delineation of the risks associated with the different stakeholders in the construction industry, their attitudes to risk, and their willingness to bear risk. The chapter will conclude with an identification of severe risks and the existing strategies for the management of severe risks in each stage of the project life cycle of road construction projects.

2.2 Concept of Risk and Uncertainty
According to Raftery (1994), the future is largely unknown and, therefore, most business decision-making takes place on the basis of assumptions about the future. Hence, Raftery argues that making a decision on the basis of assumptions, expectations, estimates and forecasts of future events always entails some element of uncertainty and risk.

Flanagan and Norman (1993) distinguish between risk and uncertainty. According to them, while the term “uncertainty” can be used to describe situations for which there is no historical data, the term “risk” can be used for situations where the success or failure of a project is predicated in probabilistic quantities on the basis of previous
data. They further argue that uncertain situations can be converted to risky situations by the assignation of subjective probabilities.

Hillson (2003) and Olsson (2007), on the other hand, posit a link between risk and uncertainty since, according to them, risk is measurable uncertainty and uncertainty is immeasurable risk. This implies that, when measurable, an uncertainty is to be considered as a risk. Furthermore, Achrol (as cited in Kolltveit, Karlsen & Gronhaug, 2004) defines risk as a situation which entails a known probability of occurrence or outcome due to a particular activity while uncertainty describes the unknown outcome of an event. Stoner, Freeman, & Gilbert (1995), describe risk as a situation where decisions made by decision-makers take into consideration probabilities calculated using historical information pertaining to that particular event and illustrate using a decision making spectrum as given in figure 2.1.

![Decision-making spectrum](figure2.1.png)

**Figure 2.1: Decision-making spectrum**

Source: Stoner et al. (1995)

Hence, in the existing literature, risk and uncertainty are more often than not distinguished, the distinction being that while risk is usually taken to have quantifiable attributes, uncertainty is understood to be non-quantifiable.

Raftery (1994) has moreover argued that risk is at the more assessable end of the continuum, with even some statistical data from which to produce an evaluation of the likelihood and size of the potential risk (refer Table 2.1). However, uncertainty is at the less assessable end. Since there will be no ‘data,’ the decision-makers will need to rely on informed opinion. The present study will, therefore, leave out uncertainty, confining itself only to risk.
Table 2.1: The risk-uncertainty continuum

<table>
<thead>
<tr>
<th>Risk</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantifiable</td>
<td>Non-Quantifiable</td>
</tr>
<tr>
<td>Statistical Assessment</td>
<td>Subjective Probability</td>
</tr>
<tr>
<td>&quot;Hard&quot; Data</td>
<td>Informed Opinion</td>
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Source: Raftery (1994)

2.2.1 Risk

Although risk is widely studied and known, it still lacks a clear and common definition. For Bunni (1997),

Etymologically, the origin of the word ‘risk’ in English, ‘risqué’ in French and ‘rischis’ in Italian is uncertain. The Latin word ‘rescum’ meaning ‘danger’ or ‘rock’ may throw some light on its origin, but the Chinese ‘wej-ji’ with the characters representing ‘chance’ and ‘danger’, is more illustrative of the concept of risk as it applies to the construction industry. This concept has evolved with these two notions embodied in it. It encompasses not only the danger of a loss but also the chance of obviating it with a consequent gain. (p.94)

According to the Oxford Advanced Learner’s Dictionary, the word ‘risk’ is defined as “the possibility of something bad happening sometime in the future; a situation that could be dangerous or have a bad result” (2000, p.1105). The Australian/New Zealand Standard for Risk Management (AS/NZS 4360), on the other hand, defines risk as “the chance of something happening that will have an impact upon objectives. It is measured in terms of likelihood and consequences” (1999, p.432). In an article published by the Institute of Risk Management (2004), risk is the combination of the probability of an event and its consequences according to the ISO/IEC Guide 73. Thus, according to the author/s of this article, there is the potential for risk in all types of undertakings, which carries a chance for benefits (which can be considered the upside) or threats (the downside).
Risk, in other words, is an unavoidable component of all activities (M.T. Wang & Chou, 2003). For Cooper, risk is “exposure to the possibility of economic or financial loss or gain, financial damage or injury, or delay, as a consequence of the uncertainties associated with pursuing a course of action (1987, p.238). According to Gupta (2011), on the other hand, risks are potential opportunities. For Perry and Hayes (1985), Barri and Paulson (1992), N.A. Kartam and Kartam (2001) and Richardson (2010), risk means an exposure to economic loss or gain but for Akintoye and Macleod (1997), Moavenzadeh and Rosow (cited in N.A. Kartam and Kartam, 2001), Mason (cited in N.A.Kartam and Kartam, 2001), Janadi and Almishari (2003) and Jha and Deveya (2008) risk is only an economic loss. Among others who have attempted to define risk, Rowe (1977) sees risk as the potential for unnecessary or negative consequences of an event or activity while Chicken and Posner (1998) consider risk as a combination of hazard and exposure. Thus, it is clear from the discussions in the existing literature that the definitions of risk encompass both welcome ‘up-side’ as well as un welcomes ‘down-side’ effects.

Nevertheless, there is still a tendency for practitioners to think of risk in largely negative terms (Ward & Chapman, 2003). Hillson (2002) points out that this is because the common usage of the word ‘risk’ only centers on the downside or negative outcomes. In light of Hillson’s point, risk will be defined for the purposes of this research as the ‘downside’ consequences of exposure to economic or financial loss, physical damage, injury or delay.

### 2.2.2 Construction project risks

As Dey and Ogunlana (2004) and Poh and Tah (2006) have pointed out, every human endeavor involves risk, the success or failure of any venture depends crucially on how we deal with it (Dey, 2001). The construction industry is more prone to risk and uncertainty than most other industries (Flanagan & Norman, 1993; Kim & Bajaj, 2000; Tah & Car, 2000; Othman, 2008), the element of uncertainty having to do with its inherent characteristics (Hayes, Perry, & Thompson, 1986; Kangari and Riggs, 1989; Bunni, 1996; Bing, Tiong, Fan, & Chew, 1999; Wong & Hui, 2006; Ebrat and Ghodshi 2011). Whether it is building construction or civil engineering construction,
risk is unavoidable (Thompson & Perry, 1992). As Wiguna and Scott (2006) have pointed out, risk plays a significant part in decision-making and it is generally accepted that they may affect the performance of a project. However, as Thompson and Perry (1992) and Mills (2001) have shown, these risks are not always dealt with properly by the construction industry.

Among the unique characteristic of the construction industry, which would ultimately cause construction to become more complex and dynamic in nature (Jamil, Khan, & Mutfi, 2008; Abdul, Jaffar, Lop, & Mohd, 2011), are the overall size of each product, the involvement of many stakeholders, the multistage construction process with complex technologies, the high exposure to the environment and the long duration of the project (Woodward, 1997). Thompson and Perry (1992) have added to these the degree of risk involvement, such as the size of a project, its location, project scope, speed of construction and familiarity with the type of work, as contributing to risk in construction. Among the effects of risk, failure to keep within the cost estimate or tender, failure to keep within the time stipulated, failure to meet the required technical standards for quality and the functional requirements of the employer are identified as most critical (Thompson and Perry 1992).

According to Mills (2001), the productivity, performance, quality and cost of the project are affected by risk. Zavadskas, Kaklauskas, Turskis & Kalibatas (2009) and Mahamid (2011) consider time and cost overruns as one reason to take risk in construction projects seriously. In addition, Cavignac (2009) has recognized the cost incurred in construction as a result of unforeseen risk as one of the biggest expenses in a project. Thus, the success of project management depends highly on the efficient and effective handling of the risk involved (Ren, as cited in S.M. Ahmed et al., 1999). Bufaied (as cited in Akintoye & Macleod, 1997) has described risk in relation to construction as a variable in construction projects the variation of which results in uncertainty as to the final cost, time duration and quality of the project. According to Dey (2001), such variation is due to the absence of proper risk management techniques in project management. Hence, risk management, as defined by Toakley (cited in Uher & Toakelay, 1999), describes a procedure which controls the level of
risk and mitigates its effects. According to Tummala and Schoenler (2011), risk management techniques need not stop at mitigating and controlling risks; they should preferably work to avoid the identified risk.

Dey (2002) points to the failure to keep to the specified completion time, higher costs and the lower quality of projects as examples of the absence of risk management techniques in project management. Therefore, the success parameters of a construction project, namely, timely completion, staying within the specified budget, and achieving requisite performance would depend upon the capability of each party in risk management. Baker et al. (1999b) have argued that risk management is also useful in maximizing profits. The construction industry, however, has been very slow in moving towards understanding the benefits of risk management (Flanagan & Norman, 1993; Raftery, 1994; Ward, 1999). But the need for risk management in the construction industry is increasing with time due to the increasing complexity, size, client-consumer requirements, the political-economic backdrop and the arduous environmental and physical conditions of such projects (Oztas & Okmen, 2003). Nevertheless, to date, the communication of construction project risks tends to be poor, incomplete, and inconsistent. As a result, project participants do not have a shared understanding of the risks that threaten a project and consequently are unable to implement effective early warning measures and mitigating strategies to adequately deal with problems resulting from decisions taken elsewhere in the chain (Tah & Carr, 2001).

However, literature has long recognized that the application of systematic risk management techniques in construction projects would go a long way towards minimizing risk impacts (Lifson, 1982; Crockford, 1986; Cooper, 1987; Thompson & Perry, 1992; Flanagan & Norman, 1993; Raftery, 1994; Rejda, 1995; Edwards, 1999; V.W.Y. Tam, Shen, Tam, & Willy, 2007). Since risk management is not easy, according to these studies, the researchers have argued for a systematic and process-oriented approach.
2.3 Risk Management

The purpose of risk management is to identify risky situations and to develop strategies to reduce the probability of occurrence and/or the negative impact of risky events (Fan et al., 2008). Risk management is “the act or practice of dealing with the risk. It includes planning for risk, assessing risk issues, developing risk handling options and monitoring risk to determine how the risk have changed” (Kerzner, 2001, p. 907). According to Al-Bahar and Crandall (1990), it is a formal orderly process for systematically identifying, analyzing, and responding to risk events throughout the life of a project in order to obtain an optimum or acceptable degree of risk elimination or control. Further, it is a systematic approach to establish the context for setting goals and objectives, identifying and analyzing risks, influencing decision-making, and monitoring and reviewing risk responses (Edwards & Bowen, 1998).

The PMI (2008) and ICE (2005) define risk management as a comprehensive and systematic process of identifying, analyzing and responding to risks for the purpose of achieving project objectives. “It involves processes, tools, and techniques that will help the project manager maximize the probability and consequences of positive events and minimize the probability and consequences of adverse events” (Project Risk Management Handbook, 2004, p.2). The risk management approach is used to identify potential risks, analyze the probability of risk events, and forecast the consequences that are associated with the occurrence (S.Q. Wang et al., 2004). It has also been defined by Toakley as “a procedure to control the level of risk and to mitigate its effect” (as cited in Uher & Toakley, 1999, p.161). According to N.A.Kartam and Kartam (2001), managing risks means minimizing, controlling, and sharing risks, and not passing them off to another party while Hlaing, Singh, Tiong & Ehrlich (2008) have argued that the main purpose of risk management is to match the type and level of risk with the appropriate management technique. Baker, Ponniah, & Smith (1999a) however identify the management of risk within the construction and oil and gas industries as not straightforward which, according to Buchan (as cited in Baker et al., 1999b), leads to the continual and detailed management of risks.
in these industries, conducted at all stages of the project life cycle from feasibility to decommissioning.

Thompson and Perry (1992) explore risk management as having major benefits for any enterprise that go beyond helping projects reach completion on time and according to the budget. According to Jaskowshi and Bruik (2011), in order to control the level of risk and to mitigate its effects, risk management should be used. They see the benefits of risk management as follows:

- To enable decision-making to be more systematic and less subjective;
- To match the robustness of projects to specific uncertainties;
- To make apparent the relative importance of each risk immediately;
- To give an improved understanding of the project through identifying the risks and thinking through response scenarios;
- To demonstrate company responsibility to customers;
- To have a powerful impact on management by bringing about a realization that there is a range of possible outcomes for a project;
- To improve corporate experience and communication.

According to Uff and Odams (1995), the usual approach to the management of risk is based on intuition and past experience and involves a high degree of judgment.

Flanagan and Norman (1993) mention four ways that have been used to tackle risk in the construction industry which have been identified by previous scholars as,

- ‘the umbrella approach’ where one allows for every possible eventuality by adding a large risk premium to the price;
- ‘the ostrich approach’ where one buries one’s head in the sand and assumes everything will be alright and that somehow one will muddle through;
- ‘the intuitive approach’ that says not to trust all the fancy analysis but to trust one’s own intuition and gut feelings;
• ‘the brute force approach’ that focuses only on the uncontrollable risk but believes that one can force things to be controlled, which of course one cannot.

It is therefore clear that managing risk is a well-defined, systematic, and multi-stage process where all possible risks have to be identified, analyzed and responded to taking into consideration the context within which the risk is applicable.

2.4 Risk Management Process
According to Taylor (2005), the risk management process consists of five stages, which are essential to the success of a project. These five stages are: risk management planning, risk identification, qualitative and quantitative risk analysis, risk response planning, and risk monitoring and control. However, C. Chapman (1997) describes the risk management process in terms of nine phases, which comprises defining, focusing, identifying, structuring, assigning ownership, estimating, evaluating, planning and managing. The nine phases are discussed in a start-to-start precedence sequence. Kululanga and Kuotcha (2010) too saw risk management to comprise nine phases: risk identification, systematic risk approach, risk exposure, risk prioritization, risk response, risk contingency planning, risk monitoring and risk continuous assessment. However, Baker et al. (1999b), citing Buchan, have settled on three processes as identification, analysis and response in risk management which they propose to implement in fifteen steps. Jaafari and Anderson (1995) also propose that risk management be viewed in three stages, risk identification, risk analysis and risk response, while Flanagan and Norman (1993) regard risk management as a process of risk identification, classification, analysis, attitude and risk response. On the other hand, the Project Risk Management Handbook (2004) defines risk management as “the systematic process of planning for, identifying, analyzing, responding to, and monitoring project risk” (p.2). It has also been defined by Toakley (as cited in Uher and Toakley, 1999) as “a procedure to control the level of risk and to mitigate its effect” (p.161). For Wysocki (2009), risk management is a process that contains the steps of risk identification, risk assessment, risk mitigation and risk monitoring.
According to Wang and Chou (2003), the objects of risk management in construction projects include identifying potential risks, analyzing the probability of risk events, and forecasting the consequences associated with its occurrence. Further, it is a systematic approach, establishing the context of setting goals and objectives, identifying and analyzing risk, influencing decision-making, and monitoring and reviewing risk responses (Edwards & Bowen, 1998). Thus Kerzner sees risk management as “the act or practice of dealing with the risk. It includes planning for risk, assessing risk issues, developing risk handling options and monitoring risk to determine how the risks have changed” (2001, p. 907). But for Kayis and Amornsawadwatana (2007), the risk management process includes the three steps of risk identification, risk assessment and risk treatment.

The definitions of risk management discussed above enable one to arrive at a more precise classification of the risk managing process. These studies have turned risk management in construction industry into a topic worth investigation and study as well as an important component in project management requiring the understanding of risk responsibilities and risk management capabilities.

Although different researchers have offered different definitions of the risk management process, this research has adopted the process proposed by Raftery (1994), who divided it into the following three stages:

1. Risk Identification
2. Risk Analysis
3. Risk Response

Among the other researchers whose studies support this particular process identified by Raftery are Healy (as cited in Shen, 1997), Al-Bahar and Crandall (1990), Dey (1999, 2002), S.Q. Wang et al. (2004), Turnbaugh (2005), Kayis and Amornsawadwatana (2007), and Othman (2008). Figure 2.2 below plots the division proposed by Raftery (1994):
Of the three stages in the risk management process, risk identification and analysis, specify and predict the likelihood and adverse impact of the risks while risk response describes the phase when management could take actions to reduce the probability and/or magnitude of risks (Fan et al., 2008).

### 2.4.1 Risk Identification

Risk identification is the first step in risk management process (Andi, 2006; Ling & Hoi, 2006; Kayis & Amornsawadwatana, 2007). According to M.T.Wang and Chou (2003) and Marques and Berg (2011), risk identification and risk allocation are influential factors in risk management while Hertz and Thomas (1984) define risk identification as risk diagnosis. In addition Skorupka (2008) sees risk identification as crucial for the accurate assessment of risk. According to D.W.M. Chan, Chan, Lam, Yeung, & Chan (2010), the determination of key risk factors and the assessment of their relative importance are essential in risk management. For S.Q.Wang et al. (2004) and Williams (1996), the risk management process begins with the identification of the potential risks associated with a construction project. The other steps in the risk management process such as analysis and response are only successful if potential risks are identified properly (Toakelay & Ling, 1991; S.Q.Wang et al., 2004). Risk identification includes the recognition of the potential risk event, the conditions, and the clarification of risk responsibilities in a
construction project (M.T. Wang & Chou 2003). However, since it takes up an enormous amount of time, effort and resources to attempt to consider every risk in a project (Uher & Toakley, 1999, El-Sayegh, 2008), it is important to identify and evaluate the critical and important risks in a project (Barkley, 2004; Andi, 2006). Thus, for Shen (1997), the purpose of risk identification is not only to identify a list of risk factors but to identify the importance of those risk factors, which would enable the stakeholders to analyze and manage properly the identified risks within the limited time-period of a construction project. However, according to Flanagan and Norman (1993), those identified risks are management problems rather than risks. Therefore, risk identification can be identified as the most important initial step in risk management (Ward et al., 1991; Uher, 1993; Zaghloul & Hartman, 2003, Banaitiene et al., 2011) and, as discussed earlier, there are a number of methods proposed by authors for risk identification. According to Al-Iabtabai and Diekmann (1992), historical data is the primary basis for identifying risks while Bajaj, Oluwoye, & Lenard (1997) identifies risk identification as highly dependent on the experience and insight of the key project panel.

Thus, Heldman (2005) sees the risk identification process as involving the identification and documentation of all the potential risks that might impact the project and their characteristics. This is seen as an important first step since the other processes of risk management may only be performed on the identified potential risks. Thus the risk identification stage should be very detailed and thorough (Bajaj et al., 1997). As Chapman (2001) sees it, unidentified risks are unchecked threats to a project.

Raftery (1994) explains the risk identification stage as the most time-consuming. He further stated that the identification of risks that are internal or external to the project requires the analyst to be systematic, experienced and creative. Bajaj et al. (1997), however, identifies this as a difficult task since there are no unerring procedures which could be used to identify construction risks. Chapmen and Ward (1997) therefore recommended the direct-thinking approach for risk identification which consists of activities such as interviewing individuals or groups, brainstorming, and
using checklists. Al-Bahar and Crandall (1990) thus identified the steps involved in the risk identification process (refer Figure 2.3) as follows:

- Preliminary Checklist
- Identification of Risk Events/Consequence Scenario
- Risk Mapping
- Risk Classification
- Risk Category Summary Sheet

Figure 2.3: Risk identification process framework
Source: Al-Bahar and Crandall (1990)

**Preliminary Checklist**

The preliminary checklist of potential project risks is the starting point for identifying risk. Perry and Hayes (1985), Toakley and Ling (1991) and Bing, Akintoye, Edward, & Hardcastle (2005) have seen the check list as one of the common methods for risk identification. Al-Bahar and Crandall (1990) have argued that failure to recognize the existence of one or more potential risks may result in a
disaster or the foregoing of an opportunity to gain results from proper corrective action. They have further stated that risks of all types that affect productivity, performance, quality, and economy of construction should be included in the checklist. The preliminary checklists used during the risk identification process are usually developed based on historical information and previous project team experience (Heldman, 2005). Thus, in the case of the present research, the preliminary checklist was prepared using previous research findings and previous project team experience.

Identification of Risk Events/Consequence Scenario

The second step in the risk identification process is the definition of a set of credible risk events/consequence scenarios. According to Al-Bahar and Crandall (1990), this set represents all reasonable possibilities associated with the realization of each primary source of risk included in the preliminary checklist while the consequences can include economic gain or loss, personal injury, physical damage, time and cost savings or overrun. Moreover, as the authors identify it, since most risks that are involved in construction projects are finance-related, the emphasis is on the financial consequence criterion as a uniform basis of assessment while any other criteria too can be valued in terms of financial gain or loss. Once scenarios for the risk event and its consequences have been developed, risk mapping can be made.

Risk Mapping

Risk mapping is a tool used in the identification, control, and management of risk. Perhaps the most important feature of risk mapping is its low cost and high-impact introduction to risk management (Ingram, 2004). According to Al-Bahar and Crandall (1990), in event risk mapping, a graph of two dimensions or scales is proposed to construct the risk map. In the first dimension, uncertainty will be assessed with regard to the probability of occurrence. In the second dimension, the risk will be assessed with regard to its potential severity. They have further argued that such a two-dimensional graph is considered an important graphical representation, and will enable the project manager to assess the relative importance of exposure to a potential risk in the early stages.
Risk Classification

The classification of risks consists of a number of steps such as the identification of the consequences, types and impacts of the risk (B.A.K.S. Perera, Danasighe, & Rameezdeen, 2009). Edwards and Bowen (1998) suggest two primary categories for classifying risks: Natural and Human Risks. Natural risks include events originating in weather systems and geological systems while human risks include risks from social, political, economic, financial, legal, health, technical, cultural and managerial systems.

Tah (as cited in Tah and Carr, 2000) separated risks into those that are related to the management of internal resources and those that are prevalent in the external environment. External risks are those which are relatively uncontrollable and, given their nature, require continual scanning and forecasting. Internal factors are relatively more controllable and vary between projects. According to Songer et al., “others classify risk in more detailed categories as political risks, financial risks, intellectual property risks, social risk, etc” (as cited in S.Q. Wang et al., 2004, p. 238).

Tah and Carr (2000) regard risk classification as an important step in the risk assessment process, which is useful in structuring risk in a project. For Wong and Hui (2006), categorizing risks can be a useful way to manage them. According to Walke, Topkar, & Matekar (2011), dividing risks into categories is important because one may not be interested in the analysis of all risks but only in a particular category for various reasons.

Many different classifications of risk have been developed over the years. According to Adams (2006), construction project risks can be broadly classified as either objective or subjective. Risks that are purportedly identified via the actual observation or calculation of their occurrence and impact on a project are often described as ‘objective’ risks. Risks that are assessed based on people’s perceptions regarding the prevalence of a particular risk rather than on ‘objective’ or recorded risk data are often referred to as ‘subjective’ risks.
Some authors try to classify risk according to their occurrence in the different stages of a project life cycle, where the attempt is to identify critical risks at each phase of a project and to classify them in terms of their occurrence in and association with particular phases of a project. Flanagan and Norman (1993), in support of this approach, suggest three ways of classifying risk. Zou et al. (2007) argue that by identifying the consequence, type and impact of risk as an integrative part of risk identification, risk classification attempts to structure the diverse risks affecting a construction project. Since the criticality of risk factors differs according to the phase of the project life cycle, classifying risks according to the different phases of a project is useful in the latter stages of project risk management compared to other classifications as it helps to evaluate risk factors according to the specific phase of the project. In line with this idea, the present study attempts a classification of risk according to the stages of a project life cycle.

**Risk Category Summary Sheet**

This is the final step in the risk identification process. Al-Bahar and Crandall (1990) have proposed the integration of all personnel participating in the project management team in the summary sheet because such participation is considered very important in the risk identification process as judging the significance of any risk cannot be delegated to a single person. They further proposed that the summary sheet be updated as information changes or as different risk exposure develops. In this way, it becomes a living picture of the management's understanding of the project risks.

It is clear that risk identification is an important process with a number of steps to identify the severe risks in a project. In addition, the risk identification process should highlight significant risks, which should be selected for further analysis (Adams, 2008b).
2.4.2 Risk analysis

Risk analysis is performed in order to show what happens if the project does not proceed according to the plan due to the potential risks and to warn the decision-maker or manager about the responses necessary to cope with risks. Furthermore, it captures all feasible options and analyses the various outcomes of any decision (Oztas & Okmen, 2003).

Risk analysis techniques are grouped into two parts: quantitative and qualitative (Flanagan and Norman, 1993). Figure 2.4 shows the sequence in risk analysis process. While both groups benefit from the data produced by risk identification, the qualitative approach consumes the gathered information through direct judgment, ranking options, comparing options, and descriptive analysis (Oztas and Okmen, 2003). Recently, a number of systematic models were proposed for use in the risk evaluation process (Dey, 2001). Kangari and Riggs (1989) identify two different types of models: classical and conceptual. The use of rigorous analytical techniques in construction risk analysis is very common in the existing literature (Pouliquen, 1970; Bjornsson, 1977; Perry and Hayes, 1985; Cooper, 1987; Ranasinghe and Russel, 1993; Adams, 2008a; Luu, Kim, Tuan & Ogunlana, 2009; J. Zeng, An, & Smith, 2007; AmirRezak, Neda, Farid, & Sayed, 2011). However, it is evident that these techniques are rarely applied as they do not fulfill the needs of the industry (Tah, Thorpe, and McCaffer, 1996; Akintoye and Macleod, 1997; Uher and Toakley, 1999). Moreover, these risks are commonly analyzed, according to Adams (2008b), in an arbitrary manner. Therefore, subjective analytical methods which are based on the historical information and experience of individuals and companies have been used to assess the impact of construction risk (Bajaj et al., 1997). According to Tversky (1974), the analysis of such risks is often based on the intuitive judgment of the decision-maker. Therefore, it is clear that results are bound to be influenced by the perceptions and biases of those making such analyses. On the other hand, an appropriate method of aggregation of opinions from multiple experts can reduce the impact of individual perceptions and biases on the analysis (Adams, 2006). In line with this thinking, this study collects data from multiple experts for analysis.
Figure 2.4: Risk analysis process
Source: Flanagan and Norman (1993)
Thompson and Perry (1992) have argued that the choice of the risk analysis technique to be used should depend on the following factors:

- The type and size of the project;
- The information available;
- The cost of the analysis;
- The time available to carry it out;
- The experience and expertise of the analysts.

According to Raz and Michael (2001), risk impact and risk probability assessments are frequently used in assessing project risks. This form of risk assessment is accepted in many publications on construction risk management in order to identify the most critical risks (Shen, Wu, & Ng, 2001; Santoso, Ogunlana, & Minato, 2003; Wiguna & Scott, 2006). However, Williams (1996) and Ward (1999) argue that the ranking of risk simply by multiplying probability by impact is misleading. But, though this method of multiplying probability by impact for risk assessment has limitations, it is still a well-known and widely used method (Wiguna & Scott, 2006). In addition, the combined use of risk mapping with this method is one way to control the limitations of use of multiplying probability by impact for risk assessment since risk mapping considers both the impact of risk as well as the probability of risk occurrence individually.

Conventionally, risk analysis is performed at the overall project level (Dey, 2001) although Cooper, Macdonal, & Chapmen (1985) have shown how systematic risk evaluation could be performed by subdividing a project into major elements by analyzing the risk associated with each in detail. Since the severity of the risk pertaining to a project varies from one phase of the project life-cycle to another, once the risks of a project have been identified and analysed, it will enable the stakeholders to adopt appropriate risk response strategies to cope with the identified risks.
2.4.3 Risk response/ Risk handling

Fan et al. (2008) have stated that risk response identifies, evaluates, selects and implements strategies in order to reduce the likelihood of occurrence of risk events and/or to lower the negative impact of those risks to an acceptable level. They have further proposed that the risk response process include the documentation regarding the risks about which action should be taken, when they should be taken, who is responsible and the associated risk response cost. Risk response is the process that allows a risk alleviation strategy to be adopted and for appropriate remedial action to be taken (Tah & Carr, 2000; Jamil et al., 2008). For Wang and Chou (2003), the appropriate handling of risks requires a realization of the contents and effects of alternative solutions.

Raftery (1994) has proposed four possible techniques for handling risks as follows:

- Risk retention
- Risk reduction
- Risk transfer
- Risk avoidance

However, according to Mills (2001), the above-mentioned risk response methods may be used individually or in combination. In a survey, Baker et al. (1999a) found that, in the construction industry, the risk reduction technique is the one most frequently utilized, followed by risk transfer, risk retention and risk avoidance.

Risk retention

According to Baker et al. (1999a), risk retention describes as ‘the risks, foreseen or unforeseen, that are controlled and financed by the company or contractor that is fulfilling the terms of the contract’. Al-Bahar and Crandall (1990) have argued that risk retention is becoming an increasingly important aspect of risk management when dealing with project risks. They have further stated that risk retention is the internal assumption, partially or completely, of the financial impact of risk by the firm. According to Flanagan and Norman (1993), risks which produce individually small,
repetitive losses are the ones most suited for retention. Carter and Doherty (1974) identify two retention methods: active and passive. Where active retention is deliberate retention after evaluating the consequences of risk, passive retention is risks incurred due to negligence, ignorance or absence of decision. S.Q.Wang and Chou (2003) too have identified of risk retention as including two conditions:

1. Unplanned risk retention, where the manager does not take any action for some risk whether he or she is conscious of the risk or not;
2. Planned risk retention, where the manager decides to take no action for some risk after cautious evaluation.

Risk reduction
Baker (1999b) argued that reducing risks is a part of risk retention because the risk has to be retained before pursuing actions to reduce the effects of a foreseen risk. They have further argued that, alternatively, risk reduction may be an action within the overall risk management and that it is because of the possibly broader use of the term risk reduction that it has been categorized separately. According to B.A.K.S.Perera and Rameezdeen (2008), risk reduction is the most difficult out of the risk handling methods for the purpose of ensuring the success of the project.

According to Flanagan and Norman (1993), risk reduction falls into four basic categories:

1. Education and training to alert the staff to potential risks;
2. Making available physical protection to reduce the likelihood of loss;
3. Putting systems in place to ensure consistency and to make people ask the ‘what if’ questions;
4. Making available physical protection devices and mechanisms to protect people and property.

Risk transfer
According to S.Q. Wang and Chou (2003), risk transfer means switching risk responsibility between contracting parties in a project. According to Thompson and Perry (1992), risk transfer has two basic forms: (a) transferring the property or
activity responsible for the risk; or (b) retaining the property or activity transferring the financial risk, i.e., insurance. But according to Uff and Odams (1995), the following devises may be used for risk transfer:

1. Insurance, which is the classic device for transferring risk. Here, the risk of the insured is transferred to the insurer for a premium;

2. Subcontracting, where a main contractor may sub-let the ground works package at a price adjustable if poor ground is encountered but only payable if the main contractor’s entitlement to that additional price is proved;

3. Transferring design obligations, where the design and build contract obligations are transferred to the contractor.

**Risk avoidance/ Elimination**

Avoidance is a useful, fairly common strategy in managing risks. Al-Bahar and Crandall (1990) have argued that the contractor knows that in avoiding risk exposure, he will not experience the potential losses that the risk exposure may generate. On the other hand, however, the contractor also loses the potential gains that may have been derived from assuming that exposure. Baker et al. (1999a) cited situations such as a contractor not placing a bid or the owner not proceeding with project funding as extreme examples of risk elimination. In addition, Carter and Doherty (1974) argue that there are a number of ways to avoid risks such as tendering a very high bid, placing conditions on the bid, pre-contract negotiations and not bidding on the high portion of the contract.

Even though the most commonly identified risk response methods in the literature are risk retention, risk reduction, risk transfer and risk avoidance, risk allocation is also identified as an important risk handling method. According to N.A. Kartam and Kartam (2001) and Mills (2001), the most efficient response to risk is to allocate the risk to the party that is in the best position to accept it. Further, in responding to each type of risk, it is more appropriate to allocate the risk among the parties in the contract or to a third party based on their ability to control the risk. Moreover, the risk can either be shared with or totally shifted to the employer, contractor, or any other third party (S.M. Ahmed et al., 1999).
Risk allocation

According to Bunni (1997), when a risk has been identified, assessed and analysed, it must be allocated to various parties in order to keep it either under control or to prevent the occurrence of harmful consequences and, thereby, to reduce the risk. Andi (2006) however claims that, ‘construction risks can hardly ever be eliminated. They can merely be transferred or shared from one party to another through contract clauses.’ This idea is also explored by Mak and Picken (2000) who have highlighted the fact that contractors are required to accept a certain level of risk due to unforeseen costs they incur during construction and that risk is also an issue for clients. The above discussion therefore underscores the significance of risk allocation and the need to make such risk allocation a part of the risk management process.

Risk allocation seeks to assign responsibility for the definition and division of responsibility associated with a possible future loss or gain in a variety of hypothetical circumstances should a project not proceed as planned (Uff, 1995). This is commonly defined through the contractual documents (Lam, Wang, Lee & Tsang, 2007). Sharing responsibilities among the parties involved in a construction project is necessary because assigning overall responsibility to one party carries some element of danger and would incur more cost should the perceived risky situation were to occur (S.M. Ahmed et al., 1999). Hence, it is customary to shift the responsibility for the risk to either the contractor or the client and sometimes to share it among both parties.

Thompson and Perry (1992) have proposed that the contract strategy to determine the right allocation of responsibilities be arrived at with the same care as that adopted in the drafting of the contract and tender procedure for a project. This underscores the importance of the role of each constituent in the contract, such as the contract agreement, conditions of contract, specifications, preamble notes, and bills of quantities and drawings, in the determination of the allocation of risk. However, as S.Q. Wang and Chou (2003) have pointed out, risks can also be transferred beyond the limits of the contract clauses although with the consensus of both parties.
Thus, a party to whom a risk is allocated is considered to have the “ownership of risk.” But, according to Godfrey (1996) and Uff (1995), it has several meanings. They are: having a stake in the benefit or harm that may arise from the activity that leads to the risk; responsibility for the risk; accountability for the control of risk; and financial responsibility for the whole or part of the harm arising from the risk should it materialize. N.A. Kartam and Kartam (2001) have pointed out that responsibility for all the risks vest rightfully with the owner and that it should be transferred to another party only with fair compensation. However, the common understanding on risk allocation is that the receiving party has both the competence and expertise to fairly assess the risk and to control or minimize it (Barnes, 1983; Abrahamson, 1984; Perry and Hayes, 1985; Thompson and Perry, 1992; Godfrey, 1996; Hartman, 1996; Fisk, 1997). In addition, Banaitiene et al. (2011) sees risk management as helping the key project participants to meet their commitments and to minimize the negative impacts on cost, time, and quality objectives of a construction project.

2.5 Involvement of Stakeholders in Risk Management

The diverse interests of project stakeholders in a construction project further exacerbate the changeability and complexity of the risks (Zou et al., 2006). According Loosemore, Raftry, Reilly & Higgon (2006), effective and frequent involvement of stakeholders at all stages of the risk management process will ensure both that more risks are identified and that their commitment can be secured for managing them.

Thus, the risk inherent in construction should be attached not to one party but to all parties involved although problems may be offloaded from one party to another by contract agreement. Figure 2.5 displays how the spectrum of risks in a project comes to affect the owner, the professionals, which includes consultants, and the contractor (Bunni, 1986).
With regard to project risk, risks appear different when viewed from the different perspectives of the stakeholders (Olson, 2007). Thus, the willingness of a contracting party to bear a risk is dependent on the factors listed below (Ward et al., 1991):

- general attitude to risk;
- perception of project risk;
- ability to bear the consequences of a risk eventuating;
- ability to manage the associated uncertainty and thereby mitigate the risk;
- the need to obtain work;
- his/her perception regarding the risk/return tradeoffs of transferring the risk to another party.

Ward et al. (1991) have further argued that one party may require a higher expected rate of return for taking on a given level of risk than another party and that while one organization may prefer low-risk, low-expected return opportunities, another may prefer high risk, high-expected return opportunities.
According to Sawczuk (1996), no matter how small or simple the project, it can still go wrong as soon as the two parties, the client and contractor, have signed the contract and have taken on board the risk. It only underscores the need for immense involvement from project contracting parties such as client, consultant and contractor in order to ensure that risks are managed properly. However, Martin (1983) stresses the special place of clients in any contracting agreement since clients are the life blood of the industry.

2.5.1 Involvement of client in risk management

The client is the key to the success of any construction project. A client may increase the risk exposure by applying unreasonable monetary and time constraints, or by not implementing the appropriate maintenance or operating procedures once the project is completed. The client must thus strike a balance between the degree of perfection required and the economic constraints to be imposed (Bunni, 1986).

Thompson and Perry (1992) have argued that unless the client recognizes a risk, the other parties to the project will pay attention to or recognize the risk only as far as they think it wise to protect their own interests. According to these scholars, the main decisions in making which the client can gain from risk management are:

- Formulating contract terms, particularly in choosing an equitable risk allocation;
- Assessing the opportunities for risk management made possible by different types of contractual arrangements;
- Choosing conditions of contract which define the risk and their allocation.

However, according to Ward et al. (1991), clients may be more willing to take on a risk if they have experience of the construction industry and build frequently.

2.5.2 Involvement of consultant in risk management

Kometa, Olomolaiye, & Harris (1996) have identified that consultants, by virtue of their job, give advice to clients as part of their duty under the laws of contract and
tort. They further point out that the risk entailed in any advice given to clients might involve substantial financial losses to consulting firms in instances where the client sues successfully, leading to a decline in client confidence and the reputation of the firm.

In the case of designers, they may be rushed to complete the design phase by owners who are keen to start construction early for the purpose of attaining market objectives. According to El-Sayegh (2008), one of main risks arising from this is deficiencies in drawings and specifications, which relates to the quality of the drawings and specifications produced by the design professional. El-Sayegh also points to changes made by the design professional during the construction phase as another risk.

Thus, while it has been often said that consultants carry very little risk because they only give advice, the loss incurred as a result of bad advice can be very significant (Flanagan & Norman, 1993).

2.5.3 Involvement of contractor in risk management

When construction projects are complex and risky, contractors are faced with a variety of situations involving many unknown, unexpected, frequently undesirable, and often unpredictable factors. In such cases, contractors are subject to cost increases that are not seen in construction projects with a relatively low degree of risk (Paek, Lee, & Ock, 1993).

Contractors who bear project risk have four basic response options (Ward et al., 1991):

- Passing the risk on to a third party;
- Continuing to bear the risk and managing it for profit while accepting liabilities;
- If a downside risk eventuates, trying to recover costs from other parties, including the client;
• If a downside risk eventuates, meeting liabilities reluctantly, walking away from the contract, or going bankrupt.

According to Zou et al. (2007), while risks are oriented towards all project stakeholders, how effectively they will be managed by the different stakeholders in the context of a project life cycle is decisive to the success of the project.

2.6 Project Life Cycle
The project life-cycle is a convenient way of conceptualizing the generic structure of a project over time (Ward & Chapman, 1995). According to Heldman (2005), all projects are divided into phases and all projects, large or small, have a similar life-cycle structure. At a minimum, a project will have a beginning or initiation phase, an intermediate phase or phases, and an ending phase. He further stated that the number of phases depends on the complexity of the project and the nature of the industry.

Dione, Ruwanpura, & Hettiraatchi (2005) have stated that in the case of most medium to large-scale projects, especially in the case of those with complicated engineering designs, financing and construction can be divided into distinct phases. Moreover, each phase represents an important milestone in the progress of the project towards completion. They have further stated that the construction project life-cycle involves five phases: Initiation Phase, Concept Phase, Feasibility Phase, Planning Phase and Design/Implementation Phase. Each of these construction project phases gives the proponent the opportunity to reflect on the project details to date, understand the implications of moving forward, and use the opportunity to make changes as necessary.

According to CIDA (as cited in Uher and Toakley, 1999), the conceptual phase of a new construction project is the first of a number of sequential phases in a project development cycle, the other phases being project planning and design, procurement and construction, and commissioning.
While many researchers and authors, as discussed above, have offered different definitions of the construction project life-cycle, this study has adopted the definition of construction project phases offered by Zou et al. (2007), which divides the comprehensive project life-cycle into four stages as follows:

1. Conceptual stage;
2. Design stage;
3. Construction stage;
4. Operation stage.

Mills (2001) argued for seeing risk management not as a one-off activity but rather as something to be applied continuously throughout the life-cycle of the project. Zou, Zhang, & Wang (2006) explain more effective management of risks as possible if the risks are managed from the perspective of a project life cycle. Hence, it is obvious that risk management throughout the life-cycle of a project would give stakeholders of a project a more effective and efficient way to manage risk.

### 2.7 Risk Management and Project Life Cycle

All project lifecycles consist of a sequence of stages and activities, from origin to completion, and there is always a degree of risk associated with each stage. Risk identification and the development and implementation of risk management strategies therefore must be carried out throughout the life-cycle of a project (Stewart & Fortune, 1995). Wiguna and Scott (2006) also argue that the identification and analysis of risks should be carried out regularly throughout the process and not confined only to the beginning of the project.

However, Walewski and Gibson (2003) point out that understanding the relationship between risk management and project phases for capital projects can be a difficult task. Chapman (1997) and Smith (2003) suggest that a formal risk management process should be applied at all stages of the project life cycle by both clients and other parties associated with a project. They have further stated that implementing a risk management process early on in the project life cycle is in general more difficult because, at this stage, the project is more fluid and less well defined. However,
implementing a risk management process later on in a project life-cycle gives rise to somewhat different difficulties without any compensating benefits.

As a project progresses, the nature and extent of foreseeable risks may change, new risks may emerge, and existing risks may change in importance or be reallocated while influencing other risks (Rahman & Kumaraswamy, 2004). While these risks may arise at different phases of a project life-cycle, some of them may possibly be concerned with more than one phase (Zou et al., 2007).

2.8 Trend on Road Construction Projects in Sri Lanka

In developing countries, the demand for infrastructure and services has created more opportunities for those in the construction industry compared to the stagnant domestic construction industry (S.Q. Wang et al., 2004). It is evident that, as a developing country looking to accelerated economic growth, there are more opportunities for investments in infrastructure development within the Sri Lankan context. Government investment or expenditure on public infrastructure is one of the components which can accelerate economic growth. In the case of Sri Lanka, it is also used to stabilize the economy.

According to the Road Development Authority (RDA 2009), the development of the road network in the country dates back to the British colonial period. The Central Bank records for the six years (2000-2006) cited below make it obvious that, from the year 2005, there has been a rapid increase in government investment in the road network.

As the Central Bank report 2006 states, “in the aftermath of the tsunami devastation, public sector as well as private sector investment had been channeled into urgent rehabilitation and reconstruction activities in tsunami affected areas”(P. 135). As Table 2.2 makes evident, government investment has been directed to the reconstruction of roads, rails and other infrastructure facilities (Central Bank Annual Report, 2005).
Table 2.2: Government investment on infrastructure

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP (current market price- Rs. Billion)</th>
<th>Government Investment (percent of GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>1258</td>
<td>3.3</td>
</tr>
<tr>
<td>2001</td>
<td>1407</td>
<td>3.0</td>
</tr>
<tr>
<td>2002</td>
<td>1582</td>
<td>2.0</td>
</tr>
<tr>
<td>2003</td>
<td>1761</td>
<td>2.3</td>
</tr>
<tr>
<td>2004</td>
<td>2029</td>
<td>2.2</td>
</tr>
<tr>
<td>2005</td>
<td>2366</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Source: Central Bank Annual Reports (2000-2006)

In addition, the present government has implemented vast infrastructure development projects, especially road construction and rehabilitation projects, such as *Maga Neguma*, which is a part of the “Ten-year Development Framework of the Government: 2006-2016” (refer Table 2.3).

Table 2.3: Ten-year development framework of the government: 2006-2016

<table>
<thead>
<tr>
<th>Sector and Development Thrust/ Vision/ Objective</th>
<th>Policy Framework/ Policy Direction/ Strategies/Key targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads:</td>
<td></td>
</tr>
<tr>
<td>To provide accessibility to the whole population in the country and to have a high quality mobility road network for the transportation of passengers and goods.</td>
<td>• Giving high priority to the maintenance and rehabilitation of the existing road network.</td>
</tr>
<tr>
<td></td>
<td>• Building carefully selected and economically maintainable new major roads and expressways.</td>
</tr>
<tr>
<td></td>
<td>• Launching a programme for traffic management and for increasing road safety.</td>
</tr>
<tr>
<td></td>
<td>• Continuing the <em>Maga Neguma</em> programme to develop the rural road network</td>
</tr>
<tr>
<td></td>
<td>• Introducing traffic management measures such as road pricing, construction of flyovers and establishment of signal lights etc.</td>
</tr>
<tr>
<td></td>
<td>• Opening investment opportunities for Public Private Partnerships (PPPs) for the development of expressways.</td>
</tr>
</tbody>
</table>

When the above information is taken into consideration, it becomes clear that the government has been implementing a vast new construction and rehabilitation road project island-wide, which increases the demand for road projects. In addition, it is predicted that the demand for road construction will be spiked by the plans in place for the rehabilitation and resettlement of people in the Northern and Eastern Provinces in Sri Lanka. All of this make it abundantly clear that there is an urgent need to come up with a risk management strategy which can be adopted in road projects for the purpose of attaining cost, time and quality achievements within unpredictable environmental conditions.

2.8.1 Risk management in road construction projects in Sri Lanka

Risk in the construction industry is inevitable and is associated with every aspect of it, be it the construction of a building or any other civil engineering project. However, according to Thompson and Perry (1992), the risk is particularly high in road, reservoir maintenance work and building refurbishment projects.

It is therefore necessary to find out why road projects are more susceptible to risk than many other construction activities. In developing countries such as Sri Lanka, it is especially necessary to investigate the high degree of risk entailed in road projects. Kwak and Dewan (2001) have suggested that one of the major factors that should be considered in the planning and implementation of a development project is the location since the project environment, say, in the form of a developing country, can post especial constraints. Among the constraints that they identify as noteworthy constraints when it comes to proper project management and for achieving project goals are: the availability of the needed technical skills or managerial expertise in order to manage complex projects; the shortage of the required material and equipment; low human capital productivity; and the lack of political stability which may lead to frequent changes in policies and the lack of confidence in the local economy.
The situation in Sri Lanka is no different from the general prognostication for developing countries described above where too political instabilities and resultant uncertainties regarding the long-term future of the society and economy make it risky to invest in civil projects and in infrastructure development projects such as transportation, irrigation, that are more vulnerable than most other development projects to sudden upsets in the social and economic environment.

2.9 Approaches to the Research Problem

Much has been written on risk management in the construction industry (Williams, 1995; S.Q. Wang et al., 2004). A great deal of research has been carried out on various aspects of risk management worldwide (Wiguna & Scott, 2006) with many country-specific models too on how to identify, analyze and manage severe risks. These studies have contributed much to adequately covering the perception of contracting parties on risk and risk management (Kangari, 1995; Cheung, 1997; S.M.Ahmed et al., 1999; N.A.Kartam & Kartam, 2001; Rahman & Kumaraswamy, 2002) while orienting both researchers and practitioners towards effective risk management.

& Fitzgerald (1998), Tah and Carr (2000) and Oyegoke (2006); Poland: Skorupka (2008); Lithuania: Zavasdska et al. (2009) and Banaitiene et al. (2011); South Africa: Mhachu and Nkado (2007); Nigeria: Aibinu and Odenyinka (2006); Mozambique: Baloi and Price (2001); and Finland: Oyegoke (2006). These studies are of immense value to those who wish to study the principles and practices of risk management in the Sri Lankan construction industry. Since the perception of risk is subjective while also being affected by the unique political, economic, environmental and cultural conditions of a country (Han & Diekmann, 2001; Andi, 2006; El-sayegh, 2008 and S. Li, 2009), researchers have argued for paying attention to the manner in which these differences in thinking, value systems and living conditions affect the construction industry, especially the management of risks. Hastak and Shaked (2000) also expose this argument because they identify how the analysis of the project risk is impacted by the country’s socio-economic and market environment. Thus, in the case of the Sri Lankan construction industry, the conditions affecting the industry have to be understood as particular to the country’s environment.

However, the surveys and case studies mentioned above were typically based on one group of project participants. More often than not, only the perspective of the contractor was considered in identifying risk factors (Kangari, 1995; S.M.Ahmed et al., 1999; Bing et al., 1999; Kim and Bajaj, 2000; N.A.Kartam and Kartam, 2001; M.T. Wang and Chou, 2003; Fang et al., 2004; Wiguna and Scott, 2006). But risk management aims at minimizing risks to all parties irrespective of who bears the risk (ASCE, 1979). Therefore, the risks of a project should not be determined on the basis of the perceptions of one party. Risk management moreover considers the total project cost due to the perceived risks of the different parties and not just the costs borne by individual parties separately (Rahman and Kumaraswamy, 2002). Therefore, it is important to understand the combined effort of contracting parties towards risk management.

Hence, while there have been many studies on the critical risks in a particular project, there is still a dearth of studies that undertake a comprehensive analysis of critical risks at each stage of the project life-cycle except for studies by Tomas et al.
According to Rahman and Kumaraswamy (2004), the nature and extent of risks can only be appreciated precisely at the stage of project execution. They have further argued that “as the project progresses, the nature and extent of such project risks may emerge and existing risks may change in importance or reallocated” (Rahman & Kumaraswamy, 2004, p.180). According to them, the criticality of the risk may differ from one phase to another in the project life cycle. A factor which is very critical at one phase may turn out to be the least important in another phase. This makes it important to identify the critical risks at different stages of a project life cycle and their management at different phases.

In the case of Sri Lanka, both the demand for and the size and complexity of projects are increasing particularly due to attempts at accelerated rehabilitation reconstruction in the northern and eastern provinces of the country. In these two provinces, the demand for road construction is particularly high. There is an urgent need therefore to study issues to do with risk management in the Sri Lankan construction industry which has to cater to this current demand for roads and other infrastructure development. However, to date, only a few studies have attempted to study the issue of risk management in the case of Sri Lanka although it has been found that most cost overruns, time overruns and low quality of projects in Sri Lanka are the result of poor risk management (K.B.D.Perera, 2006). Han and Diekmann (2001), for instance, have pointed out that risks could be the result of the unique political, economic, environmental and cultural conditions of a country. Hence, it is important to arrive at country-specific studies of critical risk factors and their management. The present study addresses itself to this lacuna when it comes to the study of risk management in the case of road construction projects in Sri Lanka.

The aim of this study is to identify and evaluate the existing risk managing strategies from the perspectives of the contracting parties throughout the project life-cycle. To achieve this aim, firstly, the critical risk factors prevailing in each phase of the project life-cycle will be identified. Secondly, the significant measures taken to manage these risks in each phase of the project life cycle will be highlighted. Finally, the barriers and solutions in the way of implementing the risk management strategies will be discussed.
Although there are a number of studies which identify risk factors in the road construction industry for other countries, only a few studies do so in the case of Sri Lanka. Since, as discussed above, risk factors are affected by the culture, politics, values, etc., of a country, the list of risk factors identified in B.A.K.S. Perera and Rameezdeen (2008) was selected for this study. The choice was further supported by the fact that it was a recent study undertaken in the context of a road rehabilitation project which covers a wide range of common risk factors. Furthermore, that research has tried to identify the combined effort of contracting parties towards risk management. In this paper researchers have explored the risk factors prevailing in the Sri Lankan context with the use of a Questionnaire survey (Full paper is given in appendix 01). Given below is the list of risk factors adopted for this research:

1. Labour shortage
2. Delays in payment by the client
3. Inflation
4. Variations
5. Contractor’s cash-flow problems
6. Labour skill
7. Inclement Weather
8. Errors in estimated cost and construction period
9. Shortcomings in tender document (specification, BOQ, drawings, etc.)
10. Design changes during construction by the client
11. Traffic
12. Inadequate early planning
13. Design errors by the consultant
14. Delays in material delivery
15. Delays in shifting utility lines by the relevant authorities
16. Poor productivity
17. Unavailability of a professional and experienced construction management team
18. Lack of project funds
19. Equipment-related risk (i.e., their availability and efficiency)
20. Delays in decision-making by client
21. Delays in mobilization
2.10 Summary
Most construction projects are consistently exposed to different types of risks due to their increasing complexity, size and client requirements. These risks affect projects in terms of cost, duration, quality and safety. Thus it is obvious that to manage these risks, a systematic approach in the form of risk management is needed.

Risk management identifies risky situations and develops strategies to reduce the probability of occurrence, or the negative impact, of risky events. Risk identification is the first step in the risk management process, which is followed by risk analysis and risk response.

Stakeholders in a construction project play an important role in risk management and the effective and frequent involvement of stakeholders at all stages of the risk management process will ensure that more risks are identified and managed properly. Moreover, risk management would be more effective if the risks were identified and considered in a more complete and systematic way as they occur in the project life-cycle.

In this chapter, it has identified the four phases of the project life-cycle and the most significant risk factors to be considered in a road construction project when it comes to Sri Lanka through a review of the literature on risk factors in the construction industry worldwide. The literature review has highlighted the dearth of literature on the subject in the case of Sri Lanka and the urgent need to engage in research on the subject given the heightened interest in road and other infrastructure development in the current socio-economic and political milieu. The present study will therefore be of great relevance to the country.