Risk Management Practices In Global Manufacturing Investment

-Exploratory Study of Risk Management in Global Manufacturing Investment-

A dissertation submitted to the University of Cambridge

By

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DEDICATION

जाड्यं धियो हरति सिञ्चति वाचि सत्यं मानोन्नतिं दिशति पापमपाकरोति।

चेतः प्रसादयति दिक्षु तनोति कीर्तिं सत्संगतिः कथय किं न करोति पुंसाम्।।२३।।

Companionship of Wise Man*

This work is dedicated to my GURU and PITA - Professor M J Gregory and Shri D N Singh, who always inspire me to take up new challenges.

* *"The companionship of wise people removes the sluggishness of one's mind, nurtures truth in the speech, enhances prestige, expiates the sins, comforts the conscience, spreads the name and fame in all directions. Say! What good is there which the company of devout bring to a man."(NITI SHATAKAM of Bhartrihari, Sanskrit Poet, 6th Century)*

ABSTRACT

This thesis explores risk management practices in global manufacturing investment. It reflects the growing internationalisation of manufacturing and the increasing complexity and fragmentation of manufacturing systems. Issues of risk management have become increasingly important in financial and company governance contexts not least because of growing international concerns about the consequences of unregulated risk. However while significant progress has been made in the awareness and articulation of financial risk there appeared to be little evidence of systematic management of risks associated with the globalisation of manufacturing despite the fact that ill-advised internationalisation projects could risk companies' futures. *Investment risk management practice* has evolved as *risk analysis* in global manufacturing investment from theoretical and practice perspectives. The need to actively manage risk has tended to be lost by the adoption of complex financial risk analysis methods in industrial investment projects.

The approach adopted in this research was to undertake detailed case investigations in a cross section of industrial businesses at different levels of maturity in order to observe current practices, identify common principles and to seek to synthesise systematic approaches to risk management where appropriate. These field studies were conducted against a background of a detailed review of the literature and practice in finance and consulting and a detailed review of literature and practice in manufacturing strategy and system design.

The key findings are as follows:

- Elements of global manufacturing risk are managed by a variety of implicit and explicit methods, typically embedded in strategic and financial evaluations. There are no widely recognised comprehensive and systematic approaches to the analysis and mitigation of risks associated with global manufacturing investments.
- A broad review and analysis of global manufacturing investment projects identified key categories of investment risks and key dimensions of investment risk management.
- A very preliminary classification of global manufacturers from an investment risk management practice perspective, which may be helpful to companies in assessing their own risk management capabilities and behaviours.
- A prototype investment risk management process architecture is proposed based upon the key research findings. It presents a structured approach to the key risk management tasks and demonstrates their generality across a range of industrial environment. This provides confidence though not conclusive evidence that these methods might be applicable across a broad spectrum of manufacturing industries.

The research findings extend the current understanding of risk management into the domain of global manufacturing strategy and provide the basis for more comprehensive and systematic assessment of risk in global investment projects. Further research will be required to validate the proposed risk management process and to explore the particular risks associated with different sectors, technologies, and business contexts.

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Finally yet importantly, I wish to thank my brothers and sister-in-laws in India for their continuous support and encouragement. The course of the PhD has been a life changing experience and I am in-debted to each and everyone who became a part of this journey with me.

DECLARATION

This dissertation does not exceed the word limit set by the Degree Committee. It has 63,916 words including appendices, bibliography, footnotes, and tables. It contains 77 figures, 46 tables, and 2 charts.

The work presented in this dissertation is first time written. Concepts and direct quotations are properly referenced. This dissertation or the part of this work is not previously submitted to any university for any degree.

Mukesh Kumar

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ACRONYOMS

BSE : Bombay Stock Exchange
CCCG : Combined Code of Corporate Governance
CEO : Chief Executive Officer
CIM : Centre for International Manufacturing
COSO : Committee of Sponsoring Organizations of the Treadway Commission
CSP : Corporate Strategy and Planning
DCF : Discount Cash Flow
DPP : Department Policy and Procedure
ERM : Enterprise Risk Management
EU : European Union
FCF : Free Cash Flow
FDI : Foreign Direct Investment
GATT : General Agreement on Trades and Tariffs
GDP : Gross Domestic Product
GMI : Global Manufacturing Investment
IfM : Institute for Manufacturing
IMC : International Manufacturing Configuration
IRR : Internal Rate of Return
KSF : Key Success Factor
LSE : London Stock Exchange
M&A : Merger and Acquisition
Mfg : Manufacturing
NIE : Newly Industrialised Economies
NPV : Net Present Value
NYSE : New York Stock Exchange
PLC : Product Life Cycle
R&D : Research and Development
RM : Risk Management
SEC : Securities & Exchange Commission (US government)
SOX : Sarbanes-Oxley Act of 2002 (public company accounting reform)
TV : Television
UK : United Kingdom
UNCTAD : United Nations Conference on Trade and Development
USA/US: United States of America
WTO : World Trade Organisation

1 INTRODUCTION

This chapter introduces the field of risk management in global manufacturing investment and it sets out the structure and scope of the investigation. It presents an analysis of risk management, global manufacturing, and global investment to establish the background of the research.

1.1 Research Background

Three main drivers of the research background are globalisation, global investment and risk regulation. This section reviews these drivers, to provide a foundation for the enquiry into risk management in global manufacturing investment.

1.1.1 Globalisation and its Impact

The literature of globalisation emerged in the 1980s and expanded during the 1990s, with six hundred publications on globalisation published during 1992-1996 (Chart 1-1) in contrast to fewer than ten topics published between 1980 and 1984. Two prominent views on globalisation have emerged from the literature.

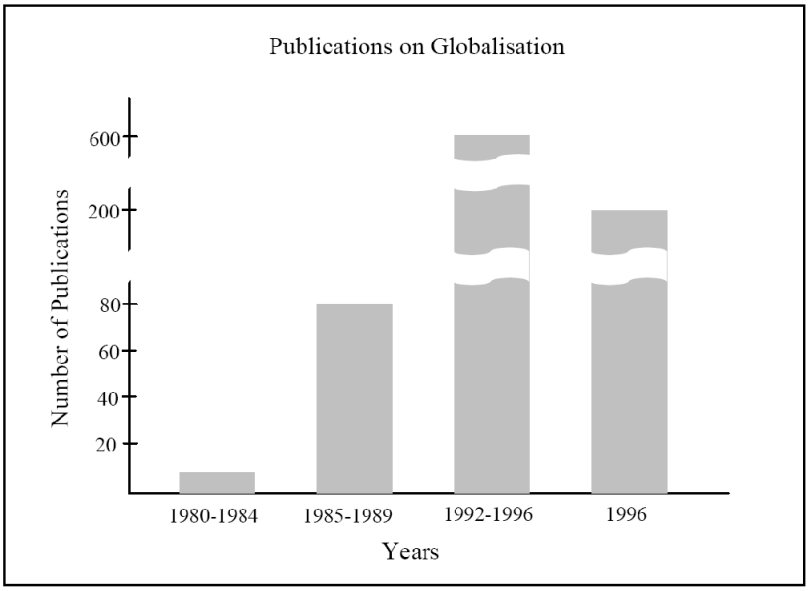

Chart 1-1: Publications on Globalisation

(Dicken, 2003)

The first view - 'the hyperglobalist' proposes a borderless world due to the higher rate of globalisation. The second view - 'the scepticalist' argues that the world is less integrated than it was 100 years ago and proposes globalisation as an analytical concept in which the world is

divided into multidomestic economies (Dicken, 2003). There are many examples in the literature of this extreme contrast of globalisation, for example "World is Flat" by Thomas Friedman (Friedman, 2005) and "Time to Replace Globalisation with Localisation" by Colin Hines (Hines, 2003). The phenomenon of globalisation lead by GATT, which is now the WTO, is continuously decreasing the distance between countries (Henzler & Rall, 1986). Indeed the changes in the world economy since 1980s might be termed as globalisation (Narula & Dunning, 2000).

Many academic publications and global institutions' reports reflect this an increase in globalisation. UNCTAD reports the positive impact of globalisation across the world. This report states *"the difference in per capita income between developed countries on one side and developing and transition economies on the other remains huge. This gap has diminished slightly in relative terms: the ratio between the per capita GDP in developed and developing countries passed from 20.4 times in 1990 to 16.1 times in 2006"* (UNCTAD, 2008). The credit for this achievement has been given to multinational corporations, government bodies and WTO. With the help of these institutions, 75,000 multinational corporations have achieved approximately 17% growth rate in sales of foreign affiliates and provided approximately 73 million employment opportunities across the world in 2006 (Figure 1-1 below). The growth rate of international production indicators clearly indicates increasing globalisation.

Selected indicators of international production, 1991-2006

Value in billion US$ and growth rate in %

Production indicator	Value	Average annual growth rate					
	2006	1991-1995	1996-2000	2003	2004	2005	2006
Sales of foreign affiliates	25,177	8.8	8.4	26.6	15.0	3.0	17.7
Gross product of foreign affiliates	4,862	6.7	7.3	21.1	15.9	6.3	16.2
Total assets of foreign affiliates	51,187	13.7	19.3	26.0	-1.0	9.3	20.1
Exports of foreign affiliates	4,707	8.5	3.3	16.1	20.5	10.7	12.2
Employment of foreign affiliates (thousands)	72,627	5.5	11.5	5.7	3.7	16.3	13.9

Figure 1-1: Selected Indicators of International Production

(UNCTAD, 2008)

Early academic work on manufacturing globalisation (Vernon, 1966; Parry, 1975; Vernon, 1979) suggested that only innovative products could satisfy the sophisticated domestic markets. When they reach maturity the product's production location be established in less developed countries in order to exploit foreign markets (Vernon, 1966). Later on it was demonstrated that multinational organisations could bring the commercial product and process innovation to any country where foreign market demand could justify the innovation

cost (Parry, 1975). These contradictory views reflect competition in international market, which is divided into two parts -*"multidomestic"* and *"global industry"* (Porter, 1986a). Academic work also shows that demand ("shrinking difference between national markets"), supply ("opportunities for substantial economies of scale on the supply side") and the economic environment ("Economic policies that permit, even demand, worldwide presence") have all influenced the globalisation of the manufacturing industry (Henzler & Rall, 1986).

Globalisation has given higher growth to multinational corporations. As the world is getting 'flatter' due to globalisation (Friedman, 2005), pure *"multidomestic"* competitions rarely exist. Hence, manufacturing companies are not only competing in domestic and multidomestic markets but also competing globally. Likewise, changes in the global environment have created challenges, which threaten traditional business models. These challenges are shorter product lifecycle, global competition, and new market dynamics. Additionally, there is some evidence of a trend towards 'deglobalisation' (Allen & Raynor, 2004) as a result of international conflicts (Iraq, Iran, China-Taiwan and India-Pakistan) and countries' protective regulations (agricultural subsidies and the closed economy of developing countries).

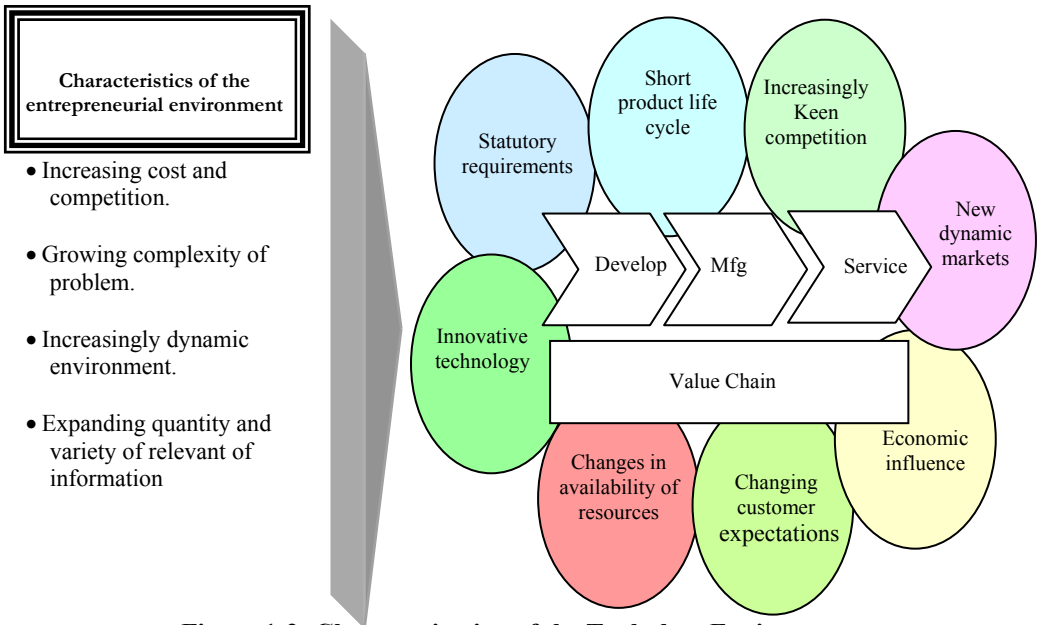

Figure 1-2: Characterization of the Turbulent Environment

(Eversheim, 1996)

Eversheim et al. (1996) describe that companies are facing challenges of cost, complexity, dynamic business environment, and product differentiations. For example, Henzler and Rall state *"certain countries with outstandingly high market volumes are key to achieving sales*

and profitability targets, and may typically also be the home markets of leading competitors" (Henzler & Rall, 1986). The authors have anticipated that even when the leading global players have established themselves in industrial markets; they face risk of stiff competition from local competitors. This turbulent business environment is one of the characteristics of globalisation.

In conclusion, globalisation has presented opportunities for multinational organisations including the emergence of less-developed countries' production competitiveness, markets for mature products, and new markets for innovative products in multidomestic market and global markets. However, globalisation presents risks for manufacturing companies as well. As globalisation is not static, it makes the business environment dynamic and turbulent. The implication of continuous changes in business environment has resulted in new risks. These risks lie not only in maintaining global operations but also in global manufacturing investment. The next subsection describes the significance of risk management in investment.

1.1.2 Global Investment

This subsection presents nature of global manufacturing investment and investment failure to illustrate the importance of risk management. It is divided into two parts - investment types and investment failure.

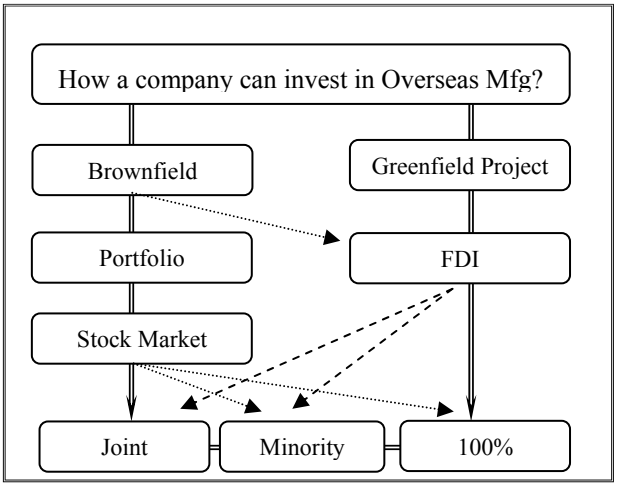

Figure 1-3: Nature of Overseas Manufacturing Investment

Investment Types: A company can acquire an overseas manufacturing firm by Merger and Acquisition (M&A) also known as Brownfield investment (Müller, 2000; Harzing, 2002; Herrmann & Datta, 2006). It is the quickest way to establish a business overseas. However, sometimes companies have to bring in new technology to produce a new product. A company

can acquire a public listed company by buying its shares from the stock exchange. This kind of investment is called portfolio investment in macroeconomics (Smith, 2007). The acquisition of a private company happens through private channels by foreign companies. This kind of investment is called Foreign Direct Investment (FDI) in macroeconomics (Smith, 2007).

When a foreign manufacturing company establishes a new manufacturing system in a host country, it is called a Greenfield investment. It takes time to develop a business in a Greenfield investment, hence significant risks are associated with the project. Greenfield investment by a foreign company is also called FDI in macroeconomics.

	Lower ← → higher		
Control	**Joint ventures** Control shared between partners		**Acquisitions and greenfield investments** Ownership provides structural control
Risk	**Joint ventures** Partners help buffer firms from political risk. Risks shared between joint venture partners	**Acquisitions** Known revenue and profit stream. However, there is risk involved in target selection and post-acquisition implementation. Also, difficult to redeploy acquired resources if required	**Greenfield investments** Firm assumes total risk, adds market capacity. Uncertainty regarding revenues, costs, and profits. Greater exposure to political and other risks
Resource requirements	**Joint ventures** Resources shared between partner firms		**Acquisitions and greenfield investments** Greenfields require investment in all aspects of business. Beginning of learning curve means higher costs. Premiums in acquisitions might add to the financial resources needed
Information requirements	**Joint ventures** Local firms provide, political, market and cultural know-how	**Acquisitions** Information needed to evaluate target firms difficult to obtain in the international context. However, target firm executives provide local business and market information	**Greenfield investments** Requires independently acquired information about all aspects of business and industry

Figure 1-4: CEO Experiences and Impact on Entry Mode Choice

(Herrmann & Datta, 2006)

A foreign company can hedge risk by risk sharing with local partners in a joint venture, and by holding a minority stake in host country operations. Holding a minority stake in foreign operation gives time to the parent company to judge the host country's business environment. The ownership structure might be heavily influenced by government policy where the government of a country makes rules for the ownership structure for specific industries. Advantages and disadvantages of joint venture, M&A and Greenfield investment have

attracted intense attention in theory (Figure 1-4) (Newburry & Zeira, 1997; Harzing, 2002; Herrmann & Datta, 2006). The point to observe is that there is thought to be higher intensity of risk in Greenfield investments in comparison to joint venture investments and acquisition investments.

Investment failures: A company carries out investments to satisfy various objectives. However, the ultimate objective of any company is to increase shareholder value. Increase or decrease in shareholder value is one of the benchmarks to judge any investment. An investment fails because of risks associated with expected rewards. However, companies typically focus more on determining rewards and less on evaluating risks associated with investment projects (Dounis, 2008). Much has been written about the failure of M&As quantitatively but little about Greenfield investment failures. Data on Greenfield investment failure, despite higher risk being involved than in M&A investment projects are hard to find.

Source	Observed M&A Failure
Right Management Consultant	• 77% of mergers and acquisition do not achieve their original purpose
Mercer Human Resources	• 50-80% of M&A never produce anticipated benefits
McKinsey & Company	• Almost 70% of mergers fail to achieve synergies • Nearly 25% of anticipated cost synergies are over estimated by at least 25%
Accenture	• Only 13% of executives strongly agreed that their companies' most recent acquisitions were completed " as quickly as possible with minimal distress" • Fewer than half of responding executives reported that their companies captured either anticipated cost or revenue synergies.
The Boston Consulting Group	• As many as two thirds of mergers fail to create shareholder value.

Table 1-1: M&A Failure Rate

(Evans, 2007)

Various reports suggest that more than 50% of M&A deals do not increase the shareholder value as expected before the M&A deals (Table 1-1). The reasons behind failures typically include failure to capture revenue synergies and costs synergies (Brahy, 2006; Rothenbuecher, Declercq, Dunne, Mezger, Moliner, & Niewiem, 2008). Costs synergies are overestimated, suggesting that indirect costs or hidden costs of an M&A have not been properly assessed, which exposes a company to a risk of overestimation of expected rewards (MacDonald, 2005). Risk management might fill the gap between expected outcome of an M&A and real outcome of an M&A (Brahy, 2006; Dounis, 2008).

As mentioned above there is little quantitative data on Greenfield investment failures but the following examples provides some qualitative insights:

- *"Three years ago we invested in one of the countries in the Far East with the assumption that we can make products faster and cheaper. However, we have realised that our initial assumptions were wrong. We are now focusing on alternative locations in the region. High employee attrition rate was one of the key reasons behind wrong assumptions".* [Vincent Megglé (Senior Vice President, Industrial Deployment), Schneider Electric][2]
- *"Our reward calculation went wrong for a Greenfield investment. After the investment we realised that we had to pay 5% local tax in addition to federal tax. Additionally, disruption in manufacturing (new material costs, performance, rejected finished projects, slow learning curve and unplanned product introduction) amplifies the risks associated with the investment project."* [Dr Pelham Hawker (Director) , Johnson Matthey][3]
- Dräxlmaier planned a Greenfield investment in Slovak Republic. The company wanted to pay less than the average salary for skilled work that resulted in political controversy. The government had decided to link the incentive to the company's labour policy. Cost and benefit analysis showed that project is not viable in the county and Dräxlmaier had to pull out its Greenfield investment from Slovak republic. This is the one of the examples of political risks. Dräxlmaiers lost time and effort in this situation. (European Industrial Relations Review, 2006)

These investment failures show that issues such as lack of information, understanding of risk and implementation of risk management in investment decisions are vital. Management is accountable to shareholders and stakeholders and ignorance of risk can have legal repercussions if investment fails (Rappaport, 2006). Regulation involving risk management received much attention after the collapse of big companies like Enron (McDonald & Rivera, 2006) with the aim of making management accountable for corporate governance to protect shareholders.

[2] Keynote speaker from Schneider Electric in CIM Symposium: Global Value Chains - capturing value in international manufacturing and supply networks, 25 - 26 September 2008 at the Møller Centre, Cambridge.
[3] Keynote speaker from Johnson Matthey in CIM Symposium: Global Value Chains - capturing value in international manufacturing and supply networks, 25 - 26 September 2008 at the Møller Centre, Cambridge.

1.1.3 Risk Regulations and Evolution of Enterprise Risk Management

Countries are increasingly mandating public listed corporations to have risk management system. These regulations have become the main driver for corporate risk management. Two examples of these laws are Combined Code of Corporate Governance (CCCG) 2003 for UK and Sarbanes-Oxley (SOX) Act 2002 for US (Details are given in Table 1-2).

	Combined Code of Corporate Governance, 2003 (UK)	Sarbanes-Oxley Act 2002 (USA)
Description	C.2 of the 2003 Code: The board should maintain a sound system of internal control to safeguard shareholders' investment and the company's assets. Code Provision C.2.1: The board should, at least annually, conduct a review of the effectiveness of the group's system of internal controls and should report to shareholders that they have done so. The review should cover all material controls, including financial, operational and compliance controls and risk management systems.	Section 404 (a): State the responsibility of management for establishing and maintaining an adequate internal control structure and procedures for financial reporting. Section 404 (b): Contain management assessment of "the effectiveness of the internal control structure and procedures of the issuer for financial reporting," which the audit firm must attest to and report on. Section 409 requires companies to disclose any events that may impacts on their financial condition or operations materially on a "rapid and current basis" and "in plain English."
Penalties	There are penalties for managers.	Certifying a report knowing it does not meet the requirements of this Section results in a fine of up to $1,000,000, or imprisonment of not more than 10 years, or both. Wilfully certifying any statement knowing it does not meet the requirements results in a fine of up to $5,000,000, or imprisonment of not more than 20 years, or both.
Costs	There are high costs associated with the implementation of risk management.	Fortune 1,000 companies are estimated to have spent an average of $2.5 million on SARBOX compliance work in 2003.

Table 1-2: Information on Combined Code of Corporate Governance, 2003 (UK) and Sarbanes-Oxley Act 2002 (USA)

(Text directly taken and assembled from (Volonino, Gessner, & Kermis, 2004; Chambers, 2005; Thomson, 2007)

These regulations, which require public listed companies to have internal controls[4], are obliging companies to have risk management systems inplace. In the absence of risk management structure in companies, regulatory compliance is unlikely to be achieved. Another significant driver in favour of risk management is that implementation of these new

[4] *"A process-affected by an entity's board of directors, management, and other personnel-designed to provide reasonable assurance regarding the achievement of objectives in the following categories: (a) reliability of financial reporting, b) effectiveness and efficiency of operations, and c) compliance with applicable law and regulations."* Greenstein, M., & Feinman, T. M. (2000). *Electronic commerce: security, risk management and control*: Irwin/McGraw-Hill.

regulations costs an average $2.5 million to corporations and this investment or expenses gives *"a strong system and culture of internal control and assessing and improving the key business processes identified during compliance. These actions can produce both a thorough and a rational approach to risk management as now required by the SEC"* (McDonald & Rivera, 2006) in USA or other stock exchange regulators in various countries including UK. However, companies are struggling to implement risk management even though there is awareness about risk management benefits (Thomson, 2007).

The concept of Enterprise Risk management (ERM) emerged following a series of high-profile business scandals and failures where investors, company personnel, and other stakeholders suffered loss. The focus was to enhance corporate governance and risk management, with new laws, regulations, and listing standards. One of the popular ERM frameworks is the Committee of Sponsoring Organizations (COSO) framework (Aabo, Fraser, & Simkins, 2005; Bohn & Kemp, 2006).

ERM Objectives	ERM Components	ERM Capabilities
Strategic	Internal Environment	Aligning risk appetite and strategy
Operations	Objective Setting	Enhancing risk response decisions
Reporting	Event identification	Reducing operational surprises and losses
Compliance	Risk Assessment	Identifying and managing multiple and cross enterprise risks
	Risk Response	Seizing opportunities
	Control Activities	Improving development of capital
	Information and Communication	
	Monitoring	

Table 1-3: COSO ERM Objectives, Components, and Capabilities
(Steinberg, Everson, Martens, & Nottingham, 2004)

COSO defines ERM as *"enterprise risk management is a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives"* (Steinberg et al., 2004).

Given the benefits and capabilities within the objectives of ERM risk management frameworks (Table 1-3) are still at the development phase (Vedupuriswar, 2003d). It is also observed that risk management is implemented at corporate level where risks are identified in fewer categories (Table 1-4), which might not be representing the holistic view of risk

categorisation of a company (Aabo et al., 2005). Additionally, the prominent view that primarily financial experts deal with risk management, still exists (Vedupuriswar, 2003d).

COMPANY	COMPANY DESCRIPTION	RISK CATEGORISATION
POSCO Steel	It is one of the largest steel makers in the world. It produces a wide range of steel products including hot rolled and cold rolled products	Market risks, political risks, operational risks, antitrust risks and financial risks (Interest and exchange rate risks)
General Motors	It is the world's number 1 car and trucker manufacturer.	Legal risks and market risks (Currency, Interest, commodity and equity risks)
Rolls Royce	It produces all kinds of engines for plane.	Product development risks, marketing risks and financial risks (Foreign exchange, interest, commodity and credit risks)
Toyota	It is the third largest car manufacturer after General Motors and Ford.	Product development risks, marketing risks, regulatory risks and financial risks (Currency , interest, commodity and equity risks)
Boeing	It is the world's largest aerospace and defence company.	Marketing risks, political risks, environmental risks, legal risks and financial risks (Leverage & liquidity, and Credit)
Dell Computers	It is one of the largest provider of computing product and services.	Technology risks, marketing risks, operational risks, intellectual property risks and financial risks (Foreign currency risks, interest rate risks and equity risks)

Table 1-4: Lack of Consistency in Risk Categorisation

Data Compiled from (Madapati, 2003; Singh, 2003; Vedupuriswar, 2003a; c; b; Khan, 2004)

There are frameworks for integrated risk management, for example - COSO ERM (Table 1-3). It is observed that there is no standard risk categorisation (Table 1-4), although, there might be companies that have manufacturing investment risk management. In conclusion, conceptualisation of risk management for manufacturing investment is limited in the literature.

Globalisation is positively affecting manufacturing companies, by creating opportunities for multinational organisations and to benefit from these global opportunities, global manufacturing investment is required. However, globalisation also presents complexity in terms of risks to multinational organisations. The objective of global manufacturing investment is to increase shareholder value. However, the prediction of investment success or failure is difficult because of risks. Various identified and unidentified risks' compositions can lead to global investment failure or success. It demonstrates the importance of risk management in manufacturing investment. The following table (Table 1-5) categories the context of the research categorically:

Subsections	Emerging Research Contexts
Globalisation and its impact	• There is trend of increasing globalisation. • Globalisation has created opportunities for multinational manufacturing companies. • Globalisation has exposed companies to various identifiable and unidentifiable risks.
Investment	• Higher intensity of risk in Greenfield investments. • Lack of data on Greenfield investment failure. • Reasons behind failures are capturing revenue synergies and costs synergies. • Ignorance of issues such as lack of information, understanding of risk and implementation of risk management in investment decisions.
Risk Regulations and Evolution of ERM	• A holistic risk management structure or framework does not exist. • There is no standard risk categorisation. • Conceptualisation of risk management for manufacturing investment is limited or non-existent in the literature.

Table 1-5: Emerging Research Context

The credit of global investment success and failure goes to the management of a company. The outcome of global investment directly affects the shareholders and other stakeholders of a company. In this situation, governments (as one of the stakeholders) have introduced regulation to protect shareholders and other stakeholders by forcing the management of a company to take the best-informed investment decision. However, there is little published literature, which sets out investment risk management in manufacturing

1.2 Research Objective

In the absence of theoretical knowledge on investment risk management in manufacturing, it would be an exaggeration to say that companies are investing based on mere luck. Hence, the preliminary exploration of theories has provided the scope of the research- 'Investment risk management practices in global manufacturing'. Drivers of this research sets out the following objective of the research is –

To explore the structure of risk management in global manufacturing investment decisions.

The scope of the research is the middle ground of the three bodies of knowledge- 'Risk Management', 'Investment' and 'Global Manufacturing', which requires a multidisciplinary approach. The next two chapters explore the existing knowledge within the research scope to define the question, which should have not only practice consequences but also inform theory.

1.3 Research Process

There are eight steps in the research process (Figure 1-5). The first and second steps determine practice gap within the context of the research topic. The third step is an exploration of the literature. The fourth step is to refine the research question and develop the conceptual framework. The backbone of the research is the fifth, sixth and seventh steps, which are concerned with (a) selection of the appropriate method and design of research, (c) application of the method, and (c) analysis of the findings. The last step involves comparison of the findings to ascertain the contribution of the knowledge, strengthened by evidences, but with limitation clarified.

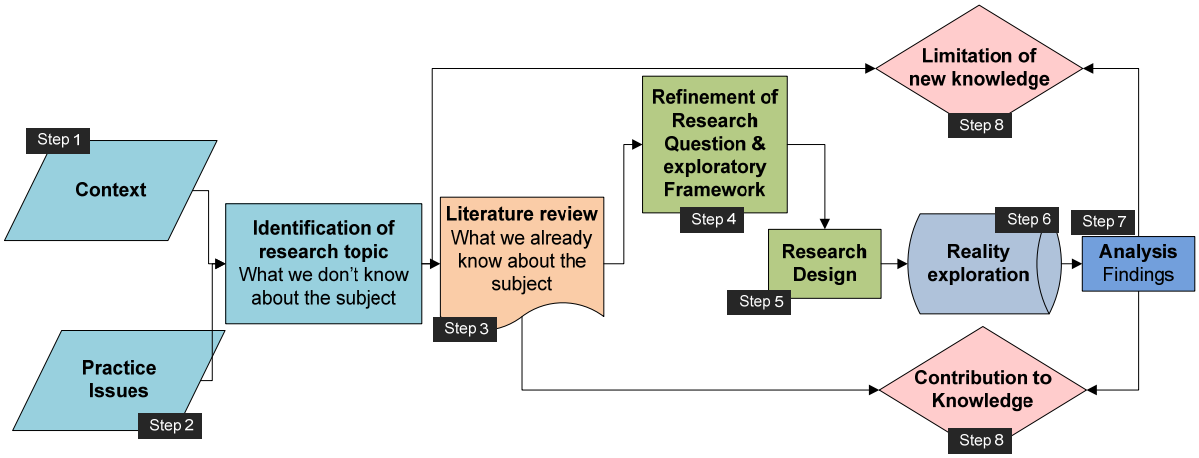

Figure 1-5: Research Process

1.4 Dissertation Structure

This dissertation comprises eight chapters. Chapter 1 discusses the research context. This chapter presents the research scope along with the preview of research process and structure of this report. Chapter 2 examines the industrial issues from practitioners' perspectives and highlights the practice gap. Chapter 3 presents literature review from three bodies of knowledge - risk, investment, and manufacturing. This chapter helps to develop the conceptual framework for further research based on the theoretical gap and industry needs.

Chapter 4 explains the research design and the questions that need to be addressed to achieve the research objective. Chapter 5 presents seven case studies analysis in structured descriptive format. Chapter 6 presents the cross case analysis in following topics – Investment risk and management (practices, patterns and process). Chapter 7 discusses the key findings of the cross case analysis and proposes a framework for Investment risk management in global

manufacturing investment. The last chapter summarises the research report and presents the conclusions of the research.

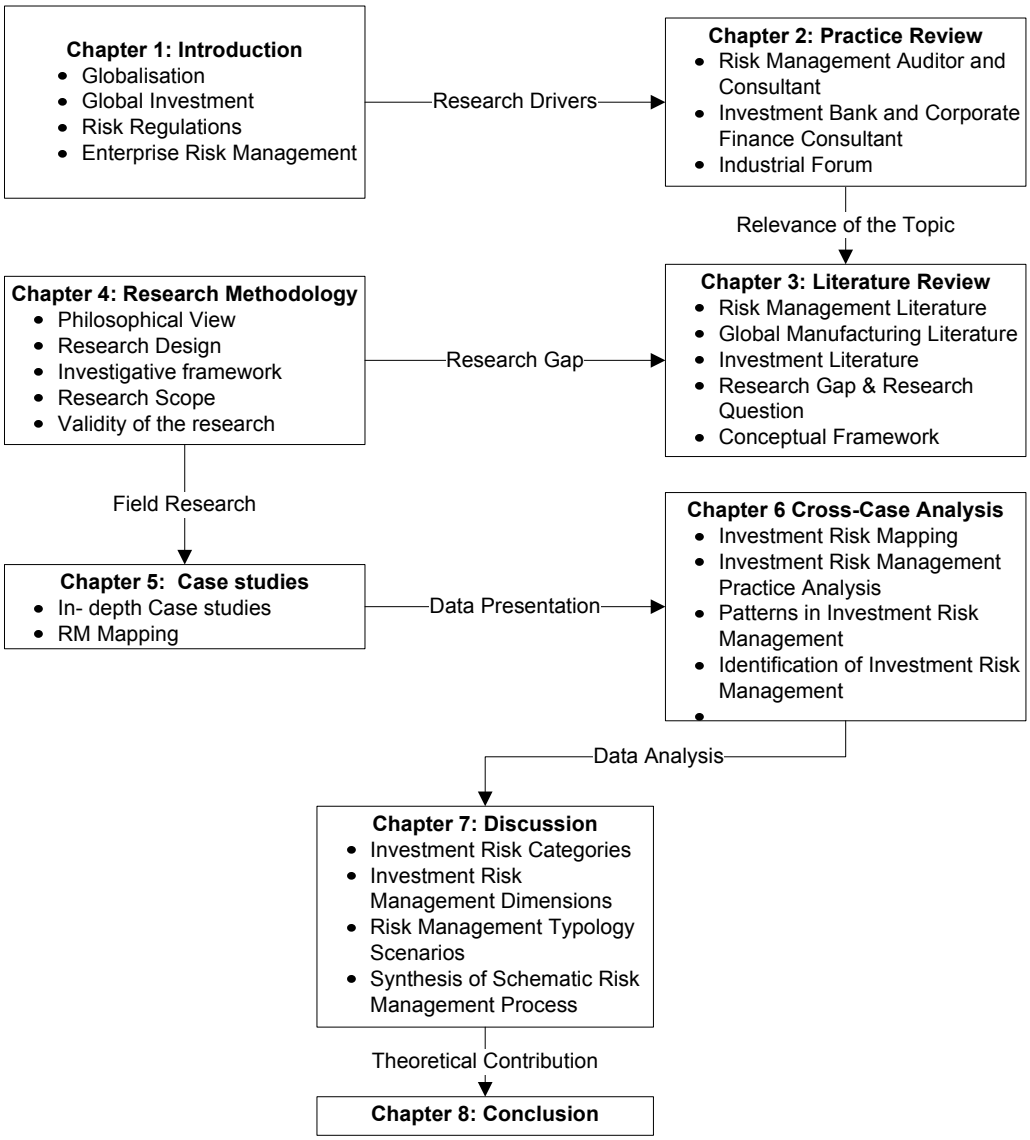

Figure 1-6: Dissertation Structure

1.5 Summary

This chapter has outlined the research background, process, and objective. It has demonstrated that the increasing global investment has exposed global manufacturers to a more complex form of risk. There are many failures of M&A investments, which have relatively less risk exposure than Greenfield investment. Understanding of risk and its management are important issues in global manufacturing investment.

2 PRACTICE REVIEW

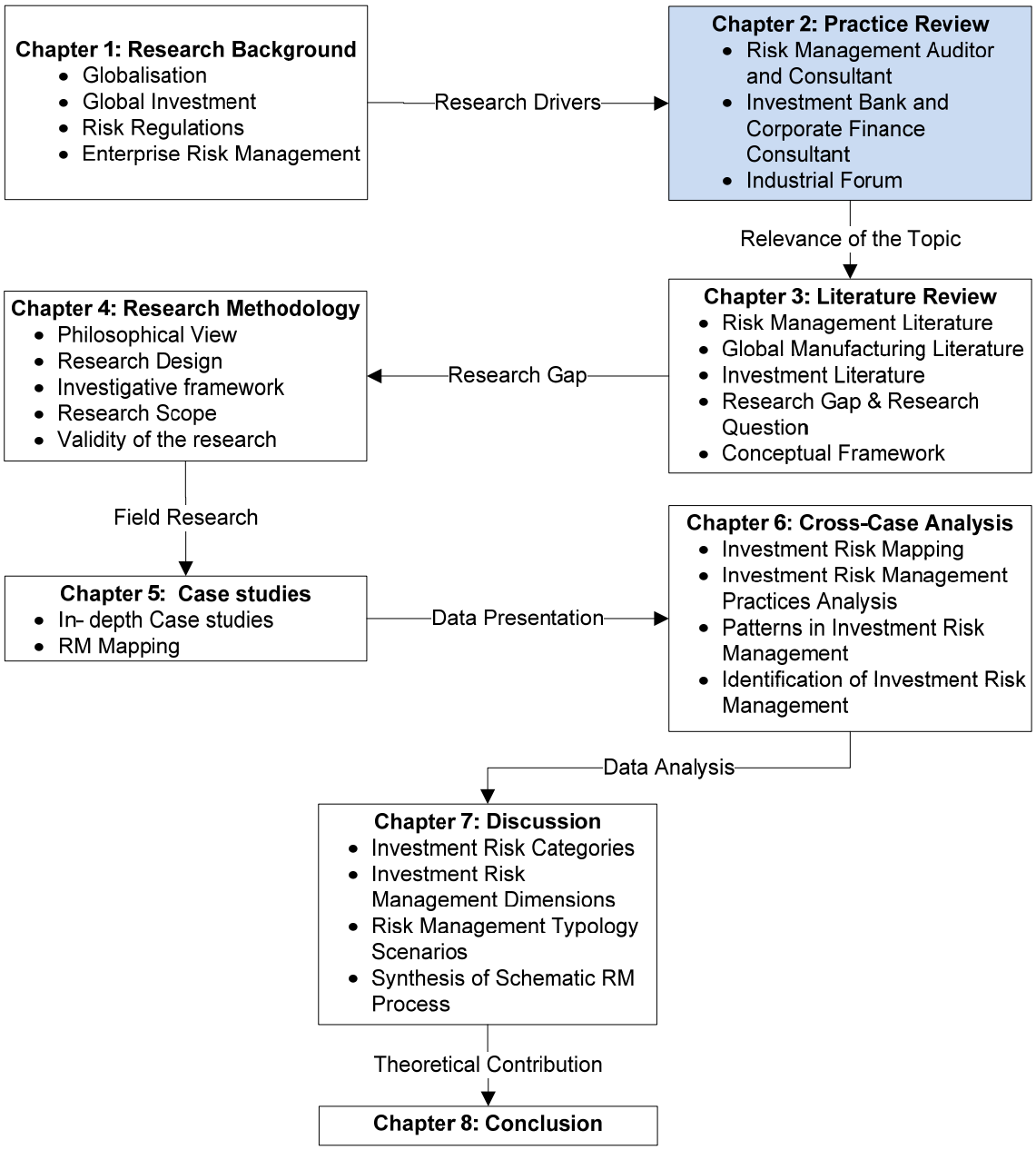

Figure 2-1: Chapter Map

2.1 Introduction

This chapter explores the research scope from practitioners' perspectives. These practitioners are personnel from corporate strategy and planning departments, external consultants, risk management auditors and risk management advisors. The pilot studies were conducted to establish the need for in-depth research into risk management in order to understand the dynamics of the subject in practical scenarios, which can guide the course of the study.

Investment projects are typically developed in the Corporate Strategy and Planning (CSP) activity through operational planning, project planning and strategic planning (Denning & Lehr, 1971). This department gets information from the value chain dimensions (Figure 2-2). Employees of this department are mainly from finance, economics, management and engineering backgrounds. There could be a cross functional team as well (Davids, 1994). Additionally, there are external advisors, such as corporate finance consultants and investment banks, whose recommendations the company may opt to seek or refer. These external advisors offer their help to companies by proposing some new investment projects. Once the business plan of an investment project is prepared by a company, with or without the help of external advisors, Board of Directors takes investment decisions.

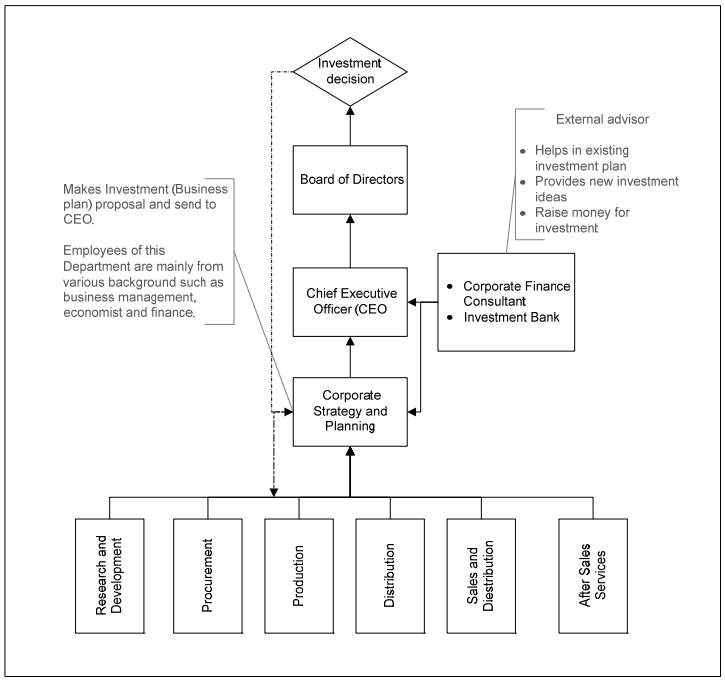

Figure 2-2: Simplistic View of Investment Decision Flow (Conceptual)

A simplistic view of investment flow (Figure 2-2), as discussed above, identifies two actors, CSP officers and external advisors, who play a vital role in investment decision-making. The previous chapter illustrated the importance of risk management from the risk regulation perspective, an exploration of risk advisor work and auditor would be useful to understand risk management. Hence, the sections below, address practical issues that surround risk management in manufacturing investment by bringing three independent actors - people who are responsible for investment in the company - risk management auditor, corporate finance or investment bank, and risk management advisor.

2.2 Risk Management Auditor and Consultant

Two interviews, one of an auditor and one of an implementer, were conducted in a professional service firm, which provides auditing service the consulting services to companies. The objective of these interviews was to understand the 'what, why, and how' of the risk management concept in the current business environment. Unstructured interviews were used to explore risk management framework auditing and implementation.

Auditing & consulting firm, interviewee's background: The firm provides professional services (audit, tax and advisory) to companies in different industries and governments in more than 100 countries. It employs more than 100,000 people globally. Corporations hire this firm for risk management auditing and advisory services. Additionally, this firm helps companies to develop risk management frameworks to satisfy the statutory requirements, which helps companies to develop the risk management capability (Table 1-3) across the organisation.

Risk Management Auditor Profile: Auditor from DPP (Department Policy and Procedure) audit and accounting group of the Company in Germany.
Risk Management Advisor Profile: Partner of advisory group (Management Assurance Services) of the Company in Germany.

Auditor perspective*:* This interview revealed that risk management concept is a developing concept, which is still on an evolutionary path. Risk management was implemented in various departments of various companies before 1998. However, risk management has become obligatory for companies since 1998 in Germany as well as other countries, including

the UK and USA. The regulatory context for risk management is corporate and commercial law. New laws came into existence after massive corporate failures such as WorldCom and Enron, where investors and stakeholders incurred heavy losses. These corporate failures not only affected the failed corporation but created negative effect in stock exchanges especially in the US and Europe. It affected not only one company but also majority of companies across the industry and economies of various countries. Hence, the emergence of obligatory risk management has the objective to protect shareholders value and other stakeholders of the companies as well.

Furthermore, stock exchanges around the world took initiatives to mandate every listed company to have an integrated risk management system. Stock exchanges had called advisory firms, including this firm, to give advice on risk management for companies. The enterprise risk management structure concept evolved from these consultations on risk management. This enterprise's risk management structure approach integrates scattered risk management frameworks across various departments of a company. It includes internal control, monitoring process, risk policy, and key risk indicators which is combined in overall system of a company. Auditor stated *"However, regulators, auditors and companies are still struggling to make sense of the risk management system. For example, what factors are important in companies for risk management? And how to judge the capabilities of enterprise risk management system".*

There are three sections of a company, which are involved in the ERM auditing. These sections are management, supervisory board and auditor. Management is responsible for implementing risk management frameworks. Supervisory boards consist of executive and nonexecutive members of other companies or the same company. There are two responsibilities of a supervisory board - (1) appointing an auditor and (2) monitoring the management to ensure compliance with the law. Auditors review the risk management structure of the company and present reports to supervisory boards. This review includes risk policy, internal control (risk accountability and risk strategy), risk monitoring process, risk indicators. Auditors use a checklist approach to review, and to pass recommendations, on risk management structure of a company.

According to the law, auditors examine risk management (auditor vocabulary for risk management is the early risk recognition system) and risk factors which are ongoing concerns

for a company which lacks standard risk categorisation -"*I do not have format of the standard risk categorisation"*, asserted by the Auditor. This interview also revealed that a comprehensive investment risk management was not observed in many companies. The reason is corporate level focus of enterprise risk management. However, *"banking companies are very good in investment risk management because one of their operations is investment"*. The Risk Management structure in a company includes a risk register or risk inventory, risk accountability, and risk strategies. Based on these documents the auditors make recommendations to improve risk management systems. A supervisory board and auditor monitor these recommendations. Following is the list of typical major deficiencies of risk management, which are revealed at auditing:

- Lack of documentation of risks
- Lack of understanding and incorporation of upside risk
- Vague risk relationship (interactions of risks and linkage of risks)
- Disproportionate focus on key risks (there is no satisfactory explanation as to why other risks are not important)
- Unclear accountability issue (accountability for a particular kind of risk is vaguely defined)
- Isolated risk holder (person or people responsible for the happenings in the department and the knowledge of occurrences in other departments of the company)
- Non-scientific method of risk quantification (magnitude and likelihood of risks is based on assumptions and consequences of accumulated risk is not taken into account)
- Lack of knowledge on accumulated impact of risk

Challenges in auditing:

- Factors of observations in auditing given the differences in perspectives between two companies.
- Recommendations for monitoring and improving risk management weaknesses.
- How to derive and measure the risk management capabilities of a risk management system? *"As an auditor we don't know how these (ERM capabilities mentioned in table 5) capabilities are derived by risk management framework based on the philosophy of ERM.",* stated by the auditor.

Risk consultant perspective: companies have been increasingly asking for help to develop or design and implement enterprise risk management from consulting companies, due to legal requirements, since 1998. According to the law, public companies have to have an early warning system, which is derived from ERM. An external advisor can help a supervisory board and management to establish the risk management system. It is important for companies to emphasise three points before establishing early warning systems. They are as follows:

- Risk management strategy: What is the objective of risk management? What and how to achieve the objective of risk management?
- Process: How to manage risk - the right methodology and the right tools?
- Structure: How to integrate risk management into the organisational structure?

Establishment of risk management structure (early warning system) is divided into seven parts. These parts are shown in figure 2-3.

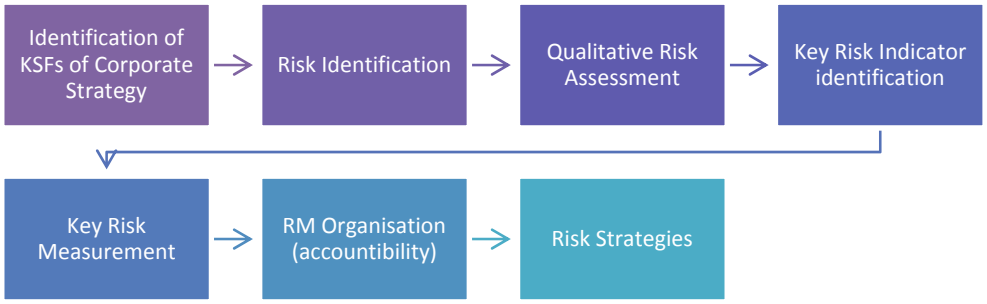

Figure 2-3: Steps of Risk Management Process

Source: Investigated Consulting Company

Risk management structure implementation starts with the understanding of a company and its strategy. The advisor stated *"It is observed that companies have corporate strategy but it is difficult to comprehend in practice"*. Strategy takes a lot of time to be defined into key success factors. Key factors should be understandable through qualitative and quantitative techniques. Risk identification and qualitative assessment are the second and third parts of risk management structure where risks are identified and assessed in a qualitative probabilistic model. Additionally, this part of the system provides risk categorisation and key risks of companies. To monitor these risks, key risk indicators are developed in the fourth part of the system. However, there is no fixed method to develop key risk indication.

"One automobile parts manufacturing company identifies demand as one of the key risks of the company. It developed a key risk indicator, which is quite innovative. They hire a helicopter and go over major customers' plants and quantify how many produced cars are parked in the plant. If the car demand is slow then more cars will be parked and if the car demand is high then fewer cars will be parked. In this way they can project demand of their product.", stated by the Advisor.

Figure 2-4: An Example of Key Risk Indicator

The fifth step is the development of an algorithmic model to measure key risks. Risk accountability (the sixth part of the system) is vital in management risk. Each risk category is assigned to one senior manager to give ownership (it is the step to identify whom to blame if things go wrong). The second last part of risk management structure is risk mitigation strategy. Risk mitigation strategy is based on risk acceptance, risk transfer and risk avoidance. The last step is risk monitoring, which adds to the dynamics of the company's risk management framework. It was revealed from the interview that risk management is linked with organisational structures, however, it is difficult to link it with every process. For example, the interviewee had not implemented risk management for manufacturing investment within the enterprise risk management framework.

Challenges in risk management system development:

- How to derive value from risk management system?
- Development of comprehensible deterministic model on complex issue.
- Integration between risk management structure and organisational structure.
- Bridge the communication gap between departments and create a common understanding for everyone in the company, which is related to development of risk language.

2.3 Investment Bank and Corporate Finance Consultant

One of the major factors that play a crucial role in investment decision-making is the project valuation (Greenfield, Brownfield or M&A). At the end of all processes (pre-merger or pre-investment analysis and due diligence), a decision maker needs an assessment of the value of the investment projects.

The CEO's questions regarding investment value include –

- How much return the investment would fetch?
- How much shareholder value would increase after the investment?
- Does the value of the investment reflect the full story of an investment?
- Does it have loopholes?

Investment banks and corporate finance consultants advise companies on their investments. Hence, it is important to understand (a) how finance experts incorporate risks in valuation and (b) how they value a project. This practical perspective will provide whether valuation process has reflection of risk management or not.

To help to understand the investment valuation, the investment valuation techniques of a corporate finance-consulting firm and an investment bank are presented. This data is collected from confidential documents of the two companies and author's experience as a senior analyst and an analyst in two companies.

Valuation method: This firm uses Discount Cash Flow (DCF) method (this method is discussed in Chapter 3) for investment valuation. The objective of the valuation is established. There are four levels for an investment project (M&A, Brownfield and Greenfield), which are as below:

- Level 1- basic parameters, which include geography, business segment size.
- Level 2- target quality, which includes potential to add value, management, and investor relation.
- Level 3- investment feasibility, which includes shareholder attitudes, cultural fit and regulatory issues.
- Level 4- execution, which includes approach, due diligence and negotiation.

DCF method is used in all four levels. The principles of DCF are well understood. This method includes (a) calculation of Free Cash Flow (FCF) for the next 10 years, (b) calculation of cost of capital, which includes country risk, and (c) calculation of terminal value, which is value of the project for infinite time. Then, discounting the FCF and terminal value by cost of capital gives the value of the investment. To do an advanced DCF,

knowledge of industry & company, economics, cost structure and revenue structure is essential. A template of a mining company DCF valuation is shown in appendix 9.1 on page 213 and another template of a pharmaceutical company valuation by an investment bank is shown in appendix 9.2 on page 219.

It is observed that valuations may not be accurate given the future of investment, use of assumptions, limited risk considerations and absence of operational challenge. These problems arise because financial experts lack comprehensive knowledge about operations (Table 2-1) and operations people lack financial expertise. Even though, these people work together, it is very difficult to quantify various factors and incorporate those factors in valuation. However, there are several methods this firm uses, such as scenario analysis, sensitivity analysis, what if analysis, multiple ratio valuation and peer group multiple ratio valuation, to reduce the variation between expected and actual return on investment.

Description	Factors Considered	Factors Missing
Revenue – Product sold per year in unit – Price of the product per unit – Everything is represented in % and then extrapolated to certain number of years	– Duration of development – Time of production – Economic cycle (GDP) – Demand – Growth in product sold – Growth in product price – Production capacity – Assumptions for future	Value chain and network risks - R&D, procurement, production, distribution, marketing, and services. (Lack of knowledge about each value chain and how issues related to value chain would impact revenue.
Cost – Cost of product sold – Administrative costs – Operating expenditure – Capital expenditure – Interest – Tax	– Growth in cost of production – Growth in operation expenses – Time of capital expenditure – Inflation – Time of debt payment – Assumptions about future	Value chain and network risks - R&D, Procurement, production, distribution, marketing, and services. (Lack of knowledge about each value chain and how issues related to value chain would impact cost.

Table 2-1: Missing Factors in Valuation

The next section focuses on the needs of the manufacturing companies. It brings manufacturing company perspective on risk management in manufacturing investment.

2.4 Industrial Forum

This forum consists of non-competing global manufacturing companies, with desire for efficient global manufacturing networks. This forum conducts four workshops a year and operates in a confidential environment. However, it contributed to this research, by organising a separate session on risk management in manufacturing network investment, in March 2007. The industrial forum participants included, member global manufacturers, one industrial fellow (IfM) and the research director of Centre for International Manufacturing (IfM). Representatives of the companies present were involved in the companies' manufacturing investment decision making.

Case Companies' Description:
Company A: makes transportation equipment and personnel transportation vehicles. It has a global presence in 60 countries.
Company B: is a global manufacturer. The company has more than 100 manufacturing facilities.

Method: a brain storming session was organised on the topic of "manufacturing investment" and "risk management" with representatives of companies A & B, and industrial experts from IfM. This topic was explored at corporate level, project level and operational level.

Outcome: Companies A & B agreed with Johansen and Riis (Johansen & Riis, 2005) that current knowledge (systems, processes and technology) would be obsolete in the future. Therefore, the current configuration would no longer be appropriate in the future because of intense globalisation. There is need for global manufacturing investment to reconfigure the manufacturing network. It was also revealed that the company did not have any scientific risk management structure apart from analysing investment projects through financial tools. Hence, these companies were interested to know about scientific methods for manufacturing investment.

Levels	Key areas	Key issues
Corporate	– Formulation of the corporate vision.	– Why does a company need to acquire, establish or shut down a factory?
	– Assessment of the current state of the manufacturing network's capabilities and flexibility.	– Which major variables are critical to the decision process? (e.g. - ownership, location decision) –
	– Matching the current state of manufacturing network to the corporate vision.	– What are the key supporting project variables (e.g. – suppliers, human resources, raw materials)?
	– Manufacturing network strategy formulation based on its vision.	
	– Devising a strategy to fill the gap between current state of manufacturing networks and the corporate vision, in a specified time frame.	
Investment Project	– Opportunity analysis: investment project identification.	– Timing: what is the key starting time for the main project?
	– Cost, risk and reward analysis: project assessment.	– Sequencing: what are the time priorities of the supporting projects?
	– Portfolio analysis: project approval and integration.	– Evaluation: how best to review of the additional of risk of supporting projects relative to total value creation of the main project?
Invt. Project Management	– Project implementation: key timing and sunk cost commitment issues.	– How should companies analyse the gap between network vision and project objective?
	– Project monitoring: transaction cost control, and feedback for continuing risk management.	– How should companies analyse the gap between planning and project implementation?

Table 2-2: Summary on Investment Risk Management from Industrial Forum

As the views of the representatives were explored, it became clear that a significant question to be answered is: "What is risk management for manufacturing investment" (Table 2-2). The recommendation emerged from the necessity of developing a risk management process, which aligns investment projects with the vision for the manufacturing network. Additionally, it should help in identifying, understanding, mitigating and monitoring risks. As the discussion developed, the industrial forum representatives highlighted the need for management to be adept at risk management in manufacturing investment.

2.5 Summary

This chapter uncovers the limitation in understanding and depth in the practical knowledge of risk management structure in manufacturing investment. Risk management auditors stated that risk management is still evolving. Hence, there is no 'the' risk management system. This

argument is also supported by Alan Greenspan[5]. He stated *"In recent decades, a vast risk management and pricing system has evolved, combining the best insights of mathematicians and finance experts supported by major advances in computer and communications technology. A Nobel Prize was awarded for the discovery of the pricing model that underpins much of the advance in derivates markets. This modern risk management paradigm held sway for decades. The whole intellectual edifice, however, collapsed in the summer of last year*" (Greenspan, 2008). He was commenting on the current bank failures and credit crisis in USA. The auditor stated that banks have sophisticated investment risk management systems, however it seems that even banking industry's risk management structure might not be sophisticated enough. Additionally, it is revealed by auditors that communication gaps are a major problem for the establishment of risk management system. Below is the summary of the thoughts of practitioners:

Practitioners	Outcome
Risk management auditor and consultant	• Lack of clarity of the risk management system. • Lack of understanding of risk • No standard for risk categorisation • Corporate level focus of enterprise risk management • Lack of knowledge on accumulated impact of risk • Manufacturing investment risk management is not observed
Investment bank and corporate finance consultant	• Knowledge of industry & company, economics, cost structure and revenue structure is essential • All valuation wrong are because of the future of investment, use of assumptions, less risk considerations and absence of operational challenge • Financial expert does not have comprehensive knowledge about operations and operations people lack financial expertise. • Lack of knowledge about value chain and how issues related to value chain would impact revenue
Industrial Forum: Manufacturing industry	• Does not have any scientific investment risk management structure apart from analysing investment project through financial tools • Scientific method for manufacturing investment • Need for management to be adept at RM in manufacturing investment

Figure 2-5: Understanding Advancement on Risk Management

Finance professionals (from corporate finance or investment banks) rarely value operational risks during valuation of the project. However, they do incorporate various ways to evaluate the variation in valuation without underpinning the influential and responsible factors. In this situation, it can be argued that finance professionals can understand numbers but might not

[5] Former Federal Reserve Chairman of USA

tell the operational story behind a number. The Industrial forum revealed that companies are struggling to select investment projects. These companies are not equipped with scientific ways of analysing risks associated with a project. Furthermore, the communication gap among departments and professionals (communication gaps, missing links are widely referred in literature[6]) might be one the biggest obstacles in creation of risk management in manufacturing investment. In this situation, it might be an over assertion that companies are not managing risks in the absence of the risk management system.

The practice review illustrates that risk management has acquired an important status at corporate level of companies because of regulations. From a finance perspective, operational risks appear to be ignored in valuation of projects, which implies that manufacturing investment is more focused on quantitatively defined rewards than risk management processes. The reasons include communication gaps between departments, lack of understanding about operations, inability to tackle complexity of vast information on operations and lack of process for managing risk. As the representatives of companies at the Industrial forum pointed out, there are no widely recognised risk management system in manufacturing investment.

Despite the emergence of the corporate risk management regulation regime, the approach of tackling risks in investment projects from practitioners' perspectives are limited.

[6] Bendoly, E., Rosenzweig, E. D., & Stratman, J. K. (2007). Performance metric portfolios: A framework and empirical analysis. *Production and Operations Management*, 16(2), 257-276.
Buehler, K., Freeman, A., & Hulme, R. (2008b). The New Arsenal of Risk Management. *Harvard Business Review*, 93-100.
Skinner, W. (1969). *Manufacturing-missing link in corporate strategy*: Harvard Business Review.

3 LITERATURE REVIEW.

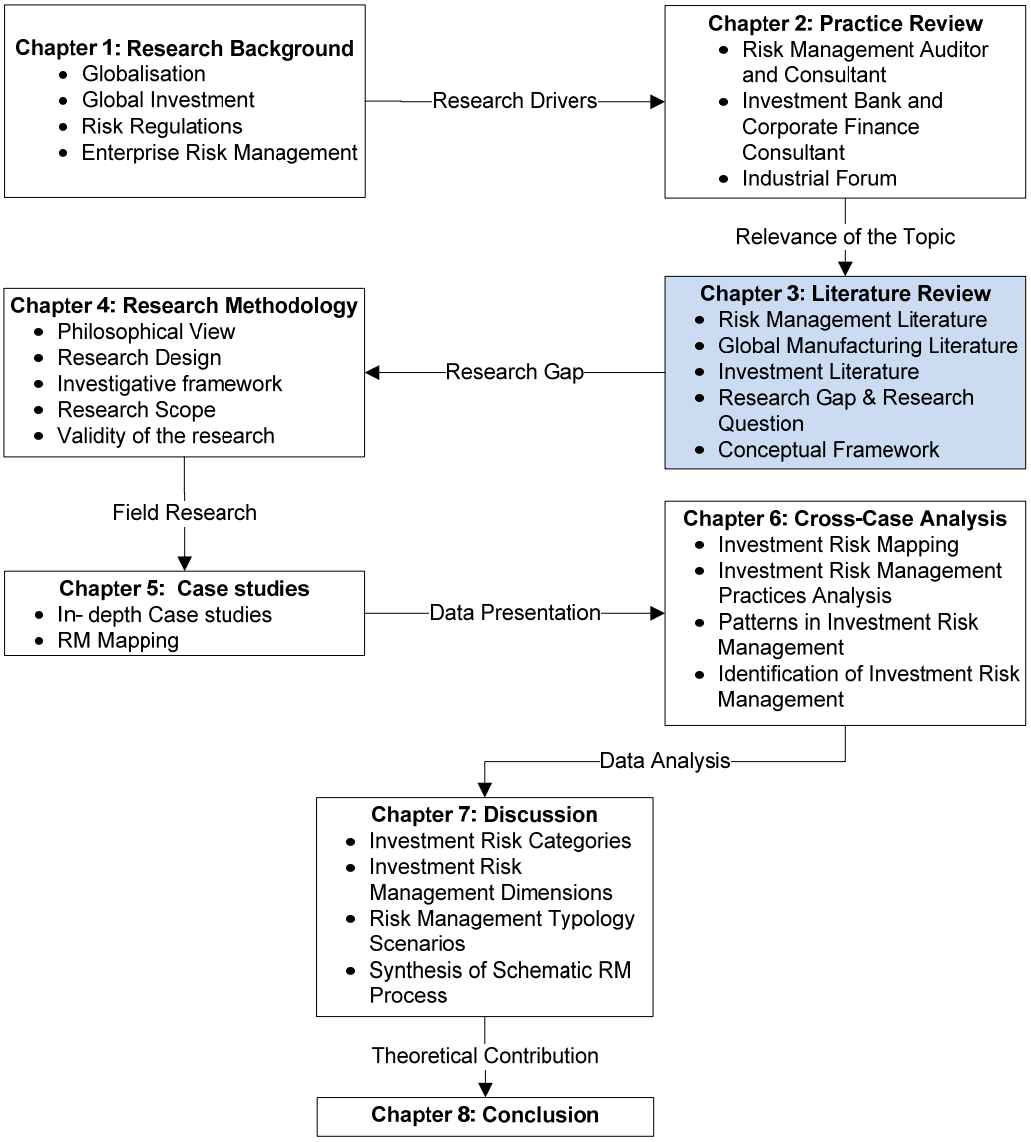

Figure 3-1 : Chapter Map

3.1 Introduction

This chapter presents literature of the three bodies of knowledge - risk management, investment and global manufacturing (Figure 3-2). The origin of the three body's knowledge can be traced back to 15th and 16th century (Figure 3-3).

The objective of this chapter is to review the relevant literature, articulate the academic research gap, and provide the foundations for a conceptual framework.

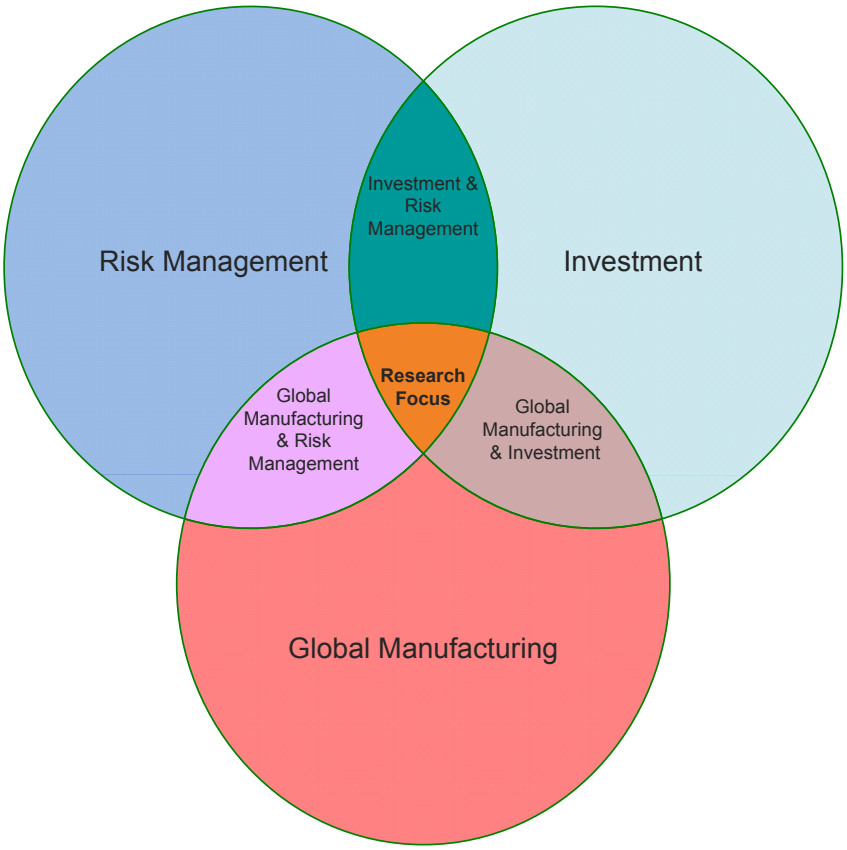

Figure 3-2: Bodies of Knowledge for Global Manufacturing Risk Management

The review starts with a brief historical perspective of relevant theories, and then presents the key concepts and concludes with a critical review of the existing multidisciplinary academic work related to the research scope (Chapter 1). A brief description of the sections is as follow:

Risk Management Literature extends the discussion on risk management of Chapter 1. The primary objective of this section is to identify the relationship between risk management and

global manufacturing investment. The secondary objective of this section is to clarify the distinction between risk and uncertainty by defining the concept of risk.

Global Manufacturing Literature presents theories of global manufacturing and informs an understanding of investment risk management within the global manufacturing environment. It also discusses the corporate decision making within the environment of global manufacturing providing a link to investment decision-making.

Investment Literature extends the discussion on Investment of Chapter 1 presenting the motivation of investment along with valuation techniques. It discusses the risk assessment techniques in investment valuation and highlights the lack of investment literature from the perspective of global manufacturing and risk management.

Research gap discusses multidisciplinary research on the topic to demonstrate the research gap. It brings together the shortcomings of the literature along with the gap in 'investment risk management' practices.

The last section presents the research and discusses the conceptual framework. The objective of the conceptual framework is to explain the significance of potential research outcomes with key arguments.

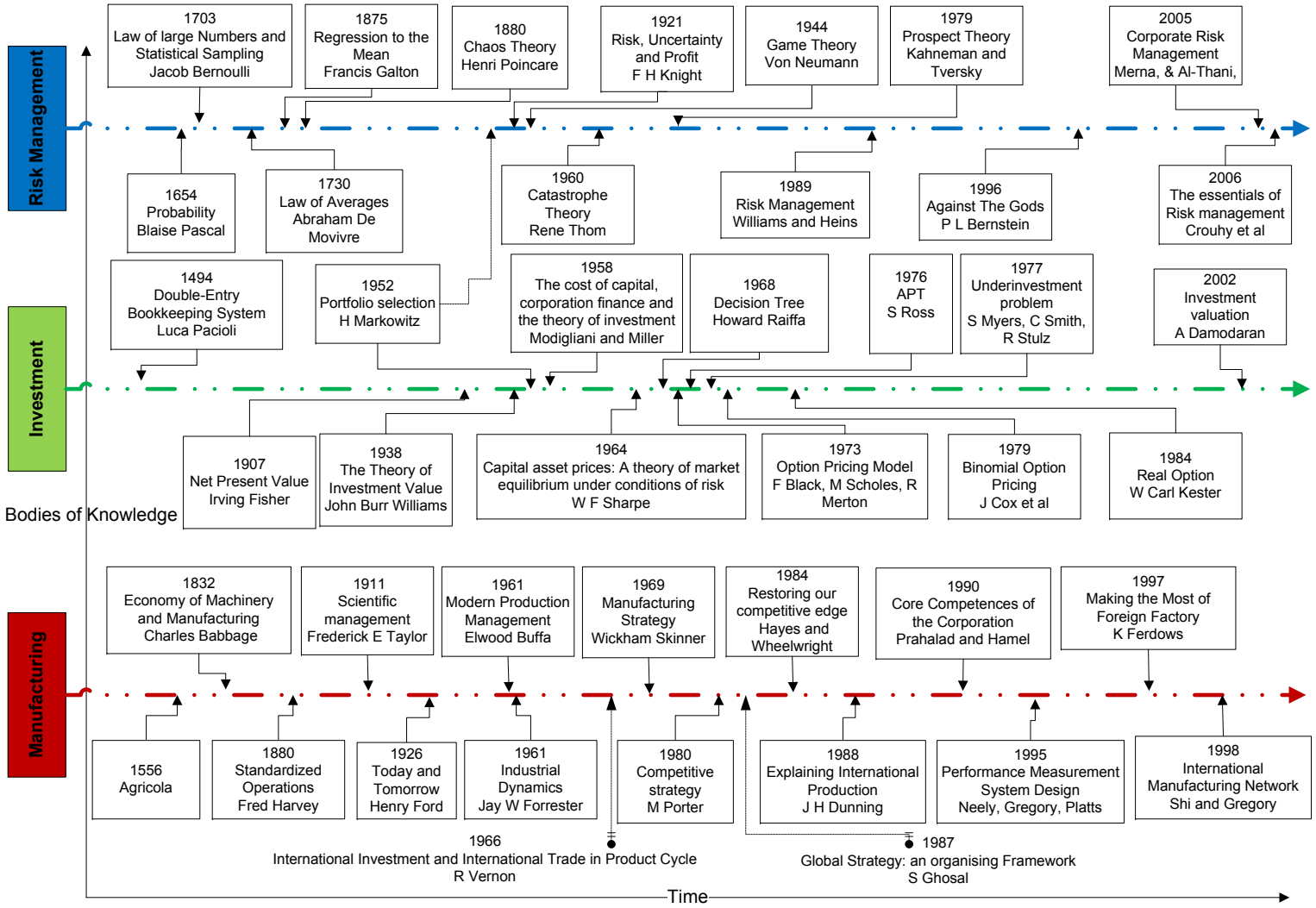

Figure 3-3: Evolution of Bodies of Knowledge

Source: (Anderson, Cleveland, & Scroeder, 1989; Bernstein, 1996; 1998; Prasad & Babbar, 2000; Damodaran, 2002; Merna & Al-Thani, 2005; Buchanan & O'Connell, 2006; Crouhy, Galai, & Mark, 2006; Lewis, 2007; Sprague, 2007; Buehler et al., 2008b; Pilkington & Meredith, 2009)

Note: Above figure illustrates the evolution of key theoretical contribution conceptually

3.2 Risk Management

This section presents the evolution of academic work on risk and risk management structures. The objective of this section is to provide theoretical understanding of risk management. It also explores risk theories, if any, from global manufacturing investment domain. The trends in risk research (Figure 3-3) illustrate that research has evolved from analysis of single risks to risk management structures (Figure 3-4). The evidence for this pattern is discussed in this section.

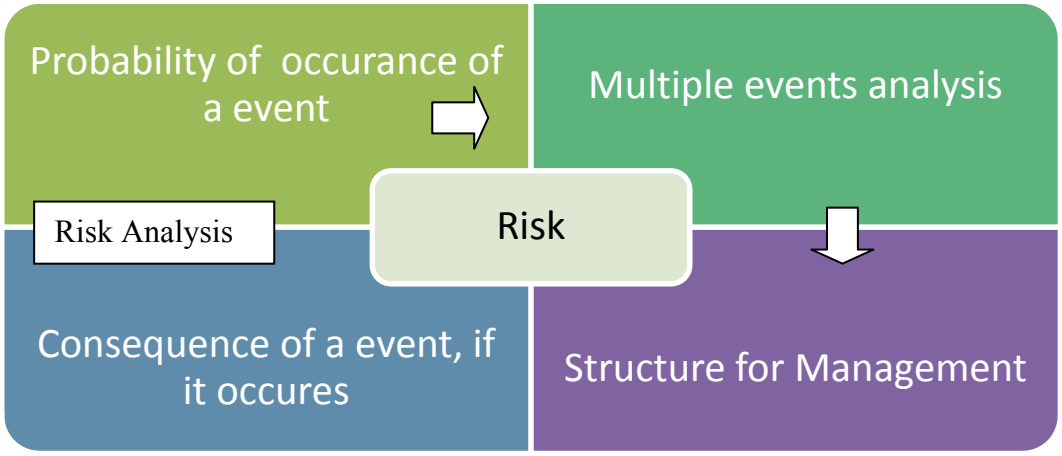

Figure 3-4: Risk Management Direction

(Developed from figure 3-3)

The academic research on risk was historically based on the one event's impact and its uncertainty analysis. Later on, risk research moved to multiple risk analysis of a system. The multiple risk analysis provided a new academic and practice challenge, which is management of various risks within a context. Recently, new theoretical risk management structures have evolved from banking and insurance industry perspectives. Against this background, this section discusses the various definitions of risk, theoretical evolution of risk and various risk management structures.

3.2.1 Definition and Theoretical Evolution of Risk and Risk Management

Defining risk: The word is risk is derived from the Italian word- 'Risicare' (to dare) (Merna & Al-Thani, 2005). However, it was academically defined, for the first time, by Abragam De Movivre[7] as an opposite of expectation (Bernstein, 1998). The concept of 'risk' is defined by various authors from economics, management, and mathematics perspectives (Knight, 1921;

[7] "The Risk of losing any sum is the reverse of the expectation; and the true measure of it is, the product of the sum adventured multiplies by the probability of the loss" Bernstein, P. L. (1998). *Against The Gods: The Remarkable Story of Risk*. New York: John Wiley & Sons, Inc.

Bernstein, 1998; Banks & Dunn, 2003; Holton, 2004; Merna & Al-Thani, 2005; Crouhy et al., 2006; Gardner, 2008). However, it is observed that definitions of risk are not consistent because of the nature of risk- subjective, objective and relative (Holton, 2004; Campbell, 2006).

There are two academic definitions for risk. The first definition of risk is related to chances of an event happening that will have negative consequences (Rowe, 1977; Rescher, 1983). The second definition of risk is related to chances of an event happening, which will have both negative and positive consequences (Damodaran, 2002; Merna & Al-Thani, 2005). Both types of risk definition are prevalent in technical research and social research (Table 3-1). However, the distinction between technical and social research is that the prior focuses on single event (for example, Markowitz defines risk as a variance in expected outcome) and the latter focuses on multiple events (For example Merna and Al-Thani analysed multiple risks in corporate environment).

Technical definitions of Risk	Social definitions of Risk
• Possibility of loss, injury, disadvantage or destruction; to expose to hazard or danger; to incur risk of danger	• Probability of an adverse event amplified or attenuated by degrees of trust, acceptance of liability and/or share of benefit
• Consequence per unit time=frequency (events per unit time) × magnitude (consequences per event)	• A code word that alerts society that a change in the expected order of things is being precipitated
• Probability of loss or injury to people and property	• Opportunity tinged with danger
• Product of the probability of an adverse event times the consequences of that event were it to occur	• A threat to sustainability/current lifestyles
• Function of two major factors: (a) probability that an event, or series of events of various magnitudes, will occur, and (b) the consequences of the event(s)	• Financial loss associated with a product, system or plant

Table 3-1: Technical and Social Definitions of Risk

Source: adapted from (Macgill & Siu, 2005; Merna & Al-Thani, 2005)

In mathematical terms, risk is defined as deviation from the mean. A factor can deviate either upward and downward from its mean. Likewise, expected value of a project or a business is treated as mean in the corporate world but the real value can either be more or less than the expected value. This understanding of more than expected in positive terms has added a new dimension to risk. Hence, chances of negative and positive outcome are called downside risk and upside risk respectively (Merna & Al-Thani, 2005). Upside risk and downside risk are

called reward and risk respectively, by Harry Markowitz. He implied that risk is associated with reward in a complicated way while explaining portfolio theory (Markowitz, 1952).

Uncertainty creates complexity in understanding of the notion of risk because of the definition provided by Frank Knight[8]. However, Frank Knight's definition of risk is criticised by G A Holton claiming that Frank Knight has defined only uncertainty because Bruno de Finetti (1937) has philosophically and subjectively commented, *"probability does not exist"*(Holton, 2004). There is also an argument that a risk incorporates uncertainty related to occurrence of an event and impact of an event simultaneously. Hence, assessment of chances of an event happening itself is analysis of uncertainty. Thus, the confusion related to the understanding of risk and uncertainty is created due to the application of both words independently and the lack of mathematical assessment knowledge of risk and its uncertainty.

Risk and uncertainty are often used in academic work interchangeably (Merna & Al-Thani, 2005). The reason behind the similarity of risk and its uncertainty is mathematical developments to measure risk and uncertainty related to an event. Risk and its uncertainty can be measured in two ways- (a) statistical approach based on historical data (where risk can be quantified), and (b) subjective probability based on informed decision (where risk is not quantifiable). However, there is still a distinction between uncertainty related to a known event and uncertainty related to an unknown event, the prior is called risk and latter is called pure uncertainty (Merna & Al-Thani, 2005).

Risk can be managed but pure uncertainty (in other words-unknown risk) cannot be managed. Based on this characteristic, risk can be defined as measurable uncertainty of happening of an event within a system. If the event happens then it affects the system positively and negatively. The uncertainty and impact of an event can be measured by statistical and subjective methods. Against this definition of risk, pilot cases revealed that the risk is generally perceived as probable negative impact of an uncertain event in global manufacturing companies, advisor companies and investment bank. Risk sources or risk categories are another important factor in understanding risk within a system. *"It is therefore important that these sources of risk are available, thus allowing the necessary identification,*

[8] 'To preserve the distinction… between the measurable uncertainty and an immeasurable one we may use the term "risk" to designate the former and the term uncertainty for latter." Knight, F. H. (1921). *Risk, uncertainty and profit*. New York: Hart, Schaffner, and Marx.

analysis and response to take place." (Merna & Al-Thani, 2005). Risk sources changes as system changes (Miller, 1992a; Barrese & Scordis, 2003; Merna & Al-Thani, 2005; Crouhy et al., 2006). Hence, the context of risk has become an important factor in understanding risk. Practice and academic work on sources of risk have not achieved standardisation (Table 1-4) that results in missing number of risks in risk analysis and risk management of a system. The above paragraphs lead to four components of risk - uncertainty of a risk, impact of a risk, nature of a risk (subjective and objective assessment) and context of a risk (relativity of a risk). The first two components are fixed components and the last two components vary at risk analysis in varied systems.

Figure 3-5: Components of Risk
Developed from (Knight, 1921; Markowitz, 1952; Miller, 1992b; Bernstein, 1998; Damodaran, 2002; Macgill & Siu, 2004; Macgill & Siu, 2005; Merna & Al-Thani, 2005; Crouhy et al., 2006)

Historical perspective: Academics have various views on the evolution of the notion of risk. One view is that the human anatomy has inbuilt risk management system, hence the origin of concept of risk is dated back to stone age (Merna & Al-Thani, 2005). Others state that origin of risk is related to Hindu-Arabic numbering system (Bernstein, 1998). However, the modern theoretical analogy, for the concept of risk evolution, often refers to the Blaise Pascal's work on probability in 1654 (Bernstein, 1998; Macgill & Siu, 2004).

Much of the theoretical work on risk has been related to risk analysis rather than risk management (Table 3-2). Additionally, the early work on risk was focused on a single event quantitative risk analysis. Later on, the risk analysis focused on multiple events, for example-

Chaos theory, Catastrophe theory and game theory (subjective risk analysis). These theories were developed in natural sciences and in mathematics but these theories are frequently used by social science to understand decision making in uncertainties. The following three paragraphs provides background information on catastrophe theory, chaos theory and game theory:

Catastrophe Theory was first applied in physics and biology. Zeeman successfully incorporated catastrophe theory into the social sciences, such as economics and finance (Fischer & Jammernegg, 1986). Catastrophe theory was developed from the theory of the dynamic systems developed by the French Mathematician Rene Thom (Rosser Jr, 1999). Fisher and Jammernegg (1986) applied the Catastrophe model to carry out an analysis of actual inflation, employment and expected inflation.

Persons	Year	Theory	Contribution to Risk Management
Blaise Pascal	1654	Probability	Helps to understand and quantify the future events
Abraham De Movivre	1711-1730	Doctrine of Chances Normal distribution, standard deviation, law of averages	Risk of losing money = money*probability of loss
Jacob Bernoulli	1738	Law of large numbers and statistical sampling	Helps in quantifying risk by historical analysis Helps in making choices and reaching to decision
Francis Galton	1875	Regression to the mean	Long term average has less volatility
Henri Poincaré	1880	Chaos Theory	There is an order in chaos. There is no randomness in the world
Von Neumann	1944	Game theory	Decision making in multiplayer environment, rational behaviour.
Harry Markowitz	1952	Theory of Diversification	Risk minimisation strategy
René Thom	1960	Catastrophe Theory	Small changes in a factor of a multifactor system, changes the system.
Kahneman and Tversky	1979	Prospect theory	Two shortcoming of rational decision making (Cognitive difficulties- emotion and understanding. These two shortcoming is affected by negativity or positivity of question)

Table 3-2: Key Theoretical Evolution on Risk

Developed from (Anderson et al., 1989; Baumol & Benhabib, 1989; Brown, 1995; Bernstein, 1996; Connelly, 1996; Gul, 1997; Bernstein, 1998; Stone, 2001; Gardner, 2008)

Chaos theory was developed to understand the nonlinear behaviour of equations in a dynamic system. Peng, Wu and Goo (2004) have applied Chaos theory in the social sciences. They

emphasized that Chaos science helps to find the rules of disorder in systems. These rules can be used to forecast the potential pattern of disorder in the future. Chaos science is very helpful in understanding the current business environment. Although the business environment always faces economic disorders, *"deterministic chaos models visualize the chaos process"* (Peng, Wu, & Goo, 2004).

John Von Neumann and Oscar Morgenstern became the founders of contemporary game theory because they were the first to work on a two-person zero-sum game in normal form. However, they could not define rational behaviour in terms of mathematics. John C. Harsanyi, John F. Nash and Reinhard Selten received the Nobel Prize for non-cooperative game theory (Gul, 1997). Game theory has widely been used in social sciences since its inception. For example, Schmitt (1969) focused on uncertainty in investment decisions. He worked on the criterion for decision making, which bears resemblances to game theory strategies and Arbitrage theory (Schmitt, 1969). He demonstrated the dominant strategy, which reflects the Nash equilibrium of game theory.

Social scientists also ventured into to understanding risk from human psychology perspective. The most significant theory emerged from this perspective is 'prospect theory'. The proponents of this theory, Daniel Kahneman and Amos Tversky, identified that human emotion and cognitive difficulties change human risk behaviour. Likewise, Gardner describes the influence of the fear element on risk behaviour (Gardner, 2008). Risk analysis is negatively affected by genralisation through small sample, which distorts human perception. It is also observed that the concept of regression to mean is applied to human behaviour during the development of the prospect theory. (Bernstein, 1998; Gardner, 2008)

Quantitative analysis of risk and human risk behaviour were important milestones in risk research. Doctrine of chances and probability became the tools to quantify risk. Law of large number brings more accuracy in assessing risk. However, regression to mean suggested that quantitative methods were also enriched with the philosophy. For example, the concept of regression to mean can be explained in simple sentence as- everything will be all right in the long run. Frank Knight's definition of risk was the quantum leap in understanding and defining risk. His definition attracted criticism but provided a platform for further discussion on risk. It was a journey of defining risk from just a variation (from mathematics perspective)

to determining the components of risk (from social science/economics perspective). This section highlights following key lessons related to risk assessment:

- Components of the concept of risk
- Risk assessment requires understanding of probability theory, law of large number theory, theory of chances and the concept of regression to mean.
- Integrated risks assessment to understand the integrated impact of risks on a system (Example- Catastrophe risk).
- Possibility of subjective risk assessment (Example- Prospect theory and Game theory)
- Risks have sources (Example- Chaos theory)

3.2.2 Risk Management Structure

For a long time, academic work on risk was restricted to risk analysis (Table 3-2). Even risk analysis was also limited to a single event or few events. Hence, the necessity for risk management frameworks did not arise. It was multiple risk analysis in financial sector, which triggered the research and practice towards risk management frameworks. Most of these illustrated frameworks are focused on the insurance or financial industry. However, recent regulations (Table 1-2) have motivated researchers to develop frameworks in other industries. For example, Merna developed the risk management structure based on his research on construction industry. However, followings are two shortcomings of the existing risk management frameworks:

- They are constructed conceptually
- They are more focused at corporate level and project management level.

Authors	Context	Description- Risk Management Structure
Williams & Heins (1989)	Insurance	6 steps: Define objective, identify loss exposure, measure potential losses, select strategy, implement, monitor
Dickson (1995)	Insurance	3 steps: Identification, analysis, economic control
Head & Horn (1991&1997)	Insurance	5 steps: Identify& analyse, examine alternative techniques, select, implement, monitor
Dorfman (1994&1998)	Insurance	3 steps: Identify & evaluate, implement, monitor
(Barrese & Scordis, 2003)	Corporate focus and conceptual	4 steps: setting risk-return goals, identification and evaluation of the causes of potential expense and revenue fluctuation, choice and balance of loss control and loss finance tools, implementation, monitoring and review
Vaughan (1997 & 1999)	Insurance	6 steps: Determine objectives, identify risks, evaluate risks, consider alternatives and select risk treatment device, implement decision, evaluate and review
Rejda (1995&1998)	Insurance	4 steps: Identify, evaluate select appropriate technique, implement and administer
Skipper (1998)	Insurance	3 steps: Identify and evaluate, explore techniques, implement and review
Harrington & Niehaus (1999)	Insurance	5 steps: Identify, evaluate, develop and select methods, implement, monitor
Trieschmann et al (2001)	Insurance	4 steps: Identify, evaluate, select technique, implement & review
(Crouhy et al., 2006)	Banking	7 steps: Identify risk exposures, measure and estimate risk exposures, find instruments and facilities to shift or trade risks, assess effects of exposures, assess costs and benefits of instrument, form a risk mitigation strategies, evaluate performance
(Merna & Al-Thani, 2005)	Construction industry, Conceptual framework	6 steps: Risk assessment for all levels, project definition, risk identification, risk analysis, risk response, risk register
(Kallman & Maric, 2004)	Conceptual framework	5 steps: Risk management programme development, risk analysis, solution analysis, the decision process, system administration

Table 3-3: Risk Management Structure

Compiled from (Miller, 1992b; Barrese & Scordis, 2003; Kallman & Maric, 2004; Merna & Al-Thani, 2005; Crouhy et al., 2006)

Preliminary observations of the risk management frameworks (Table 3-3), illustrate that a typical risk management framework might have the followings four steps (Figure 3-6):

- Identification,
- Assessment,
- Administration (mitigation or decision area),
- Monitoring

Figure 3-6: Theoretical Risk Management Framework

However, these basic steps of RM have been expanded at different levels due to the varied context in which risks are being managed. Additionally, theoretical development has influenced the structure of RM. Authors have defined RM either from its philosophy or from its structure. Following definitions show this contrast:

"The essence of risk management lies in maximizing the areas where we have control over the outcome while minimizing the areas where we have absolutely no control over the outcome and the linkage between effect and cause is hidden from us" (Bernstein, 1998)

"The art of risk management is to identify risks specific to an organization and to respond to them in an appropriate way. Risk management is a formal process that enables the identification, assessment, planning and management of risks"(Merna & Al-Thani, 2005).

Risk management can also defined as 'maximising shareholder value' as the goal of a business (Meulbroek, 2002). Moreover, it can be linked to the management of a corporation (Handy, 1999), illustrates the integration of risk management thinking in mainstream corporate management. However, risk management process in corporations are widely criticised as becoming simply a strategy to comply with the regulatory requirement (Merna & Al-Thani, 2005).

3.2.3 Missing Link in Risk Management Research

Risk has been defined in literature but contextual definitions of risk and risk categories are missing from global manufacturing investment perspective. The debate as to whether risk management is art, science or engineering, is ongoing. Nonetheless, risk management requires imagination, logical explanation, and creativity. There are various risk management models existing in practice and theory. However, it is difficult to find structured risk management in the manufacturing industry especially in the decision process of global manufacturing investment. Additionally, the existing theoretical risk management processes are not developed in global manufacturing and network context. Despite risk management

being an important process in strategic management, there is no standard to which 'investment risk management in global manufacturing investment' might be referred for the understanding of risk, practices, and process.

3.3 Global Manufacturing

This section describes manufacturing and discusses global manufacturing. The historical review of literature (Figure 3-7) suggests that there is a trend in the global manufacturing research. Initially, it focused on shop floor research (Charles Babbage and Frederic E Tylor) then on the factory (Frederick E Tylor, Henry Ford, and E Buffa) until Skinner (1969) introduced the strategic focus in manufacturing research. Subsequently, researchers have studied the internationalisation of manufacturing, which ultimately led to studies of global manufacturing and related networks.

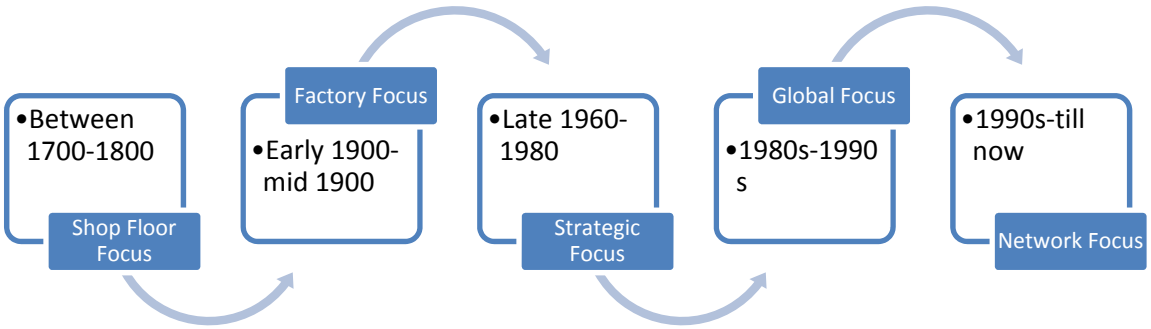

Figure 3-7: Key pattern in Global Manufacturing Research (developed from Figure 2-3)

The objective of this section is to provide theoretical understanding of global manufacturing and illustrate the theoretical gap, with respect to investment risk management. It also explores key theories related to internationalisation and network- configuration, coordination and capability, along with global risk. Finally, it discusses the missing link in the literature within the context of investment and risk management.

3.3.1 Defining Manufacturing

The definition of manufacturing has changed since the industrial revolution in Great Britain in the 18th century. Traditionally, it was only physical production. The concept of manufacturing has evolved to include the processing of raw material to produce a new products. The changing economic, political, social, technical, and international environment continues to influence the characteristics of manufacturing.

Skinner recognised that academic work on manufacturing did not reflect a correct concept. He argued that *"manufacturing is generally perceived in the wrong way at the top, managed in the wrong way at the plant level, and taught in the wrong way in the business school"* (Skinner, 1969). In his opinion, corporate strategy, which deals with production, planning, distribution, marketing, and the supply chain, has a strong relationship with manufacturing. Modern definitions of manufacturing incorporate sales, marketing and after-sales services. It also not treated as solely a process but is called system (Robinson, 1998).

Institutions	Presenter	Manufacturing includes.....
Technology Strategy Board (TSB) , UK	Peter Flinn[9]	Research, Design and development, production, sales, services, operations and decommissioning
Department for Business Enterprise & Regulatory Reform (BERR)	Dr R Sullivan[10]	Tangible: Research, Fabrication, logistics & distribution, sales & marketing, services, design & development Intangible: Design services, marketing, software, branding, business processe

Table 3-4: Manufacturing Defined by Government Intuitions

Government institutions have also expanded their views on manufacturing (Table 3-4). The National Research Council states *"manufacturing is the processes and entities required to create, develop, support, and deliver products"* (NRC, 1998). This definition is less comprehensive as per contemporary dynamic characteristics of manufacturing. According to Gregory, "*manufacturing is a cycle that starts with understanding markets, product design, production, distribution and ends with manufacturing related services with an economic and social context"*(Gregory, 2005). This definition of manufacturing is practical and comprehensive as it includes market understanding, social aspects, as well as the economic aspects. Therefore, manufacturing is a balanced combination of processes, which not only creates a new or existing product, but also can create valuable wealth to a nation in terms of a socio-economic balance in society.

[9] Keynote speaker from TSB: High Value Manufacturing, 25 - 26 September 2008 at the Møller Centre, Cambridge.
[10] Keynote speaker from BERR: Manufacturing- New Challenges and New Opportunities, 25 - 26 September 2008 at the Møller Centre, Cambridge.

3.3.2 Characteristics of International Manufacturing.

Manufacturing internationalisation and globalisation have been addressed in the literature since the 1960s. Manufacturing global expansion has been explained from the perspective of product (Vernon, 1966; Parry, 1975; Vernon, 1979), market (Henzler & Rall, 1986; Porter, 1986; 1993) and functions (Skinner, 1969; Eversheim, 1996). However, there are other factors, which present the characteristics of international manufacturing such as- location, competitive advantage, roles of plants, efficiencies, and forces of globalisation. Later on, these characteristics categorised into configuration, coordination, and capabilities of international manufacturing.

It is observed that lower growth opportunity in domestic market by demand saturation and high cost of production leads to globalisation of manufacturing. Rapp (1973) realised that *"volume and cost advantage will be translated into aggressive penetration pricing on a worldwide basis"* (Rapp, 1973). He emphasized the cost/volume relationship rather than the product lifecycle development and international operation. He measured the economic viability in terms of productivity, profitability and growth (Dunning, 1980).

Ferdows defined the strategic role of the individual factory in an international manufacturing network, such as off-shore, source, server, contributor, outpost and lead. These strategic roles change according to the changes in the international business environment (Ferdows, 1997). Two types of international manufacturing network - product focused network and process focused network have been identified (De Meyer & Vereecke, 1994). The objective of international manufacturing research is to increase performance by defining the role of the factory more accurately or by defining the focus of the international manufacturing network. DuBois et al. appropriately identified four key manufacturing performance priorities – efficiency/ cost, quality, dependability and flexibility (DuBois, Toyne, & Oliff, 1993).

Dunning developed a theory of international production, in which he stated that *"the theory of foreign owned production is thus concerned with the location of value adding activities and ownership and organization of these activities"* (Dunning, 1988a). He stressed that the international production concept is a mixture of macro resource allocation (internationally) and organizational economics at the micro level (Dunning, 1988a). He came up with the OLI (O = Ownership specific advantages, L = Location specific variables, and I = International

incentive advantages) concept in international production. He also referred to the work of Stephen Hymer on the foreign operations of firms where risk and uncertainty was incorporated in international production. Dunning realized the importance of having a regulatory policy (political environment of the host country) in international production when he wrote the paper on the "Industrial development, globalization, and multinational enterprise: new realities for developing countries" with Narula (Narula & Dunning, 2000).

Reference	Literature on Coordination, Configuration and Capability
(Porter, 1986)	♦ "Any firm competing internationally has to decide where in the world to perform each of the activities in the value chain. ***Configuration*** refers to this decision." • "The second basic variable in international strategy is the coordination question, that is, how should activities in different countries be related to each other? Should they in any way be linked, or should they be fully adapted to the local circumstances?"
(Morrison & Roth, 1993)	♦ ***"Configuration*** broadly refers to the geographical positioning of value activities". ♦ ***"Configuration*** relates to a business's capacity to exploit the comparative advantages of host countries while maintaining responsiveness to customer needs". ♦ ***"Coordination*** refers to how like activities performed in different countries are coordinated with each other".
(Roth & Miller, 1992)	♦ Competitive ***capability*** dimensions: Quality, delivery, flexibility and price (Skinner (1978) and market scope. "Market scope represents a set of value-added ***capabilities*** that transcend traditional manufacturing boundaries, and that indicate manufacturing's interface capabilities with customers and markets.
(Miller & Roth, 1994)	♦ ***Cost Driven capability***: Produce at low cost. ♦ ***Technology driven capability***: flexibility to introduce new product. ♦ ***Market driven capability***: quality and delivery.
(Wheelwright, 1978)	♦ Capability: efficiency, dependability, quality and flexibility.
(Shi & Gregory, 1998)	♦ "In the international manufacturing networks, strategic ***capabilities*** derived from the system configuration can be categorised into resource accessibility, thriftiness ability, manufacturing mobility and learning ability" ♦ "The thriftiness ability is derived from ***coordination*** and / or integration of networks."
(Liu & Young, 2004)	♦ Idea of GMC: Global mfg ***coordination*** which is the integration of activities across both functions and geographic areas.

Table 3-5: Configuration, Coordination and Capability

The emergence of international manufacturing shifted the factory focus strategy in the direction of a corporate international manufacturing networks strategy (Ferdows, 1997). Shi and Gregory identified the corporate international manufacturing network as a manufacturing system. They stated that new strategic capabilities of a coordinated international manufacturing network can optimise the performance (Shi & Gregory, 1998). The design of a coordinated and integrated manufacturing network is also called an international manufacturing configuration (some perspectives on coordination, capability, and configuration are shown in Table 3-5). The effective configuration of international

manufacturing enhances performance. However, it also raises practical and theoretical questions about risk management in global manufacturing investment decisions.

The international manufacturing characteristics do not say how to identify, assess, and mitigate the risk of international manufacturing investment. Therefore, there is a gap in the existing literature on international manufacturing with regard to organizational growth measurement and risk assessment of global manufacturing and the potential risk posed by a turbulent environment.

3.3.3 Global Manufacturing: Configuration, Coordination, and Capability

This subsection presents global manufacturing strategy, coordination and capability. It further explores global manufacturing investment decision theory to identify risk linkages in global manufacturing investment.

Porter identified two variables – configuration and coordination in the internationalization process (Porter, 1986). He observed that configuration is the company's strategic activities around the world in the value chain and coordination relates company strategic activities around the world with each other. Morrison and Roth (1993) found that configuration and coordination are an integral part of a firm's global strategies (Morrison & Roth, 1993). However, Roth and Miller (1992) focused more on performance measurement in manufacturing using the relativity concept (relative manufacturing capabilities, relative managerial successes and economic performance).

Roth and Miller (1994) stressed that manufacturing capabilities ("*Quality, flexibility, delivery and cost"*) should be linked to a choice of manufacturing strategy. Furthermore, capability and choice of manufacturing strategy should be linked to business strategy in order to gain competitive advantage (Miller & Roth, 1994). They observed that *"three distinct types of manufacturers can be identified by the importance they place on competitive capabilities; caretakers, marketers, and innovators"* (Miller & Roth, 1994). However, Cagliano et al.'s work on manufacturing strategy configurations divided configuration strategies into four parts – market-based strategy; product-based strategy; capability-based strategy; and price-based strategy (Cagliano, Acur, & Boer, 2005). By dividing manufacturing strategy configurations, they incorporated manufacturing capability and coordination into a taxonomy of configuration.

Welch and Loustarinen identified the dimensions of the business internationalization process. They posed questions to identify the internationalization process: what activities can be internationalized; how to enter into a foreign market (entry mode); and where to go (country business environment). Then the company would decide what would be the organization structure or configuration which ultimately would enhance the organizational capacity by incorporating finance and human capital assets (Welch & Luostarinen, 1988). Liu and Young believe that their experiment on the Order model, Product model and Manufacturing - "*can capture the required information and knowledge for global manufacturing co-ordination*" (Liu & Young, 2004).

Ghauri and Prasad started the discussion on international organization structure topics. Topics included products vs. geographical structure and centralized vs. decentralized structure, and they proposed an international structure stage model. They stated that a company would reach the global matrix from the international division during its internationalization process in two ways (world product division and area division). The international structure path depends upon foreign product diversity, foreign sales with ecological influence (Ghauri & Prasad, 1995).

Johansen and Riis (2005) have taken a future prospective in defining strategy for an industrial company in highly globalized world. They warned that current knowledge (systems, processes and technology) would be obsolete in the future. Therefore the current configuration would no longer be valuable in future due to intense globalization. They came up with "*a scenario in which knowledge, learning and competence will constitute key factors for economic success*" (Johansen & Riis, 2005) to propose a strategic framework for an industrial company. The strategic framework is divided into three parts. The first level is an interactive firm with the focus on knowledge, cross-functional relations and networks. The second level is a company position in a supply chain by taking in a broader production concept. The third level concerns the strategic production roles of a manufacturing firm.

Shi and Gregory's observation on International Manufacturing Configurations (IMCs) leads to key manufacturing capabilities of IMCs - resource accessibility, thriftiness ability, manufacturing mobility and learning ability. They stressed that internationalization-driving forces are complex and concurrent. *"An understanding of these forces is essential to the understanding the missions, capabilities and behaviours of manufacturing globalization"*(Shi

& Gregory, 1998). These forces have some resemblance to Welch and Loustarinen's *"dimensions of business internationalization model"*(Welch & Luostarinen, 1988). Based on case studies, they proposed a model of "coordination between the international operations." This model shows a trajectories of a number of globally coordinated company network configurations (global business configurations) designed to increase companies' global competitive capabilities.

Manufacturing strategy and decision areas[11] provided the structure and infrastructure of a manufacturing system (Hayes & Wheelwright, 1984). This established a platform for manufacturing companies to configure and reconfigure their global manufacturing to achieve competitive advantage. It is stated that configuration/reconfiguration requires global manufacturing investment. While mentioning the enablers[12] of manufacturing investment, Hayes and Wheelwright identified a process of investment decision and stated "*most people – have three major concerns in mind when they contemplate a proposed investment: security*[13]*...recompense*[14]*... and predictability*[15]"(Hayes & Wheelwright, 1984). He did not explore the above-mentioned concerns. These concerns are related to risk and risk management investment. Additionally, Srai et al. have developed and tested a framework for global manufacturing investment decision processes from a M&A perspective (Srai, Bertoncelj, Fleet, & Gregory, 2009). Even though, this included risk analysis, a detailed risk management process has been overlooked in global investment decision making (Srai et al., 2009).

The theories covered in this section show the importance of three key words of manufacturing: configuration, coordination, and capability. It is also observed that the desired capability changes the appropriate configuration of a manufacturing network. Hence, a company's investment decisions focus on its global configuration, coordination, and capability strategies. Even though global manufacturing investment has higher risk, risk management capability of global manufacturing configuration is overlooked in the literature.

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[11] "*Capacity, Facilities, technology, vertical integration, work force, quality, production planning/ material control and organisation."*
[12] *"Technology factors, structural factors, competitive factors, information flow factors, managerial factors and government factors"*
[13] "*How safe is my money? How soon will I be able to get it back?"*
[14] "*How much more will I get back than I invested?"*
[15] "*Predictability: How sure am I about the anticipated returns from this investment?"*

3.3.4 Global Manufacturing Risk

Global manufacturing risk has been mostly explored at international and political levels. Hence, this subsection discusses the international risk and country risk within the context of global manufacturing. It expands the discussion on global investment and associated risk.

International Risk

Unstable geopolitical situations increase the business risks of international operations. As far as manufacturing is concerned, international manufacturing is affected by country risk, business competence, competition (Henzler & Rall, 1986) and global discontinuity. Multinational manufacturing corporations need to know the level of country risk, and their own strength or business competence for overseas manufacturing investment.

Country Risk

The host country environment is important for a global manufacturer investing in international operations. Eventually, country risk becomes important for international manufacturing operations. Previous literature on country risk mainly focused on countries' ability to repay debt with the emphasis on the economic and financial factors (Erevelles, Horton, & Marinova, 2005).

Kogut and Singh (1988) argue that multinational corporations' investment decisions and entry mode are heavily influenced by the characteristics of the host country's culture. They further defined the entry mode in terms of acquisitions, joint ventures and Greenfield investments (Kogut & Singh, 1988). Feder and Ross (1982) argue that *"lending to sovereign borrowers is not free of risk"* (Feder & Ross, 1982). The important and often overlooked consequence is that no country in the world is without risk and the concept of a risk-free country is not legitimate.

Cosset, Siskos and Zopounidis (1992) worked on a model to help bankers to assess the country risk. They focused more on country foreign debt liabilities. They suggested that bankers should establish whether a country is earning enough foreign exchange to pay back its international debt or not (Cosset, Siskos, & Zopounidis, 1992). However, Gregorio (2005) suggested that country risk should be looked at in its entirety. He means that a company faces uncertainty in terms of its *'endogenous'* (project and organizational level) and *'exogenous'* source (industry, competition and external environment). And environment uncertainty

mainly represents the uncertainty in the operational environment of a country. Therefore, environmental uncertainty is the country risk for a company (Di Gregorio, 2005).

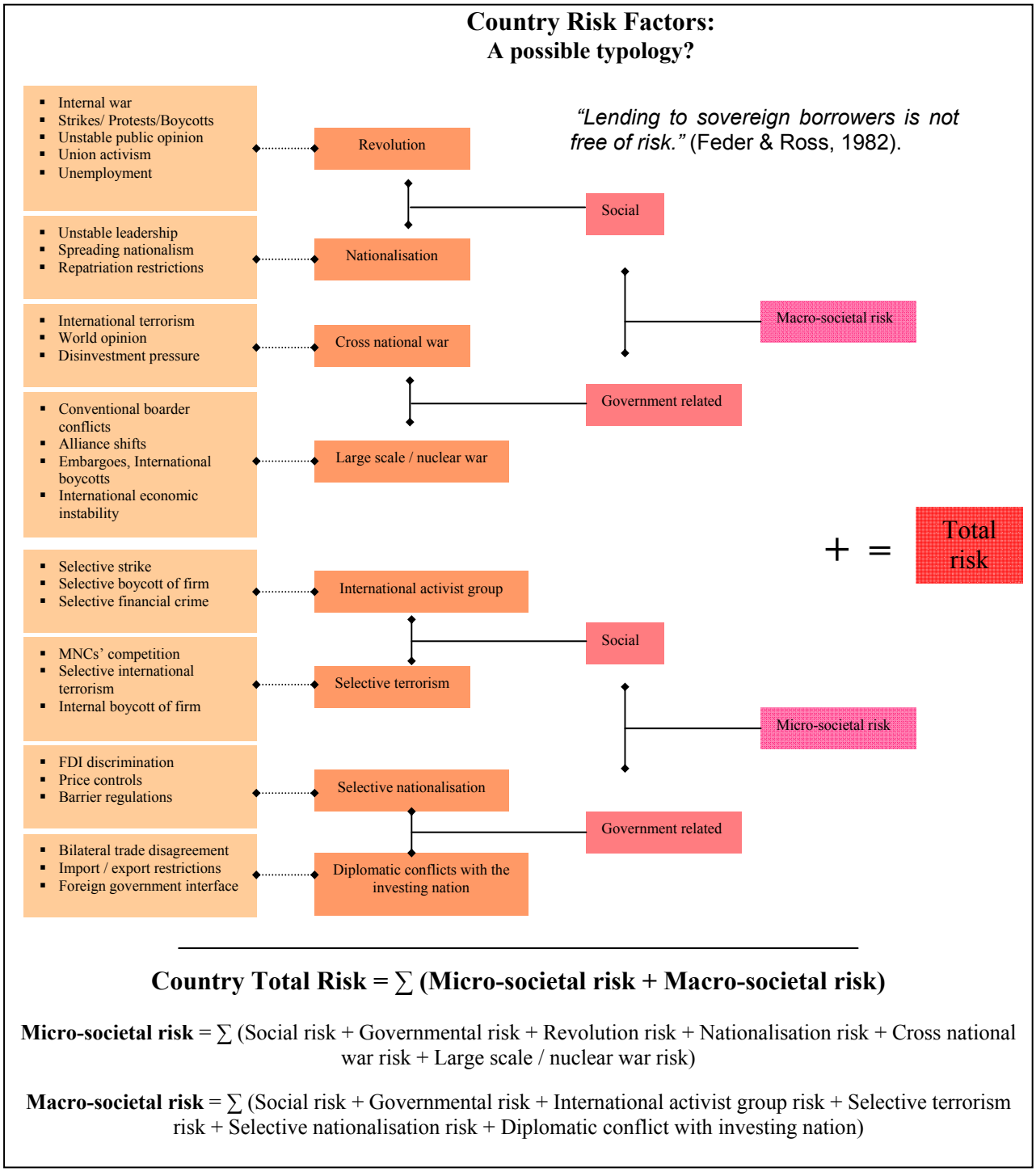

Figure 3-8: Country Risk Factors: A Possible Taxonomy

Source: adjusted from (Murtaza, 2003)

Shimizu et al. have focused more on cross-border mergers and acquisitions. They identified that multinational corporations are pursuing a merger and acquisition strategy to grow

rapidly. However, a higher country risk (*"differences in national culture, customer preferences, business practices, and institutional forces such as government organization"* (Shimizu, Hitt, Vaidyanath, & Pisano, 2004) can lower the growth prospect or render the business objectives of multinational organizations unsuccessful (Shimizu et al., 2004). Hymer (1972) recognized the importance of international government and risk and stated that *"the multinational corporation or multinational corporate system has three related sides: international capital movement; international capitalist production; and international government"* (Hymer, 1972). These three sides show how foreign direct investment, international manufacturing and international risk are closely linked.

Murtaza suggested that multinational corporations should make a careful evaluation of country risk for their business with more focus on the time of entry. With country risk analysis they can decide whether they should do business with a specific country or not (Murtaza, 2003). He has defined global risk factors in terms of social, political and economic aspects and has proposed a framework for country risk analysis (Figure 3-8, previous page). His framework on country risk includes the all elements of PLESTI (Political, Legal, Economic, Social, Technological and International) analysis.

Simon (1984) believed that political risk assessment is the growing concern of multinational corporations and researchers. He raised the question as to traditional assessments of the political risk. He argued that the dimensions of political risk had been increased due to the dynamic geopolitical environment. He supported his argument by stating that "*the millions of dollars that foreign investors lost as a result of the Iranian and Nicaraguan revolutions helped to promote an interest in political risk assessment, the size of these losses worked against the earlier efforts of scholars to develop a scientific discipline*" (Simon, 1984). Cupitt (1990) recognized that political instability and government instability are the major factors in political risk assessment (Cupitt, 1990) . More interestingly, some believe that there is no country risk except political risk because political risk covers both investment and economic risk related to a project (Solberg, 1992: 234).

Cupitt's empirical results suggested that Multinational Corporations should consider the political agenda to understand the foreign market opportunities and challenges of the future. He stresses the systematic assessment of political risk. "*Systematic assessment can discover and explore significant general patters (such as that government instability is related to both*

liberalization and protectivisim) and denote which country deviate most consistently from the general pattern" (Cupitt, 1990). Harms (2002) tested whether political risk affects foreign direct investment in a large number of developing countries because developing countries have a high level of political risk (Harms, 2002).

Dunning (1979) expressed the concern about government intervention and government stability and mentioned these as location choice variables (Dunning, 1979). He argued that *"government intervention is another country-specific variable which affects both the generation of ownership advantages and the economic ties between investing and recipient countries"* (Dunning, 1979). Hadjikhani (1998) showed a grave concern about political instability. He stated that *"political risk can sometimes leave no choice to multinational organizations but to exit from the host country."* (Hadjikhani, 1998). However, Solberg (1992) is not convinced that political stability is always bad for businesses. He argued that *"there is no easy relationship between stability and attractiveness"* (Solberg, 1992). He stressed that political risk analysis should be specific to the industry or specific to the project. He suggested a model for political risk analysis model (as shown in Figure 3-9).

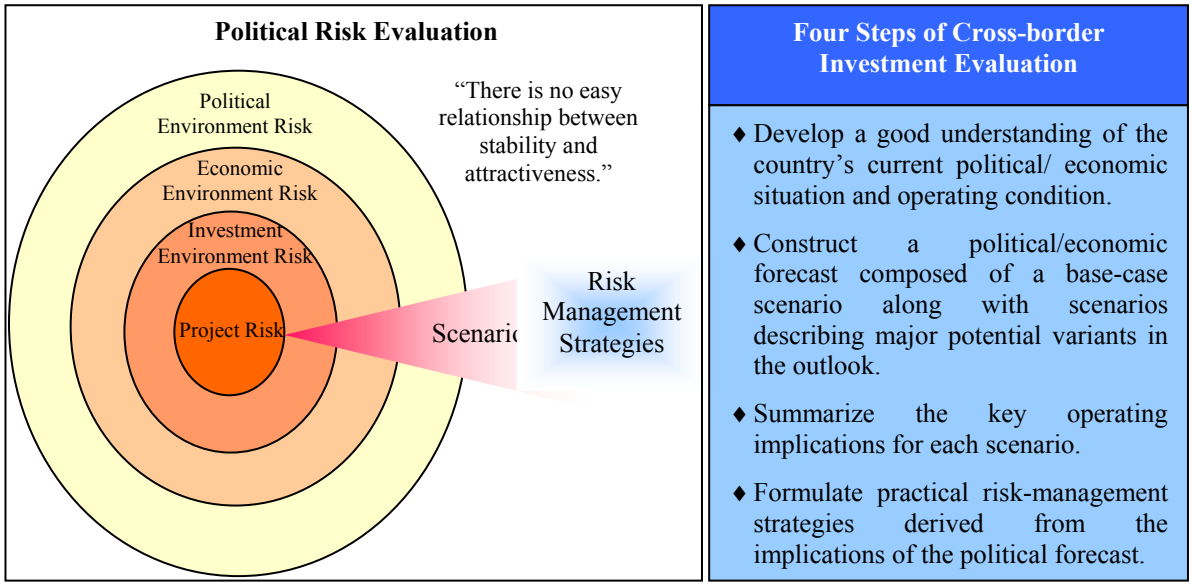

Figure 3-9: Political Risk and Cross-Border Investment Evaluation

Source: (Solberg, 1992)

He considered project risk is the core risk, which is directly affected by the investment environment risk. The investment environment risk is influenced by the economic environment risk and the political environment affects the economic environment risk. Therefore risk management should be based on operational implications for a project in

various scenarios. Although there are differences in opinion amongst academics about political risk and country risk similarities, there are several models of country risk analysis and political risk analysis, which state very similar variables for both risks. The first analysis is more focused on the macro-economic environment level and the second is focused on the micro-economic environment level.

Theories covered in this section have provided varied understanding of global business risk within the context of global manufacturing. However, these theoretical approaches do not address the micro-level (industry/company) risk analysis.

3.3.5 Corporate Strategic Decision Making

Taking decisions on global investment requires the linking of manufacturing strategy with corporate strategy. However, a gap has been seen between the manufacturing strategy and corporate strategy (Skinner, 1969). Voss (2005) discussed the paradigm changes in manufacturing decisions. He proposed three paradigms – competing through manufacturing, strategic choices in manufacturing, and best practices (Voss, 2005) based on the previous 30 years' research. Each paradigm affected the decision making process of manufacturing companies. This literature review discusses the dilemma in the decision-making process in terms of pre-decision analysis, the complexity of the decision-making, and financial decision-making. It also investigates linkages with risk management.

Pre-decision Analysis

Fine and Hax (1985) established the relationship between the corporate, business and functional levels of a company. The characteristics of these levels are distinct from one other. Therefore corporate strategy should focus on all three levels of a multinational manufacturing corporation to achieve a global competitive advantage (Fine & Hax, 1985). The corporate, business, and functional strategy mismatch is always seen in industry practices (Skinner, 1969; Fine & Hax, 1985). Hence, there is a need for pre-decision analysis before implementing corporate strategy.

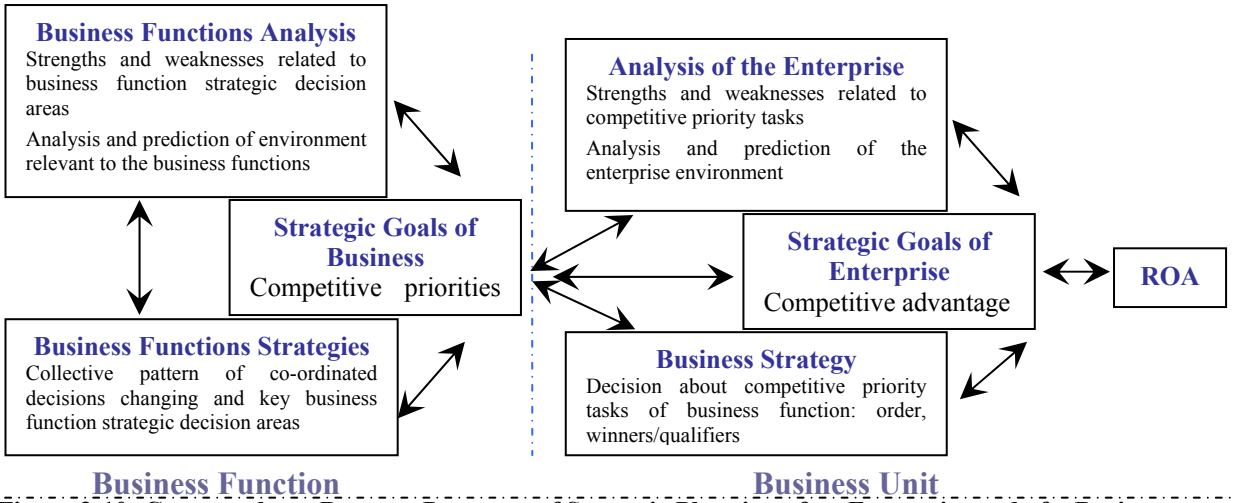

Figure 3-10: Connectedness Between Processes of Strategic Planning of an Enterprise and of a Business Function

Source: (Rusjan, 2005)

Rusjan (2005) focused on the strategic planning of manufacturing companies. He found significant empirical relationships between strategic decisions and manufacturing competitive priorities (Rusjan, 2005). He then proposed a model of strategic planning (as shown in Figure 3-10), which connects the strategic goals of an enterprise and the strategic goal of the business function of the enterprise.

He stressed that "*the business strategy has to be supported by appropriate performance of all business functions. A functional level strategy specifies how functional strategies, for example, marketing/sales; manufacturing; research and development or finance support the competitive business strategy and complement each other.*" (Rusjan, 2005). There is a requirement of the pre-strategic decision analysis in corporate strategy to evaluate whether the corporate strategic decision is well integrated with all business functions.

Mintzberg (1987) stated that "*strategies are both plans for the future and patterns from the past*" (Mintzberg, 1987). He meant that strategic decisions should be forward-looking and based on the current and past capabilities. There must be a match between current capabilities and manufacturing strategies. Along this line, Ghoshal proposed a global strategy (Ghoshal, 1987) organising framework, which not only helps in achievement efficiency and encourages innovation but also helps in managing risk. Further, Lefley (2004) has worked on the Strategic Index (as shown in figure 3-11) to solve the problem of pre-decision analysis.

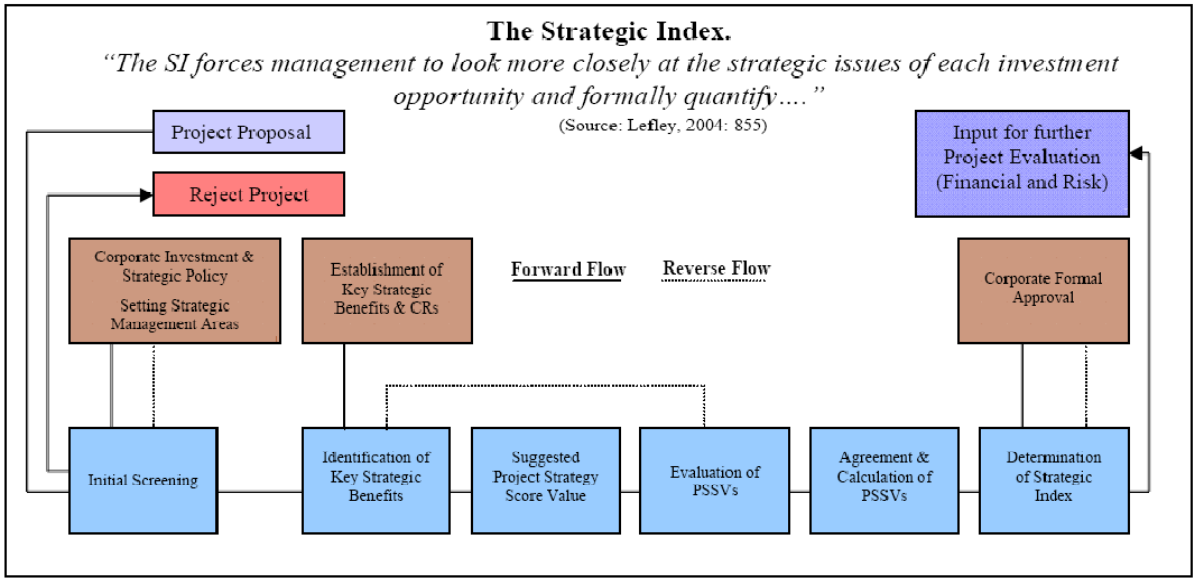

Figure 3-11: Strategic Index

Source (Lefley, 2004)

Strategic Index first focuses on strategic issues that would affect the manufacturing company as a whole. It matches corporate strategy with business strategy. By providing the communication at each level of management, it incorporates all the elements of pre-decision analysis, where a manufacturing company can evaluate all the strategic options by linking business functions with corporate strategy (Lefley, 2004).

Complexity of Decision Making

The complexity of decision-making arises because of the various alternatives and its circularity. Nutt (1998) explored evaluations of the alternatives during decision-making. He stated that decision-making is not linear process and that the evaluation of alternatives and its complexity affects the decision-making (Nutt, 1998). He had seen the complexity of decision-making in terms of political activity and ambiguity rather that evolution and its circularity.

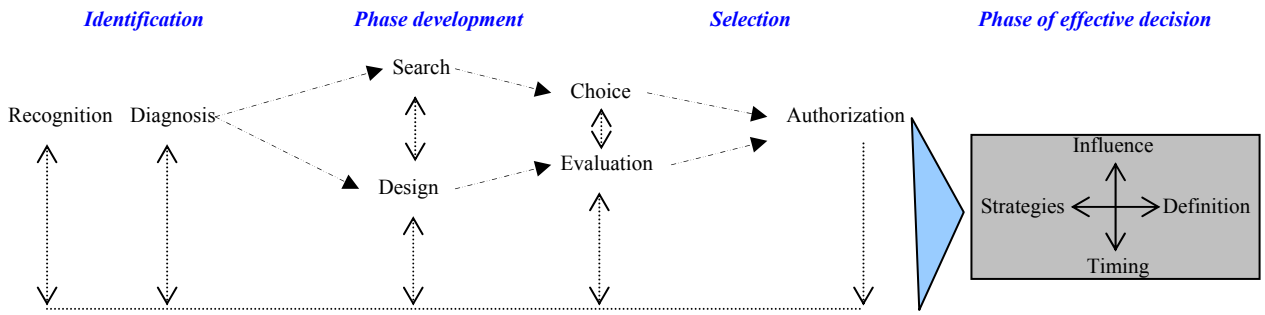

Figure 3-12: Phases and Circularity of Decision Making

(Butler, Davies, Pike, & Sharp, 1993)

Lincoln and Guba (1986) focused on why complexity arises in decision-making and stated that "*we live in a world of finite resources with a seemingly infinite number of interest groups all seeking to exploit them. It is not surprising, therefore, that demands for better and more complete information needed to service decision making, policy formation, and resource allocation are burgeoning"* (Lincoln & Guba, 1986). Therefore, information is vital in the decision-making process and sometimes counterfeit information makes decision making more complex by providing more alternatives.

Butler et al. (1991) concluded that complexity and political affairs are not independent variables of decision-making. However, these variables are part of the decision-making process. Problems arise in the decision-making process when individuality becomes more powerful than the group or team. In spite of this, information adaptability in the decision-making process would reduce the complexity of the decision-making (Butler, Davies, Pike, & Sharp, 1991).

Astley et al. (1982) argued that decision-making is relatively faster when decisions are simple and without cleavage. However, they restated that complexity is relevant to the specific decision topic (Astley, Axelsson, Butler, Hickson, & Wilson, 1982). Butler et al. (1993) demonstrated the complexity and circularity in decision-making (as shown in figure 3-12). They identified that phase development; the selection and phases of effective decisions are the steps in the decision-making process where decision-making faces circularity and complexity.

Theories covered in this subsection section have illustrated that importance of strategic alignment of decisions in a corporation. However, there are complexities in decision-making processes due to lack of information, surfeit of information, and politics. It is also understood that strategy decisions affect the manufacturing competitiveness and global manufacturing investments may influence corporate strategic decisions. Or, global manufacturing decision is part of corporate strategic decision as suggested by Skinner (1960). It observed that risk is part of the project evaluation (Figure 3-11) and risk management is part of global strategy framework. However, risk management structure in strategic decision-making process is not observed explicitly.

3.3.6 Missing Link in Global Manufacturing Research

The global manufacturing literature has illustrated the evolution of the definition of manufacturing. It is observed that many companies' investment decisions require an understanding of its global configuration, coordination, and capability strategies. Despite of global manufacturing investment having higher risk, risk management capability of global manufacturing configurations is overlooked in the literature. Global manufacturing risk has provided varied understanding of global business risks within the context of global manufacturing. However, this analysis is short of micro level risks. It is observed that risk is part of the project evaluation but risk management structure in strategic decision-making process is not observed explicitly. It is observed that risk is part of the project evaluation and risk management is part of global strategy framework.

3.4 Investment

This section describes investment motivation and discusses investment valuation techniques. An historical review of literature (Figure 2-5) suggests that there is a trend in the investment literature evolution. Initially, it focused on profit and loss calculations and then the research shifted to the valuation of future of a company (Irving Fisher, John Burr William etc.). Harry Markowitz (1952) brought a risk minimisation focus to investment research. At the same time, researchers (W F Sharpe, F Black, M Scholes, S Ross, etc.) have studied valuation of risk in investment, which ultimately blurs the boundaries of risk and investment researches.

The objective of this section is to provide a theoretical understanding of investment literature and illustrate the theoretical gap, with respect to global manufacturing and risk management. It also explores key concepts and theories related to investment motivation, valuation and risk analysis. Finally, it discusses the missing link in the literature within the context of global manufacturing and risk management.

3.4.1 Investment Motivation

Investment motivations are discussed partially in chapter 1. The corporate finance literature defines motivation of investment as the desire to increase the shareholder's value. This definition is too broad and lacks specific enablers of global investment. However, it is observed that investment motivations, within the context of global manufacturing, are found

in the literature of global business and global manufacturing. This diversity of investment motivation literature is illustrated in Table 3-6.

Determinants of Global Manufacturing Investment	**Global Business**				**Global Manufacturing**			
	a	b	c	d	e	f	g	h
Competition								
Market								
Cost								
Capability Generation								
Risk Management								

	Theoretical comments
a	*Industry globalisation Drivers: market factors (Homogeneous needs, global customers, global channels transferable marketing), cost factors (economies of scale and scope, learning and experience, sourcing efficiencies, favourable logistics, differences in country costs& skills, product development cost) environment factors (favourable trade policies, compatible technical standards, common marketing regulations) and competitive factors (interdependence of countries and competitors globalized)*
b	*"International investment variables included: investing in countries with low-cost labor, raw materials, etc; sourcing capital funds internationally; investing in countries which offer investment incentives; minimizing tax liabilities through transfer pricing and method of cash remittance."*
c	*Four types of investment motives: natural resource, market, efficiency, strategic asset or capabilities, and others- government incentives, support service and passive*
d*	*Cost, risk (currency, political and supply interruption), market (local), capability (accumulate expertise from different locations).*
e*	*Overseas market, overcome tariff restriction, raw materials, tax benefits, foreign technology access, future investment opportunities.*
f	*"They use foreign factories to enter new markets, support their domestic factories, generate new knowledge, and bring needed skills and talented people to the company.....to deal with foreign exchange and other risks"*
g	*"these new driving forces—global market opportunity, new patters of competition, and reorganising potential or possibility—require a new generation of networks beyond the classical pipeline of physical transformation". "Globalisation of manufacturing networks is typically the result of an internal push for extended capabilities rather than externally driver"*
h	*"….take advantage of low cost inputs, to secure scarce resources such as material and skills, or to facilitate the market penetration. This rationale should not be neglected when constructing alternative network option."*

Table 3-6: Determinants of Investment

Source: a= (Yip, 1989), b= (Morrison & Roth, 1992), c= (Dunning & Lundan, 2008), d= (Porter, 1990), e= (Gee, 1981), f= (Ferdows, 1997), g= (Shi & Gregory, 1998), h= (Christodoulou, Fleet, Hanson, Phaal, Probert, & Shi, 2007), *= information gathered from (Saldivar-Sali, 1997)

The exploration of global investment enablers demonstrated that there are five investment motivations for a company- competition, market, cost, capabilities, and risk management. Ferdows and Porter have touched the topic of risk management while describing investment motivation, both have mentioned currency risks in their work. Globalisation has increased the intensity of these motivations. A company wants to be ahead of global competition, expand to new markets, reduce cost, increase capability in terms of skills, technology and resources,

manages existing risks. This subsection discusses all these derived motivational factors from theories.

Competition

The phenomenon of globalisation, overseen by GATT in the past and currently the WTO, is continuously decreasing the distance between countries (Henzler & Rall, 1986). Changes in the global business environment, led by globalization, created problems, which are changing the basis of competition. These problems are shorter product life cycles, global competition and new market dynamics. Globalisation brings international competitors to domestic markets in a country. Therefore, domestic companies are forced to pursue a global strategy in order to take advantage of the international market (Pradhan, 2004). However, Pradhan (2004) asserted that competition is one of the factors for company internationalization because of the attractive international market opportunity caused by the liberalization of a country's economic policy.

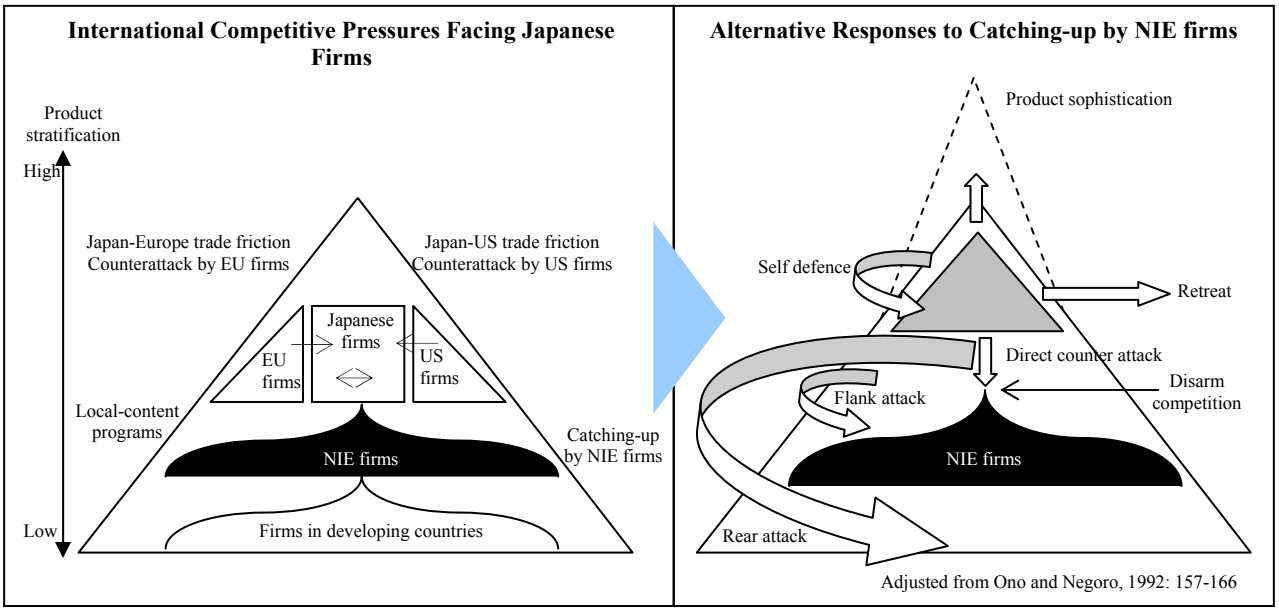

Figure 3-13: International Competitive Pressure Facing Japanese Firms

Dhingra (1991) defines the global competitive environment in the domestic market of a company as *"Push-Oriented Determinants"* for the internationalization of a domestic company. The push-oriented factor of globalisation not only forced domestic companies to be international but also forced multinational organizations to search for new locations to be ahead of their leading competitors.

Onco and Negoro (1992) observed that Japanese companies expanded their operations (by investing in Brownfield and Greenfield projects) into the Newly Industrialized Economies (NIE) in order to fight back the aggressive US, EU, and firms that operate within NIEs. Apart from expanding operations to NIE, they expanded their product lines, used government influence and retreated from some markets by using the techniques of direct counter attack, flank attack and rear attack (as shown the figure 3-13). Therefore, increasing competition plays a vital role in the overseas investment of a company, irrespective of their identity as a domestic or a multinational company (Onco & Negoro, 1992).

Market Opportunity

The second factor is market opportunity, which forces companies to invest in overseas operations. Shi and Gregory (1998) observed that the global market opportunity is one of the new driving forces in globalisation, whilst stating the importance of international manufacturing competitive capabilities (Shi & Gregory, 1998). Most recent market opportunities are created in China and India because of the structural changes in developing countries, such as the deregulation of industry, liberalisation, and an increasing disposable income (Dhingra, 1991). These structural changes are motivating multinational manufacturing companies to consider overseas investment to extend their existing market and get a greater proportion of the total market. A firm could grow by including more products or by acquiring firms, by evolving into new businesses or by exploiting foreign markets (Dunning, 1980). Therefore foreign market opportunity gives high growth options to multinational manufacturing companies. It motivates multinational manufacturing companies to invest in overseas operations.

Low Cost

Demand saturation and high cost of production has minimized the growth opportunity for companies in the domestic markets of developed countries. Rapp stated that the *"volume and cost advantage will be translated into aggressive penetration pricing on a worldwide basis"* (Rapp, 1973). DuBois et al. (1993) argue that *"manufacturing costs play in decisions to increase or decrease a firm's internationally involvement"* (DuBois et al., 1993). In an extensively competitive industry, cost pressures force a company to search for a low-cost country to reduce their production costs.

Companies are focusing more on how to reduce the variable costs such as that of labour and raw materials. Some countries have a competitive advantage in providing comparatively low-wage labours or lower costs for raw material procurement. For example, Etienne (2002) observed that "*China and India derive comparative advantage from simple factors associated with vast pools of low-wage labour, while South Africa, Brazil, Saudi Arabia and Venezuela derive comparative advantages from abundance of natural resources of one kind or another."* (Etienne, 2002). Hence the reduction of production cost motivates manufacturing companies to invest in overseas operations.

Capability Generation

Investment in international operations provides organisational capabilities (Table 3-5) because international operations allow them to tap host country's markets, resources, and technical expertise. For example, pharmaceutical and high technology companies are investing in India to take advantage of (by investing in Brownfield and Greenfield projects) the technological skills of Indian workers. Shi and Gregory (1998) observed this phenomenon in their article "International manufacturing networks - to develop global competitiveness". In their case study, a bakery food processing equipment manufacturer *"developed its first generation of world product through the coordination of the engineers in three continents,"* (Shi & Gregory, 1998). They mentioned that one of the strategic capabilities of the international manufacturing networks are *"Production factors: labour; materials; energy; product and process technology etc. to tap national resources and advantages"* (Shi & Gregory, 1998).

Etienne (2002) stated that each country has specific technical expertise; therefore the *"competitive position of a firm in one country is significantly affected by its competitive position in other countries or vice-versa"* (Etienne, 2002). As capability generation is one of the important elements of international manufacturing network, it motivates an organization to invest in international operations.

Risk Management

Dhingra (1991) analyzed the reasons behind internationalization strategy of an organization, which is facing low growth opportunities in its current business environment. He asserted that every organization has the motivation to improve the shareholder's value. To create

wealth for shareholders, organizations explore the risk minimization opportunities (Dhingra, 1991). International operation provides financial flexibility, integration and diversification, and risk sharing. However, Dunning argues, *"Government intervention is another country-specific variable which affects both the generation of ownership advantages and the economic ties between investing and recipient countries"* (Dunning, 1979). Hadjikhani (1998) expressed grave concern about political instability. He stated that *"political risk can sometimes leave no choice to multinational organizations but to exit from the host country."* (Hadjikhani, 1998). However, these risks can (by investing in Brownfield and Greenfield projects) be mitigated by an adequate risk management process. Therefore, multinational companies invest in overseas operations for risk mitigation as well, and risk management is the fourth factor that motivates a company to invest in international operations.

This subsection has presented the motivations for investment. It is demonstrated that global investment can be a tool to mitigate risks such as high cost risk and currency fluctuation.

3.4.2 Financial Theories

This section presents two prominent financial theories. The primary focus of this section is on Portfolio Theory (PT) and Efficient Market Hypothesis (EMH) because these theories deal with investment strategy and risk mitigation strategy.

Efficient Market Hypothesis

Efficient Market Hypothesis is primarily related to capital markets. This section explores the significance of EMH and analyses the relationship between EMH and overseas manufacturing investment. EMH states that "*an efficient capital market is one in which security prices adjust rapidly to the arrival of new information, and, therefore, the current prices of securities reflect all information about the security"* (Jagric, Podobnik, & Kolanovic, 2005).

As major stock exchanges such as the NYSE, LSE and BSE are treated as efficient capital market, no investor can outperform stock market earnings. It means every investor of the stock exchange will earn the same earnings. *"Proponents of the theory have never seemed interested in discordant evidence," Buffett observed."* (Hagstrom, 1997). However, it is not true in practice because an investor loses or gains in the stock market.

Several reasons have been given for the inefficiency of an efficient capital market:

- Investors do not always behave rationally.
- Investors take variable times to process the information and sometimes process the information incorrectly.
- Short-term gain can be observed, however, it is impossible to outperform the market in the long-term. (Hagstrom, 1997)

There are several lessons that can be learnt from EMH for overseas manufacturing investment decision making:

- If a manufacturing company is buying shares (by investing in Brownfield and Greenfield projects) in a manufacturing company from the stock market then it should process all the information about the company's macro and micro environment correctly and rapidly to avoid the risk of paying more than the value of the company shares.
- If a manufacturing company is investing in an overseas Greenfield project then it should analyse the potential of the total business environment and industry-specific environment of the country through the stock exchange market indices.

Portfolio Theory

Portfolio theory gives an insight into the risk management of a company investment, especially on the stock market. Harry Markowitz first proposed this in 1952 (Rubinstein, 2002). According to Markowitz, return is always unpleasantly combined with risk in a complicated way. He quantified the risk using statistical tools. He proposed that different levels of risk give different levels of return. However, he proved that high return is possible without being exposed to high risk by asset diversification (Hagstrom, 1997; Rubinstein, 2002).

Markowitz suggested that the investor tends to reduce the risk. The investor can design their investment portfolio in such a way as to earn the same level of expected return while having less risk associated than before with that level of expected return. *"Rather than "putting their eggs in one basket," the purchase of a broad range of securities would ensure that the decline in returns in some securities that perform poorly would be offset by increases in*

returns doing others that are doing well." (Leong & Lim, 1991). It is important for an investor to know what level of risk they want or they are comfortable with, and then to construct the efficient portfolio of an asset. An organization can minimize the risk of a shrinking market and various current exchanges by keeping a geographically diversified portfolio of plants (Hanink & Cromley, 1987). Therefore overseas manufacturing investment decisions may consider efficient portfolio management as a means to avoid the global business risk.

Financial theories illustrated the need to process a large volume of information with some risk management strategies in global manufacturing investment. However, these theories are a small part of the overall management of risk.

3.4.3 Investment Valuation

There are two models of finance, which are often used by investment banks, consultancy and a company's strategic planning division for international project valuation. These models are Net Present Value (NPV) or Discounted Cash flow (DCF) and real option. Real options approaches are used when there is more uncertainty related to the project. The published literature related to project valuation is discussed in this section.

Net Present Value

The NPV determines the fate of the project or investment. It is calculated by discounting the future cash flow with one *"hurdle rate"* (Dixit, 1992) or risk adjusted discount rate (De Reyck, 2005). The hurdle rate is the opportunity cost of the invested capital and it is calculated by Capital Asset Pricing Model (Dhankar & Singh, 2005) or by other financial tools to calculate the cost of equity and the cost of debt. The NPV gives the expected return on investment and is heavily influenced by the risk discount rate. Sometimes multiple risk adjusted discount rate is used in the NPV calculation because of significant *"net cash infusions after the initial investment"*(Pratt & Hammond II, 1979).

NPV is very commonly used in investment decision-making. *"The net present value rule is a pillar of modern finance theory. As known, it is a capital budgeting rule"* (Magni, 2002). However, the NPV calculation is based on an assumption about the future to determine future cash flow (Magni, 2002). Magni (2002) argues that there are some anomalies and inconsistencies when one judges the project by applying NPV. His argument was based on

case studies. However, Reyck contradicted Magni's argument. He stated that *"the net present value rule, when applied correctly, can be used to value investment projects by comparing assets of equivalent risk"* (De Reyck, 2005).

Then again, NPV analysis incorporates a potential investment opportunity using the future cash flow generated by the project (Benninga & Tolkowsky, 2002). As the NPV calculation is based on an assumption about the future, it does not give the actual return on investment because these are based on uncertain assumptions of the future.

Real Option

Real option valuation gives flexibility to decision makers taking decision in uncertain situations (as shown in figure 3-14). It provides a tool of waiting until uncertainty or risk becomes known (Trigeorgis, 2005). Real option approaches provide a portfolio of options for investment in uncertain situations. These options are not obligatory to perform. Fundamentally, it buys the time in high risk projects.

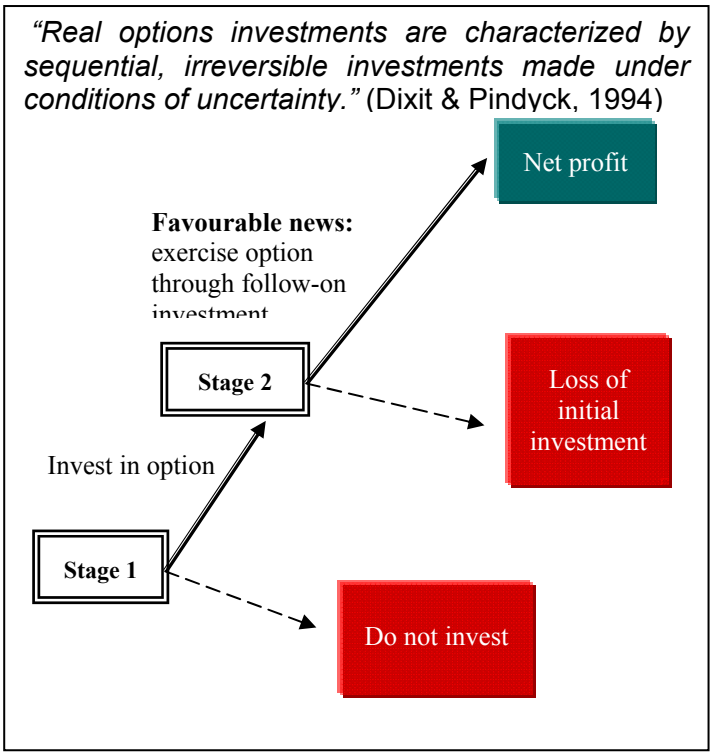

Figure 3-14: Real Option

(Adner & Levinthal, 2004)

The financial definition of real option states that an option contract should have the option to buy or sell an asset on or before the maturing or exercise date. *"When the underlying asset is a non-financial one, the contract is referred to as a "real option"* (Nembhard, Shi, & Park, 2000). Botteron identified different aspects of real options. He perceived that real options quantify the qualitative future opportunity. It develops a series of options then quantifies these options with the help of options-pricing models (Botteron, 2001). This way the decision maker can enhance their decision-making ability. However, real options do not show the decision maker how to make the decision (Lander & Pinches, 1998).

NPV gives less value to highly uncertain investments whereas *"real option value generally increases as volatility increases"* (Lander & Pinches, 1998). Managers believe that real options give unrealistically high value to projects, which have high risk. Kautt (2003) believes that real option is a powerful tool in capital budgeting; however, it is not aprropriate to use real options all the time. To use a real option, there should be a real option situation. He identifies that *"opportunities to use this analysis depend on the situation and whether enough appropriate and accurate information is available"* (Kautt, 2003).

Janney and Dess (2004) agreed with Kautt (2003) that investment uncertainty problems could not be fully solved by real options. They warned that *"failing to understand the limitations of options can lead to some perilous pitfalls, leading to unsupported confidence in the decisions made"* (Janney & Dess, 2004). Therefore, although real options are widely used in valuing high-risk projects, there is still the requirement for robust models to value high risk capital intensive projects.

Theories presented this section illustrated that the valuation technique incorporates risk analysis and risk mitigation strategies. However, the quantification of uncertainty in valuation does not expose risks. The problem in this kind of risk analysis is that a detail risk minimisation strategies cannot be formulated, as risks are not identified.

3.4.4 Corporate Finance-Risk

Corporate finance extensively addresses the risk factors for businesses. Corporate finance risk analysis is performed through corporate finance methods with the help of statistical calculations. For instance, Oxelheim and Wihlborg (1987) have shown how to measure

macroeconomic exposure based on specific conditions (as shown in Figure: 3-15)(Oxelheim & Wihlborg, 1987). They have shown how regression and scenario analysis can be used to determine the risk.

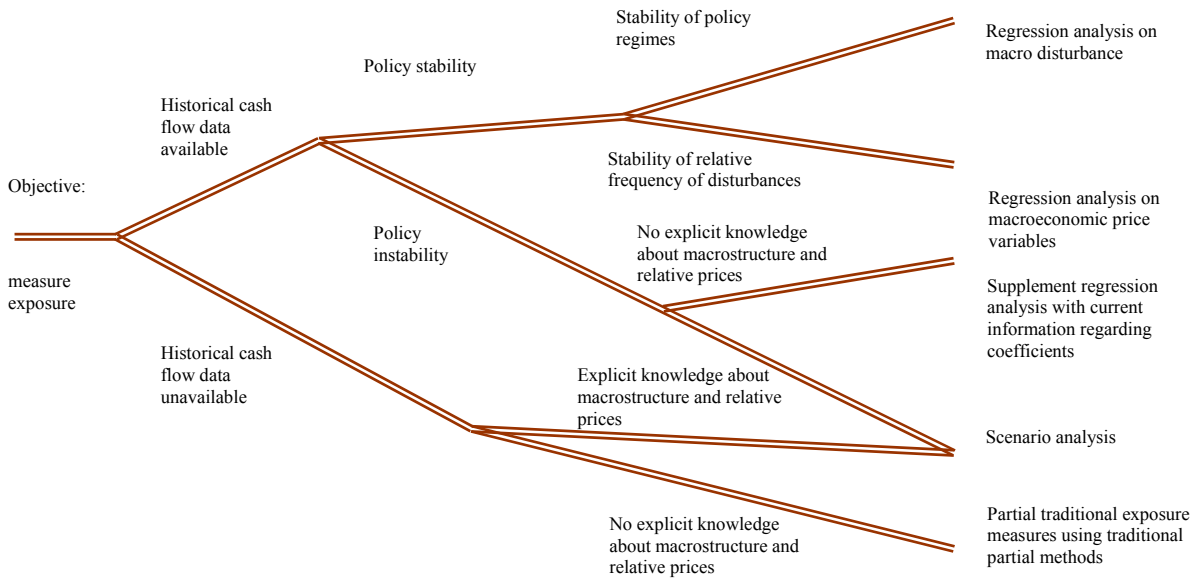

Figure 3-15: Conditions for Use of Different Methods for Measuring Macroeconomic Exposure

Source: Oxelheim and Wihlborg, 1987

This section focuses on literature about corporate finance methods on risks. These risks can be divided into two types: systematic risks and unsystematic risks. For project viability calculations, Capital Asset Pricing Model (Mullins Jr, 1982) and Arbitrage Price Theory (Ross, 1976) are widely used. This section will provide a critical literature review on these two methods.

Capital Asset Pricing Model

The financial model divides risk into two types. The first type is unsystematic risk, which deals with risk related directly to a company and its internal operations. Unsystematic risk can be mitigated or reduced by a diversification strategy. Systematic risk is related to a market, which cannot be controlled because it arises due to a turbulent market environment. The Capital Asset Pricing Model (CAPM) defines the risks and quantifies them. It also defines the returns on specific systematic risks (Mullins Jr, 1982).

CAPM application in finance was first used solely on the stock market for share valuation. As time passed the application of the CAPM model also diversified to include topics of resource allocation within the organization (Robins, 1992) and merger and acquisitions (Lubatkin, 1983). Mullins (1982) defined that CAPM mainly deals with financial markets and its theoretical aspects (as defined the Figure 3-16) can used to estimate the cost of a company's equity (Mullins Jr, 1982). Currently, it is widely used from financial markets to the organizational level. It helps to calculate the hurdle rate or discount (Dixit, 1992) for discounting future cash flow for Net Present Value of a company.

Capital Asset Pricing Model (CAPM): *"The CAPM is an equilibrium model that explains why different securities have different expected returns. It provides a methodology for quantifying risk and translating that risk into estimates of expected return on equity. In particular, it asserts that the expected returns vary because securities have different betas. There is a linear relationship between beta and expected return."*

CAPM: $E(R_j) = R_z + \{E(R_m) - R_z\}B_i$

Where, $E(R_j)$ = Expected return

R_z = Return on risk free asset

$E(R_m)$ = Expected return from asset with risk

B_i = Systematic risk of the assets

$[Cov(R_j, R_m) / Var\ R_m]$

(Dhankar and Singh, 2005: 14)

Figure 3-16: Capital Asset Pricing Model

CAPM has been developed on two assumptions: perfect or efficient market and consistent investor risk preferences. Supplementary and equally, the investor reduces the unsystematic risk by diversification and the investor always prefers less risk. It also assumes that the non-diversifiable risk behaviour of an asset will be consistent in the future. In reality, there are pitfalls in efficient market hypothesis and investor risk preferences always fluctuate based on the opportunity available in the current increasingly turbulent environment. However, Mullins (1982) argued that CAPM provided one more analytical tool to managers.

Arbitrage Pricing Theory

The Arbitrage Pricing Model (As shown in Figure 3-17) is the extension of CAPM. Dhankar and Singh (2005) argued that the Arbitrage Pricing Theory (APT) can be used as an alternative to CAPM (Dhankar & Singh, 2005). Dangerfield, Merk and Narayanaswamy (1999) asserted that APT incorporates multiple risks in the analysis of the cost of equity rather than one risk analysis (Dangerfield, Merk, & Narayanaswamy, 1999). The asset price is affected by macroeconomic factors, such as inflation GDP and global discontinuity. The risk of an asset can be calculated by the volatility of the asset's price as a result of the changes in macroeconomic factors.

Arbitrage Pricing Theory (APT): *"The alternative model for asset pricing APT assumes that security returns are generated by a factor model but does not identify the factors. It implies that securities or portfolios with equal factor sensitivities should offer the same expected returns. If not, investors will take advantage of arbitrage opportunities, causing their elimination. The equilibrium expected return on a security is a linear function of its sensitivities to the factors."*

APT: $E(R_i) = R_0 + \lambda_1 b_{i1} + \lambda_2 b_{i2} + \lambda_3 b_{i3} + \ldots\ldots\ldots + \lambda_j b_{ij}$

Where, $E(R_i)$ = Expected return
R_0 = Return on risk free asset
λ_j = premium for risk associated with factor j.
b_{ij} = risk of the assets because of factor j
(Dhankar and Singh, 2005: 15)

Figure 3-17: Arbitrage Pricing Theory

Ferson and Korajczyk (1995) argued that the expected return on the asset could be predicted to some extent within a specified period of time. However, miscalculations based on wrong assumptions can counterbalance the expected return. They believed that the variation in the expected return exists because of the inefficiency in the market or the volatility of economic factors. Therefore the expected return can be predicted, if and, only if, the assumptions of the variables would be justified in the future (Ferson & Korajczyk, 1995). The predictability of economic or market variables are the limitations of the APT model.

3.4.5 Missing Links in Investment Research

The investment literature has illustrated the motivations of global manufacturing investment. It is demonstrated that global investment processes can provide tools to mitigate risk such as high cost risk and currency fluctuation. Valuation theories presented in this section demonstrated that the valuation technique incorporates risk analysis and risk mitigation strategies. However, the quantification of uncertainty in valuation does not reveal risks. Financial theories illustrated the need to process much information with some risk management strategies in global manufacturing investment. Investment literature lacks investment risk management structure within the context of global manufacturing investment.

3.5 Research Gap: Risk Management in Global Manufacturing Investment

The objective of the literature review is to identify investment risk management in global manufacturing structures by exploring literature of global manufacturing, risk management and investment. These literatures have been evolving since 15th, 16th and 17th centuries respectively (Figure 3-18). It is observed that these literatures are converging. As a result, the

boundaries of investment and risk management increasingly become blurred. There is limited study of the interfaces between the three bodies of knowledge.

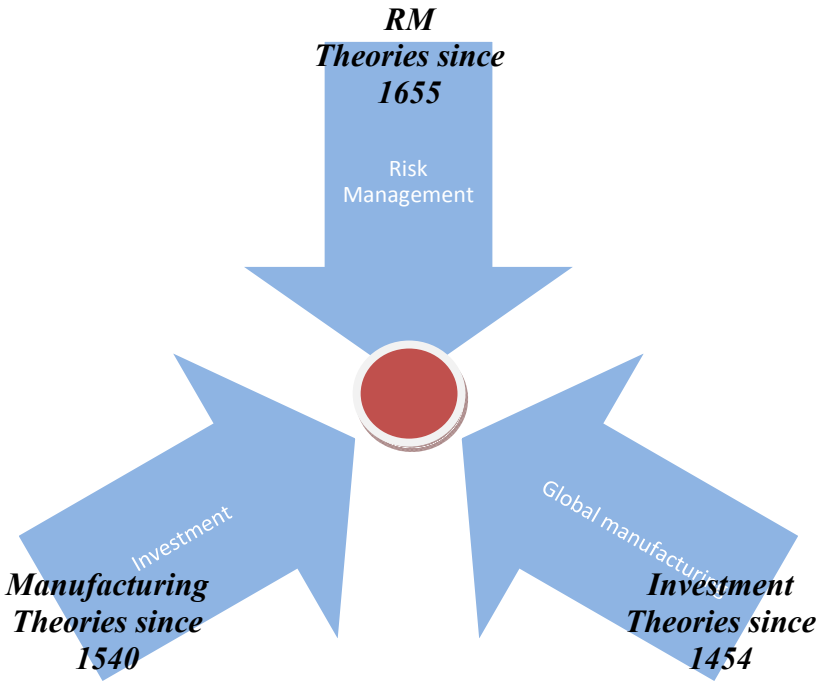

Figure 3-18: Convergence of Literature

Exploration of various theories identifies 'investment risk management in global manufacturing' as a research gap. Hence, literature review findings help to formulate the research question. Additionally, a conceptual framework can also be developed. The findings of the literature review are as follows:

- There are technical and social science definitions of risk. Risk is defined but the context of risk definition is missing.
- Risk categories are observed in literature but these categories are broad and , again, are not developed within the context of the global manufacturing investment.
- Global manufacturing concepts (strategies, configuration, coordination and capability) are discussed but relation of these concepts with risk and risk management is not observed.
- The aim of risk management is fourfold: identify risks, assess risks, administrate risks and monitor risks. However, key features within these headings are missing with the context of the research topic.
- Various tools and risk mitigation strategies are observed in literature. However, it is not clear what tools global manufacturers are using in their global investment.

3.6 Research Question and Conceptual Framework

The research question has evolved from the research background, practice review, and theoretical missing links within global manufacturing, investment and risk management theories. The research background illustrated that despite the increasing importance of risk from the perspectives of globalisation and global investment, there is less focus on risk management in manufacturing investment. However, the practice review illustrated that risk management has acquired an important status at corporate level of companies because of emerging regulations. From the finance perspective, operational risks appear to be barely considered in the valuation of projects, which suggests that manufacturing investment is more focused on reward than risk.

The literature review helped to understand risk management concepts along with investment and global manufacturing. Due to the existing theoretical limitation, it would be an exaggeration to say that companies are investing based on mere luck. As risk is an abstract term and there are limitations to the theories, there are three key arguments - (a) Investment risk management exists in global manufacturing investment, (b) explicit and implicit investment risk management exists in global manufacturing, and (c) Investment risk management does not exist. To investigate these arguments, this research proposes following research question:

How is risk management practiced in global manufacturing investment?

The investigation of the above question in global manufacturing can address the set of questions, which arise due to limitations of theoretical knowledge. From the review of practice examples and literature, risk management exists only in an implicit and unstructured form. In order to create an in-depth risk management understanding, this research aspires to investigate types of risks, dimensions of investment risk management, process of Investment risk management, and Investment risk management behaviours of global manufactures.

This research requires significant clarification of dimensions and variables before the field study. The presentation of these key variables and key understanding presented in a conceptual framework (Miles & Huberman, 1994). The conceptual framework is developed

to guide the field research and data analysis[16] (Figure 3-19). It is divided into four interrelated segments. Preliminary construct, the first segment, presents the research background, practice requirement and preliminary arguments (Chapter 1).

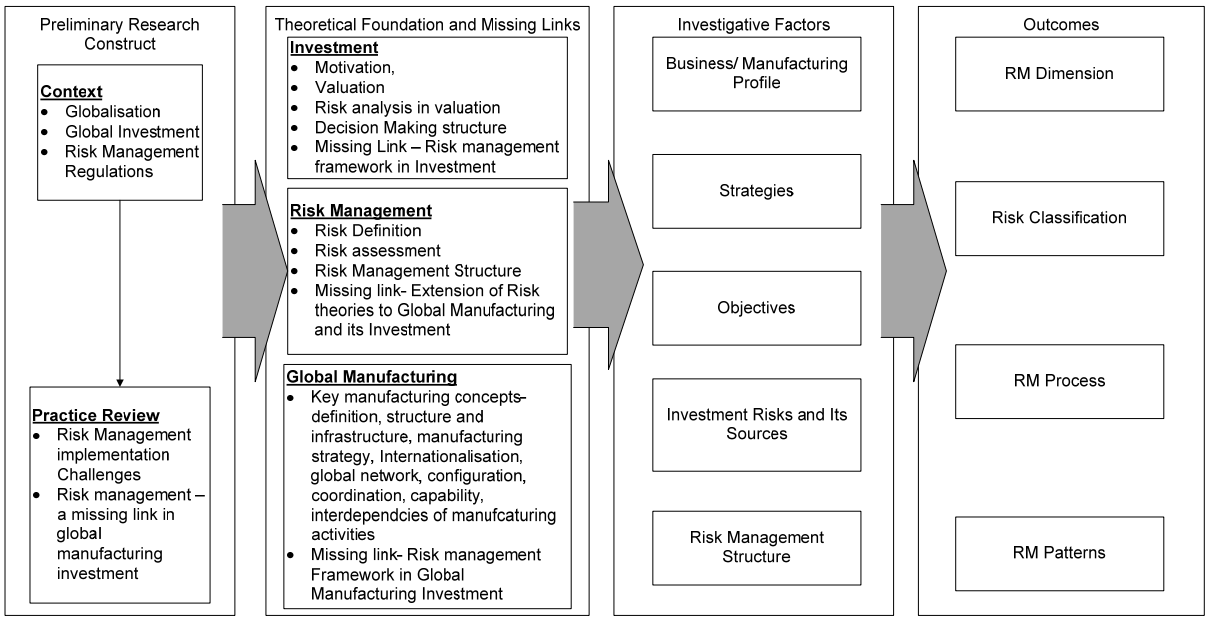

Figure 3-19: Conceptual Framework

Theoretical foundation, the second segment, illustrates key concepts within the research topic. It also presents key arguments from a theoretical perspective. The primary objective of the theoretical foundation is to develop knowledge to identify global manufacturing risks, and explicit and implicit risk management practices. Additionally, the literature review helped in determining the research scope[17].

The third segment, investigative factors, is derived from the literature review along with the research question. Investigative factors to be explored in the fieldwork include risk management dimensions, risk classification, risk management process and risk management practices pattern. These outcomes will create an understanding on investment risk management in global manufacturing.

[16] Chapter 6
[17] Explained in chapter 4

3.7 Summary

The objectives of the literature review are to set out the current state of knowledge, identify gaps, and develop a conceptual framework for further study. The findings of this chapter are as follows:

- Contextual definition of risk and risk categories are missing from global manufacturing investment perspective.
- Risk management requires imagination, logical explanation, and creativity.
- Existing theoretical risk management processes are not developed in a global manufacturing and network context.
- There is no standard to which 'investment risk management in global manufacturing investment' might be referred for the understanding of risk, practices and process.
- Investment literature lacks investment risk management structure within the context of global manufacturing investment.
- Quantification of uncertainty in valuation does not reveal risks.
- Financial theories are a small part of the overall management of risk.
- Risk management capability of global manufacturing configuration is overlooked in the literature.
- Investment risk management structure in strategic decision-making process is not observed explicitly.

A research gap has been identified based on the above findings and practice review. A research question and a conceptual framework have been proposed to investigate the research gap.

4 RESEARCH APPROACH.

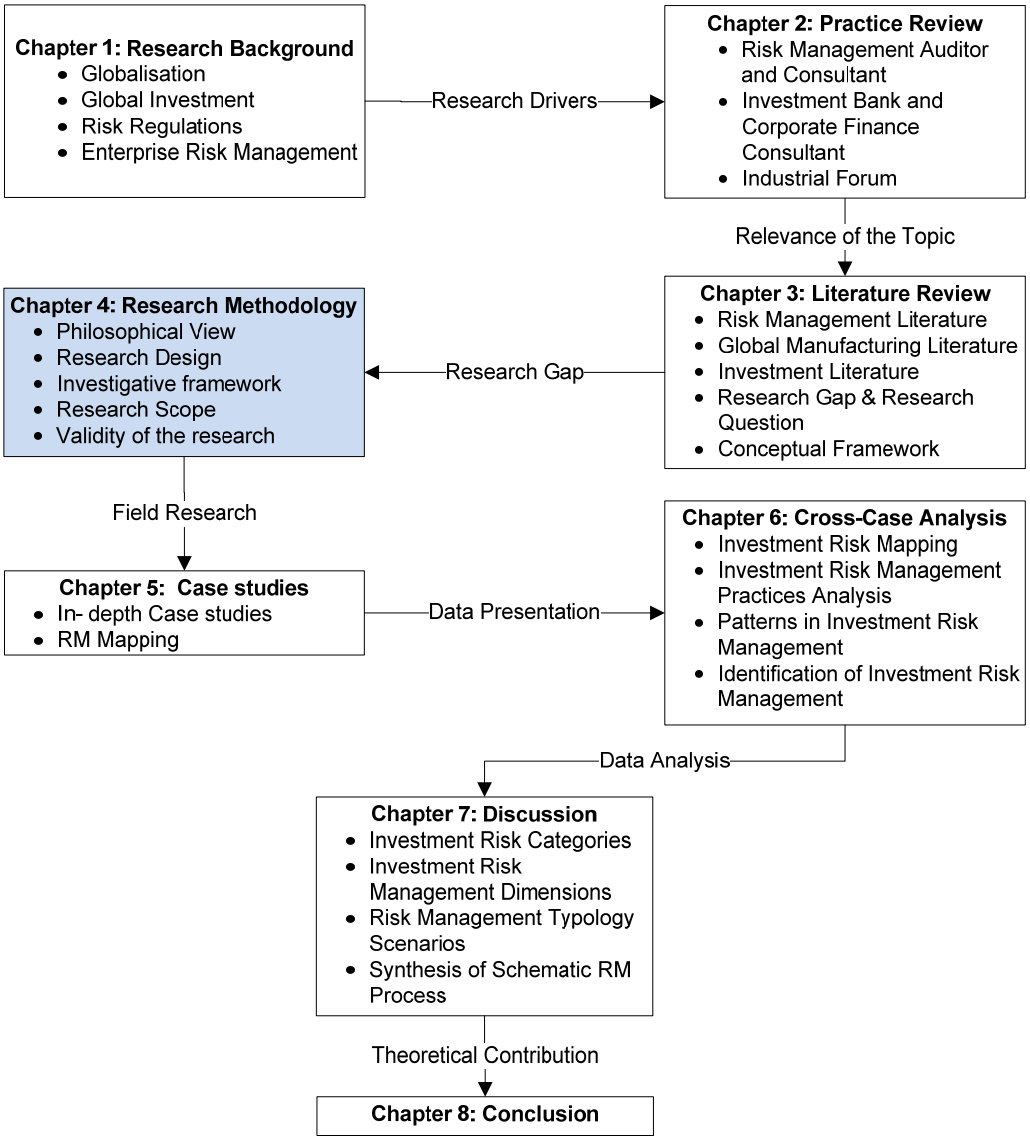

Figure 4-1: Chapter Map

4.1 Introduction

This chapter discusses the details of the research process and provides an approach through which investment risk management can be understood within the context of global manufacturing. The objective of this chapter is to define a methodology, which will facilitate field research, data analysis, and conclusion for theory development along with the quality of the research. It begins by presenting the philosophical view of the applied methodology. It then focuses on multi-dimensional pilot case studies and literature review to show the evolution of the research question. The chapter concludes with a description of the research approach.

Clarity in research design comes from the knowledge of philosophical issues such as the relationship between data and theory (Easterby-Smith, Thorpe, & Lowe, 2002). Easterby-Smith et al. (2002) stated that an acquaintance with philosophical issues gives an understanding of the appropriate methodology needed to achieve and to analyse the required evidence in order to answer the research question.

Ontology	Assumption that we make about the nature of reality.
Epistemology	General set of assumptions about the best ways of enquiring into the nature of the world.
Methodology	Combination of techniques used to enquire into a specific situation.

Table 4-1: Definition of Philosophical Terms

(Easterby-Smith et al., 2002: 31)

This chapter defines the epistemology and methodology of the research (definition shown in table 4-1), which will then help in the construction of the research design for the further investigation.

4.2 Research Question Evolution

This research seeks to adopt an approach to analyse risk management in global manufacturing investments. Three bodies of knowledge have been identified for investigation: risk management, global manufacturing, and investment. These domains of knowledge also touch the literatures of decision - making and strategy. The literature review highlights the research gap (missing links) in risk management, global manufacturing and investment, within the context of the research.

Accordingly, the theoretical understanding assisted in the development of the research question in order to conceptualise the research topic (Figure 3-19, Chapter 3). The following research question evolved from the practice and literature review:

"How is risk management practiced in global manufacturing investment?"

According to the research question, this research aims to extend risk management theories into global manufacturing. Risk management practices are not well defined in the context of global manufacturing. Even risk management and investment theories are only partially helpful in generating understanding on investment risk management in global manufacturing. These two shortcomings justify the approach of theory building for empirical studies (Eisenhardt, 1989; Strauss & Corbin, 1990; Gill & Johnson, 1991).

To construct the theory this research aims to, first, present the overview of risk understanding and risk management practices in global manufacturing investment. Secondly, it develops key categories of risk, risk management structure, risk management process and risk management behaviours. To guide the research, a conceptual framework (Figure 3-19) is derived from the research context, practice review and theoretical foundation. The further design of the research has been developed based on the research question.

4.3 Theoretical Background of Research Design and its Applicability

This research process identifies the investment risks and risk management practices of a company. The research findings will lead to the development of categories, which is an important part of theory generation, through the study of the risk management phenomenon. By comparing and contrasting the positivist and socially constructed with the nature of study (theory development), this research takes an epistemologically socially constructed viewpoint (Table 4-2). It addresses issues related to research method selection, research process and research method quality of the research.

	Positivism	*RD	Social Constructionism	*RD
The observer	must be independent	X	is part of what is being observed	✓
Human interests	should be irrelevant	X	are the main drivers of science	✓
Explanations	must demonstrate causality	X	aim to increase general understanding of the situation	✓
Research progress through	hypothesis and deductions	X	gathering rich data from which ideas are induced	✓
Concepts	need to be operationalised so that they can be measured	X	should incorporate stakeholder perspectives	✓
Units of analysis	should be reduced to simplest terms	X	may include the complexity of 'whole' situations	✓
Generalization through	statistical probability	X	theoretical abstraction	✓
Sampling requires	large numbers selected randomly	X	small numbers of cases chosen for specific reasons	✓

Table 4-2: Positivism and Social Constructionism Mapping

Adapted from (Easterby-Smith et al., 2002)

This research investigates a small sample of global manufacturers by identifying large variables derived from business profile, strategies, configuration, capabilities and investment decision-making process.

4.3.1 Research Method Selection

Case Study

The above sections explain the nature of the research (theory building-empirical research) and philosophical stance of the research (epistemological social constructive). Both support the qualitative research method for this topic (Eisenhardt, 1989; Strauss & Corbin, 1990). However, qualitative research has been criticised for low credibility, data collection difficulties, high time and resource consumption and analysis difficulties (Easterby-Smith et al., 2002). The debate about case studies is ongoing but it is well established technique whenever the research requires to explore a phenomenon that does not have well established formal structures (Skinner, 2007).

Yin has asserted that *"defining the research questions are probably the most important step to be taken in a research study"* (Yin, 2003). According to the research question, this research is using various sizes of global manufacturers for data collection, which creates restriction in controlling events. McCutcheon and Meredith state that *"this restriction eliminates the use of controlled experimentation and with it, the powerful procedures that are*

the bases of laboratory experiments and mathematical simulations"(McCutcheon & Meredith, 1993).

Strategy	Form of research question	Requires control over events?	Focuses on contemporary events?
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how many, how much	No	Yes
Archival analysis	Who, what, where, how many, how much	No	Yes/no
History	How, why	No	No
Case study	How, why	èo	Yes

Table 4-3: Relevant Situation for Different Research Strategies

(Yin, 2003)

Yin (2003) stated that the research strategy should be based on the substance and the form of the research question. He further suggested three situations to select a research strategy (Table 4-3). Therefore, the case study methodology has been selected as reflecting the nature of research and its characteristics.

4.3.2 Research Process.

Research scope and unit of analysis: It is observed in the practice review and literature review that investment risk management practices or frameworks might be implicit or explicit in global manufacturing companies. To observe the implicit and explicit nature of phenomena, this research observes the investment decision-making process. A schematic of investment decision processes is shown Figure 4-2 (Hayes & Wheelwright, 1984; Butler et al., 1993; Lefley, 2004; Srai et al., 2009). It includes investment conception, expectation generation, investment decision, investment initiation, and venture into risk.

Investment conception is related to objectives of an investment. Expectation generation is linked to qualitative and quantitative assessment of an investment, which provides expected benefits or profit. Investment decision step is related to investment choices of a company. Investment initiation related to investment project management (building infrastructure and structure of manufacturing) and venture into risk concerned with starting of operations

(producing products). This process is the conceptual understanding, which is derived from the 'corporate decision making' and 'operations management' research.

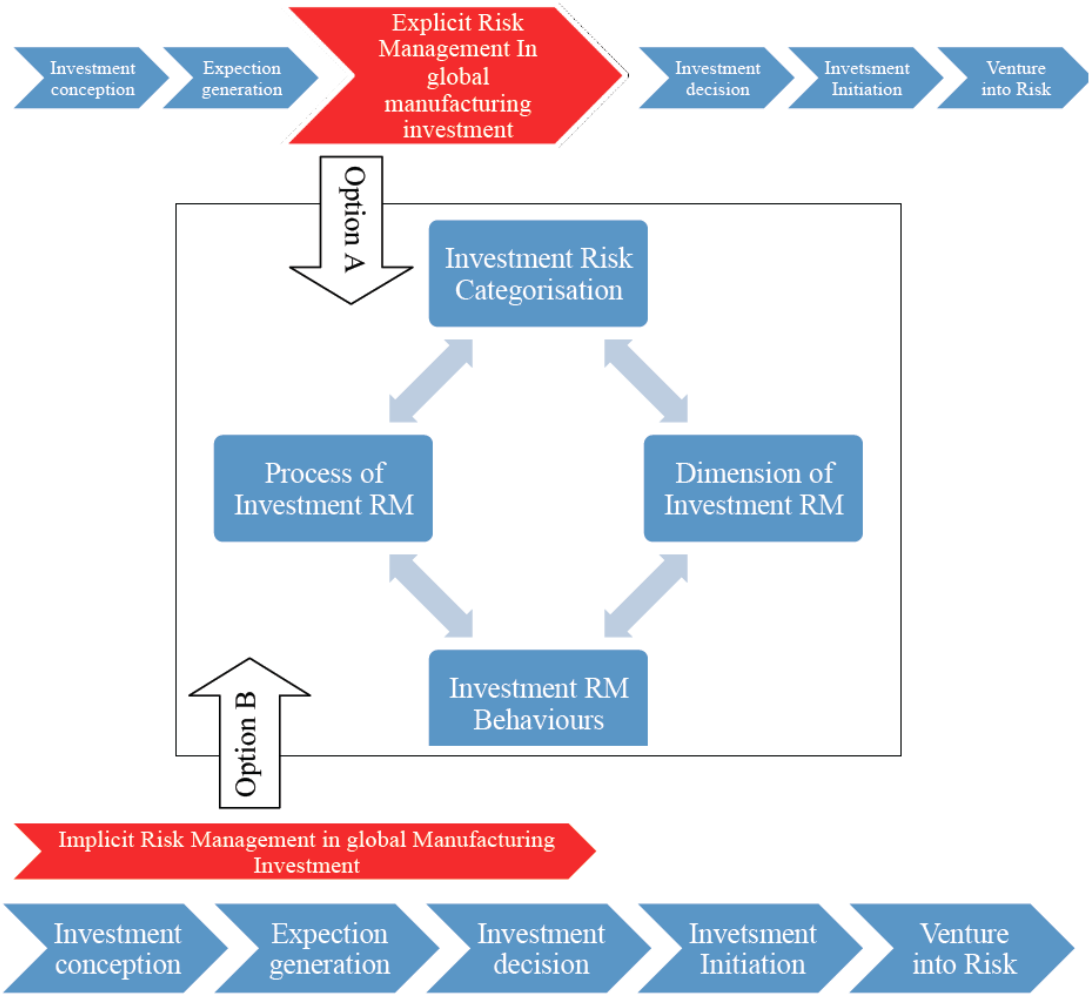

Figure 4-2: Options of Exploration of Risk Management in Investment Decision-Making
Source: After (Hayes & Wheelwright, 1984; Butler et al., 1993; Lefley, 2004; Srai et al., 2009)

The significance of risk management illustrated the need for better understanding of investment risk management in global manufacturing. However, literature and practice review are unable to identify risk management. Hence, it is assumed that there are two options (Figure 4-2) in approaching this research. The first option includes risk management in investment decision making. It means there are explicit risk management in global manufacturing investment. The second option does not include risk management in investment decision making explicitly. It means there are implicit risk management in global manufacturing investment decision-making process. In both options, this research is the observation of risk management in global manufacturing investment.

The above paragraphs explain the area where this research will focus. The unit analysis of the research is global manufacturing investment risk management and the scope of the research is limited to investment decision-making process. It is one of the important steps in empirical research (Flynn, Sakakibara, Schroeder, Bates, & Flynn, 1990).

The notion of global manufacturing investment requires clarity. Global manufacturing investments can include any manufacturing activities' investment because of a broad manufacturing definition . To bring consistency in the research, the level of analysis is global plant investment projects. This research will focus on the global manufacturers who have currently or recently invested in plants or transferred plants to a global location apart from their country of origin.

Case study research process: Yin's case study method (Yin, 2003)is followed, which is divided into three phases- conducting several case studies, writing a cross-case report, and development of the theory. This process includes the review of preliminary report (mostly interview data with some analysis) by case companies, practitioners and academics. Sharing of the research findings at various academic forums is another characteristics of this research design. To develop theory on investment risk management in global manufacturing, four outcomes (Figure 4-2) are targeted, which help to answer the research question. Different sizes of companies are investigated to explore variations in investment risk behaviour of global manufacturers of different scales.

Number of Cases and Data Collection: Meredith stated that *"the single case study with its extensive qualitative description and contextual and temporal analysis is the most applicable method and statistical methodology is inappropriate"* (Meredith, 1998). Another view is that number of cases depends upon the research maturity (Strauss & Corbin, 1990). Research maturity means when data collection becomes exhaustive and emergence of key concepts become repetitive. To achieve the research outcomes, this research has developed the following set of guidelines to select cases for field study:

- Stock exchange listed companies because they comply with risk management regulation.
- Private limited companies because they are not obliged to follow risk regulation

- Companies with more complex manufacturing network-operations spread across the world.
- Companies with less complex manufacturing network-operations spread in more than one country but less than 10 countries.
- Companies with higher financial resources- higher revenue generating companies probably in $ billions.
- Companies with lower financial resources: relatively lower revenue generating companies, probably in $ millions.
- Companies that are currently involved in plant investment or completed their investment recently.

The required number of cases for research of this type is academically debatable. However, 4 to10 cases in case methodology are understood to be typical(Eisenhardt, 1989). Given the considerable scope of research, units of analysis and case selection guidelines, seven case studies (Table 4-4) are selected for the exploratory empirical study and these cases are not used for the testing and verification purposes. This small number of case companies provides the opportunity for in-depth observation (Voss, Tsikriktsis, & Frohlich, 2002) and high quality data (Leonard-Barton, 1990). It is a multi-case study design to develop the theory (Leonard-Barton, 1990; Meredith, 1998; Voss et al., 2002).

*Selected Companies	Sales ($ millions)	Description	Types of investment
A	2	CNC precision engineering company (private company) at Cambridgeshire in UK, involved in contract manufacturing. Operation includes production of plastic and metal parts and partial work on parts assembly.	Plant transfer
B	180	Global producer and distributor of household products. makes products by mixing various chemicals	Sales & operations alignment
C	700	A non-stock exchange listed subsidiary of a fortune 500 companies. Produces diesel and gas generator sets globally at five locations	Factory network rationalisation
D	22,000	Global food product manufacturer. Privately owned company and has presence in 66 countries.	Factory network rationalisation
E	30,000	Global engineering company. European public company with five business divisions	Factory network rationalisation
F	36,000	Global manufacturer of diesel engine, turbine, construction machinery, and earth moving machines. Stock exchange listed company.	Factory network rationalisation
G	4,000	Global manufacturer of protective packaging material and systems. Stock exchange	Factory network rationalisation

Table 4-4: Selected Case Companies

Area of data collection: A case study investigative framework is formulated to collect the data (Figure 4-3). It is divided into four segments- business analysis, operational analysis, investment analysis, and risk management analysis.

Business and operational analysis investigates strategies to understand the reason behind the global investment. Investment analysis explores risks and risk management structures though explicit and implicit risk management practices. Risk management analysis categorises risk management practices. Though this research is on investment risk management, a holistic approach is taken to understand the wider relationships of investment risk management at various levels within companies.

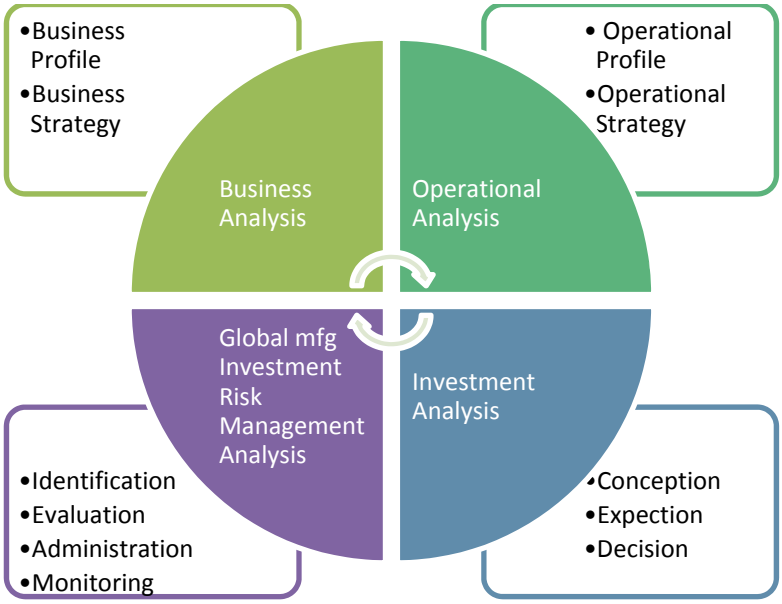

Figure 4-3: Case Study Investigative Framework

Definition of data: As this research embarks on indentifying investment risk management, following are the set of guidelines derived from risk theories to identify explicit and implicit risk management practices:

- Identification of explicit of risk management in global manufacturing investment
  - Identifying steps of investment decision-making, which are explicitly associated with word 'Risk'.
  - Categorising above identified practices and their characteristics into risk identification, risk assessment, risk administration and risk monitoring.

- Identification of implicit of risk management in global manufacturing investment

- Indentifying steps of investment decision-making, that are explicitly associated to 'Reward'. Reason being the association of uncertainty with expected reward from an investment (Markowitz, 1952; Hagstrom, 1997; Merna & Al-Thani, 2005; Kazlauskiene & Christaukas, 2007). Hence, the implicit risks are chances of not achieving expected reward and its consequence. (Refer chapter 3)
- Categorising above identified practices and their characteristics into risk identification, risk assessment, risk administration and risk monitoring

Method within case study: Participant observation provides *"the ability to perceive reality from the viewpoint of someone inside the case study rather than external to it"* (Yin, 2003). Participant observation records cause and effect relationships in real-time within the context of the event (Yin, 2003). Due to the sensitivity of the research topic, case companies were unwilling to accept a participant observation approach but were happy for interview data to be collected subject to a confidentiality agreement and anonymity in reporting.

Source of Evidence	Strengths	Weaknesses
Documentation	• stable - can be reviewed repeatedly • unobtrusive - not created as a result of the case study • exact - contains exact names, references, and details of an event • broad coverage - long span of time, many events, and many settings	• retrievability - can be low • biased selectivity, if collection is incomplete • reporting bias - reflects (unknown) bias of author • access - may be deliberately blocked
Archival records	• same as above for documentation • precise and quantitative	• same as above for documentation • accessibility due to privacy reasons
Interviews	• targeted - focuses directly on case study topic • insightful - provides perceived causal inferences	• bias due to poorly constructed questions • response bias • inaccuracies due to poor recall • reflexivity - interviewee gives what interviewer what to hear
Direct observations	• reality - covers events in real time • contextual - covers context of event •	• time consuming • selectivity - unless broad coverage • reflexivity - event may proceed differently because it is being observed • cost - hours needed by human observers
Participant	• same as above for direct observations	• same as above for direct observations
observation	• insightful into interpersonal behaviour and motives	• bias due to investigator's manipulation of events
Physical artifacts	• insightful into cultural features • insightful into technical operations	• selectivity • availability

Table 4-5: Strengths and Weaknesses of Each Case Study Approach

(Yin, 2003)

Easterby-smith et al. (1991) states that the interview method is useful when the research topic is commercially sensitive and lacks clarity. Additionally, this approach allows interviewees to be relatively relaxed in sharing confidential information. This research has therefore used unstructured interviews to collect data together with confidential documents.

Table 3.6 (previous page) lists the strengths and weaknesses of the source of evidence in data collection. Interview and public-confidential document sources are used due to the limitations in the research. Fact collection along with personal experience is one of the strong points of interview method, providing first hand information on the research topic. It also allow the exploration of new dimensions that emerges during the interview (Burgess, 1984; Yin, 2002). Survey and secondary data collection methods have disadvantages in exploratory research because these methods cannot provide subtle information which cannot be anticipated at the beginning of the inquiry (Parkhe, 1993).

Case Study Structure		Case Study Objectives
Business review		• What are the characteristics of the company? • What is the business of the company? • What are the business strategies?
Manufacturing review		• How does the company operate? • Is there any manufacturing vision? • What are the key important points of operations?
Investment review		• What are the contexts of global manufacturing investment? • What is the investment process?
Risk review		• What does company mean by risk? • Does Company has risk register? • What are risks at corporate level, operation level and investment project level?
Risk Management Mapping[18]*	Risk Identification	• How does company acquire knowledge about risk in global manufacturing investment in implicitly? • What are the factors helps company to understand the risk in investment implicitly? • Is there any explicit risk identification process?
	Risk Evaluation	• How does company evaluate implicit risks? • How does company evaluate explicit risks? • How many ways does company evaluated implicit and explicit risks?
	Risk Administration	• How does company mitigate explicit risks? • How does company mitigate implicit risks? • What are risk mitigation strategies?
	Risk Monitoring	• What are explicit and implicit and implicit risk indicators in global manufacturing investment?

Table 4-6: Case Study Structure and Data Collection Objectives

A data collection protocol is developed to collect relevant data reflecting the research scope and the case study representation structure (Table 4-6). This protocol contains a research

[18] Risk management mapping is performed based on the theoretical understanding of explicit and implicit risk management practices, described in this sub section.

project leaflet, email, PowerPoint presentation, confidentiality agreement and two semi-structured questionnaires (Appendix 9.3, page 220). Eisenhardt (1989) states that case study methodology provides flexibility in data collection because of the overlap between data collection and data analysis. Likewise, the first questionnaire is used to develop a broader understanding of the topic in a case company with a second questionnaire customised according to the outcomes of first interview. The objective of both questionnaires is to achieve the objectives of case study.

Interviewees were selected based on their experience in global manufacturing and their involvement with the existing or recent investment projects. Table 4-7 lists the designation of these interviewees. Apart from interviews, company websites, confidential documents, publicly available documents (only in stock exchange listed companies), and experiences of academics and practitioners with the companies are used. These multiple sources supports triangulation for the quality of data.

*Selected Companies	Sales ($ millions)	Data collection method	Designation of Interviewee	Mode of contact	Time period
A	2	Interview	Managing Director	Face to face	2007-2008
B	180	Interview, confidential documents	Operation Director	Face to face, phone	2007-2008
C	700	Interview, confidential documents	Operation Director	Face to face, Phone	2007-2008
D	22,000	Interview, confidential document	CFO	Face to face	2007-2008
E	30,000	Interview, confidential documents, company website	Corporate strategy and planning	Face to face, phone	2007-2008
F	36,000	Interview, confidential documents, company website	Product Manager Europe	Face to face, phone	2007-2008
G	4,000	Interview, confidential documents, company website	Operation Director	Face to face, phone	2007-2008

Table 4-7: Information on data collection method

Data analysis: There are two kinds of data analysis: (1) content analysis and (2) grounded theory. Content analysis is more statistical analysis where *"the researcher goes by number and frequency"* (Easterby-Smith et al., 2002). Easterby-Smith et al (1991) commented on the grounded theory that *"the researcher goes by feel and intuition, aiming to produce common or contradictory themes or patterns from the data, which can be used as a basis for interpretation"*. Therefore, the grounded theory approach is subjective in nature. He has

identified seven steps of grounded theory analysis, comprising familiarisation, reflection, conceptualisation, cataloguing, recording, linking and re-evaluation (Easterby-Smith et al., 2002). However, a data analysis process is not simple (Miles & Huberman, 1994). Miles and Huberman suggested three approaches of data analysis– interpretive, social anthropology, and collaborative research.

A combination of social anthropology and interpretive approach has been taken to analyse the data. Initially, the data analysis was focused on repetitive reading of interview transcript to develop understanding on investment risk management by comparing with literature findings. This approach is defined as interpretive approach. However, data analysis also included pattern recognition to develop in-depth understanding, including data from multiple sources. These two data analysis characteristics are the part of the social anthropology approach (Miles & Huberman, 1994). Cross data review illustrated the following challenges for data analysis:

- Lack of standard terms
- Multiple ways of description
- Repetition
- Confusion on missing data
- Inconsistent data representation
- Overwhelming data (in some cases)
- Unrecognisable words and abbreviations

Revisiting the literature, reviewing the conceptual framework, and consultations (case companies, practitioners and academics) helped in data reduction and consistency. This process is repeated multiple times. Cross case data is presented in one standard format. The next step was to put case data and literature findings together to seek the direction of the research outcome. The preliminary process of this step is shown in appendix 9.4 on page 229. In the last step of the data analysis, the following four data analysis tools are developed to draw specific conclusions.

- Investment Risk Categorisation Tool: This tool is developed to create understanding on investment risks in global manufacturing. It provided the categories of investment risks in global manufacturing companies. This tool has followings steps:

  - Accumulation of cross case investment risks.
  - Linking risks to its sources to identify categorisation.

- Investment Risk Management Dimensions Tool: This tool is developed to understand the risk management practices. It provided the dimensions of investment risk management in global manufacturing investment. This tool has followings steps:

  - Accumulation of cross case investment risk management practices.
  - Categorisation of these practices.
  - Re-categorisation of investment risk management practices in the theoretical structure of risk management.

- Typology creation Tool: This tool is developed to understand the global manufacturers behaviour within the context of investment risk management. It provided the typology of global manufacturers. This tool has following steps:

  - Mechanism to weight investment risk management practices.
  - Summation of the weights with respect to risk management structure.
  - Drawing charts to determine the position of global manufacture in risk management sophistication/size matrix.
  - Explanation of companies' characteristic with respect to their position on the matrix.

- Process Development Tool: This tool is developed to understand the risk management process in the context of investment global manufacturing investment. It provided a conceptual process. This tool has following steps:

  - Linking investment risk management dimensions with the help of literature and practice review.

- Explaining the process in industrial environment (Chapter 5).

The above tools have helped in creating understanding on the risk management practices in global manufacturing investment. These tools have allowed the research conclusions to emerge from the data.

4.3.3 Research Quality

This research design aims to achieve a comprehensive knowledge of the research topic, which satisfies the research validity conditions. The quality of research depends upon research reliability, validity and generalisability (Easterby-Smith et al., 2002). Yin (1994) extended the research quality dimensions to four. The four research quality dimensions are construct, internal validity, external validity and reliability.

A recent study on case study approach suggests that researchers focus more on other types of validity rather than external validity (Gibbert, Ruigrok, & Wicki, 2008). Gibbert et al. (2008) find that validity and reliability justify the quality of case study methodology and state that a researcher can be confident about their research finding only if he or she knows how to evaluate their methods on the criteria of validity and reliability.

Internal validity: Internal validity is mainly applicable to the series of logical arguments, which leads to the conclusion (Cook & Campbell, 1979; Yin, 2003). It also measures the quality of the conceptual framework. However, Yin (1994) suggested that internal validity includes data analysis phase. This research has developed a conceptual framework and research scope from literature review explicitly. The conceptual framework explains evolution of research topic, theoretical foundation, key investigative variables, and desired outcome. The multidisciplinary literature reviews have identified research gaps, theoretical structure of risk management and key global manufacturing and financial concepts.

The empirical findings are an extension of risk management theories into the manufacturing domain. Research findings have partial resemblance with risk management structure theories and theoretical risk categorisation because this research is the first exploratory study of risk management in global manufacturing investment. The multidisciplinary approach provides the theoretical triangulation of the research. The following paragraphs present the key supporting arguments for research quality.

Construct validity: Construct validity is applicable in the data collection phase (Yin, 2003). It is related to the data collection method through which research outcomes can be obtained (Gibbert et al., 2008). This research has developed a research protocol (Appendix 9.3). Multiple sources are used to collect the data. At the end of every case study, a written document based on the interview data is sent to the concerned companies. Interview data are shared and discussed with experts. This chapter has explained the methods of data collection through multiple interviews and confidential data provided by the companies (Table 3-7). This chapter also explained the challenges of data collection and analysis, and data analysis tools in detail.

External validity: External validity is related to generalisation of the research conclusion, which means this research conclusion can work in different contexts (Gobbert et al. 2008). To some extent, it is applicable in this research because it has taken theory from risk management and explains that theory in global manufacturing investment environment. However, statistical generalisability is not possible in the case study methodology (Yin, 1994). It has been suggested that analytical generalisability concept might be applied to this research (Cook & Campbell, 1979; Yin, 2003). The selection criteria and context for the seven companies studied is provided in this chapter. Cross-case analysis is presented in an integrated analytical framework (Chapter 5).

Reliability: Reliability of a research depends upon transparency and replication (Gobbert et al. 2008). This research developed a case study protocol and the data is described in detail in chapter 4. Two[19] papers have been presented in EurOMA and European Risk Conference in 2008 and 2007 respectively. These papers describe the preliminary results of the research. The research results were presented at Aalborg University in Denmark. Data has been collected in accordance with the investigative framework and conceptual framework and through constant reviews. The next chapter presents the data in detail. The names of case companies cannot be revealed because of the confidentiality agreement. However, companies' names have been shared with the academic supervisors and will be available in confidence to examiners.

[19] Kumar, M., & Gregory, M. J. (2007). Global manufacturing network transformation management: risk and reward perspective. *1st European Risk Conference*. Munster, Germany: 1st European Risk Conference.
Wang, D., Kumar, M., & Gregory, M. (2008). Following the footprint. *the 15th International Annual EurOMA Conference*. Groningen, The Netherlands.

4.4 Summary

This chapter has defined the design and methodology of the research. Based on the philosophical point view, it provides an appropriate way to investigate the research question within the practical research constraints.

This research is qualitative and studies current phenomena through case studies, in order to observe changes and to develop extended knowledge to understand risk management in global manufacturing investment.

The overall research design is divided into three phases. The first phase consists of the research identification, theoretical exploration and conceptualisation. The second phase is about data collection through case study method and the third phase is data analysis and research outcome. There are 12 important steps in the research design. These phases and steps are discussed in this chapter in details. Figure 4-4 illustrates research design phases and steps in the flowchart below.

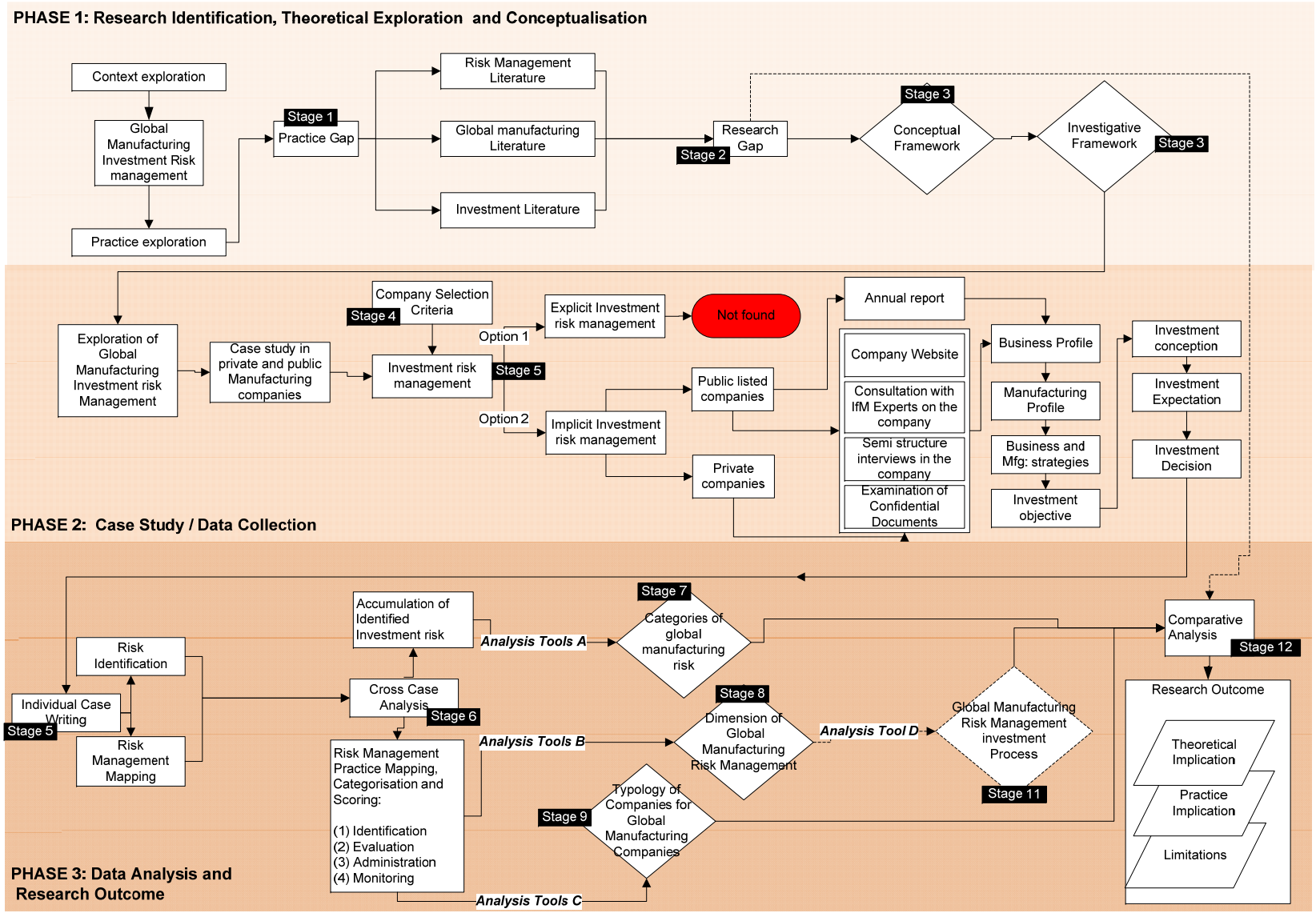

Figure 4-4: Research Design-Flowchart

5 CASE STUDIES.

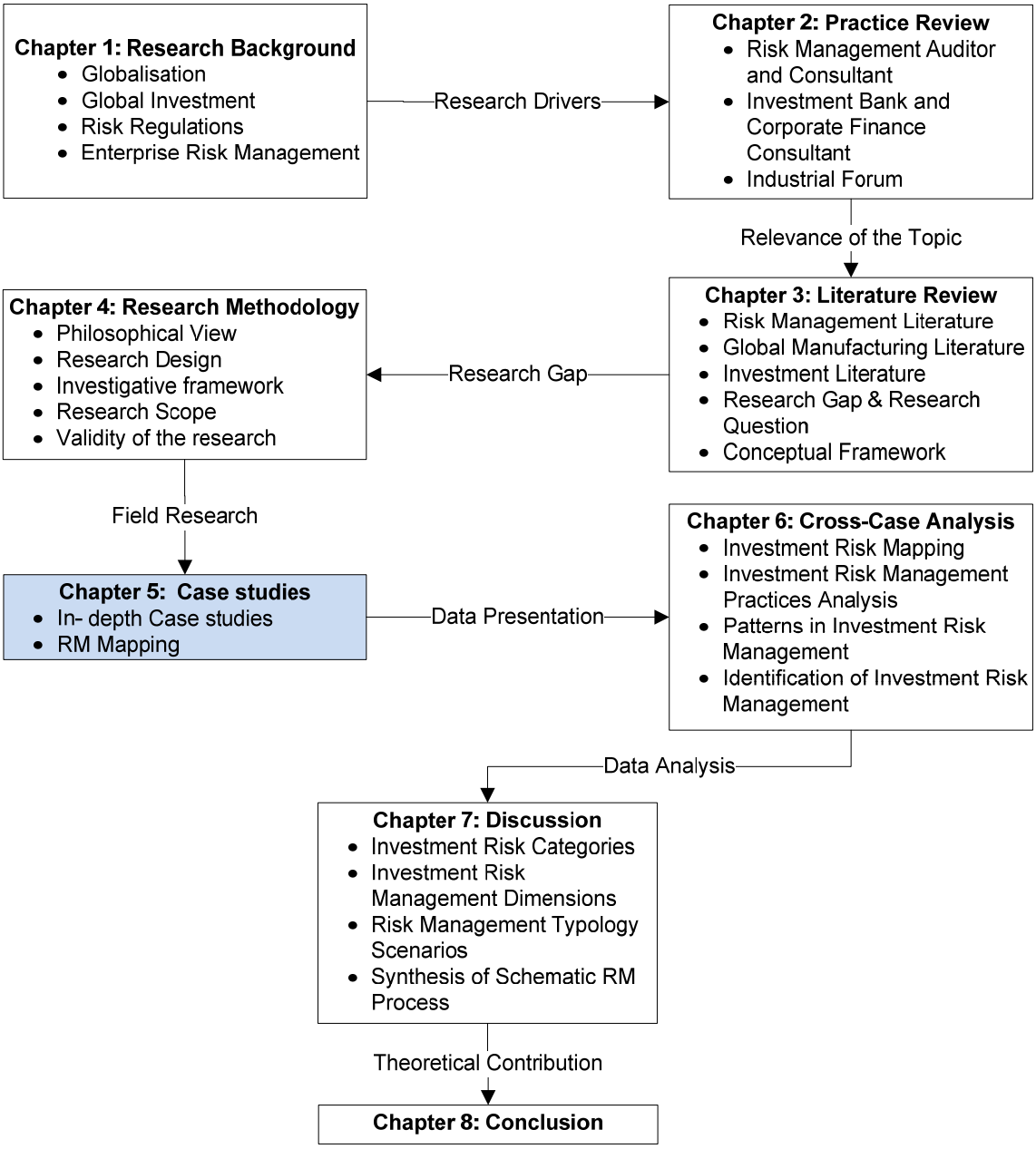

Figure 5-1: Chapter Map

5.1 Introduction

The aim of this chapter is to describe the global manufacturing investment risk management practices of seven companies. The companies are different from each other by industries that they operate in, manufacturing processes, and investment objectives. The cases explore the explicit and implicit practices used in the companies and draw out some general themes. A data collection protocol is developed to collect relevant data reflecting the research scope and the case study representation structure (Table 4-6). This protocol contains a research project leaflet, email, PowerPoint presentation, confidentiality agreement and two semi-structured questionnaires (Appendix 9.3, page 220).

5.2 Case Study 1

Case study 1 investigated the process of manufacturing plant transfer (from UK to Lithuania) investment of a small manufacturing company – A.

5.2.1 Business and Strategy Review

Company A is CNC precision engineering company in Cambridgeshire UK, with annual revenue of $4 million in 2005. It is involved in contract manufacturing. The operation of the company includes production of plastic and metal parts and partial work on parts assembly. Its main customers are medium size second tier automotive suppliers in the USA and the UK, who outsource some of their production to small companies such as company A. Two entrepreneurs acquired this company in 2002.

The current business strategy, of the company, has been based on revenue growth and customer relationship management since 2002. The strategic focus is on existing customer base management to increase revenue. Specifically, the corporate strategy of the company is to double its revenue to $8 million in five years by becoming tier 1 supplier in its customers' supply chain. Further, it has further identified that low cost of operations, differentiation from competitors and appropriate skill sets are essential features of the business strategy.

Company A is a small contract manufacturing company, which is aggressively seeking to increase its revenue in the coming years. The company works in perfect competition and understands that providing a better value proposition to its customers and higher customer relationship management are the key for its future success.

5.2.2 Manufacturing Review

This company has two manufacturing plants in UK. Both factories are established to create production capacity but there is no coordination between the factories. Customers assign work to produce plastic and metal products. Product development is not significant as its customers provide product specifications and designs. The focus of the plants is on quality and cost while raw materials and skills are locally acquired. A key factor for the company is to maintain its working capital because it does not receive payment until products have been delivered to the customers in the USA and the UK. It cannot force its customers to pay. On the other hand, the company has to pay to its suppliers in advance. Hence, its suppliers and customers financially squeeze the business.

The company does not have a complex manufacturing system. Small design work is carried out during the production. The operational focus is on time production.

5.2.3 Investment Review

The new owners of the company realised that the company growth rate had been stagnant for the past five years. The cost of operations was high because of production in a high cost country and there was only limited penetration into the customers' supply chain. Greater involvement in the customers' supply chain could mean making and assembling more products. The company wants to replace ten suppliers from its customers supply chain to become a 'one stop shop'.

Increasing globalisation is continuously creating new competitors from low cost regions such as Eastern Europe and Asia. Fortunately, the existing customers' bases are not big enough to go offshore because of lack of capacity[20] and capabilities[21]. The realisation that company A may lose its customers if they were unable to provide better value, led towards the development of a plan to shift some production to Eastern Europe.

Christodoulou, P., Fleet, D., Hanson, P., Phaal, R., Probert, D., & Shi, Y. (2007). Making the right things in the right places. Cambridge, UK: University of Cambridge Institute for Manufacturing, 1-44.[20] Capacity: individual customer's demand was not large enough to justify the investment in low cost countries.

[21] Capabilities: lack of manpower, skills for overseas investment

The initial thinking on the production transfer was dominated by the topic of subcontracting the company's production to an Eastern European country. The company looked into various countries such Estonia, Latvia, Czech Republic, and Lithuania and was impressed with the Czech Republic's manufacturing growth story. However, there is lack of capacity in the country because of the recent contract manufacturing surge[22]. The value proposition in other countries' (contestants of the beauty parade such as Latvia, Estonia, Lithuania) were attractive for the company but sub-contractors were still charging the premium[23] price to the UK company. After an analysis of shifting production capacity or subcontracting production within the financial constraints, the company decided to go with the first option to transfer one its UK plants to Lithuania[24].

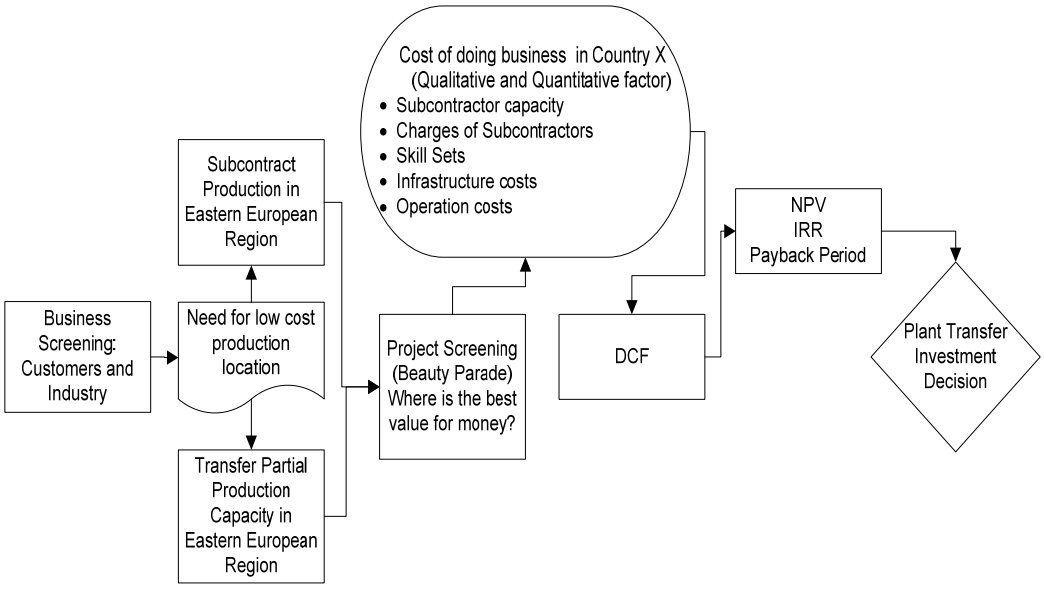

Figure 5-2: Company A's Investment Process

The company's investment processes (Figure 5-2) started with the analysis of its business. This analysis presented a challenge for the company to look for low cost production location outside UK and developing region such Eastern Europe or Asia. The notion of production location in Asia was rejected due to distance from customers and limited knowledge about the business environment in Asia. Once the Eastern European region was finalised for the investment, the company had two options- (1) subcontract its production and (2) start its own production by transferring its plant from UK.

[22] Most of the Czech companies are already tied up the multinational company
[23] The premium: Lower charges for Lithuanian company and higher charges for UK based company
[24] It has the manufacturing infrastructure since soviet era so it is easy to get manufacturing skills in the country. A factory with 500 sq meter spaces can be hired for £500 a month. A manager can be hired for £350 a months.

To choose from the above options, the company carried out project screening or "Beauty Parade". There were four contestants from Eastern Europe. The logic of screening was to find out the cost of doing business in these countries and the country that would provide the company with the best value from their investment. They considered five factors - subcontractor capacity, charges of subcontractor, availability of skill sets (managers and machinists), infrastructure costs and operational costs. These factors were put into DCF valuation. This screening process first eliminated the subcontracting option and then rejected Czech Republic as a production location. The decision for Lithuania was significantly influenced by good contacts in the country apart from the other five screening factors.

The quantitative evaluation (DCF) was done for the coming 10 years. The future costs and revenues were extrapolated based on the assumptions and discounted by country risk, widely known as hurdle rate (calculation of country risk was based on CAPM). According to the company, Lithuanian investment returns, represented in terms of NPV and IRR, were higher than the NPVs of other production locations in Eastern Europe. Sensitivity analysis also played an important role in investment decision-making.

Overall, the investment in production transfer to Lithuania was a corporate risk for the company. It understood that its customers might prefer its competitors with production location in low cost countries or its customers might start their production activities in low cost countries. Hence, the context of the investment was competition (corporate risk management) and growth of the company. Investment analysis is quantitatively dominated which is based on standard financial valuation theories. The final, the investment decision is believed to be based on the judgement of the Managing Director.

5.2.4 Risk Review

The company did not have a risk register, which could show the evolution of risk over a period. During the interview, the Managing Director of the company stated *"Risk analysis is intuitive"*. Risk is perceived as an existing or future threat to the company. The preliminary discussion revealed that the political risk and automotive industry risk are the main categories. Further discussion revealed that the biggest and the most important challenge was to make financial projections correctly at the time of investment. It was mentioned during

the interview that a small company cannot afford to have a proper risk register because it cannot afford the required time and money to perform risk analysis. Hence, it could be observed that small companies, such as Company A, have a broad understanding of risk such as cost reduction and customer relationship management but without any documented details of corporate, operational and investment project risks.

5.2.5 Risk Management Mapping

The company does not have a formal risk management system. However, the case study observation revealed that the company's investment processes have implicit risk management[25]. This subsection maps the company specific factors and processes according to four steps of risk management. The objective of the risk management mapping is to understand the risk management structure in global manufacturing investment of the company within the limits of the research design framework.

Risk Identification: It was observed that the company did not have risk identification process; hence, it does not have a risk profile. The Managing director of the company stated that risk analysis is intuitive process. Hence risk identification was also an intuitive process in the company. There were two broad risks- high cost of operation and migration of customers from the company. These two factors were responsible for the plant transfer investment decision. Furthermore, it was observed that five project screening factors (Figure 5-2) were also risk factors for the company. Hence, business screening and the "Beauty Parade" might constitute risk identification process in the company's overseas investment.

Risk evaluation: Company A did not have specific risk evaluation process. However, factors identified through the business screening and project-screening processes were quantified in DCF analysis. Hence, the risk evaluation is DCF analysis in the company. The company understood that there was risk of wrong valuation through DCF analysis because it was founded on assumptions. These assumptions are helpful in identifying with revenue and costs figures of next 10 years. The DCF analysis also incorporated country risk, which was represented as hurdle rate.

Risk Administration: A risk administration process in the company was not documented. During the investment decision process, there were two risk mitigation strategies- (a) reject

[25] Theoretical risk management structure is described in Chapter 3.

the project with low NPV and (b) accept the project with high NPV but strictly focused on maintaining the operational cost of the investment. As the company did not have detailed risk identification, specific risk mitigation strategies were not observed in the company. Although, there is the intuitive process of risk administration based on MD's experience in business, the company lacks a systematic risk administration process.

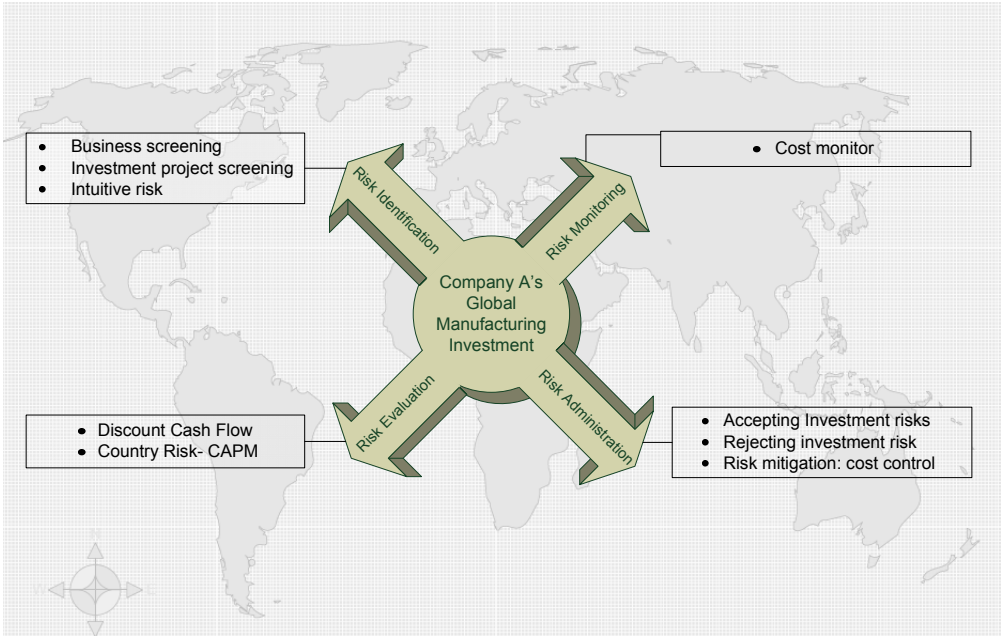

Figure 5-3: Company A's Risk Management Mapping

Risk Monitoring: The Company mentioned that cost of the operation in Lithuania was the key risk indicator for this investment. It was also mentioned that size of the company allowed them to monitor each factor of the operation effectively and then gave time to formulate strategy as existing and new risks start affecting the company.

To conclude this section, risk management in overseas investment was not observed, however there were steps in the investment process, which helped the company to identify, assess, administrate and monitor overseas investment and its risks (as shown in figure 5-3).

5.2.6 Summary

The company did not have a complex manufacturing system because of its size and its products. The motivations of the recent investment were competition and growth of the company. Investment analysis was quantitatively dominated, which was based on standard financial valuation theories. The investment decision was based on the judgement of the

Managing Director. The risk was perceived as an existing or future threat to the company. Company A, has a broad understanding of risk such as cost risk and customer relationship risk but without any documented details of corporate, operational and investment project risks. Various steps were identified in the investment process, which helped the company to identify, assess, administrate, and monitor overseas investment and its risks.

5.3 Case Study 2

This case study investigated a process of achieving growth by aligning operations with sales footprint and investing in low cost countries within the proximity of customers.

5.3.1 Business and Strategy Review

Company B was established in 1880. It is a global producer and distributor of household products. It was acquired[26] by the existing management of the company with the help of a private equity company in 2002. It is a private company with annual revenue of US$180 million in 2007. It produces bleach, toilet cleaners, air care products and insecticides. As Company B makes products by mixing various chemicals, it has some inherent challenges such as complying with strict chemical industry regulations and rigorous commitment towards health and safety in its operations (R&D, Design, Procurement, Production and Distribution).

It operates in two market segments - (a) contract manufacturing for industrial customers such as Tesco and Wal-Mart, and (b) branded product manufacturing for households. Customer relationship is crucial for the industrial market segment. In the branded product market segment, its industrial customers' products are competing with its own branded products. In other words, Company B's products compete with each other in the global market. Company B's brands are weaker in the market due to lack of market influencing capability. The main markets are UK and Europe, but it is highly active in North America, South East Asia, Australasia, China and Japan.

The corporate vision of the company is to increase its turnover from £180 million to £200 million in next five years. To realise the corporate vision, the corporate strategy focus is on operations expansion in North America, Far East and Eastern Europe region. This strategy includes (a) strengthen brand performance[27] in Europe, (b) develop brand in USA, and (c) increase operating margin[28]. It was revealed in the interviews that there are five significant factors, which can make or break the corporate strategy. These factors are customer relationship, cost reduction, production proximity to market, brand awareness, and new

[26] It was management buyout.
[27] Company B is spending money on advertisement in newspaper and television. It is also sponsoring TV shows in Europe.
[28] Operating margin can increase by reducing cost of operation and generating more revenue from its brands.

product introduction. These factors are the key success factors of the corporate strategy, stated by the company.

Company B's existing focus is on customer relationship to increase revenue from private level products, developing brand to increase revenue from its own brand and decreasing cost to improve operating margin.

5.3.2 Manufacturing Review

The configuration of the global operation network of the company has risen from the historical growth of the company. It had acquired companies and been acquired by various companies since its establishment in the late 19th century. The existing operation is divided into five functions - R&D, procurement, production, distribution and sales and marketing. It controls the global operation centrally. The upstream operations (R&D, procurement and production) are highly concentrated in UK & Europe.

It has R&D sites in UK and Europe. The European R&D facility[29] became part of the company's operational network because of M&A. The company wants to close the European R&D facility but the fear[30] of losing key people has prevented this in the short term. The procurement activities[31] are concentrated at four global locations. The company's production activity[32] requires mixing the chemicals, filling, and then packing in various sizes, for industrial customers (retailers and outsourcers) and commercial customers (buyers of the company's branded product). There are nine factories spread across five countries. The distribution centres[33] of the products are in five countries. However, the sales/marketing centres are spread across eight countries. All these activities are centrally managed and coordinated. The company stated that the existing configuration of the manufacturing operations was not planned. It was revealed that they did not have a formal process of operational network design and there were certain disadvantages in the existing global operation network.

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[29] R&D facilities are involved in new product development, product improvement, product performance maintenance, and manufacturing process support

[30] Direct quote from the case study interview: "It is easy to move the equipments from the R&D facility, but very difficult to move people. In our business skill is rare. There might be only four people around the world who can perform our R&D activities".

[31] Procurement activities: Sourcing of materials and supply management

[32] Production processes: Blending , liquid filling , extrusion packing

[33] Distribution centres are involved in storage and distribution of the finished product.

The disadvantages of the unplanned operation network are (a) higher cost of production in comparison with its peers, (b) higher distance from its customers from production perspective and (c) capacity imbalance. Whilst, globalisation opened various markets (China, India, Russia and Eastern Europe) for the company, it created domestic competitors who have the aspiration of becoming global companies in the household chemical product industry. These domestic competitors enjoy advantages of cost, proximity to domestic customers and the support from local governments. Company B experienced reduction in growth rate in some emerging markets because of the local competition. It was apparent that the existing competitive advantages (such as uniqueness of products and high level of customer services) would erode in future.

The existing and evolved network design of the company is losing its competitive advantages in the changing world. It exports its products globally from just 8 manufacturing locations and these locations are highly concentrated in high cost countries. It was observed that the company's operations, especially the R&D and production process was simple nonetheless requires higher skills to design and produce.

5.3.3 Investment Review

After the management buyout in 2002, the management realised that the company was not sufficiently responsive to customers' demand as the existing operational network is taking six weeks time to react to customers. However, the company could solve the problem of faster customer reation time by aligning its production with market location. In addition, globalisation created options of low cost countries for production locations, which could tremendously improve the operating margin. The above realisation prompted the Company to look for production investment opportunities at various low cost locations at a close proximity to Company B's customers. The company, in last five years, transferred one of its European Union plants to Czech Republic (joined EU in 2004) to save costs, invested in China to increase the market share in emerging markets, and selected a production location in Australia to improve customer responsiveness. Company B stated that production location adjustment reflects the sales profile was a continuous process because of the continuously changing business environment. This continuous alignment strategy would accelerate the growth and maintain competitive advantages for the company.

The company investment processes started with the analysis of its operations. The operational review identified two investment objectives- (a) production alignment with sales and (b) plant transfer to LCC locations within the vicinity of the sales locations. These objectives gave several locations for the manufacturing investment. The selection of the locations was based on the evaluation of industry growth and cost of production in these countries.

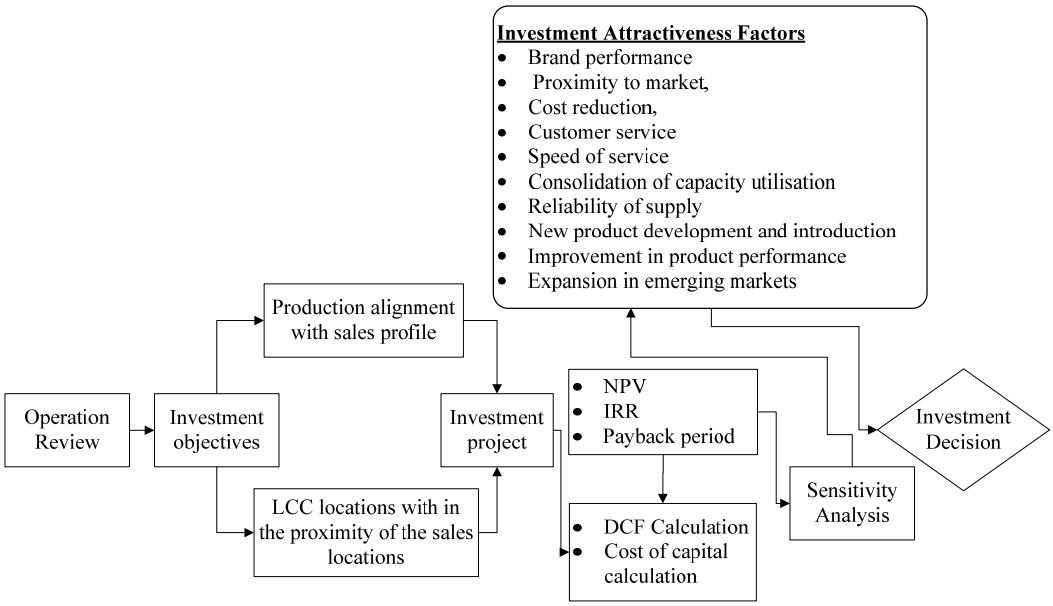

Figure 5-4: Company B's Investment Process

To choose the investment projects, the quantitative evaluation (DCF) was done for the coming 10 years to take a long-term view on investment. The future costs and revenues were extrapolated based on the assumptions and discounted by country risk, widely known as hurdle rate (calculation of country risk was based on CAPM). Sensitivity analysis also played an important role in investment decision-making. This sensitivity analysis gave the company key sensitive factors to NPV. The key sensitive factors, such as tax rate, hurdle rate, cost and revenue, helped to generate a range of NPVs in the selected country.

Qualitative evaluation was performed on the ten investment attractiveness factors (as shown in figure 5-4). At the end of this process, company B selected an investment project, which has less volatile NPV with high investment attractiveness score. Perhaps, one more factor played an important role in global manufacturing investment - local contact. It was revealed that if the company had good contacts and some operational experience in a country then it could favour that country for investment, even if the country's NPV was less than the other evaluated countries.

Overall, in the investment review, there were two objectives for Company B's investment - proximity to customers (production alignment with sales) and transfer of production to LCC but within the proximity of customers. The quantitatively dominated investment analysis was based on financial valuation theories, which included sensitivity analysis. There were further factors, which played an important part in the investment decision - investment attractiveness factors and local contacts or operational experience.

5.3.4 Risk Review

The company did not have a risk register to show the evolution of risk over a period of time. Risk is perceived as a threat to the company. Any factor, which can affect corporate and investment performance can be considered as risk. The preliminary discussion revealed that the political risk and chemical industry risk were the main categories in the investment projects. Further discussion on risk revealed that risks from all operational activities (such as R&D, procurement, distribution and sales & marketing) affect production investment as well as production investment risk itself.

Company B was weak in managing political risks because it could not influence governments. The main reason for this weakness was the size of the company. Hence, contacts and operational experience played a major role in the investment decision. Contacts and work experience in new production locations helped the company to face political and cultural challenges in new operational environments.

The analysis of confidential documents illustrated that company B's explicit risk understanding was limited to IPR and currency fluctuation risks. On the issue of risk register documents, the company's lack of a risk register was not clear. Various risks were collected in the categories of corporate, operational and project levels (as shown in table 5-1), during the interview. To conclude, company B had a more comprehensive understanding of risk than company A, but this understanding of risk was not well documented in the company properly.

	Risks	Source of Risks
Corporate level	Currency fluctuation	Unstable currency market, global sales exposes the company to risk of currency loss
	Competition	Competition from big players of the industry (such as Proctor Gamble etc.)
	New product failure in the market	Changing consumer behaviour, unable to understand the market, underperformance of new products
	New product failure due to technical problem	Rapid production problem, inefficient production processes, mistakes in R&D
	Regulation	Chemical industry regulations, Variations in regulatory requirements has operational implications
Operational level	People and skills	Lack of skills in R&D in global market, People and skills are quite important for the company's operations
	Product failures	Technical problems and rejection by customers
	Risk in supply management	Insolvency of supplier, single source of supply , erosion of cost advantage, availability of transport & warehouse, especial requirement from customers, issues of automated warehouse
	Change in demand profile	Unable to understand demand
	Information inaccuracy	Coordination and understanding problems among operational activities, malfunction of information system
	Cost	High cost of operational activities
	Changes in energy price	Geopolitical problem, demand and supply problem
	NPI failure	R&D issues, production issues, market issues
	IPR protection	Variations in IPR protection rules
	Economic slow down	Economic cycle
Investment project level	Competition	Local and global competition
	External events	Oil prices, change in demand, tax rate, employment regulation, political instability, infrastructure
	Project delay	Problem in project management
	Cost over run	Delay in project, sudden hike in price of making factory,
	Resource acquisition	People, raw materials, vehicle availability, warehouse
	Valuation risk	Wrong assumptions in valuation, human error

Table 5-1: Company B's Risks

5.3.5 Risk Management Mapping

Company B did not have a formal risk management system. However, the case study observation revealed that the company's investment processes had an implicit risk management system[34]. This subsection maps the company specific factors and processes according to four steps of risk management. The objective of the risk management mapping was to understand the risk management structure in global manufacturing investment of the company within the limits of the research design framework.

Risk Identification: It was observed that the company did not have a risk identification process. Hence, it did not have documented risk profile. There were, however, risks that the company used to evaluate the project. These risks were country risk and factors of investment attractiveness. The process of country risk identification was the requirement of the DCF valuation. The investment attractiveness factors were identified from the operational analysis. There was, also, the risk understanding that all operational activities (such as R&D, procurement, distribution and sales & marketing) affected production investment.

Risk Evaluation: There were three types of evaluations, DCF, sensitivity analysis and investment attractiveness, for investment projects, which also evaluates risks. DCF valuation included country risk factors. Investment attractiveness factors could increase or decrease investment performance. Sensitivity analysis assessed the impact of volatile characteristics of investment projects.

Risk Administration: A risk administration process in the company was not documented. During the investment decision process, there are two risk mitigation strategies- (a) reject the project with low NPV with high volatility in NPV and (b) accept the project with high NPV with least volatility in NPV. Some of the risk mitigation strategies such as better coordination among operational activities, knowledge transfer mechanisms, establishing efficient supporting projects, developing multiple suppliers, supporting suppliers, hedging currency and training system, were stated by the company.

Risk Monitoring: The Company had key indicators to monitor the investment. These key indicators were cost of operation, gross margin, inventory replenishment time, speed in

[34] Theoretical risk management structure is described in Chapter 3.

supply chain and customer response time. It stated that these indicators help the company to monitor investment risks.

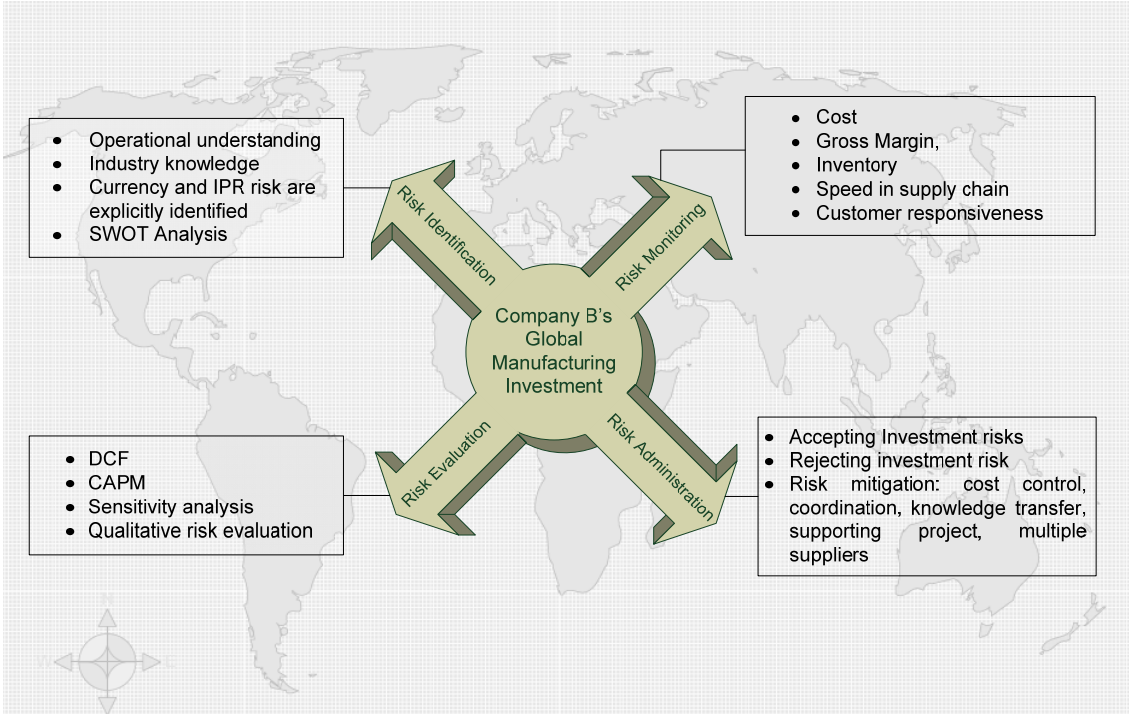

Figure 5-5: Mapping Risk Management

To conclude risk management in global investment was not observed in the company B, however, there are steps in investment process which helped the company to identify, assess, administrate and monitor global investment and its risks (as shown in figure 5-5).

5.3.6 Summary

The existing and evolved network design of the company was losing its competitive advantages in the changing world. The R&D and production process was relatively simple nonetheless required higher skills to design and produce. There were two objectives for the existing investment - proximity to customers (production alignment with sales) and transfer production to LCC but within the proximity of customers. Investment analysis was quantitatively dominated, based on financial valuation. Risk was perceived as a threat to the company. Its explicit risk understanding was limited to IPR and currency fluctuation risks. The company's lack of a risk register was not clear. It was weak in managing political risks because it could not influence governments due to the size of the company. There were steps in investment process that helped the company to identify, assess, administrate and monitor overseas investment and its risks.

5.4 Case Study 3

This case study investigated a unique process of growth opportunity capture based on restructuring investment decision - making.

5.4.1 Business and Strategy Review

Company C is a subsidiary of a fortune 500 company, with annual revenue of $ 500 million in 2007. It produces diesel and gas generator sets globally at five locations – (a) UK, (b) USA, (c) Brazil, (d) China and (e) India. It has three divisions: (a) product engineering group, (b) production and (c) sales & marketing group. All of its products are sold through distributors and dealers. There are no direct factory sales. The industry, in which the company operates, tends to follow global economic cycle. This company has some significantly big competitors, three fortune 500 companies, and various sizes of regional generator products all around world (for example, India and China has hundreds of local generators manufacturers). There are five high growth markets - Asia, Africa & Middle East, parts of Eastern Europe and United Kingdom. Sales depend upon on features, quality and functions of the products. Additionally, after-sales-service is one of its significant competitive advantages.

Company C aspires to become a world leader in generator business by 2020. To achieve this goal, the business strategies are (a) market expansion in emerging markets, (b) production expansion in emerging market, (c) acquiring engines[35] in cost effective way, (d) reduction of inventory, and (e) global operation design to mitigate supply chain disruptions. It was believed that these strategies would create competitive advantage capability to help the Company C to be world leader in the generator business.

Emerging economies are providing opportunities to increase market share for the company. However, there are hurdles in its way to become the world leader such as lower activities in emerging markets, higher cost of major components, high level of inventory and operational disruptions.

[35] Engine is approximately 60% of the total generator production cost.

5.4.2 Manufacturing Review

Company C's operations are divided into three major groups- (a) product engineering group, (b) production and (c) sales & marketing. Its product characteristics have significant impact on operations. There are two kinds of products- (a) standby product and (b) prime product. These products are produced in various sizes. Company C's competitive requirements[36] change along product line. For example, small generators are price sensitive and technology inside the product is not critical, however big generators require greater technological and technical skills to build. Company's products are better in quality than various local manufactures but with high production cost.

Design control, which is also called product-engineering group of the company, is situated in UK. This group develops global and local designs, products and processes, maintains products and processes, and tests products and processes in the UK production site. There are specific challenges to the product-engineering group. These challenges are miscommunication, cost overrun, and speed. Company C works closely with suppliers and influences their processes to reduce the cost and improve the quality. It has one big assembly plant with capacity of 60,000 units per year in UK and three small assembly plants with capacity of 1,000 units in Brazil, India and China. There are two kinds of plants- assembly and sourcing plant.

The production process technology of generators is relatively straight forward because the company assembles all of the parts of generators. Company C uses lean, robotic assembly and batch production systems. Automation is employed for mass production, punching machines, and conveyer assembly line technology and also for assembly, folding machine, punching machines and conveyer assembly line. The design of the factory network is not balanced, for example 95% of the products produced in UK are exported. It was revealed that capacity expansion in the UK plant had increased the supply chain risk[37], currency risk and higher lead-time.

This current manufacturing network is exposed to the risks of single big production plant (global capacity imbalance), high cost of production due to production capacity in the high

[36] Competitive requirements are quality, reliability, option and attachments, technology and after sales services.
[37] If something goes wrong at UK plant (fire, natural disaster) then its global sales are affected.

cost country and high distribution cost. All of the products are sold through distributors and dealers in more than 180 countries. Company C supports its distributors by providing training regularly. To minimise the operational risk, the manufacturing vision is to increase global manufacturing capacity, to satisfy current and projected demand, and distribution of capacity near to market. According to the Company C, manufacturing focus is on reduction of currency exposure, reduction of lead-time, balancing capacity parallel to global and regional demand.

It was observed that company C's operations, especially production, were relatively straightforward, however, still required high skills to produce customised products or high value products.

5.4.3 Investment Review

Company C's business strategy and manufacturing vision had given the context for the existing global manufacturing investment projects. Varying investment contexts have varying investment objectives. To achieve the business objectives and manufacturing vision, it created a new investment strategy and action plan called 'Global Footprint'. The global footprint strategy and global footprint projects came into existence in 2004.

Company C's investment process (Figure 5-6, next page) started with understanding the objectives of manufacturing vision and business strategy. Then, value chain screening was undertaken which gave an action plan called the "Global Footprint" project. Each global footprint project was carefully evaluated based on cash flow, DCF, NPV, IRR and sensitivity analysis. After quantitative analysis, a qualitative assessment was performed. The objective of the qualitative assessment was to reconfirm that the investment project was aligned with the objectives of business strategy, manufacturing vision and global footprint[38]. Investment projects were selected based on higher NPV and maximum alignment of investment projects with business and manufacturing. To control and monitor these projects, Company C was using several matrixes such as packaging per market and additional capacity against projected demand.

[38] Developing people, developing product and process at profitable level, quality, rate of manufacturing processes, distribution, growth markets, and preparation for economic downturn.

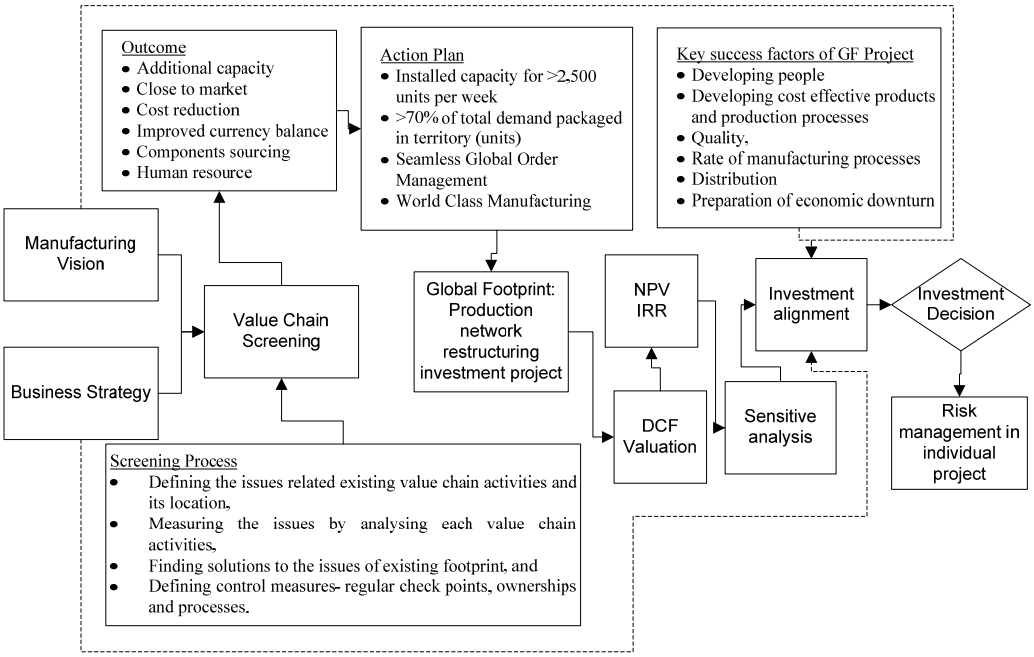

Figure 5-6: Company C's Investment Process

A business plan was required for every global footprint investment project. The business plan has various location options for investment. All locations were qualitatively and quantitatively evaluated according to global footprint strategy. However, contacts and business experiences in those locations influence the investment decision-making. Company C selected two locations (India and Brazil) recently. It was believed that the global footprint strategy and global footprint projects would deliver 4C (capacity, cost reduction, currency balance and customer responsiveness) benefits. Additional capacity would improve the ability to supply product to local customers. Along these lines, it gave the capability to adjust currency imbalances. Low cost components were developed for local region to serve global operations. Hence, these global footprint projects created an infrastructure for the company to supply its products to customers more quickly than its competitors.

The global footprint initiative of the company was focused on alignment of its value chain across the globe. It gave higher coordination among production networks, R&D networks, sales and marketing networks, which minimised the cost, balanced the capacity, enhanced the customer responsiveness and reduced the currency risk exposure. Investment decision-making depended upon the qualitative and quantitative analysis.

5.4.4 Risk Review

Company C did not have a risk register to show the evolution of risk over a period of time. Risk was perceived as a threat to the company. Any factor, which affected corporate and investment performance was considered to be a risk. The confidential documents analysis showed that there are three levels of risks. These levels were corporate l, operational and investment project. Examples of risks include higher cost, higher inventory level and supply chain disruption at corporate level; currency risk, lead-time, cost and capacity imbalance at operational level; delays and cost overrun at investment project level. In confidential documents the word 'RISK' was only associated with currency. The parent company of company C has a risk register[39], which gives a broader understanding of risk.

The preliminary discussion revealed that 'risks', 'problems', and 'challenges' were used interchangeably. As discussion developed, it was evident that higher cost of operation was a challenge to company C. This challenge became a risk when its competitors (local or global) offered relatively cheaper products. It shows that the challenges for company C had risk implications. However, the thought process of linking operational challenges to risks did not exist in company C.

It was mentioned that the company ran a risk management programme based on the concept of 'six sigma'. The outcomes of this process[40] were two risks and its management strategies. These risks were project delay and cost overrun. Company C managed these risks by establishing regular checkpoints and process ownership. It was observed that the investment risk was limited to project management only. While describing risk of investment, company C mentioned challenges of investment. These challenges were government policies, law, cost, design, suppliers, culture (local people), communication (language), coordination, sequencing, time zones, NPI[41], and product transfer[42]. To bring simplicity in the understanding of company C's risk, risk data was captured at three levels (shown in table 5-2). To conclude, risk was not documented in the company apart from risk in project management, however, it appeared that company C had extensive understanding of risk

[39] Parent company is listed in stock exchange, hence it has risk register.
[40] Define, measure, analyse, improve and control
[41] Standard time: 12 months
[42] Standard time: 6 months

because of the scientific processes of business and investment analysis, and existence of risk register of the parent company.

	Risks	Source of Risks
Corporate level	Currency fluctuation	Unstable currency market, Majority of production cost is in GBP and majority of sales in USD.
	Cost	Inflation in developed countries, changes cost of operations
	Human resources	Changes in availability of skills, changes in labour cost
	Competition	Global competition
	Regulation	Changes in environmental regulation
Operational level	Production disruption in UK	95% of the UK production is exported- capacity imbalance
	Shortage of component	Distance between production and procurement
	Higher lead time	Capacity imbalance
	Lower customer responsiveness	Capacity imbalance, higher gap between demand and supply
	Higher level of Inventory	Production is not near to market
	Weak industry	Economic slowdown leads to more capacity and less demand
	Changes in energy price	Geopolitical problem, demand and supply problem
	Higher NPI time	R&D issues, production issues, dealer training
	Uncoordinated operation network	Communication issues
	Distribution risk	Higher distance between production and market, geopolitical risk
Investment project level	Competition	Local and global competition
	External events	Oil prices, change in demand, tax rate, employment regulation, political instability, infrastructure
	Project delay	Problem in project management, failure/delay of supporting projects-IT, legal, procurement, human resource
	Cost over run	Delay in project, sudden hike in price of making factory,
	NPI and product transfer	Timing and training issues
	Valuation risk	Over estimation in valuation

Table 5-2: Company C's Risks

5.4.5 Risk Management Mapping

Company C did not have a formal risk management system; however, the case study observation revealed that the company's investment processes had implicit literal risk

management system[43]. Therefore, this subsection mapped the company's specific factors and processes according to four steps of risk management. The objective of the risk management mapping (Figure 5-7) was to understand the risk management structure in global manufacturing investment of the company within the limits of the research design framework.

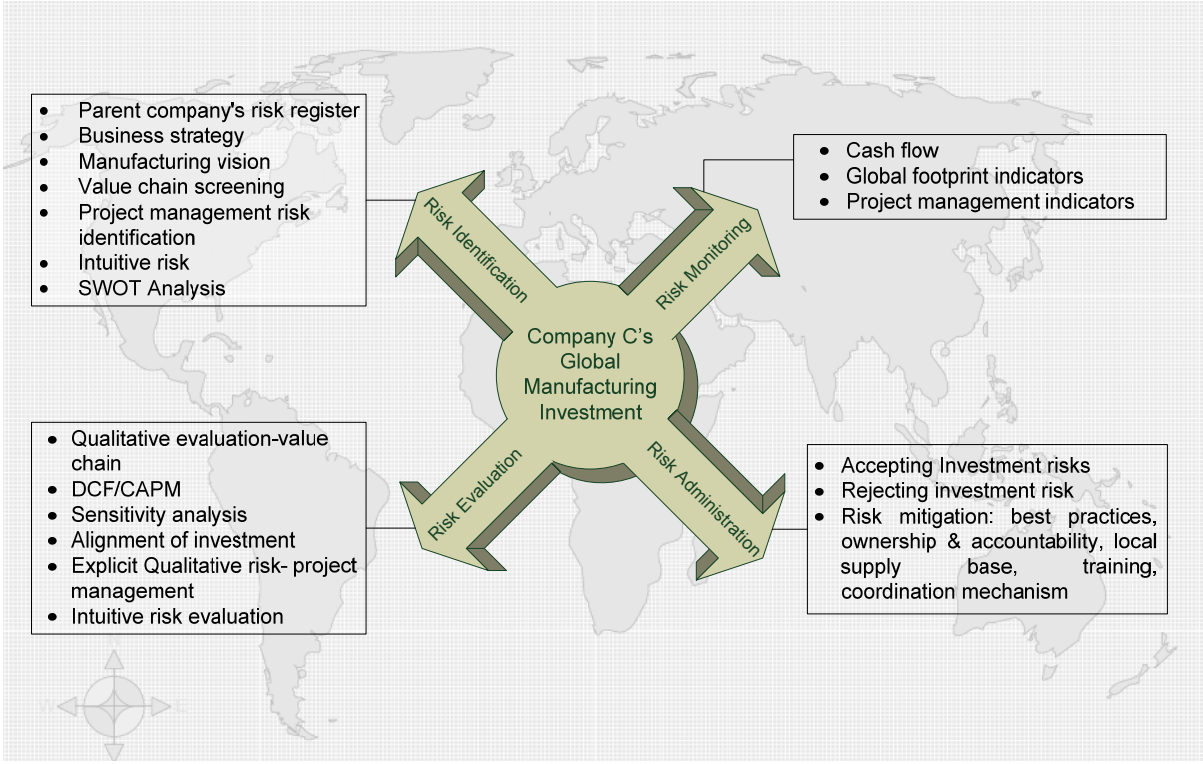

Figure 5-7: Implicit and Explicit Risk Management Mapping

Risk Identification: It was observed that that company did not have a formal risk identification process; hence, it did not have a documented risk profile. However, the parent company of company C did have a risk profile. In the global footprint investment project, company C ran a value chain screening process where it identified issues and opportunities in operations. This process was an implicit risk identification process. It identified the challenges (capacity imbalance, currency fluctuation risk, supply chain risk, and higher cost risk), which had risk implications. The second implicit risk identification came from the understanding of the business strategies, manufacturing vision and KSF of global footprint projects. Additionally, the company had an explicit risk identification process related investment project management based on 'six sigma'.

[43] Theoretical risk management structure is described in Chapter 2.

The last risk identification came from valuation of the investment project. Valuation of the project incorporated macro economic factors in projecting revenue and cost along with treatment of the country risk. It was also observed that there were intuitive risk identification processes highlighting political risk in manufacturing investment. There was an understanding that valuation was not static.

The knowledge of global manufacturing investment risks came from five factors- parent company risk register, value chain screening, incorporation business strategies, manufacturing vision, project management risk identification process, understanding of valuation risk and intuitive risk identification.

Risk evaluation: Company C did not have a formal and integrated risk evaluation process in global manufacturing investment. However, it was observed that company C used four levels of implicit and explicit risk evaluation methods in global footprint investment projects. The explicit and implicit risk evaluation methods were as follows:

- Implicit qualitative operational risks evaluation by value chain screening,
- Implicit and explicit quantitative evaluation of risks by DCF and sensitivity analysis,
- Implicit qualitative evaluation of risks by aligning investment project with business strategy, manufacturing vision, and KSF of global footprint.
- Explicit qualitative evaluation of individual project management risk
- Intuitive risk evaluation by having work experience in investment location

Risk Administration: There were three levels of risk administration, which were rejection investment location, acceptance of investment location with risk and managing the risks of accepted investment location. Implicit and explicit risk evaluation helped the company to select or reject the investment location. Rejection of investment location avoided the associated risks, while acceptance of investment location approved the associated risks. Once the associated risks were approved, company C had some implicit risk mitigation strategies. These implicit risk mitigation strategies were as follows:

- Defining accountability and ownership of the project and the new plant

- Implementing best practices of supply management and production management
- Development of the local supply base
- Providing operational training (sending people from old plant to new plant)
- Establishing coordination mechanisms among the division, suppliers, headquarter, and divisions

Risk Monitoring: There were two levels of risk monitoring mechanism (Table 5-3) in global manufacturing investment - global footprint and investment project level. At every level the company had explicit and implicit risk indicators. It was mentioned that every investment project was monitored by cash flow. However, cash flow of the investment project was not a major concern because of the objectives of the global footprint.

Level of risk monitoring	Explicit and implicit risk indicators
Global footprint	• Packaging in the territory • Capacity Vs. projected demand • Capacity by product line
Project management	• Expected time Vs. real time • Expected cost Vs. real cost • Readiness of the supporting projects

Table 5-3: Risk Indicators

Company C did not have a formal risk management system. However, the case study observation revealed that the company's investment processes had an implicit risk management system. There were steps in investment processes that helped the company to identify, assess, administrate and monitor overseas investment and it's risks (as shown in figure 5-7).

5.4.6 Summary

Company C's investment was focused on alignment of its value chain across the globe. Investment decision-making depended upon the qualitative and quantitative analysis. Company C did not have a risk register but risk was perceived as a threat to the company. Risks, problems, and challenges were used interchangeably. Risk was only associated with currency in the company's procedures. It was not documented apart from risk in project management. However, it appeared that company C had extensive understanding of risk because of the scientific processes of business and investment analysis, and existence of a risk register in the parent company.

5.5 Case Study 4

This case study investigated a unique process of restructuring investment decision - making and presented an analysis of risk management from the company's global manufacturing investment perspective.

5.5.1 Business and Strategy Review

Company D is one of the biggest global food manufactures with an annual revenue of approximately $22 billion in 2008. It is a privately owned company and has presence in 66 countries. The company has six core segments. These segments are snack food, pet care, main meal food, drinks, electronics and information technology. The company follows a decentralised management system. This system allows company's regional subsidiaries to be independent and accountable for procurement, production, distribution, and sales and marketing.

Five Principles	Key success factors
Quality	Product Quality, Brand improvement, Consumer responsiveness, Low price
Responsibility	Accountability, People
Mutuality	Sustainability, Suppliers relationship
Efficiency	Waste & Cost reduction
Freedom	Market share growth (or growth in revenue) and profit maximisation

Table 5-4: Five principals of the Business Strategy

The current business strategy, of the company, is based on five core principles, illustrated as above (table 5-4), which was first proposed in 1977 and has been applied since 1983. These principles are broadly named as quality, responsibility, mutuality, efficiency and freedom, which are sub-factored into Key Success Factors (KSFs) of the five principles. For example, the first principle, quality, means not only product quality but also it means brand improvement, customer responsiveness and low price (table 5-4). It is revealed that the KSFs of the principles are believed to be behind the success of the company till today.

Company D is a privately owned enterprise and one of the biggest food product manufacturers in the world. It has been achieving profit maximisation and growth by focusing on quality, responsibility, mutuality and efficiency since 1983.

5.5.2 Manufacturing Review

The manufacturing vision of the company is to create a network of local factories, which can supply products within a country with exception[44]. Its 150 manufacturing sites, across the world, are loosely integrated at the global level. However, limited R&D facilities and geographically restricted raw material locations have created the need for coordination in its global operations network. Other factors, which have contributed to the development of a global operational network, are product characteristics (low value and low margin), proximity to the market, proximity to the resources, and geopolitical environment (for example, a Chinese subsidiary cannot cater to the Taiwanese market). One of the important characteristics of its manufacturing operation is flexibility. The manufacturing flexibility enables the company to transfer plant from one location to another location. Although, the company does not have direct threat from competitors, it wants to makes its operational network more robust based on lower cost and customer responsiveness.

Company D's operations (R&D, procurement, production, distribution and sales and marketing) have evolved as new markets opened across the world. The existing structure of the global manufacturing system has developed because the company's earlier expansion strategy was based on the market only. The company has given constant importance on quality and delivery since its inception. However, the expansion strategy changed over time and now includes various attributes of the manufacturing system capabilities such as resources, costs, flexibility, and knowledge. It was revealed that the operation network faces challenges of inappropriate factory locations, capacity imbalance, absence from emerging markets, and disintegration of newly acquired factories.

Company D's operation network management is decentralised. However, there is need for coordination in a loosely integrated operation network because of limited R&D locations and raw material procurement locations. It was observed that the existing and evolved plant network design requires more robustness to overcome operation network challenges.

5.5.3 Investment Review

At some stage of evolution of the company's global operations, company D realised that it had a global network. However, this realisation also made them understand that their cost of

[44] A factory can supply products to adjacent country only if transportation cost justifies the margin.

global operations could be lowered with high global market share if they could make the products at the most appropriate global location. That is how the factory network restructuring investment project came into existence. The objectives of the restructuring investments were market expansion, profit maximisation and protection of Company D's global operation. The company had developed four network analysis processes (table 5-6) which provided new investment projects to achieve the objectives of restructuring investment.

Analysis of these processes revealed to the company that some factories are at wrong places, some factories are too big, and the existence of several missed opportunities in some geographic regions. During this network analysis process, the company also realised that newly acquired factories are not integrated into its global operation network as per the manufacturing vision and network restructuring objectives. Hence, the outcome of network analysis had given several investment projects such as new factory investment, plant transfer investment, existing capacity expansion investment and M&A integration investment.

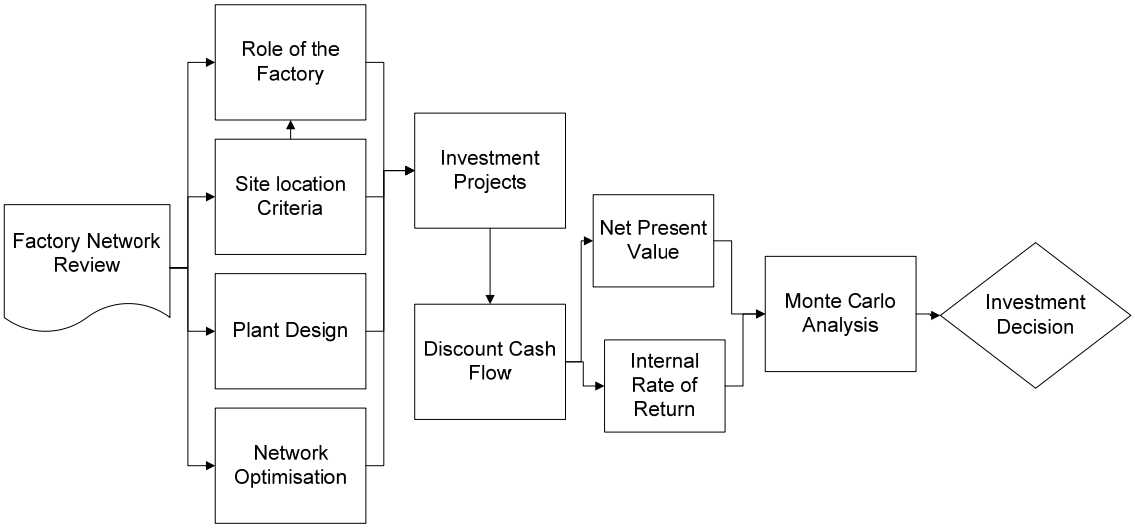

Figure 5-8: Investment Process

Once the investment projects were selected, the company made the business plan with the quantitative evaluation of the projects. The analysis of market growth and risk were the most important part of the quantitative evaluation of investment projects. The quantitative evaluation was accomplished by DCF, which provides NPV, IRR, and Monte Carlo analysis.

The company wanted to value investment projects conservatively; hence, it focused carefully on risk analysis. For example, if the investment project had higher country risk from

macroeconomic perspective then the company used higher hurdle rate to discount the terminal value. The hurdle rate was calculated from the CAPM model. Another interesting fact about DCF valuation method was that it gives flexibility in valuation. This flexibility came from assumptions on revenue and costs. The concern for the company in DCF valuation was the achievement of market growth, customer acquisition, and overcome physical challenges. However, DCF analysis did not give answers to these concerns because of uncertainty associated with the concerned factors.

The restructuring investments were long term (more than 10 years) investments. The company believes that Monte Carlo analysis was required because IRR was valid only for seven years. Monte Carlo analysis provided a series of investment values based on various uncertain factors which might influence the investment value. This analysis was an advanced deterministic model to create scenarios for the investments. However, the company stated that it was impossible to make future cost and revenue projection precise or come up with accurate probability of influential factors of the investment projects.

The investment decision was taken by the Chief Executive Officer (CEO); however regional subsidiary heads heavily influenced the investment decision, because of the decentralised management system in the company. The company's restructuring investment process started with factory network review and ended with investment decision-making by CEO based on quantitative evolution of the investment projects (as shown in figure 5-8).

The company recently accomplished restructuring investment projects, based on the sole objective of saving costs. For example, shifting a plant within South America, from one country to another country, helped the company to increase its profitability by 10%. In another investment in Asia Pacific, the company's new investment faced the problem of product quality. The company had to call back the entire product from the market in that region, which seriously decreased the operations profitability.

5.5.4 Risk Review

The current understanding of risk was undocumented in the company. However, it stated that influential factors, which affect the corporate profitability and the growth of market share, were the risks. There was an absence of formal risk documentation in the company.

However, risks were identified (Table 5-5), during the case study interview, in three broad categories- corporate level, operational level, and global manufacturing investment (GMI) level.

	Risks	Source of Risks
Corporate level	Product recall	Contaminated raw materials, lack of centralized quality control
	Negative publicity	Adverse impact of advertisement due to cultural and ethical issues
	Consumer agitation	Food safety group influence
	High distribution cost	Higher and volatile fuel prices, long distance to customers from factory
	Competition	Private level competitors: retailers, wholesalers and distributors; higher level of competition in economic slowdown, global competitors
Operational level	Contaminated raw material	Quality of raw material
	Low quality of product	Production processes, raw material management
	High costs across value chain	Labor costs, delays, higher inventory, skill shortage
	Human resources: skills and cost	Training costs, restriction, skill shortage in some geographic areas, higher wage rates
	Poor infrastructure in emerging economies	Underdeveloped countries, local government policies
	IPR issues	Leakage of knowledge to competitors
	Higher suppliers bargaining power	Fewer suppliers
	Supply chain disruption	Disturbance in geopolitical issues, spread of diseases, contamination of raw material
	NPI failure	R&D issues, Production issues, market issues
	Distance to customers	Unplanned operations network
	Distance to the site of raw material	Unplanned operations network
	Health concerns	Food safety group, new research findings, diseases
	Low demand	Economy slow down-market trends, health issues, low corporate reputation
	Environmental issues	Adverse impact of packaging , other pollutions
Project level	Corporate level risk and operations level risk	Sources of corporate level and operation level risk
	Over estimation of revenue	Future assumption
	Underestimation of cost	Future assumption
	Lack of understanding of future risk and management	Lack of knowledge, lack of proper risk management framework
	External events	Host country business environment, geo political situations

Table 5-5: Company C's Risks

The important observation of this risk identification process[45] was that the risks at corporate level and at project level also existed at the GMI project level. The company stated that corporate and operational level risk would give direct or indirect impact to existing and future investment projects as well. The other risks at the GMI project level were over estimation of revenue, underestimation of costs, lack of understanding of future risks (unknown risks) and external events. The characteristics of these risks were internal and external environment. The company was more concerned with external risks than internal risks because they judge that they can control internal risks but external risks are unpredictable. The external risks acted as catalyst to increase the intensity of internal risk and sometimes it generated new physical challenges (internal risks) for the company. For example, the company was restructuring its operation because of external risks such as the geopolitical situation (trade restriction) and global competition.

5.5.5 Risk Management Mapping

The company did not have a formal risk management system. However, the case study observation revealed that the company's investment processes had implicit and explicit risk management systems. Therefore, this subsection mapped the company specific factors and processes according to four steps of risk management.

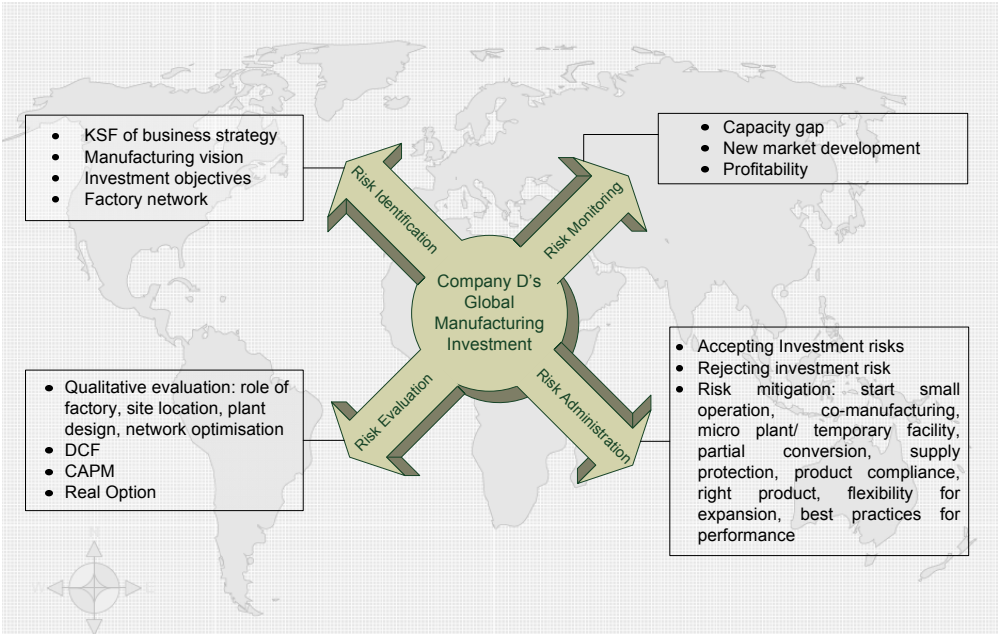

Figure 5-9: Implicit and Explicit Risk Management

[45] The process of risk identification includes three questions- (a) what are corporate risks and their sources?; (b) what are operational risks and their sources?; and (c) what are restructuring investment risks and their sources.

The objective of the risk management mapping (Figure 5-9) was to understand the risk management structure in global manufacturing investment of the company within the limits of the research design framework.

Risk Identification: It was observed that that company did not have risk identification process; hence, it did not have a risk profile. The comparative analysis between the key success factors compared (table 5-4) with data of the corporate level risks (table 5-5) shows that corporate level risks are major threats in achieving key success factors. Likewise, the company's manufacturing vision and investment objectives are the major risks in GMI because of their direct or indirect linkages to profitability and market share. Additionally, the project level risks were primarily micro level risk factors of corporate risks with some exceptions such as high costs across value chain, human resources, suppliers bargain power and supply chain disruption (table 5-5). The company stated that corporate level and operational level risk also existed at the investment project level. Therefore, the pragmatic interpretation of this analysis highlighted that corporate strategy, investment objective, manufacturing vision played an important role in implicit understanding of the GMI risks.

Risk Evaluation: There were two types of evaluations for GMI projects, which also evaluated risks. The first type was factory network review, a qualitative evaluation process. This process directly evaluated risk related to role of factory[46], site location[47], plant design[48], and network optimisation[49]. This process helped companies to identify restructuring investment projects with risk. The second type was DCF analysis. The company understood the risk of wrong valuation through DCF analysis because it was based on assumption. These assumptions were helpful to come up with revenue and costs figures of next 10 years. DCF analysis also incorporates country risk, which was represented as hurdle rate. To understand in qualitative terms the company performed Monte Carlo analysis that gave a range of minimum values of the investment project. The both qualitative and quantitative analysis showed that external and internal risk factors were embedded into the investment valuation.

[46] such as less capacity, inability to capture new market, raw material quality, wrong location of plant or wrong plant with wrong product, less flexibility and NPI capability

[47] such as wasting time in making low value products, high capital investment in purchasing new factory, expansion of current factory which is far from the new customers, global risk factors, country risks factors and industry risks factors

[48] such as high capital requirement and high costs of operation

[49] such as high cost of product sourcing, weak linkage to R&D facility, missing best practices, and in ability to implement operational and engineering excellence

Risk Administration: The company had investment management strategies. It did not have formal risk mitigation strategies' documentation. However, these investment management strategies could be seen in the risk administration. There were two integral parts of risk administration - risk avoidance and risk mitigation. The risk avoidance was to reject the investment projects. The risk mitigation part was applicable when the company accepted the investment projects with risks. If investment risk was high then investment risk mitigation strategies were to start small operations with low investment by remote sourcing, co-manufacturing, micro plant / temporary facility and partial conversion. Other risk mitigation strategies were supply protection (building spare capacity, strict implementation of product compliance and development of rapid start up capability), right product at right factory (based on product life cycle), flexibility for expansion and product variety (long term view), shared facility (to reduce costs and capital investment), and application of best practices to improve performance.

Risk Monitoring: There were also risk monitoring steps in the investment project which was investment monitoring tools. These tools were contribution capacity gap analysis, new market development gap analysis and profitability analysis. These tools helped the company to achieve investment objectives. Based on the analysis of these tools, the company developed and implemented future strategies to improve investment performance, which was again revisiting risk administration steps of the theoretical risk management framework. The periodic review of the above matrices not only monitored investment performance but also checked existing and emerging risks.

In conclusion, the mapping of the restructuring investment (Figure 5-9) according to the risk management structure revealed that there was implicit risk management process in GMI of the company. It was implicit because it lacked the risk language. The company strategy was based on five principles, manufacturing vision and investment objective set the agenda for GMI risk. Qualitative and quantitative investment evaluations had factors of external and internal risks. Investment decision was a part of risk administration; likewise, investment monitoring is risk monitoring.

5.5.6 Summary

Operation network management was decentralised. The company's restructuring investment process started with factory network review and ended with investment decision - making by

CEO, based on quantitative evolution of the investment projects. Risks at corporate level and at project level existed and also at the GMI project level. The current understanding of risk was undocumented in the company. The characteristics of these risks are internal and external. There was implicit risk management process in GMI of the company. It was implicit because it lacked the risk language.

Main factors	Phase 1- Analysis	Phase 2 Analysis	Phase 3 Analysis
Role of factory	Contribution of capacity to network	Gap analysis- Actual vs. Real	
	Develop new market	Gap analysis- Actual vs. Real	
	Unique Country Characteristics	Purity- quality of resources and product	
		Infection free animal	
	Improve local Market costs	Source locally	
	Relocation to lower cost base	Plant relocation or product relocation	If new technology does not increase product life cycle
	Supply protection	Product compliance	
		Spare capacity	
		Rapid start up capability	
Site location criteria	Selection Filter	Initial	Make or buy
			Expand existing plant
			Purchase existing factory
		Global review	Which county
		Country review	Which area
		Area review	Which Field
	Site selection criteria- local market supply	Common	Labour availability including R&D
			Proximity to specialist resources
			Local wage rates
			Proximity to existing factory and operation
			Local legal and fiscal regime
		Industry Specific	Incentives
			Communication
			Major customer location
			Raw material availability
			Relationship with local authorities
	Site selection criteria- global market supply	Trading restriction	Taiwan, Cuba etc
		External relations	Pariah states such as north Korea and Burma

	Site Selection Criteria- which field	Nabours	
		Land quality	
		Traffic movement and access	
		Local government attitude	
		Availability of services	
		Expansion opportunities	
		Distance from workforce	
	Site selection methodology	Identify optimum location	
		Site search check list	
Plant design	Take a long term view, flexibility for expansion	Benefits: Less capital required and cost reduction	
	Generic or standard plant to cover all product range		
	Integrate technologies		
	Share facilities in clusters		
	Avoid dependence		
Network optimisation	New product launches	Hub site	
		R&D facility	
		Operational excellence	
		Engineering excellence	
	Product sourcing	location transfer with lowest transportation costs	
	Performance optimisation	Apply all the best practices	
		Take ideal plant approach	

Table 5-6: Project screening Factors

5.6 Case Study 5

Case study 5 investigated a unique process of engineering, production and supply network restructuring investment decision making based primarily on the cost reduction. The restructuring project was unique because of the perpetual character of the project. This case study presented an analysis of risk management from the company's global manufacturing investment perspective.

5.6.1 Business and Strategy Review

Company E is one of the biggest global engineering companies, which designs and produces products and also provides services to commercial and industrial customers in six industrial sectors: pulp and paper, minerals and mining, chemicals and pharmaceuticals, oil and gas, power and marine. It is a European public company with annual revenue of approximately $30 billion in 2007 and listed in the European and American stock exchanges. It has presence in approximately 100 countries with a wide range of products and services in five business divisions: power products, power systems, automation products, process automation, and robotics. Its competitive advantages are technology development, service and support capabilities, value added in region, and responsiveness.

From late 1990's till 2004, the company's profitability was continuously declined, because the businesses of the company were primarily concerned about achievement of the growth in which they lost the focus on efforts of increasing operating margin and achieving higher capital. Learning from the past mistakes, the latest corporate strategy is 'profitably-grow-safely' since 2005, which equally focuses[50] on business execution[51], cost, risk management and organic growth[52]. It is a Sarbanes Oxley act[53] certified company. The impact of the Sarbanes-Oxley act is visible in the corporate strategy, for example the inclusion of risk management in corporate strategy. Additionally, 'the execution', one of the corporate goals[54], has focus on risk controls and compliance.

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[50] Corporate strategy focuses are the key success factors (KSF) of the corporate strategy

[51] According to the existing CEO, strategy is not the reason for the 1990's and early years of this decade's corporate decline but the poor executions of the businesses along with poorly managed people are the root causes of the corporate under performance.

[52] Organic growth: fundamentals, growth initiatives, product/technology and service leadership.

[53] Details of this act are mentioned in Chapter 1.

[54] The corporate goals of the company are strategy, execution and people.

5.6.2 Manufacturing Review

The company's operation network configuration is heavily influenced by the product characteristics. The company's major products are unique because it requires customisation and special sales processes. Due to the higher level of customisation, the company can take up to 6 months to design, make, deliver, and install a product. The other characteristics of the company's products are price, standardised, long sales contract, sales contract related to the performance, and safeguard from destructive nature of the product (only if products have faults). These product characteristics require the company to have its engineering units and production units side by side. Hence, the configuration of operation network depends on the market and the type of products (standardised, customised, price and nature of sales contract).

The existing operations network vision of the company is to have an optimal globally synchronised or integrated operation, which can provide maximum cost advantage. However, the current network of engineering units, manufacturing units and their supply management are still regionally integrated with focus on the developed countries whereas demand for its products are increasing in emerging economies, such as China, India and Russia. Hence, the operation network vision does not match with the existing operational network configuration. The company has approximately 600 reported engineering and production units alone that have more than US$2 million in revenue. There are approximately 66,000 employees in these units of which 49,000 are from the manufacturing units while the remaining 17,000 are from the engineering centres. The distribution of the number of units and employees, of the these manufacturing and engineering units, shows that the existing operations network are more concentrated in mature markets such as USA and EU (Table 5-7).

	Mature Markets	**Emerging Markets**
Employees, in more than 600 units	65%	35%
Number of Mfg Units	49%	51%
Number of Eng Centres	60%	40%

Table 5-7: Distribution of the number and employees of the manufacturing units and engineering units

The 1990's growth strategy coupled with extreme decentralisation of organisational design, resulted in underperformance and inefficiency in the operations network, as revealed by the company. Although, decentralisation of the organisation had increased the entrepreneurship

of the frontline manager but at an intangible cost of confusion[55], lack of coordination[56] and loss of network efficiency. The network inefficiencies have had a negative impact on the value chain[57]. These network inefficiencies are currency imbalance[58], detachment from customers of emerging market, inflexible capacity to protect supply chain disruptions, overlooking low cost countries opportunities for cost saving. The indication from the company is that the global operations network (R&D, engineering & design, supply management, production, sales & marketing, after sales services) have imprudently evolved until 2005 together with inefficiencies, which the company wants to rationalise.

Product characteristics have major influence on the global operation configuration. The current network of engineering units, manufacturing units and their supply management are regionally integrated with focus on the developed countries. The network inefficiencies have given the negative impact on the value chain.

5.6.3 Investment Review

The company started a perpetual investment project, Global Footprint, in 2006. The objective of the investment project was to continuously align the company's engineering, production and supply operation with the changes in market to ensure long term success. The long term success might be guaranteed if the company developed specific capabilities which could act as pull factors of the global footprint project's emergence. These specific capabilities were capacity balance, risk management, and development of new market. The company stated that these capabilities would help the company to efficiently serve various markets with various demands in adverse situations such as changes in demand, fluctuation in supply and currency exposure. Additionally, there were four push factors, which were also responsible for the emergence of the global footprint project. The push and pull factors defined the global footprint project focus (Table 5-8).

[55] None standardise best practices and their implementation.
[56] Lack of common guidelines, directives and processes are the reasons of lack of coordination.
[57] The broad categories of value chain are engineering, production, and supply operations (downstream and downstream).
[58] Currency imbalance is the difference between making costs in US$ and selling in various currencies except US$.

Push Factors	Pull Factors	Global Footprint Focus
Emerging markets (China, India etc) present new market opportunities	Develop new market	A need to shift centre of gravity in global sales and operations
Volatile exchange rate is proven costly	Capacity balance	Cost and revenue should be in same currency
Unstable geopolitical situation and unreliable global economic growth rate have adversely impacted supply management and customer responsiveness	Risk management	A requirement of flexibility in operational set up for developing continuous supply management and increasing customer responsiveness.
Untapped low cost manufacturing opportunities has resulted in higher cost of operation.	Capacity balance	There is need to develop global supply and manufacturing base in low cost countries.

Table 5-8: Push Factors and Pull Factors of Global Footprint Project

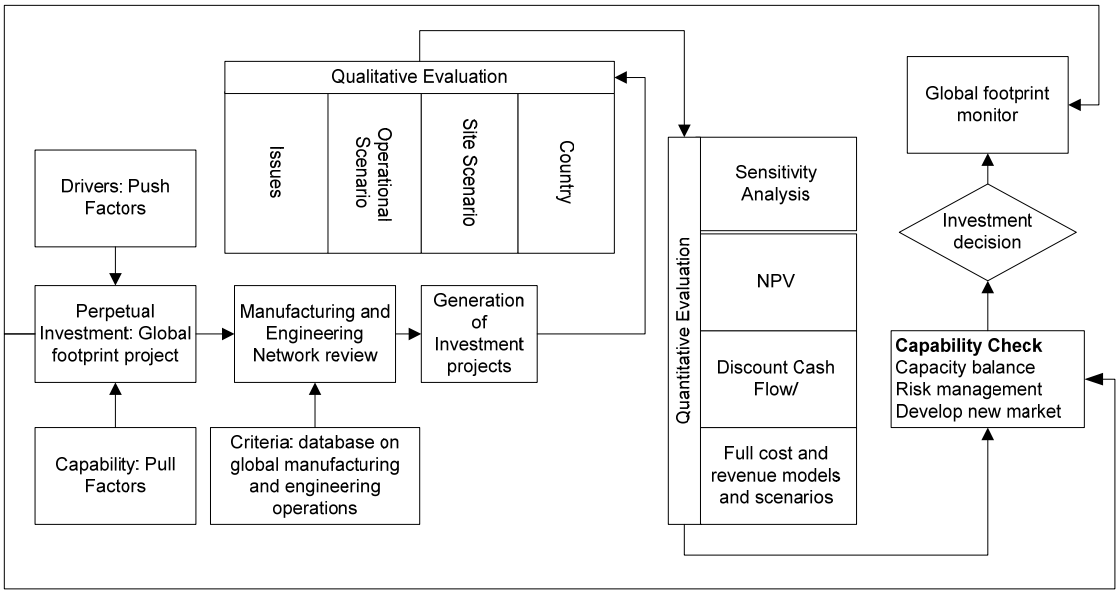

Figure 5-10: Global Footprint Investment Process

The global footprint investment process (Figure 5-10) started with push and pull factors of investment and ended with the step of global footprint monitoring. The company had created a manufacturing and engineering network database. This database helped the company to understand the gap between existing network capabilities and the company's operations network vision. This gap also provided reasons for new Greenfield investments within the context of the global footprint investment. The new Greenfield investment projects were first analysed qualitatively in following categories[59]:

[59] These categories are shown in table 5-11

1. Country: Location of value-added segments of the company which do not only provide the cost saving opportunities but also ensures the right customer service.
2. Site Scenarios: Analysis of the impact of operational site advantages and disadvantages on the operational infrastructural requirements.
3. Operations scenarios: Making and sourcing from LCC which will enhance manufacturing capabilities.
4. Major issues: The major issues at strategic, legal, sustainability, commercial, and accounting & reporting levels.
5. Profitability: Qualitative understanding of profitability.

The quantitative valuation started, after the qualitative evaluation of the investment project, with costs and revenue projections. The assumptions behind the cost and revenue projection were rooted in qualitative understanding of the investment projects. The company had employed economists who also helped in quantifying the factors that affected the cost and revenue. These economists forecasted the inflation rate, GDP growth rate, price growth rate of energy and price growth rate of raw materials. These forecasts facilitated in formulating underlying assumptions of revenue and cost in DCF analysis. The investment valuation was based on the DCF analysis, which gives NPV of the project. The hurdle rate was used to discount the future cash flow. The hurdle rate represented the country risk in the quantitative valuation. The company also performed sensitivity analysis on investment valuation.

The investment decision was taken based on the NPV and alignment of the investment project with global footprint objectives. The most important observation of the investment process was that the global footprint project was itself a risk mitigation strategy for the company.

The objective of the investment project was to continuously align the company's engineering, production and supply operation with the changes in market to ensure long term success. The existing investment projects were capabilities development driven. Investment process included qualitative and quantitative evaluation processes.

5.6.4 Risk Review

The company stated that the political, economic, societal and technological were the main categories of risks in the global footprint investment projects. However, they only had processes to identify the risks at location, strategic, legal, commercial, legal and accounting levels. In risk identification, the company associated the risk with location only. Apart from location risks the company used the word 'issues' for risks, for example major issue identification at the strategic, legal, commercial, legal and accounting levels (table 4-11). The company stated that they were aware about project management risk such as project delays and cost overrun as well. It was understood in the discussion that there was a risk of misrepresentation of costs and revenue figures in the DCF valuation model. However, these understandings on risk were not documented. The company believed that the corporate level risks were not achieving the key success factors. In the discussion, KSFs emerged as strategic risks of the company.

The company had implemented risk management, which gave the company the risk profile (table 5-9). It shows that risk management was helpful in risk documentation. However, the standard risk categorisation was not observed in the company. The risk documentation showed risks in two broader criteria. These were pure financial and non-financial. Additionally, it was revealed that risks sources were also risks in some circumstances. The company stated, in the discussion (when asked), that all the documented risks give impact on investment projects. Some of the other risks that the company has mentioned which were related to specific project management for examples delay in construction and cost overrun due to high inflation. The most important point, mentioned by the company, was all risks were positively related to the company's profitability.

Risks	Source of risks
Reputation damage	Employees and agents wrong conduct leads to fine (by legal authority), higher legal costs, and internal controls are not sufficient to detect and prevent this.
Change in global economic and political climate	Slow economic growth, political uncertainty, trade restriction, negative impact on customers' industries (utilities, automotive, mines& mineral, gas& oil, metal, manufacturing, pharmaceutical, and consumer industry)
Emerging market risk	Unstable political, social environment, economic leads to delay in order; international embargos and boycott; fluctuation in local interest rate and in local currency; imposition of higher tax; exchange control; lack of legal protection
Underestimation of costs of customized products	Product characteristics and sales strategy coupled with economic environment
Currency exchange risk	global operations
Loss of IPR	IP is fundamental of the business, weak IP protection in various countries across the world
Technology changes	Unable to match with technological changes.
Competition	Industry consolidation, new competitors because of privatization, dependence on product and service innovation, consolidation in customer's industry (loss of knowledge if the competitors customers' acquire the company 's customers, customers' bargaining power
Changes in environmental regulation	current operation might in liable to pay in future, various rules across the world, higher compliance cost because of nature of the operations which pollutes and the environment in some cases it releases hazardous material into the environment, higher costs of environment protection products
Global operations risks	Currency translation, currency transaction (making cost in different currency and selling price in difference currency)
Fluctuation in raw material costs	depends on small number of supplier, higher suppliers bargain power, price volatility
Unknown liability	defective products can damage clients business and facilities
Low confidence of financial institution	does not achieve the performance
Investor confidence	affected the value of the company
slow growth in customer's industries	power products and power systems depends on utilities, automation depends upon automotive, pharmaceutical, Pulp and paper, manufacturing, metal and minerals, consumer industry
Loss on long term fixed price projects	technical (product development and design) problem, changes in costs of components, permits requirement, supplier's failure, delays, penalties for delays
Credit risk	External environment
Interest risk	External environment
Supply and manufacturing disruption	Natural disasters, other factors

Table 5-9: Documented Risk Profile

5.6.5 Risk Management Mapping

The company had a formal risk management structure at corporate level. However, the company did not have a formal risk management structure at the global footprint investment level. In spite of this, there were a number of scattered explicit and implicit risk management processes, which fell under the investment decision process. This subsection mapped the explicit and implicit risk management processes (Figure 5-11) in global footprint investment

according to four steps of risk management. The objective of the risk management mapping was to understand risk management in global manufacturing investment of the company within the limits of the research design framework.

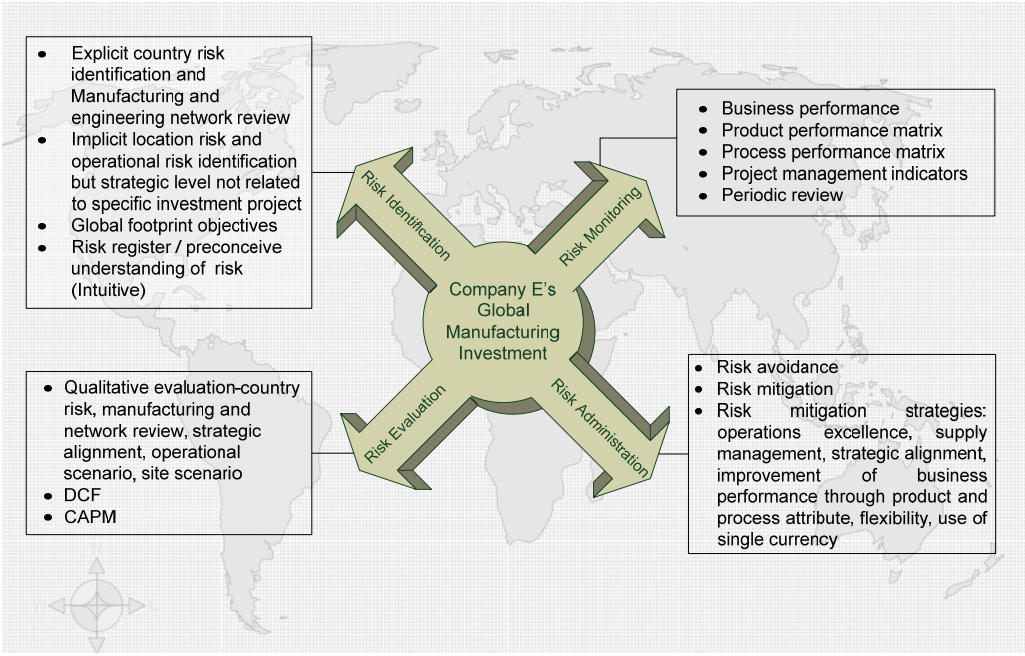

Figure 5-11: Explicit and Implicit RM

Risk Identification: It was observed that the company had an explicit risk identification process, which was only limited to country risk and an implicit risk identification process of identifying major issues in five categories (Table 5-11). Additionally, the analysis of site scenarios and operational scenarios identified the risk in investment implicitly. The company's risk profile also provided investment decision maker a broader understanding of the investment risks. The understanding of the investment risks were also enriched by the objectives of the global footprint project. The misalignment of global footprint objectives with new investment was understood as one of the biggest threats to the company. Therefore, risk identification by risk management, objective of the global footprint project, operational scenario and site scenarios were implicit understanding of risks, however country risk was explicitly identified and treated as a risk in the global investment.

Risk evaluation: There were two types of evaluations for global footprint investment projects which also evaluated risks explicitly and implicitly. The first qualitative evaluation was the engineering and manufacturing network evaluation. This evaluation brought the existing inefficiency in the network. The second was investment project qualitative assessment, which included country assessment, site scenarios, operational scenarios and major issues. In this

stage the company evaluation was based on relative ranking basically intuitively. Based on this the company investment projects were quantitatively evaluated with DCF analysis. The company understood the risk of wrong valuation through DCF analysis because it was based on assumptions. These assumptions were helpful to come up with revenue and costs figures for the next 10 years and to bring more accuracy in assumption, the company employed economists. DCF analysis also incorporated country risk which was represented as hurdle rate. Both qualitative and quantitative analysis showed that external and internal risk factors were embedded into the investment valuation which gave a risk adjusted NPV. The last step of risk evaluation, the alignment of investment with global footprint objective, was completed qualitatively.

Risk Administration: The company had investment management strategies. It did not have formal risk mitigation strategies document, however, the investment management strategies could be part of risk administration. There were two integral parts of risk administration - risk avoidance and risk mitigation. The risk avoidance was to reject the investment projects. The risk mitigation part was applicable when the company accepted the investment projects with risks. The company managed investment project risk, to protect cost appreciation and revenue depreciation, by several implicit strategies. Investment process included qualitative and quantitative evaluation processes.

External risks	Valuation risk	Risk administration
Macroeconomic risk	Cost underestimation and revenue overestimation	Operations excellence
		Supply management- Collaborative planning with key suppliers
		Corporate strategy alignment
		Linking product and process attributes to the business performance
		Flexibility- capacity expansion
		Shared services
		Most of the sourcing in and production, and sales in one currency

Table 5-10: Risk Mitigation Strategies

Risk Monitoring: There were also risk monitoring steps in the investment project which were investment monitoring tools. These tools were product and process attributes of business performance. These tools helped the company to achieve investment objectives. Based on the analysis of these tools, the company developed and implemented future strategies to improve investment performance, which was again revisiting risk administration step of risk

management. The periodic review of above matrices not only monitored investment performance but also checked existing and emerging risks.

In conclusion, the mapping of the restructuring investment (Figure 5-10) according to theoretical risk management structure revealed that there was implicit risk management process in global manufacturing investment of the company. It was implicit because it lacked the risk language.

5.6.6 Summary

The Company had risk documentation, however, some intuitive risks (mentioned during the interview) were missing. Standard risk categorisation was not observed in the company. Risks sources were also risks in some circumstances. There was implicit risk management process in GMI of the company.

Restructuring project	Key decision area	Check list	Tools	Action Plan
Manufacturing Footprint	Country	Macro-economics	Country Prioritisation	Develop Action plan for investment
			Country Risk Assessment	
	Site Scenarios	Equipment	Site soft factor assessment	
		Human resources		
		Information system		
		Production		
		Site facility		
		Supporting Infrastructure		
		Transportation		
	Operational scenarios	Make Vs Buy	Make Vs buy	
			LCC sourcing	
			Mfg Capability	
	Major issues	Strategic	Conflict with strategic plan analysis	
		Legal	Legal issues	
		Sustainability	Health and safety	
			Environmental legislation	
		Commercial	Commercial terms on land and real estate	
			VAT/duty/ tax incentives and issues	
			Financing and amortization	
		Accounting and reporting	Issues	
	Profitability		Profitability calculation	

Table 5-11: Footprint analysis process

5.7 Case Study 6

Case study 6 investigated a unique process of restructuring investment decision making and presented an analysis of risk management from the company's global manufacturing investment perspective.

5.7.1 Business and Strategy Review

Company F is a fortune 500 company with annual revenue of more than $30 billion in 2007. It employs more than 80,000 employs globally to manufacture of diesel engine, turbine, construction machinery, and earth moving machines. It is a Sarbanes Oxley act[60] certified company.

There are three product groups: (1) finished product, (2) transmission and (3) engine. Its target markets are natural resource extraction, building and infrastructure construction and electric power generation. All of its products are sold through distributors and dealers. There are no direct factory sales. After-sales-services are provided by dealers. The industry, in which the company operates, follows a global economic cycle. Hence, if global economy goes downward then the revenue of Company F also goes downward. Its main revenue comes from North America because of the evolution of the company. However, it has been focusing globally since 1997 with exception of Europe.

Company F wants to achieve 60% revenue growth by 2010. To achieve this financial target, the business strategies are (a) developing people, (b) developing product and processes at profitable level, (c) profit growth. It is, further, revealed that company F has developed following critical success factors (Table 5-12) to achieve its financial target.

Critical Success Factors	Description
People	Leadership, engagement, health and safety, training for managers
Product and processes	NPI, order to delivery, Brand management
Quality	Warranty, suppliers defects
Velocity	Speed of production
Distribution	Effective distribution channel
Emerging Market	Market expansion , additional capacity, cost reduction
Economic cycle	Planning for cyclical downturn

Table 5-12: Critical Success Factors of the Business Strategy

[60] Details of this act are mentioned in Chapter 1.

Company F is a global manufacturer, which has strong desire to achieve its financial goal. It wants to achieve its goal by expanding in emerging markets, developing people, increasing speed in operations, managing suppliers, and preparing itself for economic downturn. There are several challenges in achieving the financial goal, mentioned by the company. These challenges are high capital requirement[61] for expansion, decline demand from developed countries, price competitiveness[62] in emerging market.

5.7.2 Manufacturing Review

Company F's manufacturing vision is to have common processes and world class quality around the world. Its operations are divided into R&D, procurement, production (testing plants, parts manufacturing plants and assembly plants), distribution, sales and marketing and services. However, its focus is on supply chain, manufacturing, R&D and order fulfilment process. Distributors and dealers play major roles in distribution, sales and marketing and service. It has more than 170 manufacturing locations, 20 R&D technical centres, and more than 100 distributors and dealers globally. However, these manufacturing activities (especially production) are highly concentrated in high cost countries. For examples, 90% of the value-add costs[63] (non-material cost of production or processing costs) are from North America, Western Europe and Japan, which only accounts for 50% of total revenue.

There are two plant roles - design work and pure production. The design work plant is situated near to R&D centres and it is used for testing plant for manufacturing processes and new products. The company's production technologies are casting, forging, metal cutting, welding, machining, heat treatment, precision grinding, polishing, assembly, test, paint. Pure production plants were divided into two parts- component manufacturing plant and assembly plant. The ratio of component manufacturing plant and assembly plants were not balanced[64]. Company F was shipping lots of products across world, but did not have enough dispersion of assembly plants.

The current manufacturing network was established approximately 20 years ago, based on the assessment of the major economic factors prevalent at that time. The network concept was

[61] Company has the right amount of capacity to meet higher demand but not too much in given capital investment cycles
[62] A Price point in emerging market is lower than traditional market of the company.
[63] It is a measurement to show –how much Company F is doing at specific location
[64] More assembly plants and less component plants

not used then as it was developed in the literature later. The key factors involved - the location of major demand, and relative costs, both of which have evolved significantly since then. The historically evolved manufacturing network is highly concentrated in comparatively high-cost countries. It is revealed that the existing manufacturing network requires restructuring. Followings are the disadvantages of the current manufacturing networks:

- Higher cost of production (than the company could achieve with a different mix of plant locations).
- Production location may no longer be close to the largest market opportunities, and necessitate product-shipping around the world.
- Assembly plants are in the wrong locations, because of lack of decoupling points.

Company F's global operations are complex. There is high production distance from emerging market. It was revealed that the existing operations network design required restructuring because of its current demerits.

5.7.3 Investment Review

The existing investment projects came from individual product groups of the company. These projects were called manufacturing transformation projects. These product groups made their investment proposal based on network factors of network design. They also performed additional analysis of plant location, plant role, product and performances. These analyses provide investment projects such as new plant investment, plant transfer[65], expansion of existing plant. The company developed a qualitative method to screen these projects with the help of supporting services departments. The supporting services department was responsible for estimating cost of supporting projects and establishing supporting projects.

After the qualitative evaluation process, product groups performed DCF analysis. There was a corporate methodology[66] to determine the cost projection of the investment. For the revenue projection, the company had employed economists. Revenue and cost were boiled down to a 10 year DCF and projects were evaluated based on IRR (internal rate of return) and NPV (net

[65] Examples: (a) plant A was getting old and the big wave of attrition was coming. They identify the labour intensive process and highly mobile process. So there was high cost in the plant and high turnover of labour so they did plant transfer and closure in one business unit. (b) Company put assembly plant at Mexico in 1930 because of high tariff. Now that the tariff does not exist so the company transferred the plant.
[66] Corporate methodology for cost estimation is documented. This document has approx 150 pages.

present value). There was a significant amount of supporting materials. After the quantitative analysis, the investment project business plan was sent to the corporate headquarter for approval.

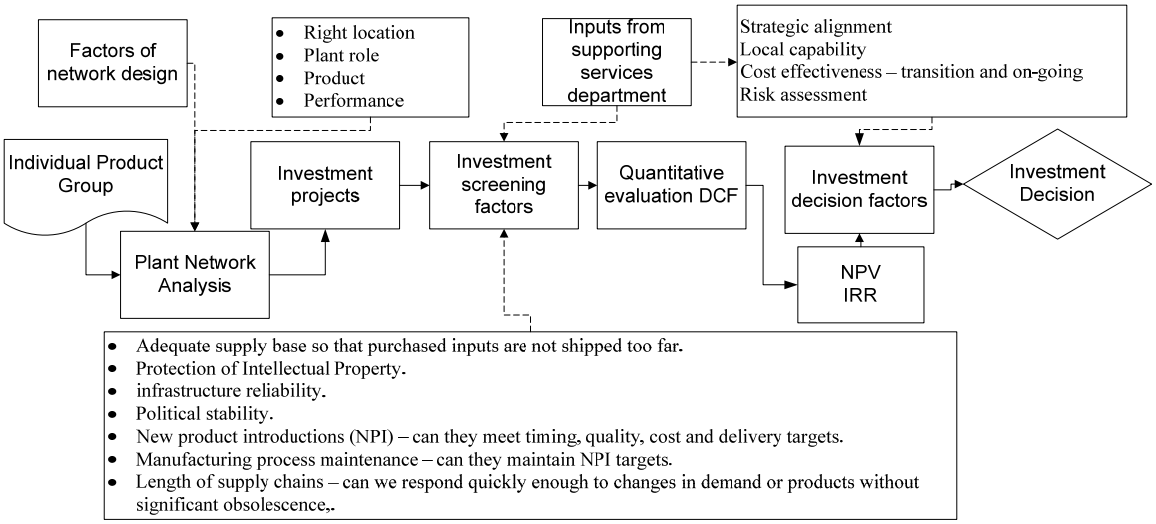

Figure 5-12: Company F's Investment Process

Corporate headquarter examined the business plan and revaluated the investment project assessment of strategic alignment, local capability, cost effectiveness and risk assessment. Investment risk was assessed by changing key inputs of the DCF model. For example, higher expected return on investment in troubled regions such as in Saudi Arabia. It was known that chances of unforeseen situations in that region are higher than in Brazil, so the company needed to see higher rate of return. It was revealed that key inputs assessment methods were adequate given the forecasting ability of the company. Based on the corporate headquarters evaluation, Company F took the investment decision. However, there were several layers of capital approval process depending upon size of investment. More than $5 million projects need directors' approval and analysis. Hence, corporate investment process (Figure 5-12) was not adequate, as stated by the company.

5.7.4 Risk Review

The current understanding of risk was documented in the company but at the corporate level. There was absence of formal risk document in investment. During the interview, only seven risks[67] were revealed. However, risk document of the company stated 40 risks (Figure 5-13).

[67] Higher distance of raw materials, Protection of Intellectual Property, Infrastructure reliability, Political stability, New product introductions (NPI) – can they meet timing, quality, cost and delivery targets,

The confidential document of risk management revealed that the riskmanagement framework at the corporate level is not completed.

External Risks
1. Competitor
2. Economic
3. Legal/Regulatory
4. Market requirements
5. Political
6. Technological innovation

Financial Risks
7. Budget & forecasting
8. Credit
9. Financial & regulatory reporting
10. Fraud
11. Investment evaluation & monitoring
12. Liquidity

People Risks
13. Communications
14. Employee engagement
15. Employee knowledge/skill
16. Health & Safety
17. Knowledge capital
18. Leadership
19. Legal compliance
20. Process/Policy compliance

Operational Risks
21. Business interruption
22. Capacity
23. Customer satisfaction
24. Distribution channel
25. Information access
26. Information infrastructure
27. Information relevance
28. Inventory management
29. Partnering/Supplier management
30. Performance
31. Performance measurement
32. Quality

Strategic Risks
33. Alignment
34. Business intelligence
35. Intellectual property
36. Planning
37. Product development
38. Product/Service pricing
39. Resource allocation
40. Unbalanced measurements

Figure 5-13: Company F's risks

The company had stated that a risk management programme was in progress at corporate level with external help. The basic framework of risk management included risk identification, assessment, and management (Table 5-13). There were five categories of risks- external, financial, operational, people and strategic. This document also had event risk. The purpose of event risk was to assess the nature of risk with the occurrence of certain events.

Corporate Risk Management	Steps
Identify	Compile list of trigger events and continuous risk
assess	Describe impact of each event/risk in 2015
	Prioritise event/risks based on likelihood and significance
	Translate each event/risk into a set for forecasts
	Quantify impact of uncertainties on key matrix under scenarios
Manage	Interpret results and determine appropriate next steps/mitigations

Table 5-13: Corporate Risk Management

Manufacturing process maintenance – can they maintain NPI targets, Length of supply chains – can we respond quickly enough to changes in demand or products without significant obsolescence.

It was found that the company did not mention these risks during the interview and it was also not mentioned in the investment process. However, company F stated that product groups were working to insulate themselves from various risks. It is a suboptimal approach as all groups are trying to achieve currency balance and ensure supply continuity. However, Company F was trying to approach global manufacturing from a more enterprise-wide perspective and deal with the risks at a higher level.

Company F had documents on risks at corporate level but they were properly communicated across the organisation because the risk management framework was not yet completed.

5.7.5 Risk Management Mapping

The company did not have a formal risk management structure in investment. However, the case study observation revealed that the company's investment processes had implicit and explicit risk management in investment. Therefore, this subsection mapped the company specific factors and processes according to four steps of risk management. The objective of the risk management mapping (Figure 5-14) was to understand the risk management structure in global manufacturing investment of the company within the limits of the research design framework.

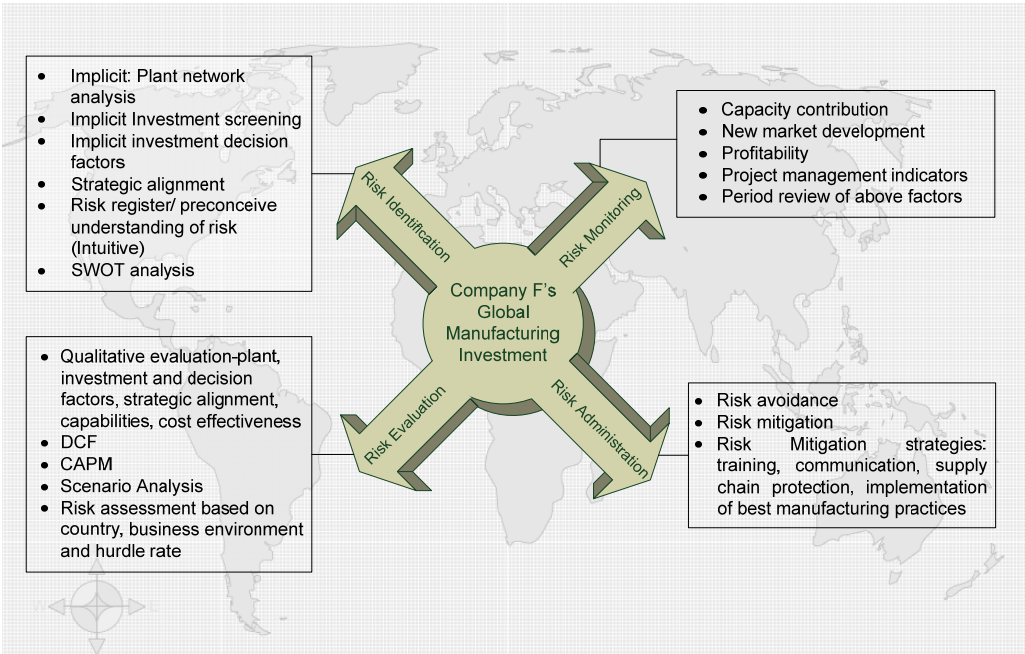

Figure 5-14: Explicit and Implicit RM

Risk Identification: It was observed that that company did not have risk identification process at investment level. Hence, it did not have a risk profile at investment level. It was

also observed that there was risk profile at corporate level. Following were the steps of investment where the company identified the risk implicitly:

- Plant network analysis
- Investment screening
- Investment decision factors

The investment screening factor had explicit risk identification which was only related to country risk.

Risk evaluation: There were two types of evaluations for investment projects which also evaluated risks. The first type was factory network review, a qualitative evaluation process. The second type was quantitative analysis - DCF analysis. The company understood the risk of wrong valuation through DCF analysis because it was based on assumption. These assumptions were helpful to come up with revenue and costs figures of next 10 years. DCF analysis also incorporated country risk which was represented as hurdle rate. Both the qualitative and quantitative analysis shows that external and internal risk factors were embedded into the investment valuation.

Risk Administration: The company had investment management strategies. It did not have formal risk mitigation strategies document. However, the investment management strategies could be part of the risk administration. There were two integral parts of risk administration- risk avoidance and risk mitigation. The risk avoidance was to reject unsatisfactory investment projects. The risk mitigation part was applicable when the company accepted the investment projects with risks. Company used four risk mitigation strategies - training, communication, supply chain protection and implementation of best manufacturing practices.

Risk Monitoring: There were also risk monitoring steps in the investment project which were investment monitoring tools. These tools were contribution capacity gap analysis, new market development gap analysis and profitability analysis. These tools helped the company in achieving investment objectives. Based on the analysis of these tools, the company developed and implemented future strategies to improve investment performance, which was again revisiting risk administration steps of the literal risk management system. The periodic review of the above matrices not only monitored investment performance but also checked existing and emerging risks.

5.7.6 Summary

The investment-screening factor had explicit risk identification that was only related to country risk. The qualitative and quantitative analysis showed that external and internal risk factors. There was a process of periodic review of investment performance. The mapping of the restructuring investment (Figure 5-14) according to theoretical risk management structure revealed that there was implicit risk management process in global manufacturing investment. It was implicit because it lacked the risk language.

5.8 Case Study 7

Case study 7 investigated a unique process of global manufacturing network transformation investment decision making.

5.8.1 Business and Strategy Review:

Company G was founded in 1960. It is a global manufacturer of protective packaging materials and systems with annual revenue of more than $4 billion in 2007. It employs more than 18,500 employees globally to manufacture of bags, laminates, and vacuum packaging films. It also provides propriety packaging solutions for protein products. It is a Sarbanes Oxley act[68] certified company and listed in NYSE.

There are three product groups: (1) Packaging products division, (2) Engineered product divisions and (3) Food packaging division. The Company restructured its organisational design according to the product group. It spends more than two percent of its total yearly revenue on research development. This continuous investment has given key branded products.

The Company's target markets include retailers, food manufacturers and consumer product manufacturers. All of its products are sold directly to the customers. The industry, in which the company operates, is highly regulated due to customers' health concerns and gets affected by oil price fluctuation because its main raw materials are hydrocarbon based materials. Hence, if there is global endemic (such as foot and mouth disease, swine flu and bird flu) then the revenue of the Company goes downward. Its main revenue comes from North America because of the evolution of the company.

Company G wants to become one of the Fortune 100 companies by 2025. To become the industry leader, the business strategies are (a) focused on customer relationships, (b) increasing shareholders value, (c) increasing market share in new markets, and (d) operational growth in emerging markets. It was, further, revealed that Company G has developed following key success factors (Table 5-12) to achieve its goals.

[68] Details of this act are mentioned in Chapter 3.

Key elements of business strategy	Key success factors
Leader	Becoming fortune 100 company
Increasing shareholders value	PE ratio, Increasing earnings per share
Customer relationship	Partner of choice
Operational growth in emerging markets	More than five percentage
Increase market share in new markets	More than twenty percentage in five years

Table 5-14: Critical Success Factors of the Business Strategy

5.8.2 Manufacturing review:

The Company has two main manufacturing processes – multi-layer co-extrusion and printing converting. It has approximately 100 manufacturing locations. However, manufacturing activities (especially production) are highly concentrated in high cost countries. For example, 80% of the total manufacturing capacity is in North America and Western Europe. Decisions around the decoupling point are crucial in the network because Company G has 100's SKUs (Stock Keeping Units) and several hundred semi-finished products. It was stated that Company G was working on standardisation of operating platforms across the global manufacturing network because difference in platform created challenges in NPI.

Previously, the manufacturing network design had been based on the 1970s model, which included multi-domestic markets, geographic based, close to markets, close to railways, and close to airport. The current configuration provides a unique core capability based on platforms such as ability to separate the production process, which helps in the standardising primary process and customising secondary process.

Company G's manufacturing vision is to support the business strategy by implementing a step-change reduction in manufacturing cost base. Hence, creating opportunities to upgrade both leadership in industrial markets, and aggressively competing in consumer markets and new geographies, without compromising on service, quality, environment standard, and health & safety rules. There are three objectives of the existing manufacturing strategy – operational cost reduction, productivity improvement, and expansion in emerging markets.

It was stated that some product lines did not have de-coupling points, which increased the complexity in the manufacturing. Some products could not be transported to geographically dispersed locations in large countries with poor infrastructure, for example: China and India,

because of a higher additional transportation cost (in some cases the cost exceeded the value of the product).

It was observed that Company G's manufacturing network required reconfiguration to rationalise the network objective due to globalisation and change in the business environment since the 1970s. The operational reason being the competitive inefficiencies in the network such as need for new technology and strategy for new markets (India, China and Middle East), which are culturally different from west.

5.8.3 Investment review

The business and manufacturing challenges initiated a multi-year investment project – manufacturing network transformation. The current manufacturing transformation investment projects are based on better serving customers while using scale to improve sourcing and minimising costs. These projects focuses on strategically positioning plants in a new global network, taking advantage of low cost labour countries and utilizing best available technology.

The existing investment projects revolve around plant transfer, Greenfield and Brownfield investments. Planning directors approach members of board every three months to present financial projections. Financial criteria contribute towards managing the risk-approach in these investments. It was stated that the investment decision making was rigorous and financially valid. However, it required additional contextual tools for effective investment project selection.

The process of investment decision making (Figure 5-15) starts with global manufacturing strategy. The Company evaluates the network based on the key manufacturing strategic objectives. This process gives several potential investment projects including plant transfer, plant expansion and setting up new plants. These investment projects are then screened qualitatively and then evaluated financially with the help of DCF, scenario analysis and exit analysis. Company G creates a Portfolio of projects, which is intuitively evaluated based two parameters – risk and attractiveness. Investment decision is then taken by the board. Investment project approval process is incremental and Company G measures the

justification on short term gain in productivity or defending a market (benefits) rather than its long term cost of inflexibility across the network.

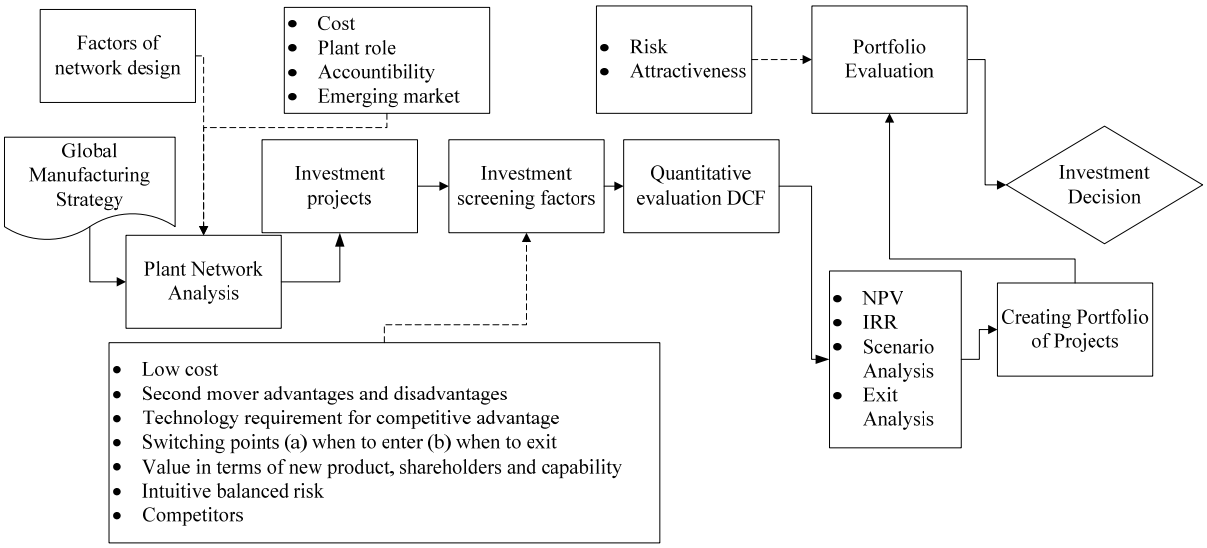

Figure 5-15: Investment Process

Portfolio assessment tool was developed by a consulting company, which consisted approximately of 100 questions. These questions were mostly related to investment project management. It was observed that there were challenges in answering these questions because it subjectively assessed project management risks. It was observed that the Company investment decision making was relatively more advanced than the other investigated companies because it included a exit analysis and portfolio evaluation. It was stated that the Company preferred a scientific process for evaluating risk in their investment projects.

5.8.4 Risk Review

The current understanding of risk was documented in the company but only at the corporate level. There was absence of a formal risk document in investment. However, currency fluctuation risk, IPR risks and supply chain disruption risk were written in the confidential comments. During the interview, 18 risks[69] were revealed. However, the risk document of the company stated a number of risks but in an unstructured format (Figure 5-13).

[69] Currency risk, corruption risk, tax risk, language risk, IPR risk , profit repatriation risk, plant performance risk, disruptive technology risk, information mismanagement risks, common architecture of plant design and platform, culture risk, Reinvestment risk, retaining market risk, quality risk, timing of investment risk, strategic adaptability, sustainability risk and technology adaptability risk

Risks	Source of risks
Legal risk	Asbestos litigation and related litigation risk
Raw material and Energy risks	Increase in raw material price, raw material scarcity (supply disruption), suppliers' capacity imbalance, due to natural disaster, political instability, terrorism
Customer's health and safety risk	Animal and food related issues and government restriction due to mad cow disease, foot and mouth disease, and bird flu
Currency exchange risk	global operations
Loss of IPR	Weak IP protection in various countries across the world
Technology changes	Unable to match with technological changes.
Competition	Local and global competition
Changes in environmental regulation	Policy risk, country risk,
Global operations risks	Political risk, geo political risk currency exchange risk, various regulations, government restriction
Low confidence of financial institution	Does not achieve the performance
Investor confidence	Affected the value of the company, volatility of stock price
Economic slow down	Regional and global economic slowdown affects demand
Credit risk	External environment
Interest risk	External environment
Supply and manufacturing disruption	Natural disasters, other factors

Table 5-15: Company F's risks

It was found that understanding of risk in investment was relatively better than that of the other investigated companies. Some of the identified risks during the interview were not presented in the risk document.

5.8.5 Risk Management Mapping

The company did not have a formal risk management structure in investment. However, the case study observation revealed that the company's investment processes had implicit and explicit risk management in investment. Therefore, this subsection mapped the company specific factors and processes according to four steps of risk management. The objective of the risk management mapping (Figure 5-16) was to understand the risk management structure in global manufacturing investment of the company within the limits of the research design framework.

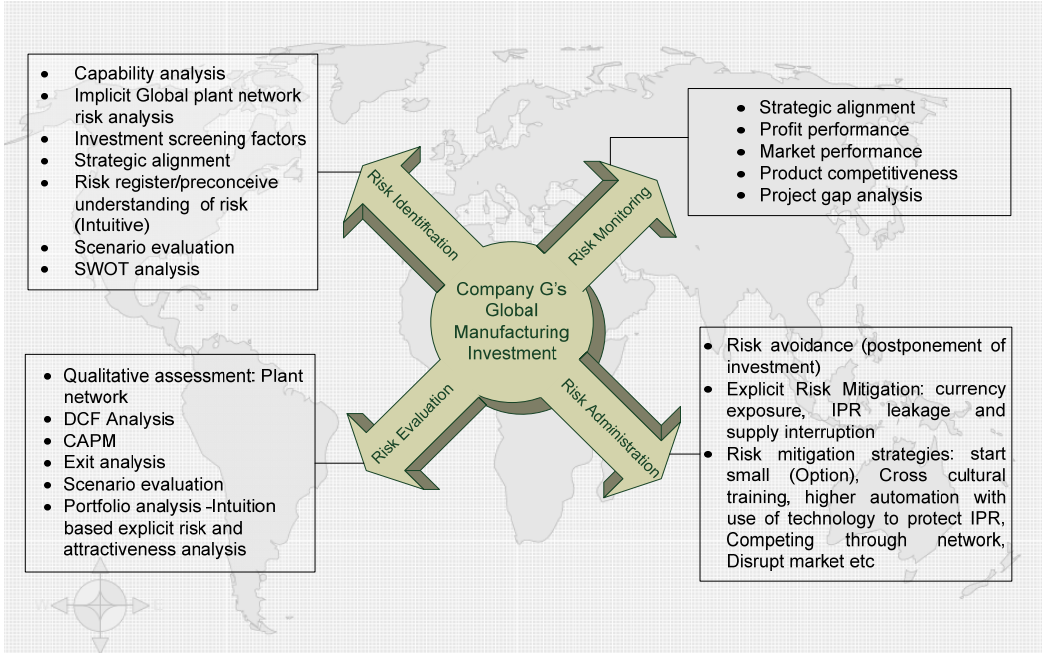

Figure 5-16: Explicit and Implicit Risk Management

Risk Identification: It was observed that that company did not have a risk identification process at the investment level. Hence, it did not have a risk profile at the investment level. It was also observed that there was a risk profile at corporate level. Following were the steps of investment where the company identified the risk implicitly:

- Capability analysis
- Global plant network analysis
- Investment screening
- Risk register
- Undocumented understanding on risk
- SWOT analysis
- Scenario analysis

It was observed that SWOT analysis was not the part of the confidential investment document. However, a separate network analysis document contained SWOT analysis.

Risk evaluation: There were two types of evaluations for investment projects which also evaluated risks. The first type was a plant network review, a qualitative evaluation process and the second type was quantitative analysis - DCF analysis, exit analysis and scenario analysis. The company understood the risk of wrong valuation through DCF analysis because it was based on assumptions. These assumptions were helpful to come up with revenue and costs figures of next 10 years. DCF analysis also incorporated country risk, which was

represented as hurdle rate. Both the qualitative and quantitative analysis shows that external and internal risk factors were embedded into the investment valuation.

Risk Administration: The company had investment management strategies but did not have formal risk mitigation strategies document. However, the investment management strategies could be part of the risk administration. There were four integral parts of risk administration- risk avoidance, risk postponement, risk acceptence, and risk mitigation. The risk avoidance was to reject the investment projects. The risk migration part was applicable when the company accepted the investment projects with risks. The risk postponement was to delay the investment. Company used the following risk mitigation strategies:

- Start small if country risk is high
- Cross cultural training to mitigate cultural and language risk
- High automation to mitigate high labour costs risk and quality risk
- Use of technology to mitigate IPR risk
- Network approach to mitigate competition risk
- Disrupting market to mitigate local competition risk

Risk Monitoring: There was also explicit and implicit risk monitoring steps in the investment project, which were investment monitoring tools - strategic alignment, profit performance, market performance, product competitiveness, and project gap. These tools helped the company in achieving investment objectives. Based on the analysis of these tools, the company developed and implemented future strategies to improve investment performance, which was again revisiting risk administration steps of the literal risk management system.

5.8.6 Summary

Company F is a unique company among the investigated companies. It was working with an external consultant to develop a risk analysis tool based on portfolio theory. However, this tool did not provide an investment risk management system. It was observed that the company used exit analysis in their investment decision, which reflected quantification of the risk impact. However, this kind of analysis does not reveal risks in investment projects.

5.9 Summary

The above seven case studies are revealing various characteristics of global manufacturing investment risk management: the investigation demonstrates that the there are various facets of investment objective, which challenges the traditional single purposed objective of an investment. The reason behind this transformation is an integrated view of an investment from business strategy and manufacturing strategy perspectives. This chapter shows that the objectives of a global manufacturing investment are derived from business strategy and manufacturing strategy of a manufacturing company.

These investment objectives have risk implications to a company at corporate level and operational level, observed in investigated companies. The objective of a global manufacturing investment is not just to achieve the expected cash flow from an investment, but also to protect the acceleration of value growth of a company.

There is a narrow view of manufacturing strategy in investigated companies. It is observed that manufacturing strategy is constrained to production and typically does not consider the importance of R&D, procurement, distribution, sales & marketing, and services. The reason for this narrow view of manufacturing strategy may be the changing nature of manufacturing. Literature shows that the definition of manufacturing is evolving. Manufacturing is not limited to production; it is increasingly take to include incorporates other value adding operational activities.

Risk is perceived as an existing or future threat to companies. Risks, problems, and challenges are used interchangeably The investigated companies lack risk language in investment decision-making process. Their documents on investment projects show two or three risks explicitly. Its explicit risk understanding is limited to IPR, currency fluctuation, project management risks. Investment decision is the gut feeling in private companies. Risks at corporate level and at project level exist also at the investment project level. Public listed companies have risk documents, however, some intuitive risks are missing in investment project documents. Standard risk categorisation is not observed in the company. Risks sources are also risks in some circumstances.

Investment decision making depends upon the qualitative and quantitative analysis. Risk communication at various levels in companies is weak. Although formal risk management

process is not observed in the seven companies, bits of explicit and implicit risk management process are scattered all over on investment decision process. (Figure 5-17). Tables 5-16, 5-17, 5-18, 5-19, 5-20, 5-21 summarise key findings of this chapter and presents an overview of the investigated topic.

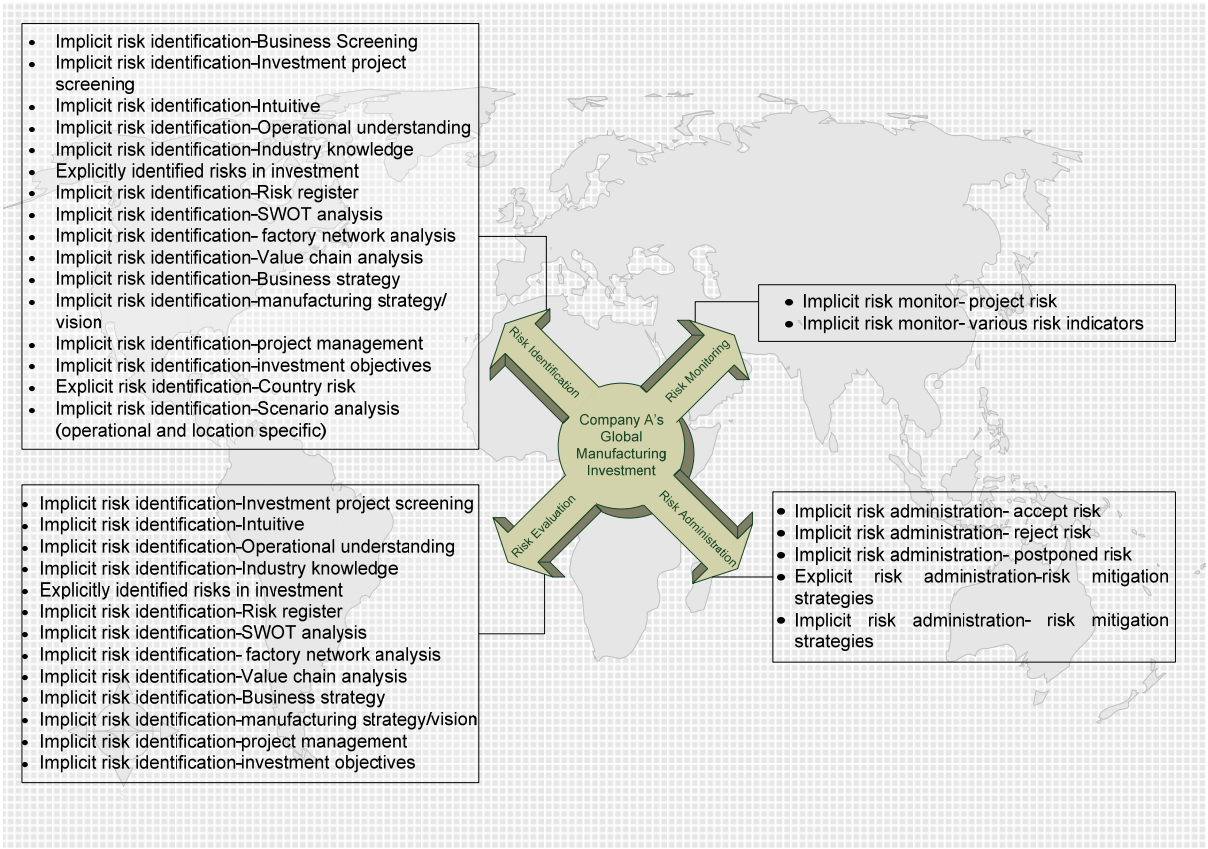

Figure 5-17: Summary of Explicit and Implicit RM

	Business Review	Strategic Objectives	Manufacturing Objectives	Investment Objectives
Company A	CNC precision engineering company. Automotive contract manufacturer Annual revenue is $4 million Privately owned company	Double its revenue Low cost of operations Differentiations from peers Right skill sets	Higher quality Lower cost Maintaining working capital Production on time	Minimisation of cost Ahead in competition
Company B	Global producer and distributor of household products Privately owned company with annual revenue of $180 million Market segments-contract manufacturing and production of own branded products	Increase its turnover Operations expansion Brand performance Brand development Operating margin Customer relation NPI	Reduce cost Align production with sales Capacity balance Customer responsiveness Unique products	Alignment of production with sales Low cost location within the proximity of market Increase in market share Customer responsiveness
Company C	A non-stock exchange listed subsidiary of a fortune 500 companies, Annual revenue of $ 500 million Produces diesel and gas generator sets globally at five locations	Market expansion Production expansion Cost effective key parts sourcing Inventory reduction Supply chain risk management	Capacity balance Lower cost Increase capacity Production near to market	Currency balance Capacity balance Increase capacity Supply management Reduce lead time Increase market share
Company D	Global food product manufacturer Annual revenue of approximately $22 billion Privately owned company and has presence in 66 countries.	Product Quality, Brand improvement, Consumer responsiveness, Low price Accountability, People Sustainability, Suppliers relationship Waste & Cost reduction Market share growth (or growth in revenue) and profit maximisation	Production proximity to customers Cost reduction	Market expansion Profit maximisation Protection of the Company D's global operation

Table 5-16: Business and Strategy Cross Case Analysis of Company A, B, C & D

	Business Review	Strategic Objectives	Manufacturing Objectives	Investment Objectives
Company E	• Global engineering company • European public company with annual revenue of approximately $30 billion. • Five business divisions	• Business execution • Cost reduction • Risk management – supply and currency • Organic growth	• Globally integrated operation • Cost reduction • Globally balanced capacity-proximity to customers	• Develop new market • Capacity balance • Risk management-supply chain
Company F	• Global manufacturer of diesel engine, turbine, construction machinery, and earth moving machines • Stock exchange listed company with annual revenue of $30 billion • Target markets natural resource extraction, infrastructure construction, power generation	• Leadership, engagement, health and safety, training for managers • NPI, order to delivery, Brand management • Warranty, suppliers defects • Speed of production • Effective distribution channel • Market expansion , additional capacity, cost reduction • Planning for cyclical downturn	• Common processes • World class quality • Cost reduction • Capacity balance-assembly plant vs component plants	• Price competitive locations • Proximity to customer: expansion in emerging markets • Right ratio of assembly and component plants
Company G	• Global manufacturer of protective packaging material and systems • Stock exchange listed company with annual revenue of $4.6 billion	• Becoming fortune 100 companies. • Customer relationship • Increasing shareholders value • Increase market share in new markets • Operational growth in emerging market	• Operational cost reduction • Productivity improvement • Expansion in emerging market	• Cost reduction • Geographical capacity balance • Increasing turnover • Productivity improvement • Emerging markets

Table 5-17: Business and Strategy Cross Case Analysis of Company E, F & G

	Risks	Explicit and Implicit Global Manufacturing Investment Risk Management			
		Identification	**Assessment**	**Administration**	**Monitoring**
Company A	- Risk is threat - No documentation - Intuitive risk understanding	- Business screening - Investment project screening - Intuitive risk	- Discount Cash Flow - Country Risk- CAPM	- Accepting Investment risks - Rejecting investment risk - Risk mitigation: cost control	- Cost monitor
Company B	- Risk is threat - No documentation - Intuitive risk understanding - Political risk and chemical industry risks - Operational risk equivalent to investment risk	- Operational understanding - Industry knowledge - Currency and IPR risk are explicitly identified - SWOT Analysis	- DCF - CAPM - Sensitivity analysis - Qualitative risk evaluation	- Accepting Investment risks - Rejecting investment risk - Risk mitigation: cost control, coordination, knowledge transfer, supporting project, multiple suppliers	- Cost - Gross Margin, - Inventory - Speed in supply chain - Customer responsiveness
Company C	- Risk is threat - No documentation - Levels of risk: corporate, operational and investment project - Explicit currency risk - Explicit risk management process	- Parent company's risk register - Business strategy - Manufacturing vision - Value chain screening - Project management risk identification - Intuitive risk - SWOT Analysis	- Qualitative evaluation-value chain - DCF/CAPM - Sensitivity analysis - Alignment of investment - Explicit Qualitative risk-project management - Intuitive risk evaluation	- Accepting Investment risks - Rejecting investment risk - Risk mitigation: best practices, ownership & accountability, local supply base, training, coordination mechanism	- Cash flow - Global footprint indicators - Project management indicators
Company D	- Risk is threat - No documentation at company level - Corporate level risk and operational level risk has direct or indirect impact on investment project - External risk increases the intensity of internal risks	- KSF of business strategy - Manufacturing vision - Investment objectives - Factory network	- Qualitative evaluation: role of factory, site location, plant design, network optimisation - DCF - CAPM - Real Option	- Accepting Investment risks - Rejecting investment risk - Risk mitigation: start small operation, co-manufacturing, micro plant/ temporary facility, partial conversion, supply protection, product compliance, right product, flexibility for expansion, best practices for performance	- Capacity gap - New market development - Profitability

Table 5-18: Risk Management Cross Case Analysis of Company A, B, C & D

	Risks	Explicit and Implicit Global Manufacturing Investment Risk Management			
		Risk Identification	**Risk Assessment**	**Risk Administration**	**Risk Monitoring**
Company E	- Risk is threat - ERM implementation - Key risk factors are published in 10K report - Risk categories in investment: political, economic, societal and technological	- Explicit country risk identification and Manufacturing and engineering network review - Implicit location risk and operational risk identification but strategic level not related to specific investment project - Global footprint objectives - Risk register / preconceive understanding of risk (Intuitive)	- Qualitative evaluation- country risk, manufacturing and network review, strategic alignment, operational scenario, site scenario - DCF - CAPM	- Risk avoidance - Risk mitigation - Risk mitigation strategies: operations excellence, supply management, strategic alignment, improvement of business performance through product and process attribute, flexibility, use of single currency	- Business performance - Product performance matrix - Process performance matrix - Project management indicators - Periodic review
Company F	- Risk is threat - ERM implementation - Key risk factors are published in 10K report - Difference between published risk, risk identified through interview and risks in confidential document developed with consulting firm - Risk categories: Strategic , operational, external, financial and people	- Implicit: Plant network analysis - Implicit Investment screening - Implicit investment decision factors - Strategic alignment - Risk register/ preconceive understanding of risk (Intuitive) - SWOT analysis	- Qualitative evaluation- plant, investment and decision factors, strategic alignment, capabilities, cost effectiveness - DCF - CAPM - Scenario Analysis - Risk assessment based on country, business environment and hurdle rate	- Risk avoidance - Risk mitigation - Risk Mitigation strategies: training, communication, supply chain protection, implementation of best manufacturing practices	- Capacity contribution - New market development - Profitability - Project management indicators - Period review of above factors
Company G	- Risk is threat - ERM implementation - Key risk factors are published in 10K report - Difference between published risk and risk identified through interview	- Capability analysis - Implicit Global plant network risk analysis - Investment screening factors - Strategic alignment - Risk register/preconceive understanding of risk (Intuitive) - Scenario evaluation - SWOT analysis	- Qualitative assessment: Plant network - DCF Analysis - CAPM - Exit analysis - Scenario evaluation - Portfolio analysis – Intuition based explicit risk and attractiveness analysis	- Risk avoidance (postponement of investment) - Explicit Risk Mitigation: currency exposure, IPR leakage and supply interruption - Risk mitigation strategies: start small (Option), Cross cultural training, higher automation with use of technology to protect IPR, Competing through network, Disrupt market etc.	- Strategic alignment - Profit performance - Market performance - Product competitiveness - Project gap analysis

Table 5-19: Risk Management Cross Case Analysis of Company E, F & G

Global Manufacturing Investment Risk	A	B	C	D	E	F	G	Repetition
Brand Performance Risk								1
Capacity imbalance								3
Changes in Labour Cost								4
Common architecture of plant design and platform								1
Corporate Image								2
Corruption Risk								2
Country Risk								7
Credit Risk								3
Culture risk								2
Currency Fluctuation Risk								5
Customer Agitation								1
Customer Mismanagement and Responsiveness Risk								5
Dealers loyalty								1
Demand Risk								6
Distribution Cost and Disruption Risk								5
Distributors bargaining power								1
Economic Slowdown Risk								4
Employment Regulation Risk								1
Environment Regulation Risk								6
Erroneous Valuation Risk								7
Financial Institution confidence risk								1
Fraud								1
Health and Safety								3
High Level of Inventory								1
Higher lead time								1
Higher New Product Introduction Time								1
Higher Product Transfer Time								1
Industry Decline Risk								6
Interest Rate Risk								3
Investment project delay								6
Investor Confidence Risk								2
IPR Leakage Risk								4
Language risk								1
Legal risk								3

Table 5-20: Cross Case Analysis- Investment Risks- Part 1

Global Manufacturing Investment Risk	A	B	C	D	E	F	G	Repetition
Local and Global Competition Risk		■	■	■	■		■	5
Local and Global Political Instability Risk	■	■	■	■	■	■	■	7
Low quality of product				■	■			2
Market access						■		1
Market risk					■	■	■	3
Maturity of customers industry							■	1
New Product Failure Risk from Market Perspective		■		■	■			3
New Product Failure Risk from R&D perspective		■		■	■			3
NPI profitability							■	1
Oil Price Fluctuation Risk		■	■	■			■	4
Operational Cost Fluctuation Risk	■	■	■	■	■	■	■	7
Operational Infrastructure Development Cost Risk	■	■	■	■	■	■	■	7
Operational Network Coordination Risk			■					1
Product Pricing Risk					■	■		2
Product Recall Risk				■	■			2
Product supply during transition							■	1
Production disruption			■		■			2
Productivity and performance							■	1
Raw Material Availability, Quality and Cost Risk		■		■	■		■	4
Reinvestment point						■	■	2
Repatriation of profit							■	1
Retaining market share							■	1
Retaining quality							■	1
Right time to invest						■	■	2
Shortage of components			■					1
Single Source Supply Risk		■			■			2
Skill set	■	■	■	■		■		5
Strategic adaptability							■	1
Strategic alignment						■		1
Supplier's Capacity	■				■			2
Supplier's Charges	■	■		■	■			4
Supplier's Insolvency Risk		■						1
Supply chain disruption			■	■	■	■		4
Sustainability							■	1
Tax rate		■	■		■			3
Technology Changes (disruptive technology) Risk					■	■	■	3
Technology adaptability							■	1
Transport & warehouse Risk (Tech and Availability)		■						1

Table 5-21: Cross Case Analysis- Investment Risks- Part 2

6 CROSS CASE ANALYSIS.

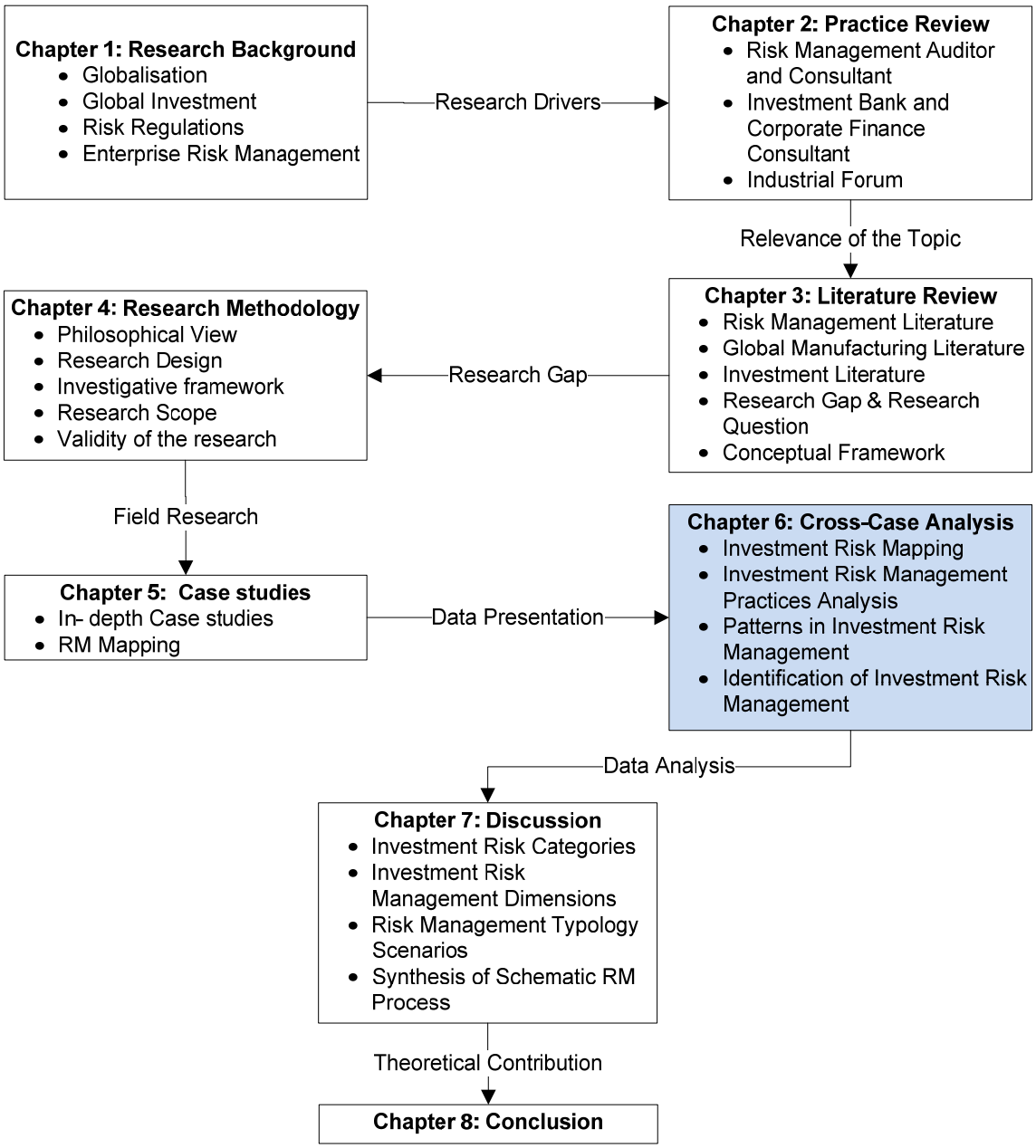

Figure 6-1: Chapter Map

6.1 Introduction

The objective of this chapter is to present the analysis of relevant factors related to the research question and create foundation to discuss the outcomes in the next chapter. The previous chapter presented the individual analysis of seven global manufacturers from investment risk management perspective. This chapter presents the cross case analysis of the cases to identify patterns of investment risk and investment risk management practices. The chapter also synthesis findings from previous chapters to outline propose a process for investment risk management. There are four subsections- investment risk mapping, investment risk management practices analysis, patterns in risk management practices and risk management process identification.

6.2 Investment Risk Mapping

An investment risk mapping approach is developed to identify investment risk categories, which can allow global manufacturers to identify the sources of risks. This approach includes accumulation of cross case investment risks and then linking these risks to their sources. An understanding of risk management in global manufacturing requires an insight into investment risks.

The sample of seven companies did not allow for a conventional statistical analysis but clear patterns could be observed and relationships among the risks identified. Additionally, Creating an exhaustive list of investment risk in global manufacturing is not possible because of the relativity[70] of risk and also its dynamic[71] nature.

All the identified investment risks across the seven companies were compiled together and, linked to their sources. The investment risks could be clearly related to eight categories mainly related to global manufacturing activities - R&D risk, procurement risk, production risk, distribution risk, sales/marketing risk, investment project management risk, external risk, and risk from organisation (Figure 6-2).

[70] Significance of a risk varies from company to company
[71] Emerging risks

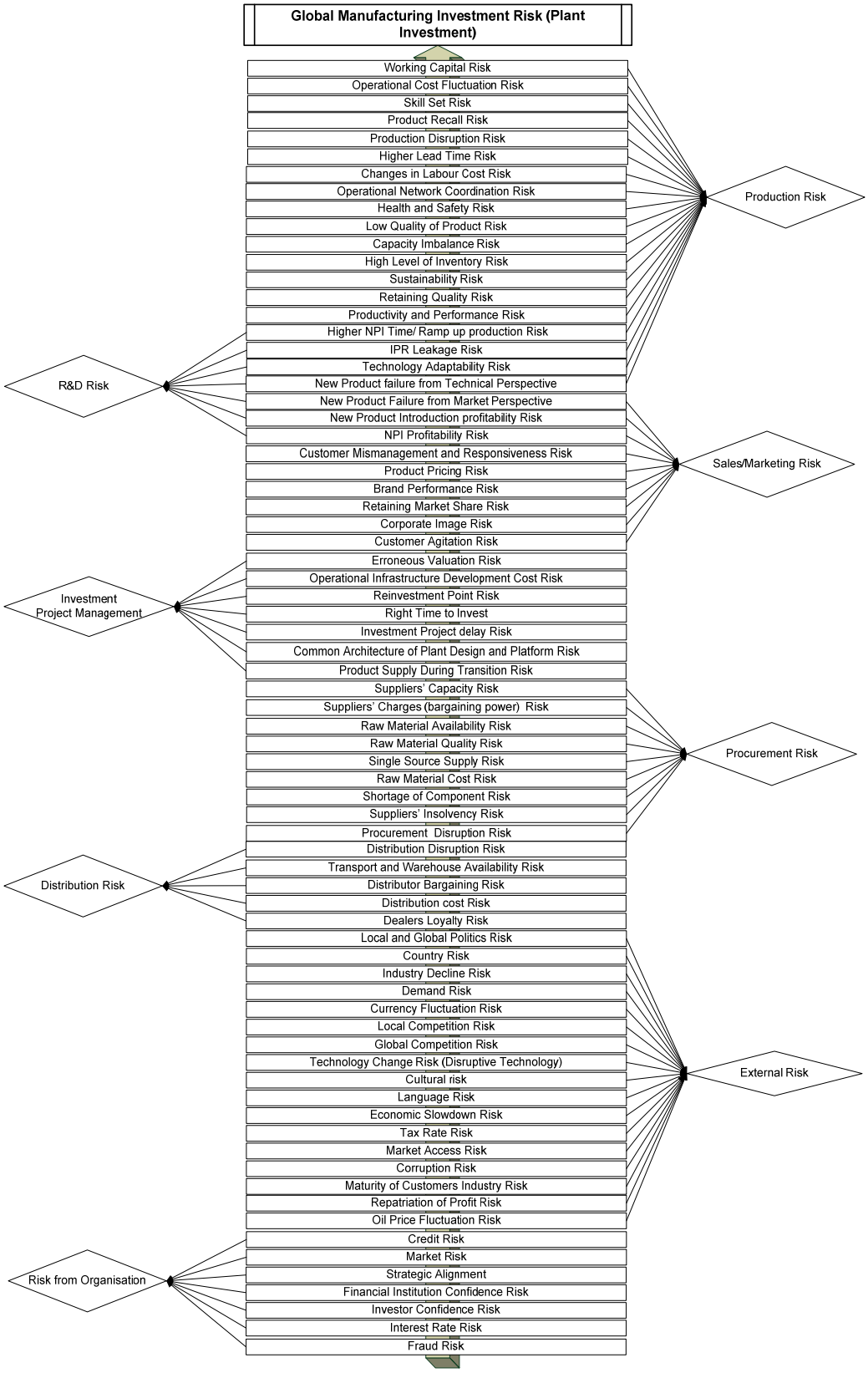

Figure 6-2: Investment Risks Categories

These eight categories of risk are independent. However, some of the identified investment risks exist in multiple categories due to the interdependencies of global manufacturing

activities. External risk has the maximum number of the identified risks. These categories help to understand global manufacturing investment risk coherently and have wider implications because it suggests a standard risk categories at corporate risk management level as well.

6.3 Investment Risk Management Practices Analysis

This section presents the dimensions of risk management with evidences found from the case studies. An approach is developed to identify investment risk management dimensions. This approach includes following steps:

- Accumulation of cross case investment risk management practices.
- Categorisation of these practices.
- Re-categorisation of investment risk management practices in the theoretical structure of risk management.

Risk Management Dimensions	**Characteristics**	**Key Practices**
Risk Management Objectives	Purpose for managing expected reward	Business Strategy
		Manufacturing Strategy
		Investment Strategy
Risks areas	Expected reward sources	Factory Network
		Value chain
		Business/ Industry
		Investment Project Management
		Country/Location
		Risk register: historical and existing risks
Quantitative Risk assessment	Measurement of expected reward	DCF
		CAPM
		Sensitivity
		Real Option
		Exit Evaluation
Qualitative Risk assessment	Measurement of expected reward	SWOT Analysis
		Country Analysis
		Project Management Analysis
		Value Chain Analysis
		Strategic Alignment
		Investment attractiveness factors
		Scenario analysis- Operation, network, locations
		Project Portfolio Analysis
Risk decision	Deciding preference of expected reward	Accept Investment Risk
		Reject Investment Risk
		Postponed Risk
Risk Mitigation	Expected reward treatment	Mitigation Strategies of key risks
Risk Indicators	Following expected reward	Key risk indicators
Period review	Updating expected reward	Check of risks

Table 6-1: Description of Global Manufacturing Investment Risk Management Dimension

(Developed from Table 6-2)

Identified Practices of Risk Management in Global Manufacturing Investment		Case Study						
		A	B	C	D	E	F	G
Risk Identification	Implicit risk identification-Business Screening	■						
	Implicit risk identification-Investment project screening	■	■		■	■	■	■
	Implicit risk identification-Intuitive	■	■	■	■	■		
	Implicit risk identification-Operational understanding		■					
	Implicit risk identification-Industry knowledge		■					
	Explicitly identified risks in investment		■	■		■	■	■
	Implicit risk identification-Risk register			■		■	■	■
	Implicit risk identification-SWOT analysis		■	■	■		■	■
	Implicit risk identification- factory network analysis				■	■	■	■
	Implicit risk identification-Value chain analysis			■		■		
	Implicit risk identification-Business strategy			■	■	■	■	■
	Implicit risk identification-manufacturing strategy/vision			■	■	■	■	■
	Implicit risk identification-project management			■	■	■	■	■
	Implicit risk identification-investment objectives	■	■	■	■	■	■	■
	Explicit risk identification-Country risk				■	■		
	Implicit risk identification-Scenario analysis (operational and location specific)				■	■		■
Risk Assessment	Implicit quantitative risk assessment- DCF	■	■	■	■	■	■	■
	Explicit quantitative risk assessment-CAPM	■	■	■	■	■	■	■
	Explicit quantitative risk assessment-sensitivity analysis	■	■	■	■	■	■	■
	Explicit qualitative risk assessment-project management			■	■	■	■	■
	Implicit qualitative risk assessment-Investment attractiveness factors	■	■		■	■	■	■
	Implicit qualitative risk assessment- value chain			■				
	Implicit qualitative risk assessment- Strategic alignment			■		■	■	■
	Implicit risk assessment- Intuitive	■	■	■				
	Explicit quantitative risk assessment-Real Option				■			
	Explicit qualitative risk assessment- country risk					■	■	
	Implicit qualitative risk assessment- scenario evaluation (operational & location specific)				■	■	■	■
	Explicit qualitative risk assessment- portfolio							■
	Explicit quantitative risk assessment- exist analysis							■
Risk Administration	Implicit risk administration- accept risk	■	■	■	■	■	■	■
	Implicit risk administration- reject risk	■	■	■	■	■	■	■
	Implicit risk administration- postponed risk							■
	Explicit risk administration-risk mitigation strategies					■	■	■
	Implicit risk administration- risk mitigation strategies	■	■	■	■	■	■	■
Risk Monitoring	Implicit risk monitor- project risk			■			■	■
	Implicit risk monitor- various risk indicators	■	■	■	■	■	■	■

Table 6-2: Cross Case Analysis of Global Manufacturing Risk Management Investment

(Developed from Chapter 5)

Explicit and implicit risk management practices in global manufacturing investment were identified based on factor classification process. First, the investment risk management practices were grouped into four parts of the theoretical risk management structure- risk

identification, risk assessment, risk administration, and risk monitoring (Table 6-2). There were duplications in the identified risk management practices due to the use of multiple words for a single meaning.

These practices were, then, classified according to their characteristics (Table 6-1). For example, various strategies are define the purpose to achieve expected reward. As expected reward is implicit risk because there are uncertainties[72] in expected reward, these strategies become purpose for risk management implicitly. Table 6-1 illustrates the characteristics alignment with classification. This classification approach provided the dimensions of RM in global manufacturing investment. These categories are risk management objectives, risk areas, qualitative risk assessment, quantitative risk assessment, risk decision, risk mitigation, risk indicator and periodic review (Table 6-1).

6.4 Patterns in Investment Risk Management Practices

The objective this section is to identify the key patterns in investment risk management practices of the investigated companies. The approach to identify these pattern includes followings steps:

- Mechanism to weight investment risk management practices.
- Summation of the weights with respect to risk management structure.
- Drawing charts to determine the position of global manufacture in risk management sophistication/size matrix.

Investment risk management practices reflect multiple attitudes towards risk management in investigated companies, reason being lack of knowledge and limitation of financial resources as creating an investment management might be expensive for companies (refer Chapter 1). A classification of global manufactures with respect to their risk management sophistication might provide valuable insight into companies' growth. It might also allow preliminary screening of a company for development of risk management system. Hence, the purpose of this analysis is to propose a preliminary typology, which could be tested in future academic research and implemented in practice.

[72] Uncertainty is one of the components of risk (defined in Chapter 3)

The risk management auditor (Practice Review) pointed out that there is no standard risk management approach. Individual case analysis indicated that companies have various approaches and attitudes towards investment practices. This variation is reflected in their explicit and implicit investment risk management practices. Hence, there is an opportunity to categorise companies with respect to their investment risk management practices. Patterns in the differential approaches might create an understanding on significance of company's size and nature on investment risk management practices. To create this understanding this section has allotted equal weight to practices to identify patterns.

Pattern identification approach:

- Identify key practices of the investment risk management in global manufacturing investment (Table 6-2) and assign equal value (which is 1 in this analysis) to every step (identification, assessment, administration and monitoring) of risk management.

  - Total score of risk identification = 1
  - Total score of risk assessment = 1
  - Total score of risk administration = 1
  - Total score of risk monitoring = 1

- Assign equal value to the every practice of each risk management step.

  - There are sixteen identified risk identification practices. Hence, score of one risk identification practice is 0.06 (1 divided by 16).
  - There are thirteen identified risk assessment practices. Hence, score of one risk assessment practice is 0.08 (1 divided by 13).
  - There are five identified risk administration practices. Hence, score of one risk administration practice is 0.2 (1 divided by 5).
  - There are two identified risk identification practices. Hence, score of one risk identification practice is 0.5 (1 divided by 2).

- Assign 100% score to an practice, which is explicitly expressed in risk terminology (Based on individual case analysis) and assign 50% score to an practice, which is implicitly expressed in risk terminology.

- Score of an explicit risk identification practice is 0.06 (100%)
- Score of an implicit risk identification practice is 0.03 (50%)
- Score of an explicit risk assessment practice is 0.08 (100%)
- Score of an implicit risk assessment practice is 0.04 (50%)
- Score of an explicit risk administration practice is 0.2 (100%)
- Score of an implicit risk administration practice is 0.1 (50%)
- Score of an explicit risk monitoring practice is 0.5 (100%)
- Score of an implicit risk monitoring practice is 0.25 (50%)

- Add all the value to reach risk sophistication score for every company.
- Create a bubble chart to understand the implication companies' size and nature on risk management sophistication
- Convert of the bubble chart into two by two matrix

Limitation of the analytical approach method:

- Case study methodology limitation- large number of variables in limited global manufacturing companies. The characteristics of these companies are different from each other from the perspectives of product, operations, revenue, and global spread.
- Unknown significance of each step of risk management, as there are no standard benchmarking framework in the theory (Chapter 2) and practice (Chapter 1).
- Unknown importance and efficiency of the identified practices of the every step of risk management.
- Criticism of typology development as a part of theory development (Doty & Glick, 1994)

	Case Study Companies						
	A	**B**	**C**	**D**	**E**	**F**	**G**
Identified Elements of Risk Identification (Total score =1)							
Implicit risk identification-Business Screening	0.03						
Implicit risk identification-Investment project screening	0.03	0.03		0.03	0.03	0.03	0.03
Implicit risk identification-Intuitive	0.03	0.03	0.03	0.03	0.03		
Implicit risk identification-Operational understanding		0.03					
Implicit risk identification-Industry knowledge		0.03					
Explicitly identified risks in investment		0.06	0.06		0.06	0.06	0.06
Implicit risk identification-Risk register			0.03		0.03	0.03	0.03
Implicit risk identification-SWOT analysis		0.03	0.03	0.03		0.03	0.03
Implicit risk identification- factory network analysis				0.03	0.03	0.03	0.03
Implicit risk identification-Value chain analysis			0.03		0.03		
Implicit risk identification-Business strategy			0.03	0.03	0.03	0.03	0.03
Implicit risk identification-manufacturing strategy/vision			0.03	0.03	0.03	0.03	0.03
Implicit risk identification-project management			0.03	0.03	0.03	0.03	0.03
Implicit risk identification-investment objectives	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Explicit risk identification-Country risk				0.06	0.06		
Implicit risk identification-Scenario analysis (operational and location specific)				0.03	0.03		0.03
Risk Identification Score	*0.13*	*0.25*	*0.31*	*0.34*	*0.44*	*0.31*	*0.34*
Identified Elements of Risk Assessment (Total Score =1)							
Implicit quantitative risk assessment- DCF	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Explicit quantitative risk assessment-CAPM	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Explicit quantitative risk assessment-sensitivity analysis	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Explicit qualitative risk assessment-project management			0.08	0.08	0.08	0.08	0.08
Implicit qualitative risk assessment-Investment attractiveness factors	0.04	0.04		0.04	0.04	0.04	0.04
Implicit qualitative risk assessment- value chain			0.04				
Implicit qualitative risk assessment- Strategic alignment			0.04		0.04	0.04	0.04
Implicit risk assessment- Intuitive	0.04	0.04	0.04				
Explicit quantitative risk assessment-Real Option				0.08			
Explicit qualitative risk assessment- country risk					0.08	0.08	
Implicit qualitative risk assessment- scenario evaluation (operational & location specific)				0.04	0.04	0.04	0.04
Explicit qualitative risk assessment- portfolio							0.08
Explicit quantitative risk assessment- exist analysis							0.08
Risk Assessment Score	*0.27*	*0.27*	*0.38*	*0.42*	*0.46*	*0.46*	*0.54*
Indentified Elements of Risk Administration (Total Score = 1)							
Implicit risk administration- accept risk	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Implicit risk administration- reject risk	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Implicit risk administration- postponed risk							0.10
Explicit risk administration-risk mitigation strategies					0.20	0.20	0.20
Implicit risk administration- risk mitigation strategies	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Risk Administration Score	*0.30*	*0.30*	*0.30*	*0.30*	*0.50*	*0.50*	*0.60*
Identified Elements of Risk Monitoring (Total Score =1)							
Implicit risk monitor- project risk			0.25			0.25	0.25
Implicit risk monitor- various risk indicators	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Risk Monitoring Score	*0.25*	*0.25*	*0.50*	*0.25*	*0.25*	*0.50*	*0.50*
Risk Management Sophistication Score	**0.9**	**1.1**	**1.5**	**1.3**	**1.6**	**1.8**	**2.0**
Size of the company (Revenue in billions)	**0**	**0**	**1**	**22**	**30**	**36**	**4**

Table 6-3: Risk management sophistication scores

(Developed from Table 6-2)

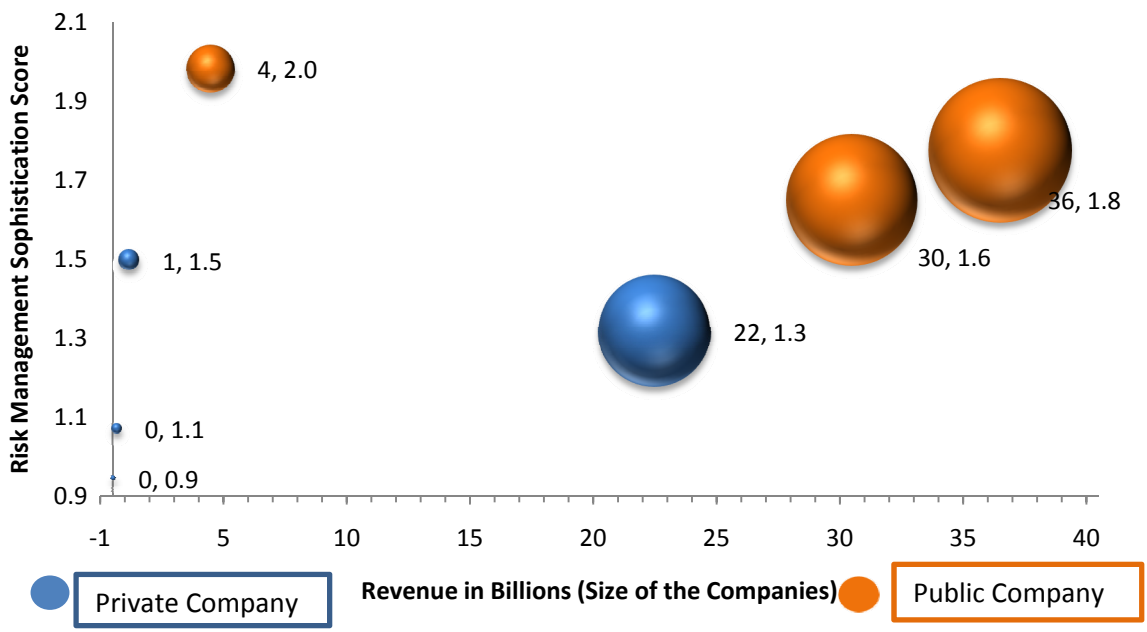

Chart 6-1: Risk Management Sophistication Vs Size of Companies

(Developed from Table 6-3)

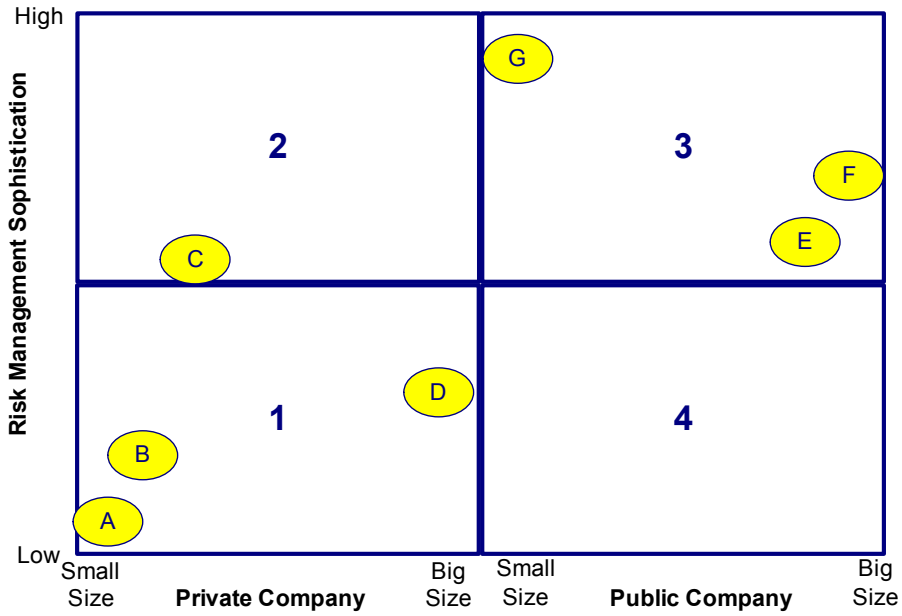

Figure 6-3: Typology of Global Manufacturers

(Developed from chart 6-1)

This analysis gave the score for investment practices of the case companies. Each company's investment risk management sophistication was determined and based on accumulated risk management practice score. The two by two matrix consists of four segments. It illustrated that some companies were better at managing risks in their investment due to the size, business profile and the nature of operations (Appendix 9.5). The role and relationship of key actors, in the case companies, was frequently influential in the investment decisions, for example – head of subsidiary has high political influence on the corporate strategy planning

in company D. The research approach is not designed to address these behaviour issues – rather it is revealed the necessary logic for risk management. Hence, it is not possible to assess these issues quantitatively clearly. However, relationships, trust, hierarchy, and knowledge among decision makers have impact on risk management behaviour of global manufacturing companies. For example, 'power struggles' between departments such as global operations and treasury were observed in Company G. Further discussion of this analysis is presented in the section of investment risk management typology in the next chapter.

6.5 Investment Risk Management Process Identification

The objective this subsection is to develop a process of risk management in global manufacturing investment . The approach to develop this process includes linking investment risk management dimensions with the help of literature and practice review.

Individual cases analysis demonstrated that investment processes lacks systematic risk management. Similarly, the industrial forum (Practice Review) illustrated the industry demand for a systematic risk management process. Hence, the purpose of this analysis is to propose a process, which could be tested in future academic research and implemented in practice. The investment risk management process is illustrated in Figure 6-5 and approach of the process development is demonstrated in Figure 6-4. The key points of figures will be elaborated in the discussion chapter.

The investment risk management process is developed by integrating:

- Knowledge of practitioner,
- Theories on risk and risk management,
- Cross case study findings.

This process has rows and columns. There are four columns, which represent that, the boarder theoretical framework of risk management - risk identification, risk assessment, risk administration, and risk monitoring. These categories are inter connected with each other, flow from risk identification to risk monitoring and are developed from the risk theories and pilot case studies. These columns are again divided into rows. The contents of rows have emerged from the case study chapter and figure 6-1.

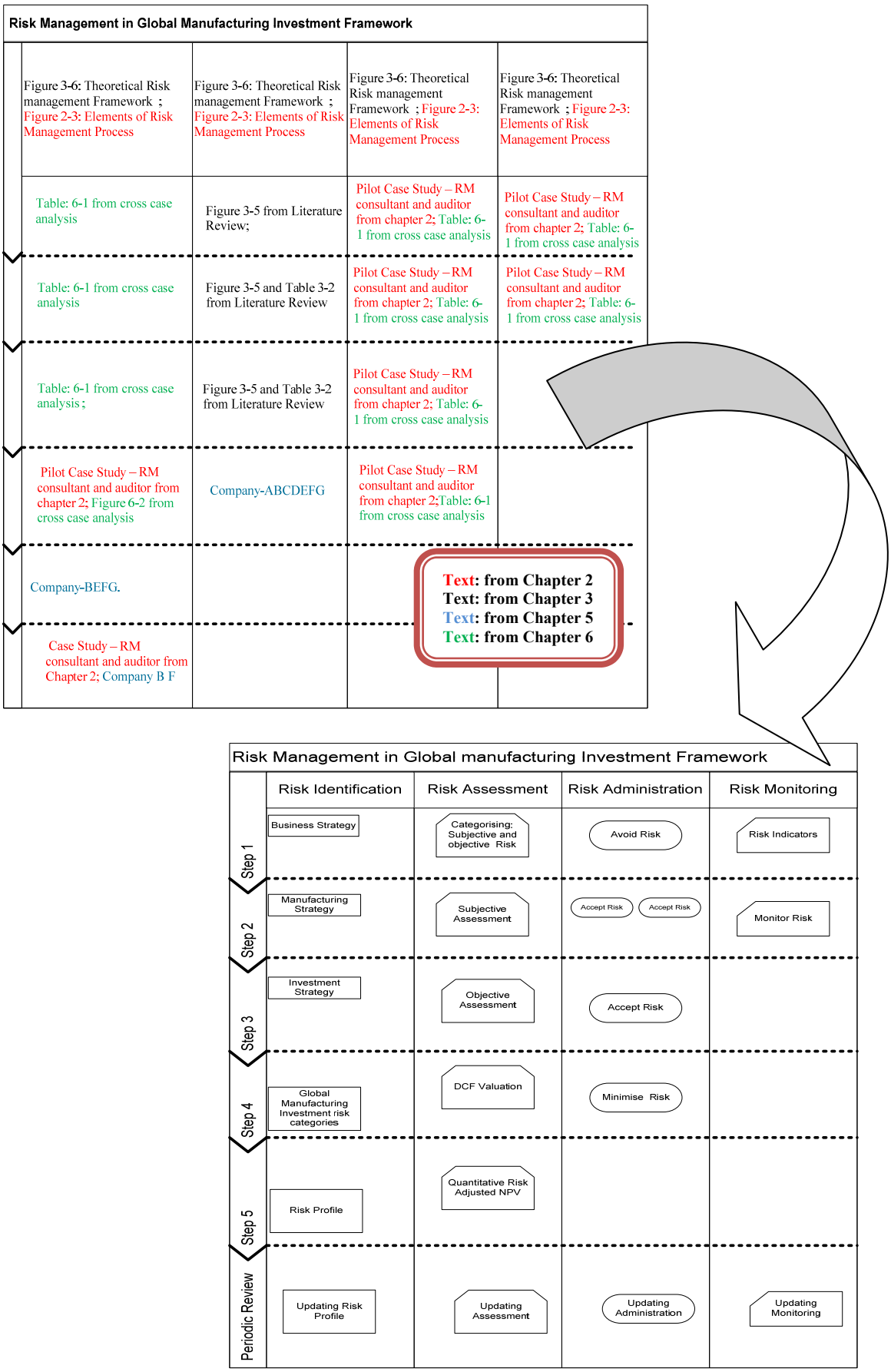

Figure 6-4: Approach for Process Development

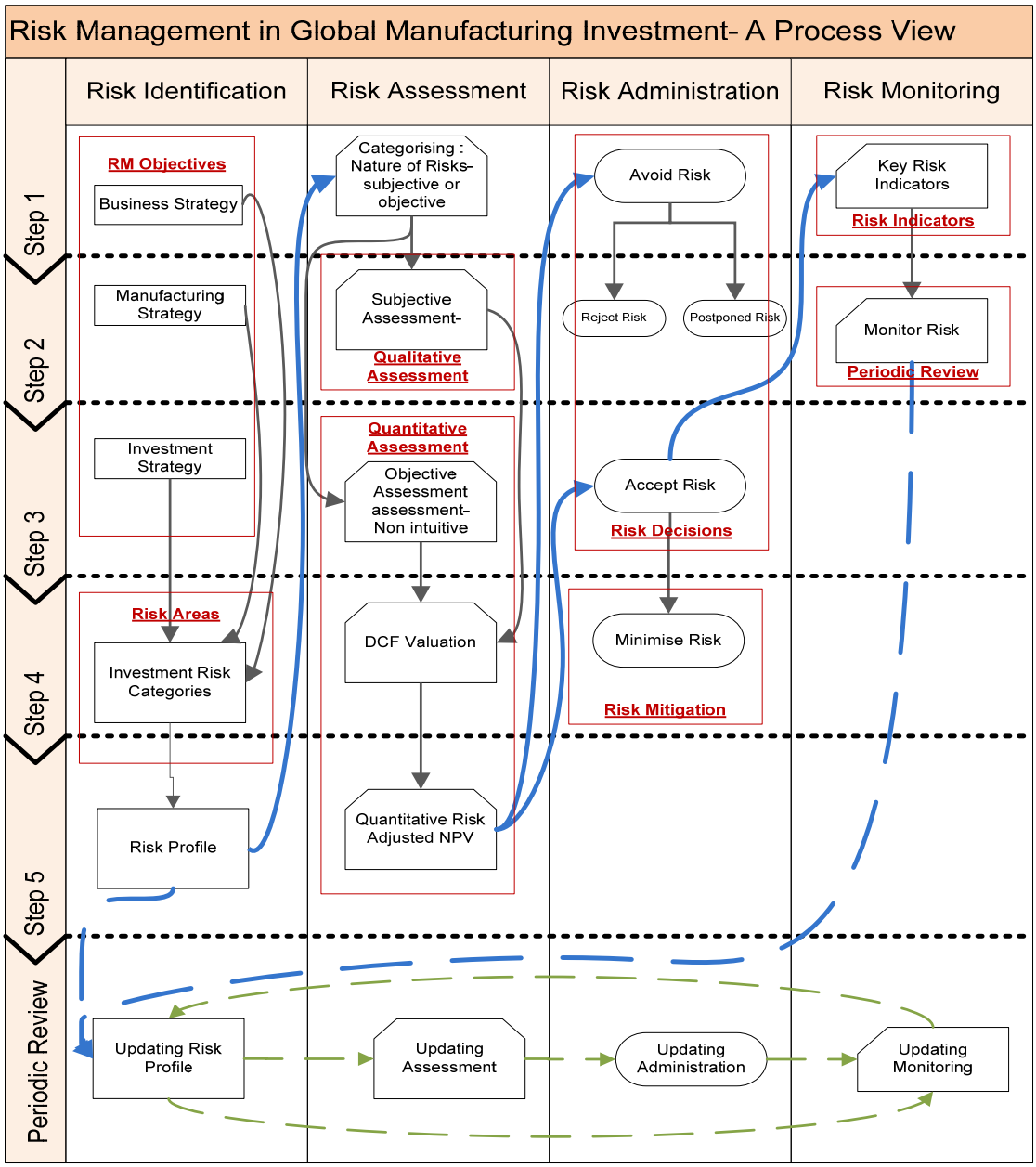

Figure 6-5: Emerged Process of Investment Risk Management

This analysis has provided a process for investment risk management. Case studies have illustrated that a formal risk management process is missing in global manufacturing investment. This empirically developed process fills the gap in investment decision-making. Further discussion of this analysis is presented in the sub-section of investment risk management process in the next chapter.

This research sought to develop investment risk management process rather than focus on the human factors. Nevertheless, it is clear that the qualitative and quantitative aspects of risk

might influence the risk management process due to human behavioural factors such as knowledge, emotions and over confidence. There human factors are more effective when risk is qualitatively assessed in investment risk management. Quantitative risk analysis minimise human influence to a certain extent. Table 6-3 illustrates the qualitative aspects of identified investment risks.

Global Manufacturing Investment Risk	Qualitative	Quantitative
Brand Performance Risk	Human influence	
Capacity imbalance		
Changes in Labour Cost		
Common architecture of plant design and platform		
Corporate Image	Human influence	
Corruption Risk	Human influence	
Country Risk	Human influence	
Credit Risk		
Culture Risk	Human influence	
Currency Fluctuation Risk		
Customer Agitation Risk	Human influence	
Customer Mismanagement and Responsiveness Risk	Human influence	
Dealers loyalty Risk	Human influence	
Demand Risk		
Distribution Cost and Disruption Risk	Human influence	
Distributors bargaining power Risk	Human influence	
Economic Slowdown Risk		
Employment Regulation Risk	Human influence	
Environment Regulation Risk	Human influence	
Erroneous Valuation Risk	Human influence	
Financial Institution confidence Risk		
Fraud	Human influence	
Health and Safety	Human influence	
High Level of Inventory		
Higher lead time		
Higher New Product Introduction Time		
Higher Product Transfer Time		
Industry Decline Risk	Human influence	
Interest Rate Risk		
Investment project delay	Human influence	
Investor Confidence Risk	Human influence	
IPR Leakage Risk	Human influence	
Language Risk	Human influence	
Legal Risk	Human influence	

Table 6-4: Conceptual Qualitative and quantitative aspects of risks

This research has observed human influence on investment risk identification and assessment. However, human factors issues in investment risk are out of the scope of the research and cannot be generalised due to research methodology limitations.

6.6 Summary

This section presented the qualitative analysis to develop general themes. It briefly set out the rationale and requirement for analysis. The requirement of each analysis emerged from field research where rationale is developed to structure data, which can provide a comprehensive understanding of the research topic. The cross case analysis has empirically identified risk categories and investment risk management dimensions. Additionally, it has illustrated the patterns in investment risk management practices and developed a process within the context of the research. This chapter has developed a platform to discuss these outcomes in the next chapter

7 DISCUSSION.

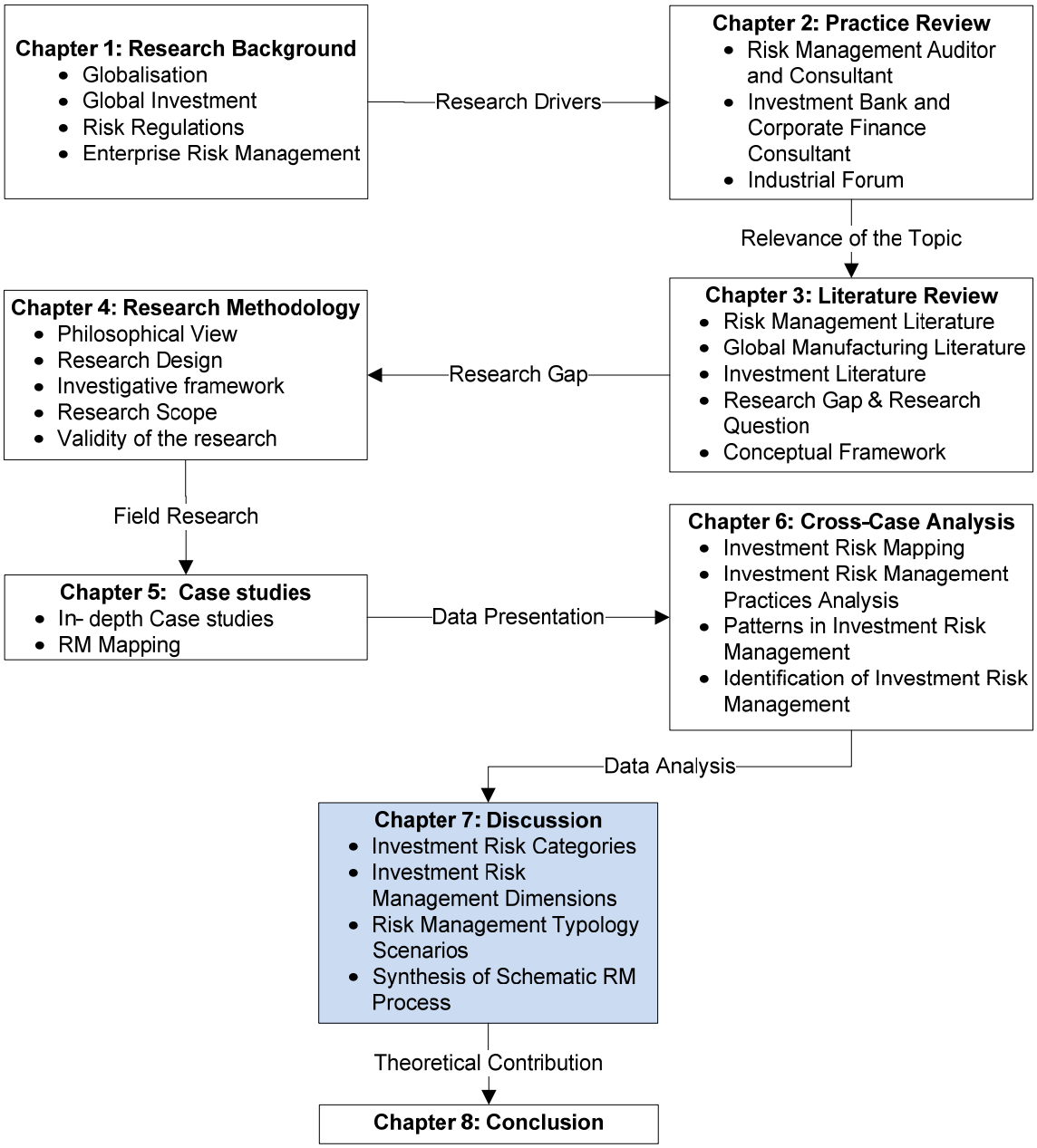

Figure 7-1: Chapter Map

7.1 Introduction

This chapter discusses the findings of the cross case analysis. It is divided into four sections- risk categories, dimensions, scenarios, and process within global manufacturing investment risk management. These sections start by reiterating the limitations of current theory and then integrates the findings from the cross case analysis. Evidences from the field research are presented to discuss the general themes.

7.2 Investment Risk Categories

7.2.1 Introduction

The understanding of risk is not enough to indentify risks in global manufacturing investment. Risk categorisation helps companies to identify risk comprehensively (Merna & Al-Thani, 2005; Crouhy et al., 2006). Studies in the financial sector revealed eight risk categories that help banks to capture risks closely (Crouhy et al., 2006). Investment risk categorisation is one of the theoretical gaps highlighted in the literature of global manufacturing (Skinner, 1969; Hayes & Wheelwright, 1984; Ghoshal, 1987; Dunning, 1988b; Ferdows, 1997; Shi & Gregory, 1998; Srai et al., 2009). Preliminary investigation in risk categorisation in manufacturing companies revealed that there was no standard risk categorisation (Table 1-4 and Table 1-8) leading to inadequate risk identification.

Individual case analysis findings show that there is a tacit rather than explicit understanding of investment risk. Few risks are explicitly identified, and none appear to be objectively evaluated. Evaluation of confidential documents and semi-structured interviews identified seventy-three investment risks. The cross case analysis provided the eight categories of investment risks. This section discusses these risks with their empirical evidence.

7.2.2 Discussion on Categories

(a) Investment Project Management Risks

It was observed from cross case analysis that global manufacturing companies face risks from investment project management. Investigated companies (A, B, C, D, E, F, and G) stated that erroneous valuation is one of the common risks that have negative impact on the value of the investment. The common source of this risk lies in assumptions of the valuation method, in addition to human error (Company B). However, assumptions change in the future. The valuation method requires assumptions, without subjective assessment, because of the lack of

reliable future data and historical data. Company F raised the question of reliability of projection from volume, cost and capability perspectives in investment project valuation. Reliability of projection results in overestimation revenue and underestimation of cost. Additionally, assumption based valuation also gives enough flexibility to create desired and biased result.

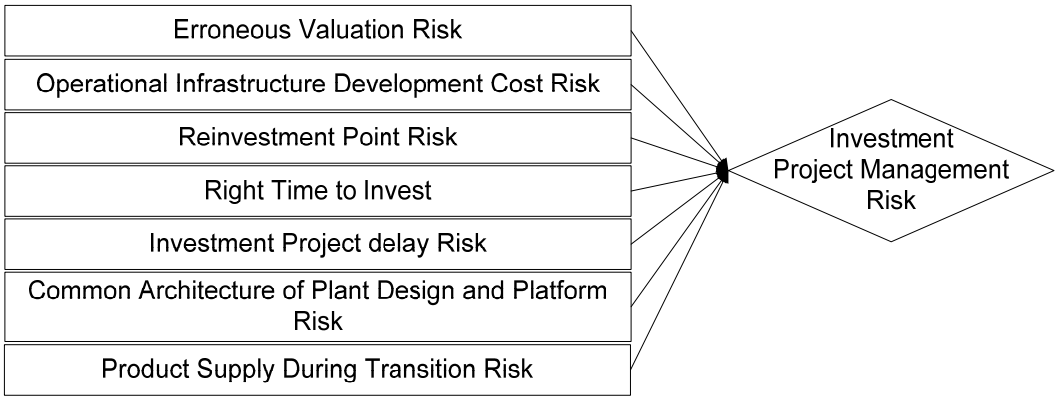

Figure 7-2: Investment Project Management Risks

Investigated companies mentioned that they had experienced rises in operational infrastructural development cost. Operational development costs increased due to delays in projects, sudden rise in factory construction costs (due to external risks), difficulties in resource acquisition (such as people, raw materials, vehicle availability and warehouse availability), and failure/delay of supporting projects (information technology system, procurement, and human resources).

During Company G's Chinese investment, a new plant collapsed due to the practice of common architecture of plant design and platform. The soil at the location of the plant could not support the weight of the plant structure. This event delayed the investment project and increased the cost of investment at the same time. This is an example of how one risk can create another risk. Similarly, delays in investment projects (except in the case of company A) had affected their investment expected earnings.

Company F & G raised risk issues such as timing of entering the market and timing of reinvestment. Wrong timing can significantly influence investment returns. If an economy slows down during reinvestment and market entry then it can affect production as a result of decrease in sales. Maintaining the product supply during the plant transfer is one the biggest challenges in Greenfield investment. Company G was involved in plant transfer investment

during this research. This investment involves shutting down a plant and opening a new plant at a different location by transferring machinery and people. The Company could not keep the product supply consistent during the transition and resulted in losing revenue for a short period and loss of market share. Hence, product supply during transition becomes one of the risks in plant transfer investment.

(b) R&D Risks

Global manufacturing investment projects are exposed to risks from R&D activity due to interaction and dependability of value activities with each other. Companies B & G experienced risk in transition from NPI to production ramp up of new products in their global investment projects and in existing operations. Making a new product in small quantity is relatively easier than making the same product at mass production level.

Various factors are responsible for the risk of higher NPI time, NPI failures and NPI profitability. For example, mistakes in R&D, new production issues during adjustment of production process or implementation new production processes, lack of training for production, unpredictable market, and lack of training of dealers are among those influential factors, stated by Company B, C, D, E, F, and G.

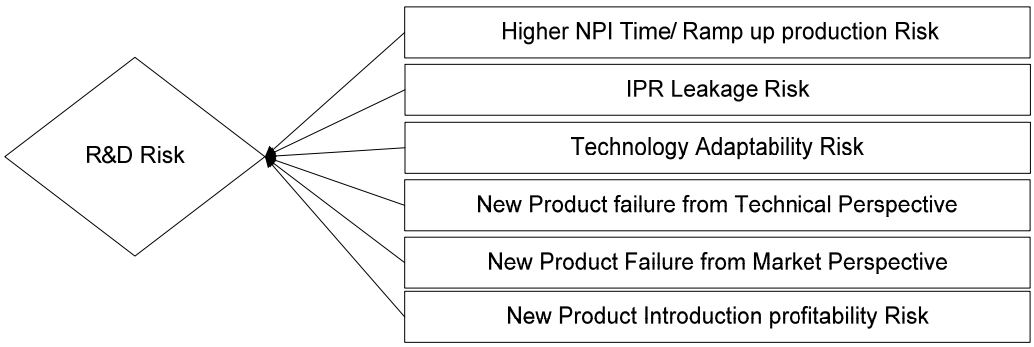

Figure 7-3: R&D Risks

IPR leakage risk was explicitly mentioned in the confidential investment project documents of companies B, E, F, and G. This risk exists in global manufacturing investment because of variations in IPR protection laws across the world and weak IP regulatory framework in developing and low cost countries, stated by Company B. Technology can minimise the IPR leakage risk. Company G uses digital codified product design that configures the machines in the Chinese plant. Additionally, deployment of new production process technology and

higher automation protects the IPR leakage risk in global investment as stated by the company G.

Company E makes complex and customised products. This example shows that one risk has multiple risk sources linked to various value activities. External factors such as changing consumer behaviour, inability to understand the market and underperformance of new product in market increases the R&D related risks. Additionally, Company G had experienced the risk of new technology adoption in production. New technologies are usually adopted to improve efficiency and product. External risks such as disruptive technology risk and high competition force companies to go for new technology adoption. However, new technology adoption may increase the cost of operation and might delay or halt production.

(c) Production Risk

Field studies revealed that global manufacturing investment is exposed to risks from production activities (Figure 7-4). Working capital risk arises due to unexpected larger gap between accounts payable and accounts receivable as stated by Company A. This risk becomes more severe when external risks (such as economic slowdown) lead to low confidence in financial institutions. Investigated companies mentioned unexpected increase in operational cost as a risk as they had experienced cost increases in their recent investments.

Company A, B, and C mentioned lack of skill set as risk. One of the problems is finding the right people for the operations in overseas investment. Company G mentioned that they wanted some people who could speak Chinese and know the parent company, when they initiated the investment in China. It was quite difficult to find skilled expats who can work in China. They hired senior managers from the company for Chinese investment, but they returned due to cultural differences. However, they found a solution when they searched their employees' profiles. The company found several Chinese nationals/Chinese race employees in the company. These employees were happy to work in the new Chinese plant.

Production disruption risks originate from external factors, factory issues, and procurement issues. For example, Company C's previous investment is facing capacity imbalance risks in India, Brazil and China. Capacity imbalance risk surfaced due to incorrect forecasting of regional demand before investment. Capacity imbalance leads to lead time risk. Higher lead-time increases the sales and marketing risk. Company A particularly experienced change in

labour cost. After their investment in Poland, the country received EU membership. This resulted in Polish labour migration to the Western Europe. The unexpected labour migration increased the labour cost and scarcity of skill set too. Skill set risk and labour cost risk can even undermine the investment in rare circumstances, for example, Company G had to move back its factory from Poland to Germany.

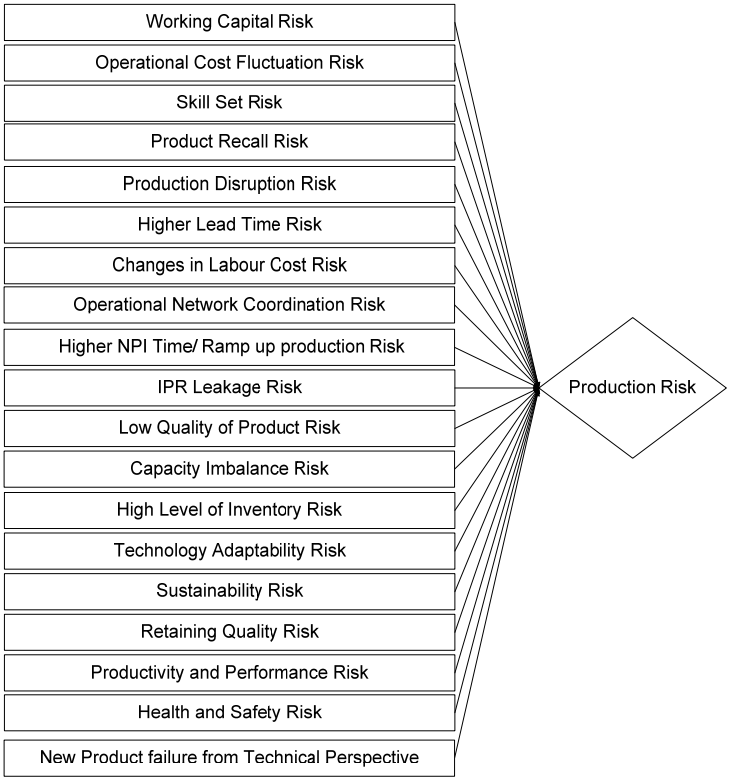

Figure 7-4: Production Risks

Low product quality risk and product recall risk are linked to each other. Lack of training and mistakes in sourcing are the main factors that trigger the risk in investment. Company D had to recall product from the Asia Pacific market due to contaminated raw material sourcing from China to its new production facility in Indonesia. Company E had to recall its low quality product because of the news that employees were not well trained. In both cases, companies had to suffer by losing revenue and damaging corporate image.

Company C mentioned that coordination issues between engine and generator assembly plants, sometimes led to production disruption risk in its new assembly plant in Brazil. Another risk is the sustainability risk in global manufacturing investment. However, the concept of sustainability is limited to environmental risk (Company G). Companies D, E, and

G separately mentioned health and safety risk from sustainability risk. However, interpretation of this risk is not just limited to health and safety in plant but also to customers (Company D & E). Company G referred to productivity and performance risk and company C stated high level of inventory. Production risk also includes risks from R&D activity and supportive services risk (Figure 7-2).

(d) Procurement Risks

Field studies revealed that global manufacturing investment is exposed to risks from procurement activity. Company B experienced supplier's insolvency risk, which resulted in lower production output. Company B stated that chances of this risk occurring is less as they have taken major steps to ensure that their supplier's are financially sound and it monitors the financial soundness of their suppliers. Companies A, B, C, D & F have mentioned that some of their components are supplied by single supplier. If something goes wrong with that supplier then production will suffer. Companies are looking for cost effective and IPR protection solution for single source supply risk. Higher bargaining power of suppliers increases the supplier change risk, mentioned by company A, B, D, and E.

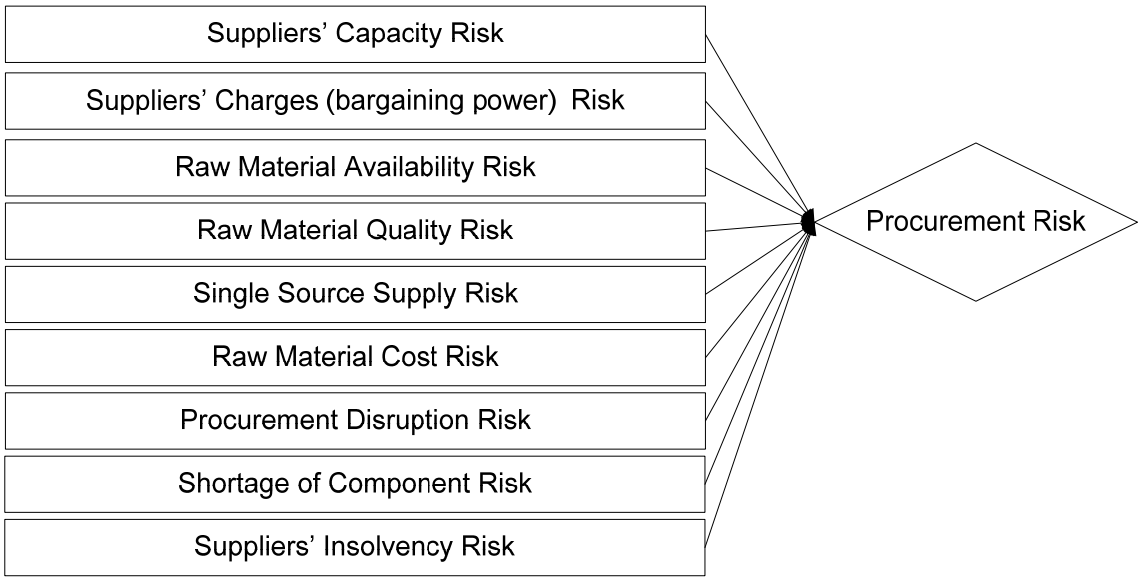

Figure 7-5: Procurement Risks

Company B, D, E, G mentioned the risk related to raw materials' quality, availability and cost. Raw material quality is more specifically concerned with companies related to food industry and their products are related to customers' health. Nonetheless, companies related to the chemical industry and engineering services companies concerned about raw material quality risk. On the other hand, Company C, whose core production focus is on assembling, mentioned about time-to-time shortage of components as they source components from the

Far East. Procurement disruption risk in the Far East or disruption in the logistics increases this risk.

Suppliers' capacity risk arises when companies do not control customers demand. Company B is a small automotive parts' supplier and its suppliers are even smaller. A sudden surge in car demand leads to shortage of supplier's capacity. Company E makes customised engineering products. It often bids for engineering projects more than its capacity due to uncertainty in tender process. A favourable outcome of multiple tenders in a year can put its supplier in capacity stress.

(e) Distribution Risks

Field studies revealed that global manufacturing investment is exposed to distribution risks. It was observed that supply chain disruption and distribution disruption risk are synonymously used in companies. Company B, D, F, and G stressed that production disruption also comes into supply disruption. In other words, supply chain disruption is divided into procurement disruption, production disruption and distribution disruption. Company B, C, D, E, F, and G mentioned that there are uncertainties in distribution risks due to external risks. Company B mentioned that the transportation availability had created short time disruption in distribution previously. Industrial customers are demanding automated warehouse facilities. This kind of facility is limited all around the word. This situation leads to shortage of space in automated warehouses. Demand for technologically advanced warehouse facility not only disrupts the disruption but it also increases cost. Distribution cost risk, additionally, increases by the bargaining power of the distributors. Company C and F work with distributors in a transparent way to mitigate this risk.

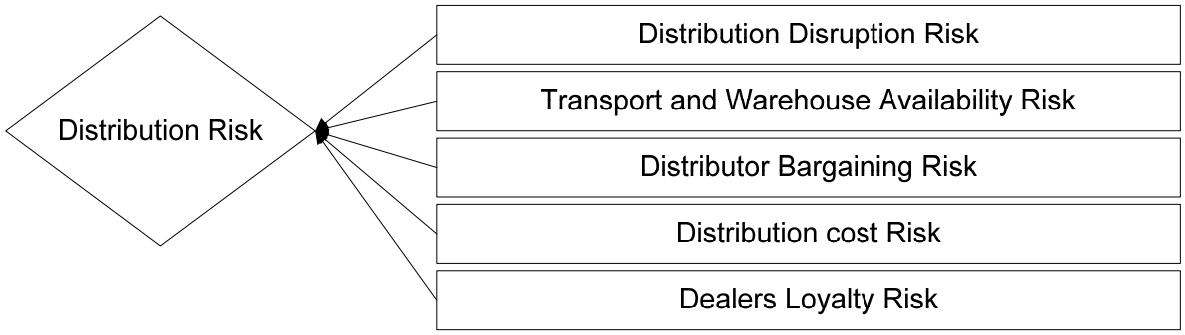

Figure 7-6: Distribution Risk

Distribution cost risk increases by shortage of distribution capacity and more importantly by external risks, specifically by oil price fluctuation. Company C and F's distribution depends mainly upon dealers. If dealers' loyalty changes, it can create a huge loss in revenue. They think that dealers' loyalty is one of the biggest risks in distribution. Hence, they focus on creating new dealers and on strengthening partnership with dealers.

(f) Sales and Marketing Risks

Field studies revealed that global manufacturing investment is exposed to risks from sales/marketing activity. Company B, D and E mentioned NPI failures risk from market perspectives. The source of this risk lies in misunderstanding of local, regional, and global markets. This misunderstanding creates a new product that does not satisfy the customers' need in terms of price and functionality relative to other competitive products. NPI profitability risk and product pricing risk arises when price is low and production cost is high, mentioned by B, C, D, G, and E. Company E mentioned that their products are customised products and take 6 months to produce. However, the price of the product is determined six months before, which leads to NPI profitability and product pricing risk. On the other hand, Company B, C and G make external risk responsible for both risks such as competition risk and oil price fluctuation risk.

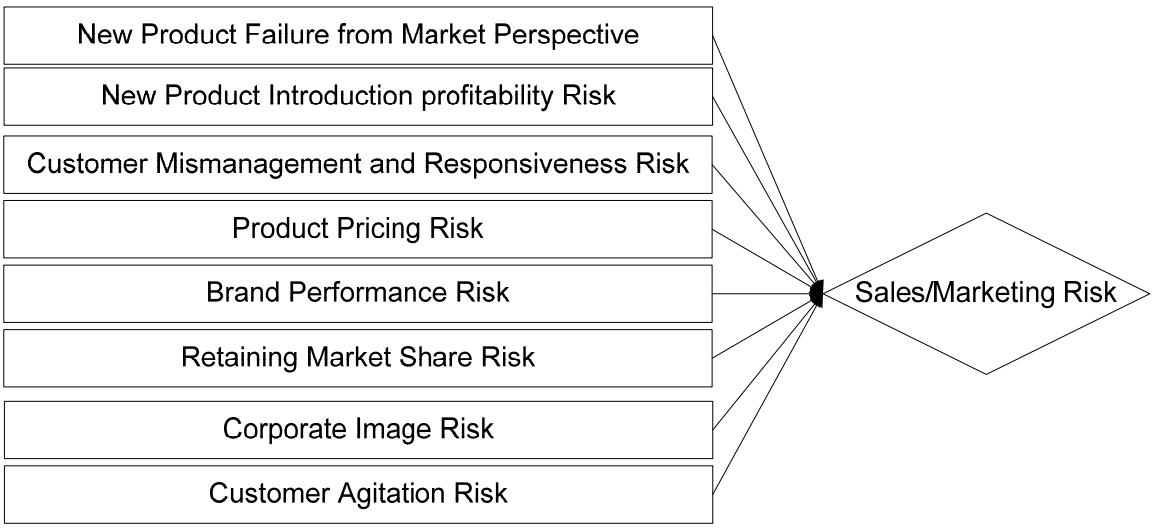

Figure 7-7: Sales and Market Risk

Company D and E believe that they have robust processes for customer relationship management. However, customer mismanagement and responsiveness risk is one of the concerns for global manufacturers as mentioned by company A, B, C, E and G. The source of this risk lies in the responsiveness of the global manufacturers. Customers are becoming

increasingly demanding, especially in the case of industrial customers. Responding quickly to changing demand of customers is the key to mitigate this risk.

Company B has its own branded products and it also makes branded products for its industrial customers. Its branded products compete with its industrial customers' brand in the same market. This kind of competition has created a unique kind of brand performance risk to the sales and marketing division of the Company. Retaining market share risk arises when there is perfect competition in the market (Company G). Corporate image and customer agitation risks appear when company products harm customers. Company E's products faults can be dangerous to the customers commercial infrastructure whereas company D's products' are directly responsible for customers' health. However, publicly available information on corporate image risk illustrates many facets of its origin such as ethics, sustainability etc.

(f) Risk of organisation

Field studies revealed that there are risks from the organisation. These risks are indirectly responsible for global manufacturing investment failures. If the organisation fails then investment project fails along with organisation.

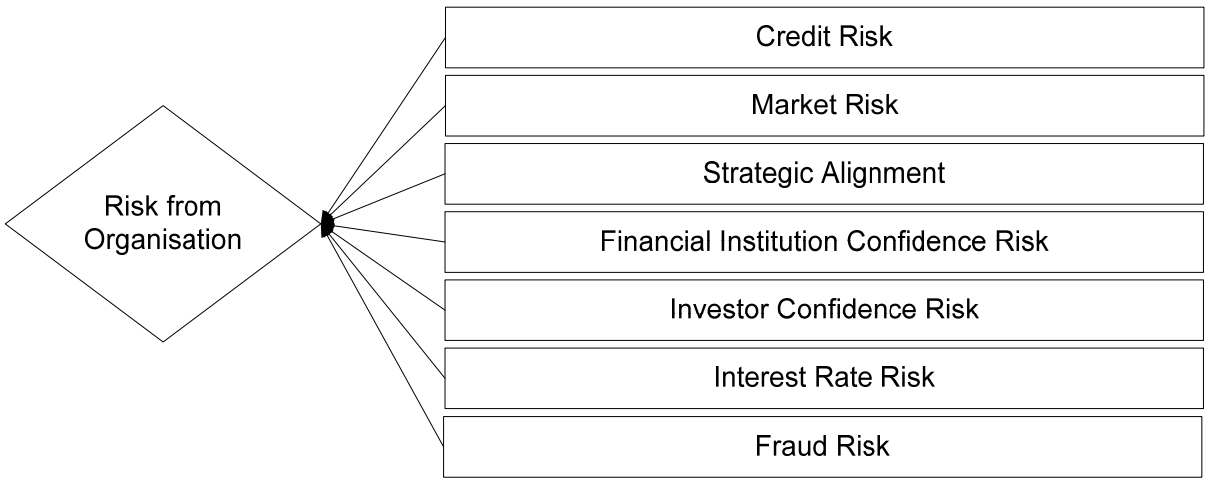

Figure 7-8: Risk from organisation

Company C, E, F and G mentioned that strategic alignment is important for any investment. Even in the industrial forum (Chapter 1), strategic alignment of investment was considered as one of the most important factors in the investment decision process. Company G mentioned that they had investment in production operations in Europe some years ago because the company had money. However, they are thinking of divesting that investment because it is not strategically aligned.

Company A, mentioned financial institution confidence risk and the source of this risk is external risks. This risk is not only a hindrance to the growth of the company but it also makes it difficult to run the Company. Credit risk, market risk, investor confidence risk are found in Company E, F & G. All these companies are listed in the stock exchange. Company G mentioned that new investment could push the share price up or down. This category of risk can be further categorised into financial risk and strategic alignment risk.

(g) External Risk

Field studies revealed that global manufacturing investment is exposed to risks from the external environment. Investigated companies are more frank in describing external risk factors than internal risks.

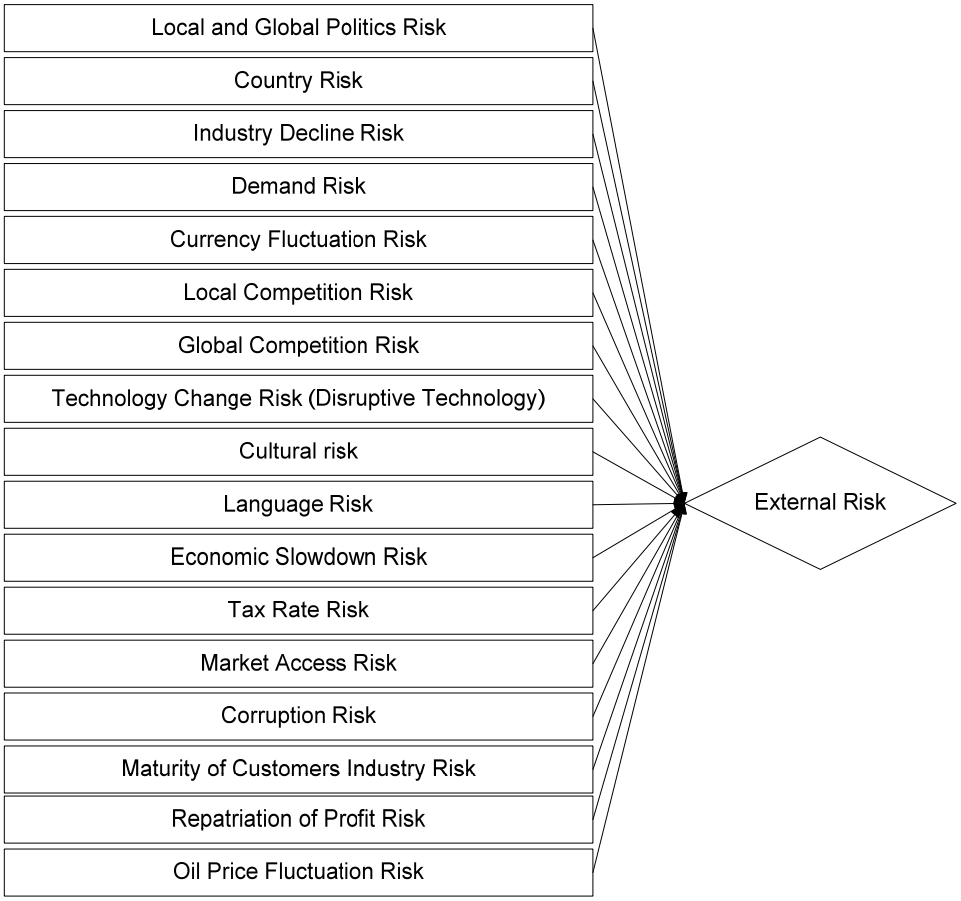

Figure 7-9: External Risk

Among all the external risks, currency fluctuation risk is explicitly mentioned in the confidential investment documents of the Company B, C E, F, and G. In some cases, recent investments were currency risk mitigation strategy. However, local sourcing and local market

is the solution to mitigate this risk as mentioned by Company B. External risks are location specific in nature such as cultural risk, language risk, tax rate risk, local competition risk, corruption risk, market access risk, local politics and country risk. However, external risks also arise from global business environment such as maturity of customers industry, technology change risk, economic slowdown, global competition and global politics. In theory, location specific external risks are treated as political risk and political risk is also called policy risk. Corruption risk arises when a company chooses investment location. Corruption increases cost and it also increases the litigation risk. If corruption charges are proved then there is monetary punishment and it is also linked to corporate image risk as stated by Company F. The identified country risk can be categorised into global risk and country risk.

7.2.3 Summary

Risk has uncertainty, impact, measurability nature and context. This section illustrated the eight risk categories along with evidence found in the field studies. However, the broader view of these risks present three broad categories -upstream risk, downstream risk and external risk. Upstream risk exists at corporate headquarters level, which has little to do with investment projects. However, upstream risk is so important that it can destabilise the investment project. Downstream risk includes project management risk, R&D Risk, procurement risk, production risk, distribution risk, and sales/marketing risk. Figure 7-10 illustrates a schematic flow of risk in global manufacturing investment project. All activities of the value chain create risks, which mean that activities, which generate business value also generate risk.

All the risks are linked. Some have ability to set off a number of other risks. For example, economic slowdown and external risk can set off sales & marketing risk and production risk. Likewise, raw material quality risk of procurement activity, an internal risk, can set off production risk, sales & marketing risk, after sales services risk and external risk. This section has presented a list of investment risk and its categories. A list of risk can be reference table for risk identification process. However, the fundamental definition of risk suggests that risk is not a static term. Thus, application a list of risk for risk identification process can produce misleading and incomplete results. The classification of global manufacturing investment risks can help companies and practitioners to identify risk because it indicates the sources of risks rather than claiming to identify ‘the’ risk.

Figure 7-10: Schematic Flow of Risk in Global Manufacturing Investment Project

7.3 Investment Risk Management Dimensions

7.3.1 Introduction

This section presents and discusses the dimensions of risk management in global manufacturing investment. The cross case analysis has provided eight dimensions of investment risk management (Figure 7-11). These dimensions are identified from the investigated companies' existing explicit and implicit investment RM practices. Academic work on risk management dimensions are limited to corporate/enterprise risk management or the banking sector's risk management (Kemp & Bohn, 2006, Aabo, Fraser, & Simkins, 2005) (Merna & Al-Thani, 2005; Crouhy et al., 2006).

Figure 7-11: RM dimensions in global manufacturing investment

(Developed from cross case analysis)

7.3.2 Discussion on Dimensions

Risk management objective: Risk management objective is important because it sets the agenda for risk management process. It defines a purpose for companies to have an investment risk management system. However, this research did not find a risk management system in manufacturing, explicitly. Nonetheless, it is observed that business and global manufacturing objectives are implicit risk management objectives because these are

investment objectives of the company. In other words, companies are in search of broader rewards expressed in the objectives below.

The cross case analysis illustrates that global manufacturing investment objectives are derived from business and manufacturing strategy which is supported by the existing global manufacturing theory (Skinner, 1969; Hayes & Wheelwright, 1984). It is also observed that there could be other investment objectives, which are not necessarily linked to business or manufacturing strategy. Hence, business strategy, manufacturing strategy and investment objectives constitutes the first dimension of RM of global manufacturing investment. It is also important to notice that investment objectives explicitly mention some of the broad risks and thier management (Company D & E). Additionally Company F's business strategy analysis demonstrates the increasing importance of risk in management of global operations.

Risk areas: It is observed that many global manufacturers seek specific operational areas where they can improve their performance. Their investment processes, explicitly, illustrate the areas where global manufacturers are actively looking for expected rewards. Risk areas are not explicitly identified in the field studies. As expected reward has uncertainty, which means the areas of expected reward generation are the areas where risk comes from. These risk areas are factory network, value chain, business and industry, investment project management, country/locations, and risk register (Company A, B, C, D, E, F and G). Additionally, this study suggests the external and internal nature of risk. Risk areas guide companies to the sources of various risks. However, identified risk areas are not mutually exclusive. For example, value chain analysis incorporates the factory network analysis (Company C) and the risk register (which is created at corporate level) takes into account of risks from external and internal environment.

Quantitative risk assessment: Five quantitative risk assessment factors were observed. These factors are DCF, CAPM, Sensitivity analysis, real option, and exit analysis. The DCF analysis explicitly assesses the reward. As reward is associated with risk, it is implicitly assessing the risk. In other words, DCF analysis also assesses' losses implicitly if the investment fails at any point of time. It is illustrated in Company G's DCF analysis, where the company uses exit analysis to determine cost of investment failure and to cut the losses in investment.

DCF analysis includes CAPM concept to derive NPV (Buchanan & O'Connell, 2006). The concept is recognised as a risk assessment tool in financial theories (Hertz, 1990; Crouhy et al., 2006; Buehler, Freeman, & Hulme, 2008a). Additionally real option and sensitivity analysis provide variance in NPV analysis. However, quantitative analysis does not include individual risk objectively. it is therefore difficult to identify which individual risk or a set of individual risks have caused the variance in NPV. These implicit and explicit methods of risk assessment make the third dimension of risk management in global manufacturing investment.

Qualitative risk assessment: Eight implicit and explicit qualitative risk assessment practices have been identified. These factors are SWOT, country/location, project management, value chain, strategic alignment, investment attractiveness, scenario analysis and project portfolio, which vary in individual analysis. Some of these factors' analysis overlap. For example, value chain analysis and operations/ network analysis overlaps with scenario analysis.

The SWOT analysis is not directly associated with the investment decision. However, the supporting documents provided by the companies illustrated a comprehensive SWOT analysis at corporate level and operational level. SWOT analysis provides key threats and weakness of the companies and has the explicit nature of qualitative risk assessment. The qualitative risk assessment is a partially scientific method of risk assessment. Company G is developing a method of selecting investment project to reorganise its factory network. This method is called project portfolio analysis. The problem with this method is that the company' executives are assigning number to more than 100 factors based on their best guess to determine risk of the investment and the investment attractiveness. In one of the analyses, they found that all the seven investments clustered around each other on the matrix of investment risk and investment attractiveness. It is observed that all the qualitative risk assessment methods are based on judgement. Nonetheless, it is an extra step in risk assessment, which makes qualitative risk assessment the fourth dimension of risk management in global manufacturing investment.

Risk decision: Risk decisions, which are a part of risk administration, are considered to be straight forward in theory and practice. This research has identified three implicit risk decisions- accept the risk (accept the investment), reject the risk (reject the investment project) and postpone the risk (postponed the investment, which is found exclusively in Company G). Investment projects are associated with reward (however reward expressed in

NPV terms is associated with identified and unidentified risk) and risk. Hence, the decisions related to investment projects represent the decisions related to investment risks, which makes risk decision the fifth dimension of the risk management in global manufacturing investment.

Risk mitigation: In-depth case study in global manufacturing companies illustrated various strategies to protect the investment such as training, communication, supply chain protection and implementation of best manufacturing practices. These practices are directly protecting the value of the investment. It is observed that these practices developed over time due to historical or recent bad experiences in global manufacturing investment. However, these practices don't align with identified risks in the companies and also do not align with qualitatively and quantitatively assessed risks. Nonetheless the implicit risk mitigation individuality and exclusivity makes it another dimension to risk management in global manufacturing investment.

Risk indicators: Every company in this research has some kind of investment performance indicator. Examples of risk indicators include business performance, product performance matrix, process performance matrix and periodic review. These indicators can be divided into three types- project management indicators, financial investment performance indicators and non-financial investment performance indicators. In the absence of systematic investment risk management, these investment project indicators are implicit risk indicators, hence forming another dimension of the RM in global manufacturing investment.

Periodic review: Global manufacturers with the help of risk indicators periodically review the investment projects. Company C, F and G review the whole purpose of the investment, several times each year. Company C found four extra benefits of its global footprint investment projects during the periodic review- capacity, cost reduction, currency balance and customer responsiveness, which benefits checking of risk implicitly in timely intervals. Periodic review is the last observed dimension of risk management in global manufacturing investment.

This research sought to generalise risk management dimensions rather than focus on the characteristics of particular industry. Nevertheless, it is clear that the drivers and consequences of risk vary across sectors and indeed business. A variety of industrial risks such as supply chain disruption, currency fluctuation, IPR leakage drive companies to look

into risk management aspects of global operations. Also risk priorities vary across sectors. For example raw material quality and epidemic diseases have major concern for food manufacturer; health & safety and environment is major concern for chemical manufactures.

7.3.3 Summary

The dimensions of risk management in global manufacturing investment emerged from a series of explicit and implicit practices in global manufacturing investment. The foundation of identifying dimensions is based on risk management mapping of seven global manufactures, individually. These dimensions are not out of the broader framework of risk management as shown in the Table 7-1).

RM	*Dimensions of RM in GMI*	Key elements
Risk Identification	Risk Management Objectives	Business Strategy
		Manufacturing Strategy
		Investment Strategy
	Risks areas	Factory Network
		Value chain
		Business/ Industry
		Investment Project Management
		Country/Location
		Risk register: historical and existing risks
Risk Assessment	Quantitative Risk assessment	DCF
		CAPM
		Sensitivity
		Real Option
		Exit Evaluation
	Qualitative Risk assessment	SWOT Analysis
		Country Analysis
		Project Management Analysis
		Value Chain Analysis
		Strategic Alignment
		Investment attractiveness factors
		Scenario analysis- Operation, network, locations
		Project Portfolio Analysis
Risk Administration	Risk decision	Accept Investment Risk
		Reject Investment Risk
		Postponed Risk
	Risk Mitigation	Mitigation Strategies of key risks
Risk Monitoring	Risk Indicators	Key risk indicators
	Period review	Check of risks

Table 7-1: Risk Management and Dimension of Risk Management in Global Manufacturing Investment

This research and its analysis establish key dimensions and their descriptions without judging their effectiveness. It is the representation of 'the dimensions of risk management in the companies. These dimensions of investment risk management are used to propose a process framework of risk management in global manufacturing investment in this chapter.

7.4 Risk Management Typology Scenarios

7.4.1 Introduction

This section illustrates the global manufacturers' behaviours towards investment risk management. These behavioural patterns were developed from their explicit and implicit risk management practices. Academic research created various typologies in international business and in global manufacturing (Rich, 1992; Doty & Glick, 1994). Accordingly, the variations in risk management approaches in global manufacturing companies created patterns in the theoretical framework of typology due to the different characteristics and risk management practices of the investigated companies.

The two by two matrix illustrated that some companies were better at managing risks in their investment due to the size, business profile and the nature of operations. It might also allow preliminary screening of a company's risk sophistication assessment in the investment process.

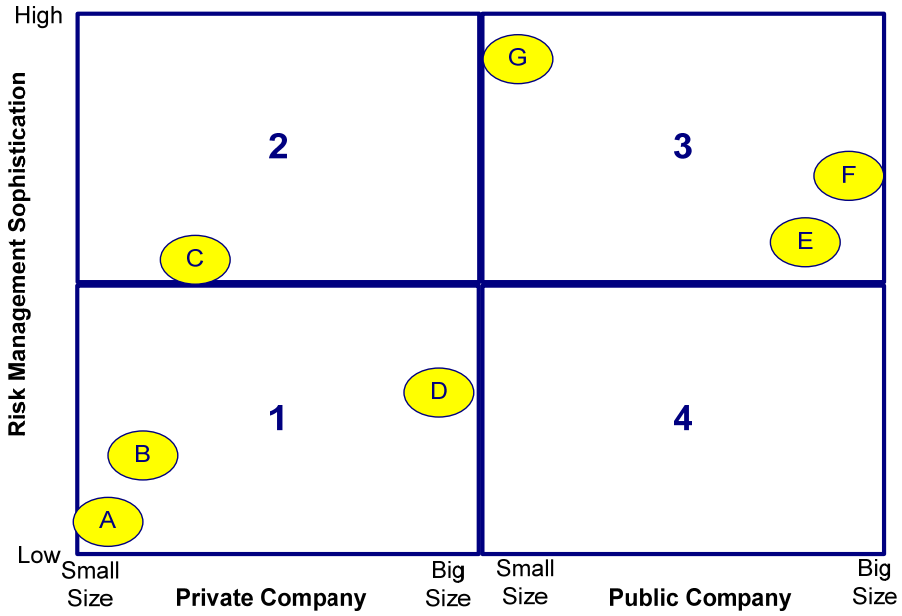

Figure 7-12: Typology of risk management sophistication in Global Manufacturing Companies

This typology has two axes- risk management sophistication (vertical axis) and size of the investigated companies (horizontal axis). There are two parts of the horizontal axis - private and public company. The position of each company was determined by the cross case analysis.

The typology of global manufacturers with respect to existing risk management sophistication identify following trends:

- The majority of company's investment risk management sophistication increases as their size increases.
- Public listed typically companies have higher risk management sophistication than private companies.

This analysis also presented four segments of risk management sophistication based on size of global manufactures within the context of global manufacturing.

7.4.2 Typology Description

The first segment: In this place, global manufactures are relatively small companies. They follow standard rules of investment decision making, which incorporates mostly intuition based investment risk management (Company A and B). They also reflected that risk management is waste of their time (Company A) or too costly in terms of time spent and monetary requirement (Company A). In one case, the global manufacturer simply does not get acquainted with what investment risk management means (Company B). CEO of Caparo stated *"we have enough financial models to measure the risk but our investment decision depends upon three factors CEO's wishes, market and local contacts"*. The gist of the above statement is expressed in one or another form by the investigated companies during the interviews.

These organisations have most of the implicit risk management steps. However, they have some explicit risk management steps only because those are the standard steps in investment decision making or investment valuation, for example DCF, NPV and sensitive analysis etc. There is an exception to this pattern. For example, Company B has a distinct step of mentioning IPR and currency risks in their investment document. The reason being their external advisors have created a standard document in investment project. Their external advisor was the same advisor who advised Company F and G. It was observed that types of investment and frequency of investment had an impact of development of risk management sophistication. Small companies had fewer investment projects and lacks network integration processes after the investment.

Investment risk management sophistication score reflects the understanding of above paragraph. Company A has achieved the lowest score on indentified parameters of risk identification, risk assessment, risk administration and risk monitoring. This typology reveals that no public listed companies are in the criteria of indifferent global manufactures. There are several reasons because of (a) limited number of companies in this investigation. Mostly public companies are bigger than private companies (exception Company D). Company D is private limited company.

The second segment: In this global manufacturers are not very small size companies and there is no upper size limit. In this category companies' revenue varies from $700 million to $36 billion. Their investment projects are related to market expansion and operational system rationalisation from the cost and market alignment perspectives.

There are two public (Company E & F), one private company (Company D) and one subsidiary (Company C) of public listed company in this category. Three out of four companies come under the purview of the SOX law. Other characteristics of these companies include the engagement in multiple investment projects at the same time. They view their investments from global market perspective rather a single market perspective. However, Company E is an exception. Its investments are regionally focused because they operate in the food industry (food products have relatively shorter life). Additionally, their investment process is better documented than indifferent global manufacturers. They prefer to have a scientific system to measure reward and risks, during the interview.

Company F was interested to create a portfolio method of investment project selection. They got the inspiration from Company G. Company E called all its key employees from corporate strategy and planning department in Switzerland for brainstorming to improve their investment approval system by incorporating country risk assessment and operation scenario analysis in the investment evaluation process. Company E included relatively high sophisticated risk assessment (Real option) tool to understand the multiple variations in NPV. They also got inspiration from their competitors. Company C is using six sigma methods to select new investment projects. However, the six sigma method is forced upon them by the parent company. These distinct approaches show that follower global manufacturers are not trend setters but they have better understanding risks because of risk regulation, size complexity of the operations, and the nature of ownership in the company. In the case of

Company C, which is part of the big company, there already exists a systematic process of investment decision making.

All the above characteristics are translated into specific explicit and implicit investment risk management practices. The performance of these companies in individual sections of risk management varies. Company F's process of identifying risk explicitly and implicitly is relatively better than other companies in this category because of two explicit practices of indentifying risks. However, Company F has highest risk sophistication in this segment. To sum up, follower global manufacturers have more steps in RM than the indifferent global manufacturers. They have relatively robust process of investment decision-making, and also relatively higher documentations than first segment companies.

Third segment: This analysis has identified one global manufacturer in this segment - Company G. Company G has the single highest score in risk assessment. This category of companies has innovating approach of decision-making. However, these approaches are being developed with the help of credible associations such as universities and external advisors. In this category, companies are continuously advancing their investment process. For example, the global operations director stated "*We have reached to the known risk management now we want to move into unknown risks and their management*". The Henkel Corporation gave the same expression during the 1st European Risk Conference 2007. On a similar note Bharat Forge's[73] (an Indian global manufacturer) Associate Vice president stated- "*we are planning our business in a way this recession would be the last recession for the company and we are making dual offshore strategy to cope up with external and internal global environment*". However, Bharat Forge's and Henkel's statement are in the context of corporate risk management.

The Fourth segment: This analysis does not identified any investigated companies in this segment. It might be because public listed companies have risk management at corporate level due to regulation and the corporate risk management practices might get transfer to these companies' investment decision.

[73] Data collected during the Cambridge University's undergraduate overseas tour 2009- India.

Companies' internal environment (trust, relationship, hierarchy and knowledge) has impact of investment decision making which some time might impair the capability to pursue the right investment at right time. Company F's decentralised global operations prohibits them to transfer factory from disadvantage locations. Systematic risk management responsibility comes under the preview of treasury or finance departments, which again lead to power conflict. It happens because of lack of understanding and skill in risk management.

7.4.3 Summary

The above typology illustrated global manufacturers positions on the two by two matrix based on the comparison of company characteristics (size, ownership and nature of explicit and implicit RM Practices). Smaller companies used basic financial concepts with very little documentation in investment decision-making. They also largely depended on the complex, and intuitive (which can be scientifically challenged) risk management process. If companies are in segment two, they have a combination of explicit and implicit risk management process along with an intension to follow the rules of risk management, and additionally had relatively larger documentation. If they are in segment three, they continue to innovate, adopt, and amend new concepts (for example, Company G developed a novel approach to select investment projects based on portfolio theory and real option concept). This analysis can provide a useful tool to assess risk sophistication in global manufacturing investment.

7.5 Risk Management in Global manufacturing investment a Process View

7.5.1 Introduction

This section presents the proposed process of investment risk management in global manufacturing investment. Risk management process is defined in theory from insurance, banking and corporate risk management perspectives. However, there are theoretical and practice limitations for investment risk management perspective in global manufacturing. Cross case analysis has provided a process by integrating the findings from pilot case study, literature review, field studies and cross case analysis of risk management practices. This proposed process has four connected sub processes - risk identification process, risk assessment process, risk administration process and risk monitoring process, which include several steps.

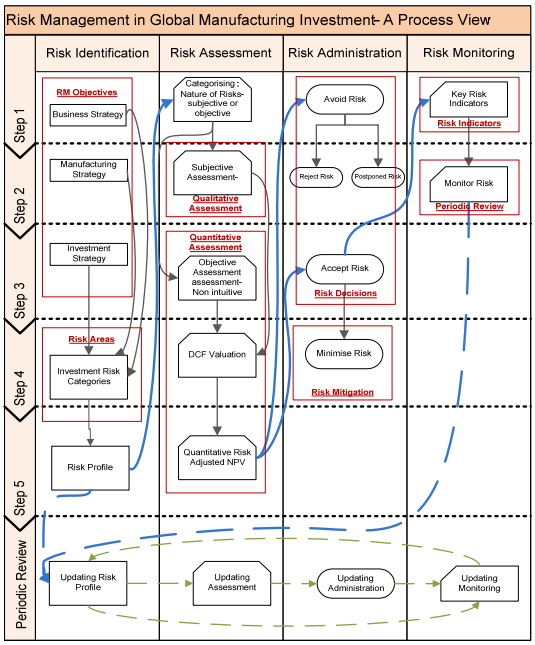

Figure 7-13: Proposed Risk Management Process in Global Manufacturing Investment

7.5.2 Discussion on Process

(a) Risk identification process: Investment risk management process starts with identifying the objective. Risk management objectives provide the nature of risk that a company should investigate in its global investment. These objectives are not only limited to investment objectives that are determined by the investment strategy but also require a broader approach, which includes business and manufacturing strategy because of the global manufacturing nature of the investment. Investigated companies have provided indirect reference to the RM objectives. Hence the first, second and third steps of risk identification includes key

objectives - business strategy, manufacturing strategy and investment strategy. According to these objectives risks should be aligned into key categories- Project management risk, R&D risk, procurement risk, production risk, distribution risk, sales/marketing risk, and risk from organisation. These categories can be customised according to value chain of a company. Risk identification in these categories provides the risk profile for the investment project, which is fifth step of the process.

(b) Risk assessment process: This sub process has five steps. The first step is the categorisation of the risk profile into the nature of measurability (subjective and objective). The second step involves the assessment of subjective risks. As per risk theory, subjective risk assessment is based on experience of employees. It requires estimating uncertainty and impact. The third is objective risk assessment, which requires much of historical data. Based on the historical data, uncertainty and impact can be determined by using statistical tools. Integration of all these assessment steps provides a risk map for a global manufacturing investment project. The fourth step is to incorporate risk in DCF calculation and finally determining risk-adjusted value of a investment project.

(c) Risk administration process: This sub process has three steps. The first step is to determine if risk adjusted investment project is desirable or not. If it is not desirable then the company has to take decision on the rejection or postponement of the investment project. If risk adjusted value is acceptable, then existing risk mitigation strategies has to be formulated. This step involves risk decision and risk mitigation.

(d) Risk monitoring process: This sub process has two steps. The first step is to determine risk indicators for the investment project and the second step requires monitoring these risk indicators regularly. Risk monitoring requires periodic review process. The periodic review process repeats the sub processes of investment risk management.

The sub processes are clearly related. The integrated view of these sub processes provides an Investment Risk Management Process. These processes are dynamic in nature. Current business environment can change the risk monitoring step. For example, fuel leakage in deep-sea water oil exploration has introduced as risk monitoring step in the risk management. Hence, steps of risk management might change as business environment would change. One of the important factor for this process to identify risks for the period of the investment life

rather than identify just the existing or start-up risks. Hence, the application of this process requires creativity and scientific knowledge. While this process is not fully tested, the approach is overarching in wide range of global manufacturing companies.

Investment risk management might be influenced by human behaviours. Small company's investments are more based on decision makers' intuitions due to lack of quantitative risk assessment. Big companies are less exposed to intuition based decision making because big companies have more rigorous investment process. These rigorous investment processes limit the human behaviour influences. There is limited knowledge about industrial context of the investment risk management process. However, there would be no effect on the structure of the process itself but the objective of risk management might change according to industrial context. For example, chemical industry will focus on environmental risks and food industry will focus on consumer health risks.

In the context of behavioural issues, it can be seen that any application of the framework approach must be sensitive to practical behavioural issues such as trust, relationship, knowledge, and hierarchy. Such consideration cannot be incorporated in the framework itself but sensible incorporation in user guide (future work) will facilitate allowance of behavioural issues, where appropriate.

7.5.3 Summary

The proposed risk management has four processes. The sub processes are linked to each other. The integrated view of these processes provides investment RM process in global manufacturing. Incorporation of this process might provide better understanding of investment decision and capability to manage risk. However, this research is not tested this process in global manufacturing companies.

7.6 Summary

This chapter has extends the findings of the cross case analysis. It has discussed the risk categories, investment RM dimensions, typology, and process by first introducing the theoretical limitations and then elaborating the supporting evidences. The discussion is arranged to answer research questions.

8 CONCLUSION.

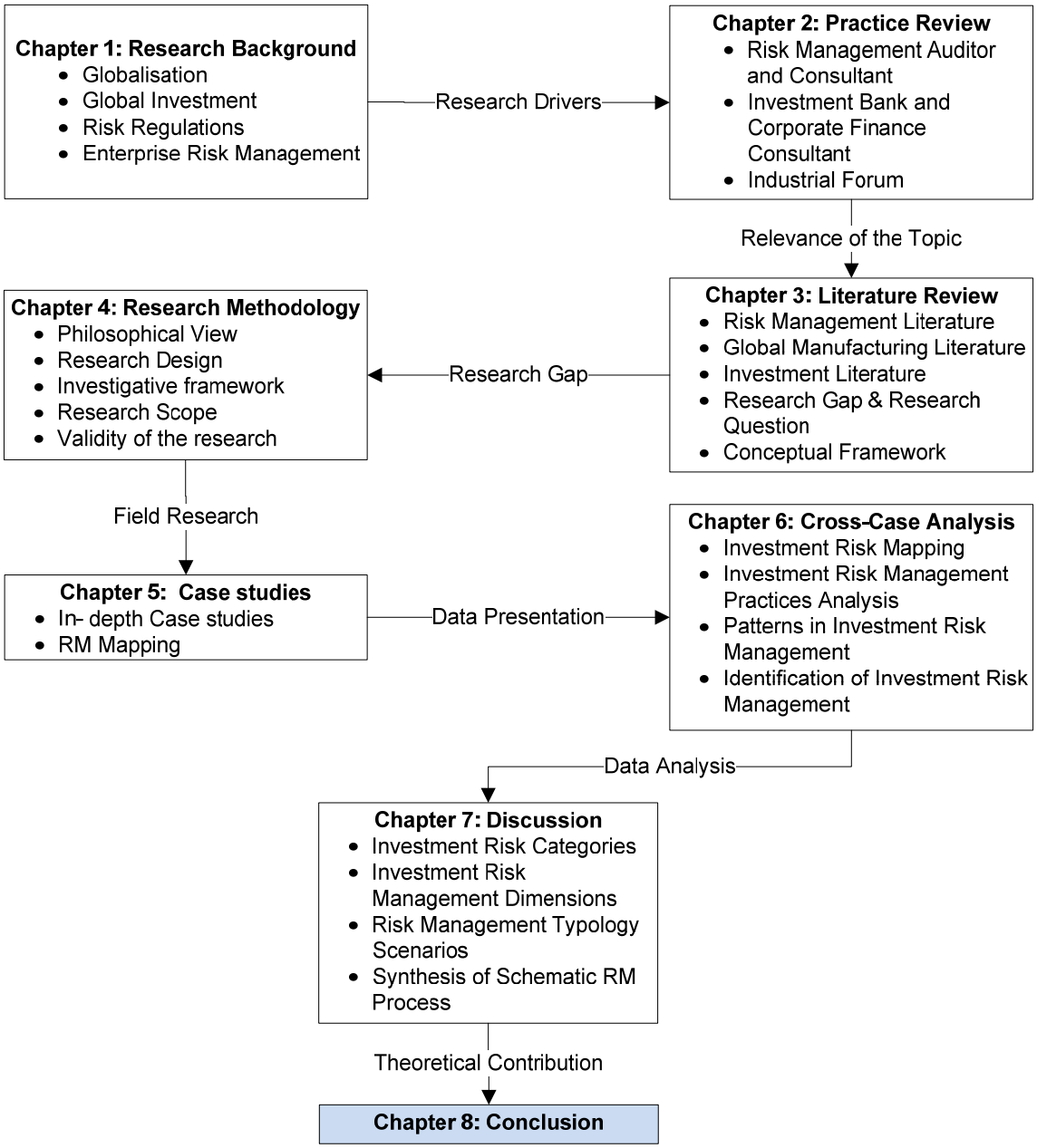

Figure 8-1: Chapter Map

8.1 Introduction

This chapter presents the key findings of the research and discusses its implications and limitations. The research question was:

How is risk management practiced in global manufacturing investment?

There are four key outcomes:

- Types of investment risk,
- Dimensions of investment risk management,
- Investment risk management behaviours of global manufactures, and
- Process of Investment risk management

8.2 Research Approach

The approach of the research was to explain the broader concepts and practices in investment risk management in global manufacturing. The exploratory study focused on implicit and explicit risk management practices in investment processes. The findings were synthesised into categories and processes to enable comprehensive understanding of risk management in global manufacturing investment.

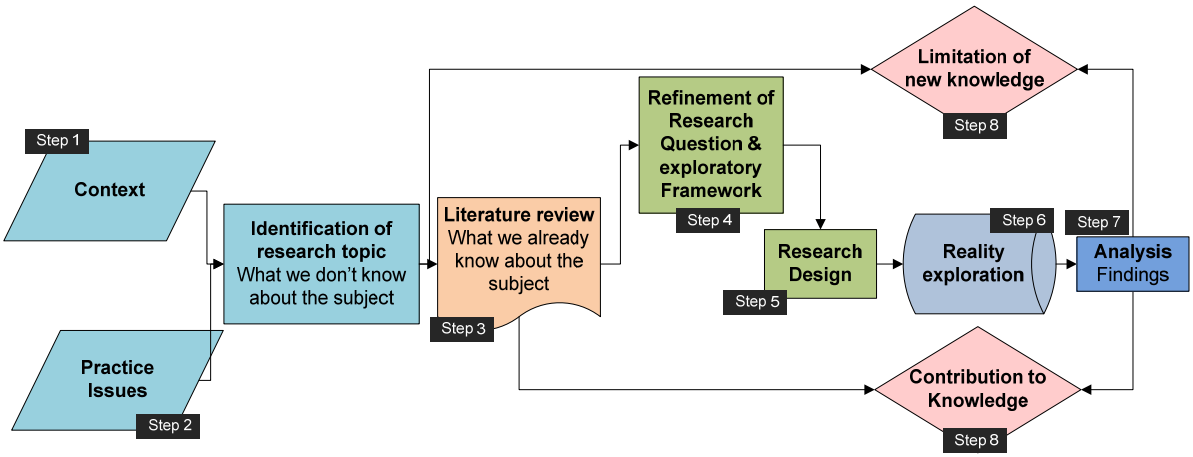

Figure 8-2: Research Process

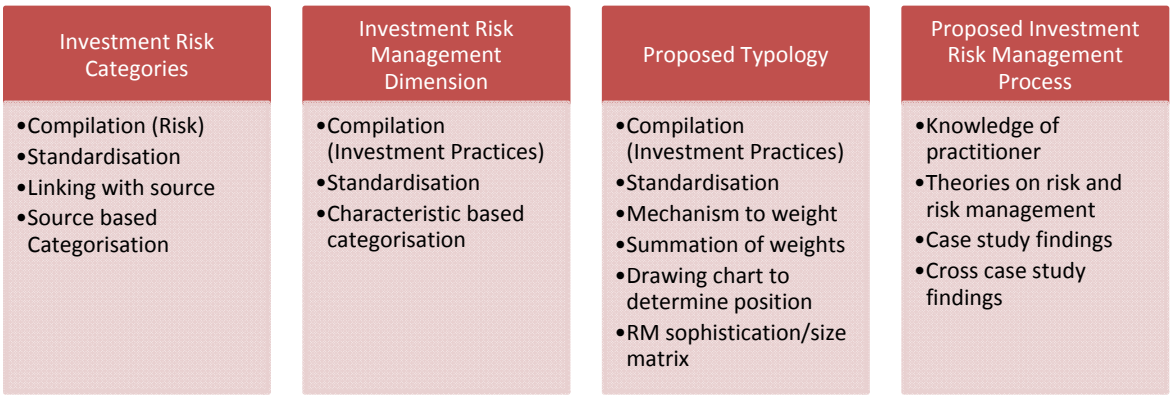

Figure 8-3: Data Analysis Approach

8.3 Research Context

Globalisation, global investment, risk management regulations, and emerging corporate risk management frameworks were key drivers for this research. To develop understanding of the research topic, further investigation into practice of risk management in investment was carried out in risk management auditing, risk management consulting, corporate finance consulting, investment banking and manufacturing companies. The key findings[74] of the practice exploration are:

- lack of clarity surrounding risk management systems
- no standard risk categorisation
- no examples of systematic risk management in global manufacturing investment,
- Recognised need for manufacturing companies to have a risk management

8.4 Theoretical Foundation

The exploration of literature identified the research gap and informed the theoretical framework for the research. Risk theories help in understanding risk, risk management structure and risk assessment. Manufacturing theories provide knowledge of global manufacturing from the perspective of definitions, configuration, coordination, capabilities and inter-dependencies of manufacturing activities. Investment theories provide investment decision structure, motivation, valuation, risk analysis in valuation. The key theoretical concepts are as follows:

- Global manufacturing investment (Porter, 1980; Hayes & Wheelwright, 1984; Kogut & Singh, 1988; Srai et al., 2009),

[74] For full details figure 9

- Manufacturing network (De Meyer & Vereecke, 1994; Ferdows, 1997; Shi & Gregory, 1998),
- Decision making theories (Wheelwright, 1978; Hayes & Wheelwright, 1984; Buchanan & O'Connell, 2006; Srai et al., 2009),
- Global strategies (Skinner, 1969; Wheelwright, 1978; Porter, 1986; Ghoshal, 1987),
- Risk definitions (Damodaran, 2002; Barrese & Scordis, 2003; Macgill & Siu, 2004; Macgill & Siu, 2005; Merna & Al-Thani, 2005; Crouhy et al., 2006)
- Corporate risk management (Miller, 1992b; Barrese & Scordis, 2003; Merna & Al-Thani, 2005),
- Investment valuation(Pratt & Hammond II, 1979; Hertz, 1990; Dixit, Pindyck, & Davis, 1994; Kautt, 2003),
- Risk analysis in investment valuation (Mullins Jr, 1982; Hertz, 1990; Kautt, 2003; Dhankar & Singh, 2005; Kazlauskiene & Christaukas, 2007).

The above theoretical perspectives underpin the conceptual framework and investigative frameworks.

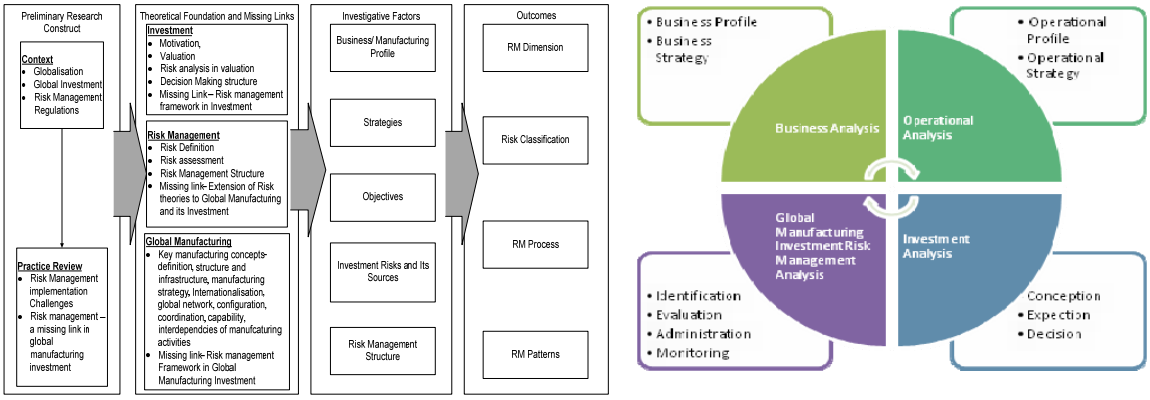

Figure 8-4: Conceptual Framework and Exploratory Framework

Investment risk management practice has evolved as risk analysis in global manufacturing investment from theoretical and practice perspectives. The need to actively manage risk has tended to be lost by the adoption of complex financial risk analysis methods in industrial investment projects.

8.5 Findings

Global manufacturers have been observed to have a variety of explicit and implicit investment risk management process. Risk is perceived as a threat to organisation but there

appear to be no widely accepted comprehensive frameworks to structure risk assessment. Synthesis of the findings, into structure and process, enable a more comprehensive understanding of risk management in global manufacturing. It was found that investment risks are aligned with value generation in manufacturing projects. The key findings of the research are as follows:

- Preliminary exploration with practitioners (investment bank, corporate risk finance consulting, risk management auditor and risk management consultant) revealed that there are no widely accepted risk management frameworks.
- Exploration of global manufacturing investment decisions in a cross section of leading global manufacturing companies did not use any systematic investment risk management systems.
- Investment risk management mapping illustrates the existence of explicit and implicit risk management practices in investment decisions
- Some twenty-eight explicit and implicit investment risk management practices and seventy-three investment risks were identified during the field studies.
- Eight *dimensions* of global investment risk management have been identified These *dimensions* are as follows:

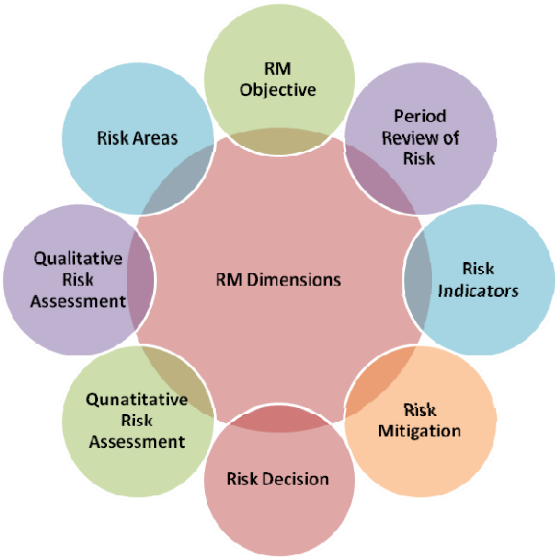

Figure 8-5: Risk Management Dimensions in Global Manufacturing Investment

- *Risk management objectives*: to determine the purpose of risk management from business strategy, manufacturing strategy and investment strategy
- *Risk areas*: where to look for risks in risk identification?
- *Qualitative risk assessment*: subjective assessment if historical data is not available
- *Quantitative risk assessment*: mathematical quantification if historical data is available
- *Risk decision*: what to do with risk- accept, reject, postpone
- *Risk mitigation*: strategies to minimise risk
- *Risk indicator*: risk monitoring method
- *Periodic review*: revision and updating risks

- Eight global investment *risk categories* have been classified. These eight *categories* can be further clustered into – 'upstream risk', 'downstream risk' and 'external risk'. The *categories* are as follows:

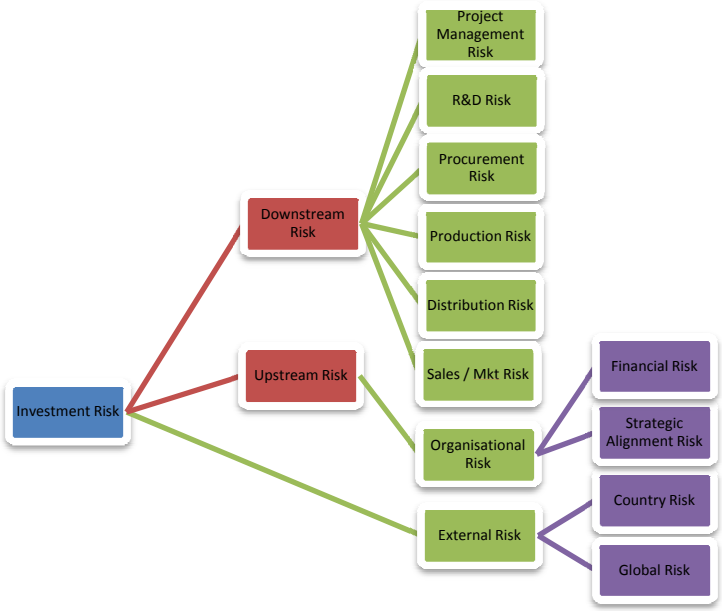

Figure 8-6: Investment Risk Categories

- *Project management risk*: due to uncertainty in building new factory and supporting infrastructure
- *R&D risk*: due to uncertainties in product development, product transfer, and process transfer

- *Procurement risk*: due to uncertainties in raw material or semi finished product procurement activities
- *Production risk*: due to uncertainties in making products in a factory.
- *Distribution risk*: due to uncertainties in distribution of products to customers
- *Sales and marketing risk*: due to uncertainties in sales and marketing activities.
- *Organisational risk*: related to organisation failure due to financial uncertainties
- *External risk*: due to unexpected chances in business environment

- A proposed *typology* of global manufacturers, which assesses the investment risk management sophistication and illustrates their behaviour towards risk management in global manufacturing.
- A proposed investment risk management process incorporates the risk management dimension, risk categories, subjective and objective risk assessment, risk decision, risk monitoring and periodic review.

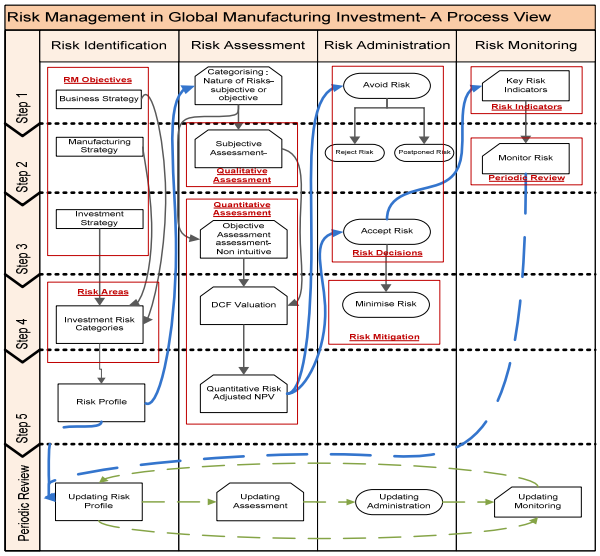

Figure 8-7: Key Investment Risk Management Process

Risk *categories*, risk management *dimensions*, proposed *typology*, and proposed *process* along with existing understanding on investment risk management in global manufacturing is developed analysis of data and the existing theories. Figure 8-8 illustrates the linkages between cases, data, analysis, discussion and conclusion.

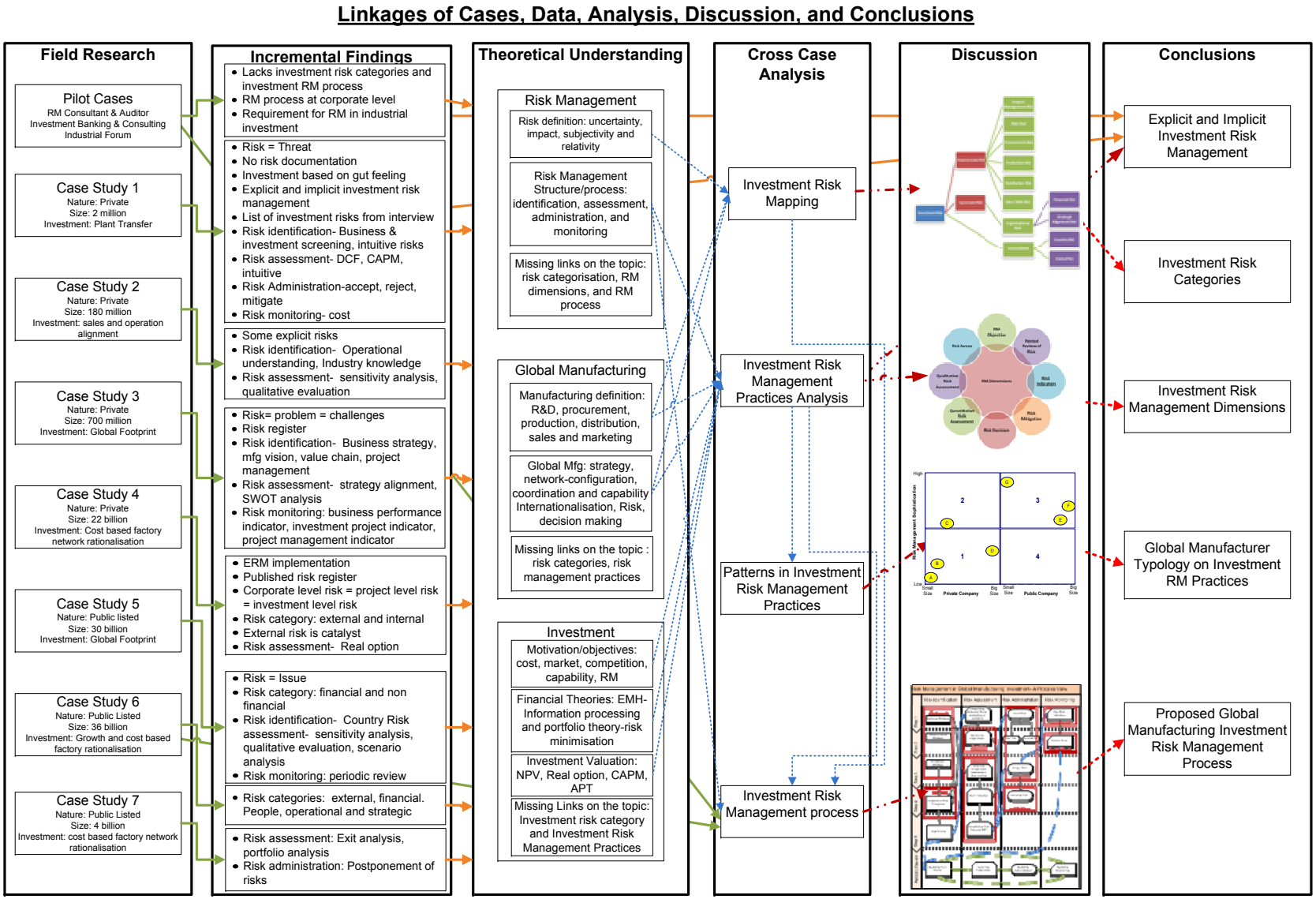

Figure 8-8: Key Finding of the Research

(Developed from Conceptual framework and Discussion Chapter)

8.6 Theoretical Implications and Limitations

This research builds theory on investment risk management by defining investment risks, identifying risk management dimensions, recognising organisational behaviour (typology), and proposing a process. It extends risk theories into the global manufacturing.

A theoretical risk taxonomy and risk management processes are proposed and tested in financial industry. However, there are no widely accepted standard risk categorisation and risk management process in global manufacturing investment. The existing global manufacturing research focus is limited to capability development, performance measurement and network development where the notion of 'risk' and 'risk management' are mentioned casually. This research adds risk and risk management dimensions to the global manufacturing research agenda and portfolio. The following table shows the theoretical gap and theoretical contribution:

Theories	Theoretical limitations	Theoretical contributions	Limitations
Risk and Risk Management	• Risk management in global manufacturing investment in not defined. • Limitation related to defining investment risk • Missing Investment RM process • Unknown behaviours of global manufacturers towards investment RM	• Investment risk are: Project management risk, R&D risk, Production risk, Procurement risk, Distribution risk, Sales and marketing risk, Organisational risk and External risk. • These risks are again categorised into three - upstream risk, downstream risk and external risk.	• Manufacturing Investment focused • Non industry specific • Non location specific research • Theory testing across industry and across global locations • Observation in limited number of companies • Significance of specific risk • Limitation on identifying human factor for behavioural issues
Global Manufacturing		• There are nine investment risk management dimensions: objective, areas, Qualitative assessment, quantitative assessment, decision, mitigation, indicators and Periodic review	
Investment		• There are three kinds of global manufacturers- indifference, follower and innovator • A conceptual investment risk management process	

Table 8-1: Theoretical Contribution and Limitations

Additionally, this study has broadened risk research, which is currently limited to either financial sector or corporate risk management. The multidisciplinary approach is itself a novel approach in operations management research. Three bodies of knowledge have been

explored and seven global manufactures investigated. The emergence of the theoretical contribution is shown the figure 8-8.

8.7 Practice Implications

The research findings have practice implications not only at investment project level but also at corporate level. The current practice of analysing macroeconomic risks without identifying global manufacturing investment risk can make risk management ineffective. Also existing unsystematic investment risk management processes do not even monitor the identified risks. The research provides a novel approach to understanding investment risks and can help companies to correctly identify risks from new risk categories, assess risk from subjective and objective points of view, take risk decisions, create risk mitigation policy, and develop risk-monitoring capability.

The findings of this research can also help companies to standardise risk categories at corporate level risk management and provide structure in risk reporting for regulators and investors.

Finally, the standardisation of risk categories and the proposed process can help risk auditors and practitioners in the establishment of corporate risk management so that risk management systems not only satisfy the regulatory requirements but also develop risk related capabilities. The key practice implications are as follows:

- Global Manufacturing Directors: Adopt investment risk management framework to ensure broad and transparent risk evaluation.

- Investment Project Manager: A reference point to understand risk, identify emerging risks and manage risks.

- Investment Banker: Apply reference model and process in due diligence of global manufacturing investment project.

- Risk Management Auditor: Employ categorisation and process as reference in auditing.

The application of the investment risk management process might require people from various departments in a company. For example, engineers are required to understand risks in production process and factory architecture and sales and marketing people are required to understand risks in product development for target market.

Risk management is treated as science and art because it requires scientific process as well as creativity in identifying and mitigating risks. Hence, the practice implication of this research is not just limited to finance department of a global manufacturing companies but also it brings people from other various core functions.

8.8 Summary

Elements of global manufacturing risk are managed by a variety of implicit and explicit methods, typically embedded in strategic and financial evaluations. There are no widely recognised comprehensive and systematic approaches to the analysis and mitigation of risks associated with global manufacturing investments. The research findings extend the current understanding of risk management into the domain of global manufacturing strategy and provide the basis for more comprehensive and systematic assessment of risk in global investment projects. Further research will be required to validate the proposed risk management process and to explore the particular risks associated with different sectors, technologies and business contexts.

9 APPENDIX

9.1 Appendix 1: Investment Bank X's Valuation Approach of Pharmaceutical Company

Revenue Build-Up Analysis **INCLUDES NON-PUBLIC PROJECTIONS FOR X** ***Company X***

($ in millions)

Revenue Projections

	Patent Expiry	Peak Sales	Model Peak	03-'07 CAGR	Equity Research 2003	2004	2005	2006	2007	Investment Bank X Estimates 2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Marketed Rx Products																				
A	2011	?	4,587	(0%)	4,277	4,587	4,575	4,372	4,226	4,128	4,061	4,014	1,204	843	590	531	478	430	387	348
A	2013	?	1,955	11%	1,021	1,141	1,291	1,420	1,562	1,671	1,753	1,814	1,857	1,888	1,911	1,926	1,937	1,945	1,951	1,955
A	2012	?	1,670	9%	1,022	1,154	1,246	1,346	1,453	1,535	1,595	1,638	1,670	1,169	1,052	947	852	767	690	621
A	2015	?	1,372	30%	370	677	799	928	1,048	1,143	1,215	1,269	1,308	1,337	1,357	1,372	411	288	202	181
A	2012	?	1,466	9%	922	1,026	1,112	1,201	1,290	1,356	1,405	1,441	1,466	440	308	216	194	175	157	141
A	2000	?	1,029	(4%)	1,060	1,029	978	929	883	852	831	817	807	800	795	792	790	788	787	786
A	2015	?	568	7%	364	381	412	445	480	507	527	541	552	559	564	568	170	119	84	75
A	2011	?	543	(20%)	430	465	512	543	119	54	33	24	22	20	10	16	14	13	12	10
A	2015	?	603	25%	161	208	274	326	394	451	497	532	559	578	592	603	181	127	89	80
A	2001	?	543	(17%)	645	543	438	362	306	273	252	238	230	224	219	217	215	213	212	212
A	2003	?	468	6%	371	404	424	446	468	468	468	468	468	468	468	468	468	468	468	468
A	2005	?	565	72%	65	253	374	498	565	565	565	565	565	565	565	565	565	565	565	565
A	2016	?	316	33%	74	139	174	200	230	254	272	286	297	304	310	313	316	95	66	46
A	1998	?	171	1%	165	162	165	168	171	154	139	125	113	101	91	82	74	66	60	54
A	NA	?	173	18%	58	65	77	93	112	127	140	149	156	162	165	168	170	171	172	173
A	1979	?	193	1%	173	193	190	186	182	164	147	133	119	107	97	87	78	71	63	57
A	NA	?	868	NM	0	152	210	262	328	426	553	718	739	868	868	868	868	868	868	868
A	1992	?	131	(17%)	171	131	105	84	82	74	67	60	54	49	44	39	35	32	29	26
A	NA	?	93	(1%)	98	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93
A	NA	?	126	6%	63	47	56	68	81	93	102	109	114	118	120	122	124	125	125	126
A	Expired	?	58	(5%)	71	58	58	58	58	52	47	42	38	34	31	28	25	22	20	18
A	2007	?	2,254	NM	0	80	650	850	1,303	1,788	2,254	676	473	331	298	268	242	217	196	176
A	NA	?	884	NM	0	93	404	586	786	826	859	884	884	884	884	884	884	884	884	884
A	Expired	?	0	(100%)	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A	Expired	?	53	1%	52	53	53	53	53	48	43	39	35	31	28	25	23	20	18	17
A	1993	?	37	(7%)	43	37	35	33	32	29	26	23	21	19	17	15	14	12	11	10
A	NA	?	28	(3%)	32	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
A	Expired	?	47	(3%)	32	47	39	33	28	25	23	20	18	17	15	13	12	11	10	9
A	NA	?	99	24%	40	91	91	93	94	96	97	97	98	98	98	98	99	99	99	99
A	NA	?	16	(5%)	19	14	15	15	15	15	16	16	16	16	16	16	16	16	16	16
P A																				
A	NA		921	NM	0	0	40	335	435	725	798	877	921	921	921	921	921	921	921	921
A	NA		579	NM	0	0	90	165	243	341	479	526	579	579	579	579	579	579	579	579
A	2007		288	NM	0	15	127	208	288	86	60	42	38	34	31	28	25	22	20	18
N A																				
A	NA		1	0%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	NA		1,274	5%	727	765	803	844	886	930	976	1,006	1,036	1,067	1,099	1,132	1,166	1,201	1,237	1,274
A					0	0	0	0	0	0	200	2,550	6,478	9,597	11,320	12,807	16,013	17,871	19,448	20,875
Total Revenues					12,505	14,132	15,937	17,260	10,322	19,376	20,419	19,313	16,629	14,753	14,274	14,030	12,060	11,454	11,121	10,937

Free Cash Flow Projections

		Equity Research				Investment Bank X Estimates										
		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Revenues		14,132	15,937	17,268	18,322	19,376	20,419	19,313	16,629	14,753	14,274	14,030	12,068	11,454	11,121	10,937
EBIT (excl. goodwill)		3,719	4,278	4,777	5,332	5,638	5,942	5,620	4,839	4,293	4,154	4,083	3,512	3,333	3,236	3,183
Cialis JV	2016	(137)	51	176	194	213	234	258	283	312	343	377	415	124	87	61
Taxes		(788)	(974)	(1,114)	(1,243)	(1,317)	(1,390)	(1,322)	(1,153)	(1,036)	(1,012)	(1,003)	(883)	(778)	(748)	(730)
Unlevered Net Income		2,795	3,354	3,838	4,282	4,535	4,786	4,555	3,970	3,569	3,485	3,456	3,043	2,680	2,575	2,514
(+) D&A (excl. goodwill)		611	680	747	812	858	905	856	737	654	632	622	535	507	493	485
(-) Capex		(1,272)	(1,273)	(1,209)	(1,191)	(1,066)	(905)	(856)	(737)	(654)	(632)	(622)	(535)	(507)	(493)	(485)
(-) Increase in Working Capital		(109)	(577)	(390)	(265)	(265)	(263)	279	676	472	121	61	494	155	84	46
Unlevered Free Cashflow		**1,725**	**2,184**	**2,986**	**3,638**	**4,062**	**4,524**	**4,834**	**4,645**	**4,041**	**3,605**	**3,518**	**3,537**	**2,834**	**2,659**	**2,560**
Revenue Growth		*12.3%*	*12.8%*	*8.3%*	*6.1%*	*5.8%*	*5.4%*	*(5.4%)*	*(13.9%)*	*(11.3%)*	*(3.2%)*	*(1.7%)*	*(14.0%)*	*(5.1%)*	*(2.9%)*	*(1.7%)*
EBIT Margin (excl. goodwill)		*26.3%*	*26.8%*	*27.7%*	*29.1%*	*29.1%*	*29.1%*	*29.1%*	*29.1%*	*29.1%*	*29.1%*	*29.1%*	*29.1%*	*29.1%*	*29.1%*	*29.1%*
Tax Rate		*22.0%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*	*22.5%*
D&A (excl. goodwill) (% of Sales)		*4.3%*	*4.3%*	*4.3%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*
Capex (% of Sales)		*9.0%*	*8.0%*	*7.0%*	*6.5%*	*5.5%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*	*4.4%*
Increase in Working Capital (% Change in Sales)		*26.4%*	*31.9%*	*29.3%*	*25.2%*	*25.2%*	*25.2%*	*25.2%*	*25.2%*	*25.2%*	*25.2%*	*25.2%*	*25.2%*	*25.2%*	*25.2%*	*25.2%*
R&D (% of Sales)		*19.5%*	*19.2%*	*18.8%*	*18.6%*	*18.6%*	*18.6%*	*18.6%*	*18.6%*	*18.6%*	*18.6%*	*18.6%*	*18.6%*	*18.6%*	*18.6%*	*18.6%*
R&D		2,758	3,068	3,246	3,408	3,604	3,798	3,592	3,093	2,744	2,655	2,610	2,245	2,130	2,068	2,034
% of Revenue on Development		*90.0%*	*80.0%*	*70.0%*	*60.0%*	*50.0%*	*40.0%*	*30.0%*	*20.0%*	*10.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*
Research		276	614	974	1,363	1,802	2,279	2,515	2,474	2,470	2,522	2,479	2,132	2,024	1,965	1,933
	12,405	*231*	*507*	*732*	*931*	*1,119*	*1,266*	*1,290*	*1,154*	*1,047*	*972*	*869*	*679*	*586*	*517*	*463*
	44,047															
	3.550774															

Revenue Build-Up Analysis

Key Assumptions

Date for Stock Price	17/08/2004	Ticker	X
Date of Latest Balance Sheet	30/09/03	Company Name	X
Valuation as of:	31/12/03	Share Price (17/08/04)	#NAME?
First Projected Year End	31/12/04	Shares Outstanding (30/09/03)	1130.6
Partial Year	100%	Market Capitalization	#NAME?
Revenue Cliff Year *(last year before drop-off)*	2009	( ) Cash (30/09/03)	(6,089)
Cliff Year for AUC Analysis	2007	(-) Investments (30/09/03)	0
FCF Perpetuity Growth in 2007	*0.0%*	(+) Debt (30/09/03)	5,130
FCF Perpetuity Growth in 2018	*0.0%*	(+) Minority Investment (30/09/03)	0
Discount Rate	*10.0%*	Enterprise Value	#NAME?

	Number	Strike		
	6.76	$21.29	#NAME?	#NAME?
	21.37	56.14	#NAME?	#NAME?
	31.51	71.93	#NAME?	#NAME?
	23.17	77.9	#NAME?	#NAME?
			#NAME?	
		Option Shares	#NAME?	
		Basic Shares	1129.5	
			#NAME?	

DCF Analysis

	DCF 2004-2007			DCF 2004-2018	
	$	%		$	%
PV of Cash Flows (2004-2007)	8,101	*25%*	PV of Cash Flows (2004-2007)	8,101	*26%*
			PV of Cash Flows (2008-2018)	17,321	*55%*
PV of Terminal Value in 2007	24,845	*75%*	PV of Terminal Value in 2018	6,129	*19%*
Enterprise Value	$32,946	*100%*	Enterprise Value	$31,551	*100%*
(-) Net Debt / (+) Net Cash	1,858		(-) Net Debt / (+) Net Cash	1,858	
Implied Equity Value	$34,804		Implied Equity Value	$33,409	
Current Market Capitalization (17/08/04)	#NAME?		Current Market Capitalization (17/08/04)	#NAME?	
DCF Value / Market	***#NAME?***		***DCF Value / Market***	***#NAME?***	
2003E Revenue Multiple	***#NAME?***		**Value Sustainability Index (DCF Value 2008-2018 / PV of FCFs 2004-2007)**	**2.9x**	

Sales Growth Analysis

CAGR 2003-2007	*9.6%*
CAGR 2007-2018	*(4.6%)*
CAGR 2003-2018	*(0.9%)*
Growth Sustainability Index (CAGR 2008-2018 / CAGR 2003-2007)	**NM**
CAGR 2003 to Revenue Cliff Year (2009)	*8.4%*
CAGR Revenue Cliff Year to 2018	*(6.7%)*
Cliff Growth Sustainability Index	**NM**

Area-Under-Curve (AUC) Analysis

	$	%
AUC 2004-Revenue Cliff Year	105,453	*46%*
AUC Revenue Cliff Year-2018	124,579	*54%*
AUC 2004-2018	$230,032	*100%*
AUC 2004-2007	65,659	*29%*
AUC 2008-2018	164,374	*71%*
AUC 2004-2018	$230,032	*100%*
AUC 2004-2018 / '03 Sales	**18.3x**	
AUC Sustainability Index (AUC 2008-2018 / AUC 2004-2007)	**2.5x**	
Enterprise Value / AUC 2004-2018	**#NAME?**	
Total Non-Rx AUC (2004-2018)	**$15,437**	

Drivers

				70%										
2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
7%	0%	-4%	-3%	-2%	-2%	-1%	-70%	-30%	-30%	-10%	-10%	-10%	-10%	-10%
12%	13%	10%	10%	7%	5%	3%	2%	2%	1%	1%	1%	0%	0%	0%
13%	8%	8%	8%	6%	4%	3%	2%	-30%	-10%	-10%	-10%	-10%	-10%	-10%
83%	18%	16%	13%	9%	6%	4%	3%	2%	2%	1%	-70%	-30%	-30%	-10%
11%	8%	8%	7%	5%	4%	3%	2%	-70%	-30%	-30%	-10%	-10%	-10%	-10%
-3%	-5%	-5%	-5%	-4%	-2%	-2%	-1%	-1%	-1%	0%	0%	0%	0%	0%
5%	8%	8%	8%	6%	4%	3%	2%	1%	1%	1%	-70%	-30%	-30%	-10%
8%	10%	6%	-78%	-55%	-38%	-27%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
29%	32%	19%	21%	15%	10%	7%	5%	3%	2%	2%	-70%	-30%	-30%	-10%
-16%	-19%	-17%	-16%	-11%	-8%	-5%	-4%	-3%	-2%	-1%	-1%	-1%	0%	0%
9%	5%	5%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
289%	48%	33%	14%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
89%	25%	15%	15%	11%	7%	5%	4%	3%	2%	1%	1%	-70%	-30%	-30%
-2%	2%	2%	2%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
11%	20%	20%	20%	14%	10%	7%	5%	3%	2%	2%	1%	1%	1%	0%
12%	-2%	-2%	-2%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
NM	39%	25%	25%	30%	30%	30%	10%	10%	0%	0%	0%	0%	0%	0%
-23%	-20%	-20%	-2%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
-5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
-26%	20%	20%	20%	14%	10%	7%	5%	3%	2%	2%	1%	1%	1%	0%
-19%	0%	0%	0%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
NM	713%	31%	53%	37%	26%	-70%	-30%	-30%	-10%	-10%	-10%	-10%	-10%	-10%
NM	333%	45%	34%	5%	4%	3%	0%	0%	0%	0%	0%	0%	0%	0%
NM	NM	NM	NM	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
2%	0%	0%	0%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
-13%	-5%	-5%	-5%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
-12%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
49%	-17%	-16%	-14%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
128%	0%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%
-23%	2%	2%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%
NM	NM	738%	30%	67%	10%	10%	5%	0%	0%	0%	0%	0%	0%	0%
NM	NM	83%	47%	40%	40%	10%	10%	0%	0%	0%	0%	0%	0%	0%
NM	747%	63%	39%	-70%	-30%	-30%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
5%	5%	5%	5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	3%	3%

Discounted Cash Flow & Cliff Year Analyses

Cliff Year Analyses																
Cliff Year	2009	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Discount Periods from 2004 until Cliff Year	6.0															
Sales in Cliff Year	$20,419	14,132	15,937	17,268	18,322	19,376	20,419	19,313	16,629	14,753	14,274	14,030	12,068	11,454	11,121	10,937
Sales in Cliff+1 Year	$19,313	14,132	15,937	17,268	18,322	19,376	20,419	19,313	16,629	14,753	14,274	14,030	12,068	11,454	11,121	10,937
AUC from 2004 to Cliff Year	$105,453	14,132	30,069	47,337	65,659	85,034	105,453	124,766	141,395	156,148	170,422	184,453	196,521	207,975	219,096	230,032
Cliff Year for AUC Analysis	2007	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Sales		14,132	15,937	17,268	18,322	19,376	20,419	19,313	16,629	14,753	14,274	14,030	12,068	11,454	11,121	10,937
AUC from 2004 to 2007	$65,659	14,132	30,069	47,337	65,659	85,034	105,453	124,766	141,395	156,148	170,422	184,453	196,521	207,975	219,096	230,032
Non-Rx Analysis	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Sales	12,585	14,132	15,937	17,268	18,322	19,376	20,419	19,313	16,629	14,753	14,274	14,030	12,068	11,454	11,121	10,937
Non Rx Sales	728	766	804	845	887	931	977	1,007	1,037	1,068	1,100	1,133	1,167	1,202	1,238	1,275
Non-Rx Sales as % of Sales	5.8%	5.4%	5.0%	4.9%	4.8%	4.8%	4.8%	5.2%	6.2%	7.2%	7.7%	8.1%	9.7%	10.5%	11.1%	11.7%
DCF																
Free Cash Flows		1,725	2,184	2,986	3,638	4,062	4,524	4,934	4,645	4,041	3,605	3,518	3,537	2,834	2,659	2,560
Discount Periods		1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
DCF 2004-2007																
FCFs		1,725	2,184	2,986	3,638											
Terminal Value					35,375											
Discounted FCFs		1,568	1,805	2,243	2,484											
PV of Discounted FCFs		8,101														
PV of Terminal Value		24,845														
Total Value		$32,946														
DCF 2004-2018																
FCFs		1,725	2,184	2,986	3,638	4,062	4,524	4,934	4,645	4,041	3,605	3,518	3,537	2,834	2,659	2,560
Terminal Value																25,601
Discounted FCFs		1,568	1,805	2,243	2,484	2,522	2,554	2,480	2,167	1,714	1,390	1,233	1,127	821	700	613
PV of Discounted FCFs (2004-2007)		8,101														
PV of Discounted FCFs (2008-2018)		17,321														
PV of Terminal Value		6,129														
Total Value		$31,551														

Allocation of Value (Graham's add-on)

EBIT Margin (excl. goodwill)					26.3%	26.8%	27.7%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%
Tax Rate					22.0%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%
D&A (excl. goodwill) (% of Sales)					4.3%	4.3%	4.3%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
Capex (% of Sales)					9.0%	8.0%	7.0%	6.5%	5.5%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
Increase in Working Capital (% Change in Sales)					26.4%	31.9%	29.3%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%
Marketed Revenue				12,585	14,117	15,680	16,560	17,356	18,223	19,082	17,867	15,091	13,219	12,743	12,502	10,543	9,931	9,600	9,418
+ Share of Cialis JV					(137)	51	176	194	213	234	258	283	312	343	377	415	124	87	61
Marketed UFCF					1,727	2,218	2,985	3,505	3,862	4,269	4,535	4,322	3,694	3,259	3,172	3,192	2,490	2,316	24,300
Pipeline Revenue				0	15	257	708	966	1,152	1,337	1,446	1,538	1,535	1,531	1,528	1,525	1,523	1,520	1,518
Visible Pipeline UFCF					(2)	(33)	1	133	201	255	299	324	347	346	345	345	344	343	3,773
Total UFCF					1,725	2,184	2,986	3,638	4,062	4,524	4,834	4,645	4,041	3,605	3,518	3,537	2,834	2,659	28,161
From London's DCF					1,725	2,184	2,986	3,638	4,062	4,524	4,834	4,645	4,041	3,605	3,518	3,537	2,834	2,659	2,560
Balance Check					0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discount Rate Assumed					10%														
Enterprise Value					#NAME?														
Value of Marketed					29,312	#NAME?													
Value of Visible Pipeline					2,240	#NAME?													
Implied Value of Invisible Pipeline					#NAME?	#NAME?													
Model NPV					31,551														
London NPV					31,551														
Balance check					0														
							10.0%	12.0%	14.0%	16.0%									
Marketed					1,727	2,218	2,985	3,505	3,862	4,269	4,535	4,322	3,694	3,259	3,172	3,192	2,490	2,316	2,217
Visible					(2)	(33)	1	133	201	255	299	324	347	346	345	345	344	343	343
Total Marketed & Visible					1,725	2,184	2,986	3,638	4,062	4,524	4,834	4,645	4,041	3,605	3,518	3,537	2,834	2,659	2,560
Discount Factor at					0.91	0.83	0.75	0.68	0.62	0.56	0.51	0.47	0.42	0.39	0.35	0.32	0.29	0.26	0.24
Marketed and Visible	2004-2007	8,101.4			31,551														
	2008-2018	17,321.4																	
	Terminal	58,383.0																	
		83,805.8																	
				10.0%	12.0%	14.0%	16.0%												
	2004-2007	8,101.4	8,101.4	8,101	7,719	7,363	7,032												
	2008-2018	17,321.4	17,321.4	17,321	14,858	12,812	11,102												
	Terminal	58,383.0	58,383.0	58,383	31,504	18,066	10,843												
				83,806	54,081	38,241	28,977												

Allocation of Value (Graham's add-on)

EBIT Margin (excl. goodwill)					26.3%	26.8%	27.7%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%
Tax Rate					22.0%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%
D&A (excl. goodwill) (% of Sales)					4.3%	4.3%	4.3%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
Capex (% of Sales)					9.0%	8.0%	7.0%	6.5%	5.5%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
Increase in Working Capital (% Change in Sales)					26.4%	31.9%	29.3%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%	25.2%
Marketed Revenue				12,585	14,117	15,680	16,560	17,356	18,223	19,082	17,867	15,091	13,219	12,743	12,502	10,543	9,931	9,600	9,418
+ Share of Cialis JV					(137)	51	176	194	213	234	258	283	312	343	377	415	124	87	61
Marketed UFCF					1,727	2,218	2,985	3,505	3,862	4,269	4,535	4,322	3,694	3,259	3,172	3,192	2,490	2,316	24,388
Pipeline Revenue				0	15	257	708	966	1,152	1,337	1,446	1,538	1,535	1,531	1,528	1,525	1,523	1,520	1,518
Visible Pipeline UFCF					(2)	(33)	1	133	201	255	299	324	347	346	345	345	344	343	3,773
Total UFCF					1,725	2,184	2,986	3,638	4,062	4,524	4,834	4,645	4,041	3,605	3,518	3,537	2,834	2,659	28,161
From London's DCF					1,725	2,184	2,986	3,638	4,062	4,524	4,834	4,645	4,041	3,605	3,518	3,537	2,834	2,659	2,560
Balance Check					0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discount Rate Assumed					10%														
Enterprise Value					#NAME?														
Value of Marketed					29,312	#NAME?													
Value of Visible Pipeline					2,240	#NAME?													
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Model NPV					31,551														
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Balance check					0														
							10.0%	12.0%	14.0%	16.0%									
Marketed					1,727	2,218	2,985	3,505	3,862	4,269	4,535	4,322	3,694	3,259	3,172	3,192	2,490	2,316	2,217
Visible					(2)	(33)	1	133	201	255	299	324	347	346	345	345	344	343	343
Total Marketed & Visible					1,725	2,184	2,986	3,638	4,062	4,524	4,834	4,645	4,041	3,605	3,518	3,537	2,834	2,659	2,560
Discount Factor at					0.91	0.83	0.75	0.68	0.62	0.56	0.51	0.47	0.42	0.39	0.35	0.32	0.29	0.26	0.24
Marketed and Visible	2004-2007	8,101.4			31,551														
	2008-2018	17,321.4																	
	Terminal	58,383.0																	
		83,805.8																	
				10.0%	12.0%	14.0%	16.0%												
	2004-2007	8,101.4		8,101	7,719	7,363	7,032												
	2008-2018	17,321.4		17,321	14,858	12,812	11,102												
	Terminal	58,383.0		58,383	31,504	18,066	10,843												
				83,806	54,081	38,241	28,977												

9.2 Appendix 2: Corporate Finance Company X's Valuation Approach of Mining Company

COMPANY NAME

Listing	Stock Exchange	Type

Liquidity		$ Mn
Market capitalisation	[No. shares]	
Free float	[%]	
Av. daily vol. (last 12m)	[No.shares]	
Market capitalisation t/o	[days]	

Shareholders	Name	%
1		
2		
3		
4		
5		
Others		
Total		100%

Markets	Tonnes	%
[Asia-Pac country 1]		
[Asia-Pac country 2]		
[Asia-Pac country 3]		
[Other Asia-Pac]		
SUB-TOTAL ASIA-PAC		
Europe		
Other		
TOTAL		100%

Company description
Main business activities, history, technologies used...

Company's long term strategy
Where does it want to expand ? What does it want to divest ?

Cost of capital	*Weighting ?*	
Coal asset beta		0.4
Country 1		
LT sov debt YTM		
EMRP		
Cost of capital		
Country 2		
LT sov debt YTM		
EMRP		
Cost of capital		
etc		
Wtd cost of capital		

Equity research
Comments on valuations by equity analysts

Analyst coverage:
[Firm] [Analyst]

Production and cashflows	2000 H1	2000 H2	2001 H1	2001 H2	2002 H1	2002 H2	2003 H1	1 2003	2 2004	3 2005	4 2006	5 2007	6 2008	7 2009	8 2010	9 2011	10 2012	11 2013	12 2014	13 2015	14 2016	15 2017	16 2018	17 2019	18 2020	19 2021	20 2022
Asian steam coal benchmark price																											

[Country 1]

[Name of operation]		
[Type of operation]	**Reserves**	*Mn t*
[GCV adb]	**As is production**	*Mn t*
[Reserves]	**Growth production**	*Mn t*
[Resources]	**Av. sale price**	*$/t*
	Revenues	*$ Mn*
	Op. cost	*$/t*
	Maint. capex	*$/t*
	OCF	*$/t*
	As is	*$ Mn*
	As is present value	*$ Mn*
	Growth	*$ Mn*
	Growth present value	*$ Mn*
	Growth capex	*$ Mn*
	Present value	*$ Mn*
	Growth NCF	*$ Mn*
	Present value	*$ Mn*

[Name of operation]		
[Type of operation]	**Reserves**	*Mn t*
[GCV adb]	**As is production**	*Mn t*
[Reserves]	**Growth production**	*Mn t*
[Resources]	**Av. sale price**	*$/t*
	Revenues	*$ Mn*
	Op. cost	*$/t*
	Maint. capex	*$/t*
	OCF	*$/t*
	As is	*$ Mn*
	As is present value	*$ Mn*
	Growth	*$ Mn*
	Growth present value	*$ Mn*
	Growth capex	*$ Mn*
	Present value	*$ Mn*
	Growth NCF	*$ Mn*
	Present value	*$ Mn*

Country sub-total		
	Reserves	*Mn t*
		% total
	Production	*Mn t*
		% total

[Country 2]
etc

Total reserves		*Mn t*
Total production		*Mn t*
Wt av selling price		*$/t*
Total revenues		*$ Mn*
Total operating costs		*$ Mn*
Total gross margin		*$ Mn*
Total OCF		*$ Mn*
	Present value	*$ Mn*
Total capex		*$ Mn*
	Present value	*$ Mn*
SG&A		*$ Mn*
Other CF items ?		*$ Mn*
Taxation		*$ Mn*
Total 'other'		*$ Mn*
	Present value	*$ Mn*
FCF		*$ Mn*
(DCF)	*Present value*	*$ Mn*
Gross debt		*$ Mn*
Cash & MS		*$ Mn*
Net debt		*$ Mn*
Market capitalisation		*$ Mn*
Enterprise value		*$ Mn*
Net interest payments		*$ Mn*
D&A (for tax calc)		*$ Mn*
EV / OCF		*x*
EV / FCF		*x*
EV / DCF		*x*
EV / t (production)		*$/t*
EV / t (reserves)		*$/t*
ND / EV		*%*
ND / OCF		*x*
OCF / Net Interest		*x*

9.3 Appendix 3: Case Study Protocol

Confidentiality Agreement Standard Format

CONFIDENTIALITY AGREEMENT

This Confidentiality Agreement ("Agreement") is made and effective 1st of October 2007 by and between ***Name*** with offices at ***Name of the Company and Address*** ("Owner") and ***Mukesh Kumar*** with offices at ***Institute for Manufacturing, Mill Lane, Cambridge, CB2 1RX UK*** .

1. Confidential Information.

Owner proposes to disclose certain of its confidential information (the "Confidential Information") to Recipient. Confidential Information shall include all data, materials, products, technology, computer programs, specifications, manuals, business plans, software, marketing plans, financial information, and other information disclosed or submitted, orally, in writing, or by any other media, to Recipient by Owner.

2. Recipient's Obligations.

A. Recipient agrees that the Confidential Information is to be considered confidential to Owner and Recipient shall hold the same in confidence, shall not use the Confidential Information other than for the purposes of case studies with Owner, and shall disclose it only to anyone except as specifically authorised by Owner*. Recipient will not disclose, publish or otherwise reveal any identifiable details received from Owner to any other party whatsoever except with the specific prior written authorization of Owner.

B. Confidential Information furnished in tangible form shall not be duplicated by Recipient except for purposes of this Agreement. Upon the request of Owner, Recipient shall return all Confidential Information received in written or tangible form, including copies, or reproductions or other media containing such Confidential Information.

Owner (***Name***)	Recipient (***Mukesh Kumar***)
Signed: _____	Signed: _____
Date: _____	Date: _____

* Specially authorized persons ()

_____

Research Flyer

UNIVERSITY OF CAMBRIDGE

Centre for International Manufacturing

IfM

Overseas Manufacturing Investment: Risk Management

-- a new architecture for risk management process

Outcomes

- Map of key organisational risks from an international manufacturing network perspective.
- Trends & characteristics of risk management.
- Strategic framework and design process for risk management.
- Case examples of risk management process design, implementation and operations.
- Guidelines for the integration of organisational levels (corporate, project and operational) in the risk management process.
- Working manual on risk management in overseas manufacturing.

Further information from

Mukesh Kumar
Professor Mike Gregory

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Email: mk501@cam.ac.uk
http://www.ifm.eng.cam.ac.uk/

Aims

- To understand the new global business environment in which the risk management process in overseas manufacturing investment is evolving.
- To understand the characteristics of overseas investment decisions in terms of the global business environment and industry dynamics.
- To identify the risk management process in overseas investment projects (specifically projects related to new plant establishment, plant transfer and plant acquisition) at corporate level, project level and operations level.
- To develop a strategy process to facilitate the analysis of the overseas business environment and the design of an integrated risk management process.
- To identify core capabilities required to establish the risk management process. This includes information process tool, integration process tool, communications tool, control point in process and monitoring process.

Background

Manufacturing companies in developed and developing countries are facing the challenge of depleting earnings growth in competition with global leaders. For example, manufacturing industry is growing at the rate of only two percent a year on average with a six percent rate of earnings per annum in the UK. The industry has several alternatives to achieve high growth and earnings, for instance, cost cutting, the provision of value added services, new technologies, and increased economies of scale to reduce cost. On the other hand, they could invest overseas in Greenfield or Brownfield projects where high growth opportunities exist. However, finding the overseas business opportunity and its evaluation often exposes companies to high risk.

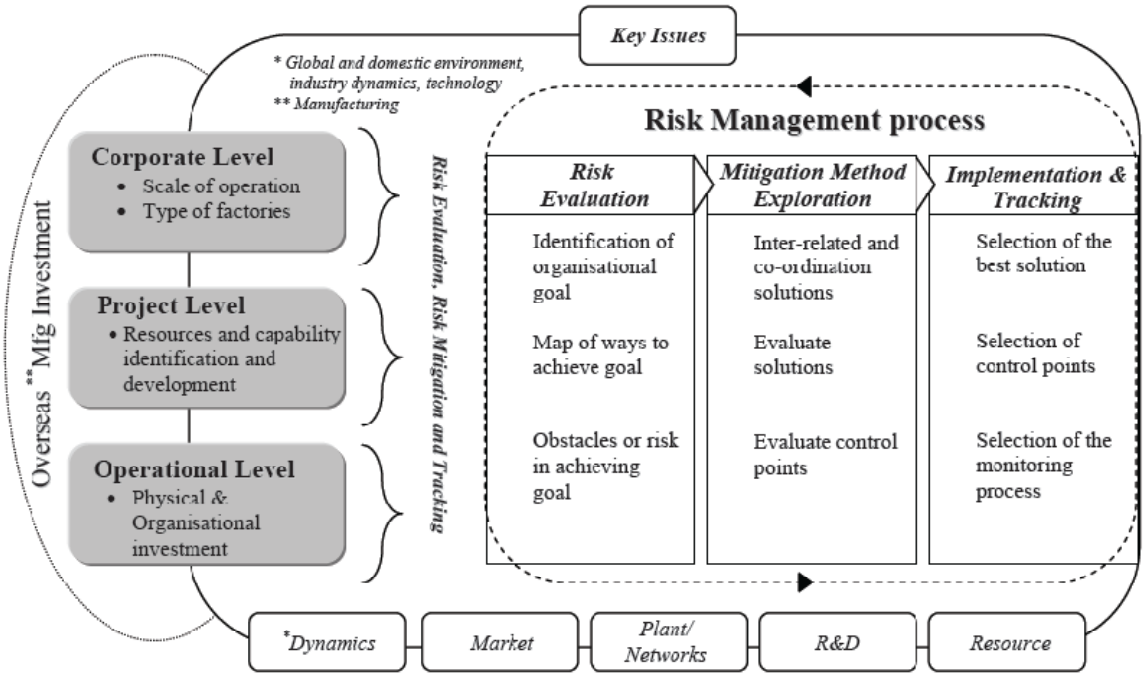
Current manufacturing industry dynamics involve shutting down and starting up new operations at specific global locations. This research is an opportunity to understand overseas manufacturing investment decisions from the perspective of risk, investment and international manufacturing networks. Investment in overseas manufacturing increases the different kinds of risk an organisation faces. This research therefore addresses the primary issue of achieving high growth in business by increasing overseas manufacturing earnings while reducing its international manufacturing risk.

Research Scope

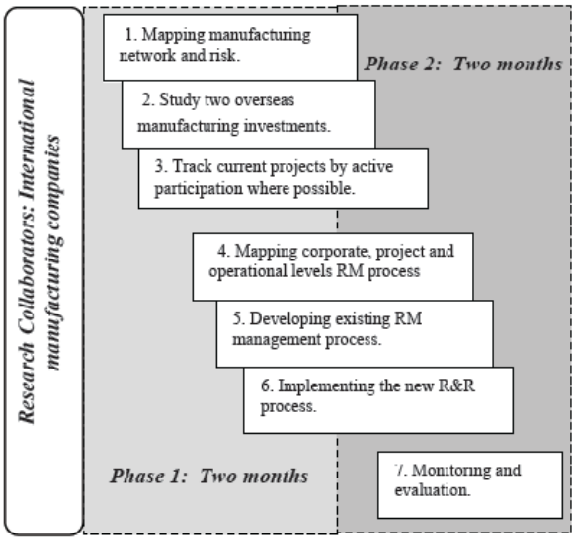
The research work on the risk management process in overseas investment projects (specifically projects related to new plant establishment, plant transfer and plant acquisition) includes three main strands.

- Corporate level: Identifying the risk management in the development of organisational goals.
- Project level: Identifying the risk management in the development of resources and capabilities.
- Operational level: Identifying the risk management in physical and organisational investments.

These three levels are linked with key issues:



Research Approach



This research aims to develop the risk and reward framework or construct a working manual in line with current international manufacturing industry practices and challenges.

This research will be a collaborative work with companies on the primary issue of achieving high growth in business by increasing overseas manufacturing earnings and reducing the international manufacturing risk.

Benefits to Companies

- Mapping of organisational risks from an international manufacturing network perspective.
- Access to the working manual on risk management in overseas manufacturing through case studies in international manufacturing corporations.
- A report on company specific risk management.

Research Topic Presentation to Companies

Risk Evaluation and Management in International Manufacturing Investment.

IfM

Professor Mike Gregory
Head of the IfM
Centre for International Manufacturing
Institute for Manufacturing

Mukesh Kumar
Doctoral Researcher
Centre for International Manufacturing
Institute for Manufacturing

2. Objectives of Research

- Is to investigate the research question- *how can risk be managed and evaluated in overseas manufacturing investment in the context of a company's growth strategy?*
- Is to provide a generalised version of the risk evaluation and the management process to the manufacturing industry, which would enable them to make their current decision-making processes more robust.

4 IfM

Outline

1. Manufacturing Industry
2. Objective of Research
3. International Manufacturing Review
4. Risk and Reward Description
5. Illustrative Case Studies
6. Company's Interest

Configuration
Coordination
Capability

2 IfM

3 International Mfg Review

The objective of the international mfg review is to find the emerging issues on international manufacturing.

- It shows why manufacturing firms are shifting their production base aboard or to developing countries. (cost, quality, delivery, innovation, market scope and risk management)
- It focuses on a company's internationalization path and competition outlook in global business. (resources accessibility, thriftiness ability, learning ability and manufacturing mobility)
- It shows a wide range of issues, such as macroeconomic risk and microeconomic risk of a country through corporate competencies, competition and global discontinuity and decision making problems.

5 IfM

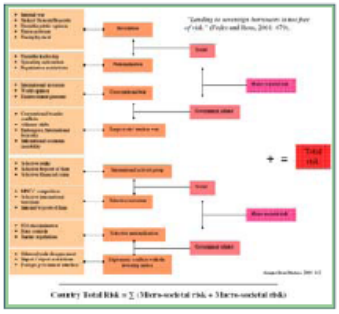
1. Manufacturing Industry

- International manufacturing companies are increasingly shutting down and starting new operations at specific locations globally.
- Status quo of International Manufacturing Industry.
  - Inclined towards geographically dispersed operations.
  - Overwhelmed with international manufacturing network issues.
    - -Configuration.
    - -Coordination.
    - -Capability.
- Misconception in understanding **risk** in international Manufacturing investment.

3 IfM

4. Risk Description

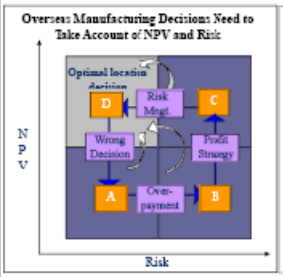
The important and often overlooked consequence is that no country in the world is without risk and the concept of a risk-free country is not legitimate.

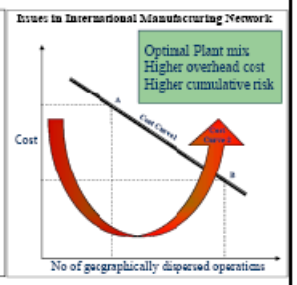


6 IfM

4. Risk Description

The primary issue of achieving high growth in business by increasing overseas manufacturing earnings and reducing its international manufacturing risk.





7 IfM

5 Illustrative Case Studies

Case studies show the need for an understanding of the process of the identification of risk management evaluation as well as the management of overseas manufacturing investment decisions.

Companies	Overseas Manufacturing Focus	*REM Approach	*REM Process
Company A (USA) Manufacturer: Industrial, commercial and consumer products	• Low cost country-production and engineering. • Proximity to markets.	• Diversified offshoring portfolio- Plant portfolio management • Hedging risk.	• Implicit knowledge.
Company B (S. Korea) Manufacturer: Steel-long and flat products (Cold Roll Coil and Hot Roll Coil)	• Proximity to fast emerging market. • Resource based-Proximity of raw material and upstream plants to downstream plant.	• Diversified market access- market portfolio management. • Diversified upstream and downstream plants.	• Implicit knowledge.

Source: CIM database

10 IfM

4. Plant and Market Portfolio

Market and Plant Mapping

	Market 1	Market 2	Market 3	Market 4	Market n
Plant 1					
Plant 2					
Plant 3					
Plant 4					
Plant n					

Hypothetical

Risk and Reward Mapping

	Plant 1	Plant 2	Plant 3	Plant 4	Plant n
Country Risk					
Operational Risk					
Market Risk					
Total Risk					
Reward					
Reward/Risk					

Hypothetical

8 IfM

7 Company's Interest

Research collaborators are offered the following.

- Access to the working manual on risk management in overseas manufacturing investment through case studies in international manufacturing corporations.
- A report on company specific risk management.
- Mapping of organisational risks from an international manufacturing network perspective.

11 IfM

4. Risk Assessment

Qualitative Assessment of Risk: Country Perspective

	Country Risk						
	Army	Hostile nation	Opp. party	Ruling party	USA	FDI	Terrorism
UK	+	++	+	++	++	+	--
India	+	-	++	--	-	-	--
Thailand	+	-	+	-	--		--
China	++	--	++	-	-		+
US	+	++	+	++	++	+	--

Hypothetical

Qualitative Assessment of Risk: Organisation Perspective

	Organisational Risk						
	Plant	R&D	Mfg Network	Market	Competitors	Cross-culture	Communication
UK	+	++	+	++	++	+	--
India	+	-	++	--	-	-	--
Thailand	+	-	+	-	--		--
China	++	--	++	-	-	+	+
US	+	++	+	++	++	+	--

Hypothetical

9 IfM

Thank you

31 December 2009

IfM

4. Risk Assessment

Risk Assessment Approach: The CEO's Question: "How much more will this make us?"

π = Total Profits = Total Sales – Total Costs = TS – TC Ω = Risk

Value added manufacturing return in UK = (8%?) = $f\ (TS_0 - TC_0) = {}^{UK}\pi_0$, at t = 0 and ${}^{UK}\Omega_0$

Value added manufacturing return in India = (19%?) = $f\ (TS_1 - TC_1) = {}^{Ind}\pi_1$, at t = 1 and ${}^{Ind}\Omega_1$

Change in Profit = $\Delta\pi$ = Ind π_1 – UK π_0
$= [f\ (TS_1 - TC_1) = \text{Ind}\ \pi_1]\ {}^{Ind}\Omega_1 - [f\ (TS_0 - TC_0) = \text{UK}\ \pi_0]\ {}^{UK}\Omega_0$

Where, ${}^{Ind}\Omega_1 > {}^{UK}\Omega_0$

${}^{Country}\Omega_1 = f$(Army, Hostile Nation, Opposition Party, Ruling Party, USA, FDI, Terrorism) + C

Assume: C = other risks = (Army, Hostile Nation, Opposition Party, Ruling Party, USA, FDI, Terrorism), *and is, in fact, very small.*

13 IfM

Unstructured questionnaire for risk management auditor:

1. What is risk?
2. What is ERM and how does it work?
3. Explain the historical evolution of ERM?
4. How do you audit RM system in manufacturing companies?
5. Is there any standard categorisation of risk in manufacturing companies?
6. What are the major issues in RM?
7. What are the major deficiencies of the existing RM system in companies?
8. What are the critical issues in RM auditing?
9. How does ERM system derive the stated ERM capabilities?
10. Have you observed or audited the investment RM in global manufacturing companies?

Unstructured questionnaire for risk management consultant:

1. What is risk?
2. What is risk management system?
3. Why risk management is important for manufacturing companies?
4. How does RM system work?
5. What are the steps of RM?
6. How do you help companies in establishment of RM system?
7. Do you link RM system with investment process of global manufacturing companies?
8. What are the issues in establishment of RM system?

Sample Semi Structure Questionnaire Version 1 for in-depth case study

1. What is the existing growth strategy of the company?
2. What were the challenges to the company's growth five years ago?
3. What are the current challenges to the company's growth?
4. Is there any need to reorganise the international manufacturing network? If yes, then why?
5. What are the key risks in overseas manufacturing investment (specifically related to new plant establishment, plant transfer and plant acquisition)?
6. What are the challenges in decision making on overseas manufacturing investment?
7. What are important factors in screening of potential overseas manufacturing investment projects?
8. What are the challenges in evaluation of these projects?
9. Describe the current evaluation tools (qualitative and quantitative) of overseas investment projects. Are these sufficient?
10. Describe the current internal capabilities for the selection of investment projects at corporate level, project level and operational level. Are these sufficient?
11. Are integration investment and expansion investment an integral part of the overseas investment evaluation? If so, describe the approach used.
12. How much does the company depend upon external help (consultants) in overseas investment projects?
13. What are the macro and micro-economic challenges in overseas investment at corporate level, project level and operational level?
14. Does the company have efficient internal capabilities to cope with these challenges?
15. How do you match risk with reward in overseas manufacturing investment?
16. How do you deal with the key trade-off of achieving high growth in overseas manufacturing earnings and reducing international manufacturing risk?

Sample Semi Structure Questionnaire Version 2 for in-depth case study

Industry Level:

1. **What are characteristics and dynamics of the industry?**
2. **What are the requirements to be competitive in the industry? (For example, in terms of capabilities: cost, market scope, quality, innovation, delivery, flexibility, and risk management)**
3. **What is the product cost-structure of the overall industry? (Which cost factors seem most significant?)**
4. **How does technological development currently (for product and processes) influence the industry dynamic? Is it anticipated step-change change suddenly in the future?**

Organisational Level:

5. **What is structure of the organisation?**
6. **What is your outline corporate strategy for business development?**
7. **What is the capital expenditure approval process for new investments?**
8. **What are the chief characteristics of the company's existing manufacturing network?**
9. **What are company's major growth strategies for the short (1 year) and medium (2-5 years) term future?**
10. **How are product groups divided between manufacturing sites?**
11. **How is R&D organised for each of the product groups?**
12. **How are the roles of each manufacturing plant defined?**

The Global Footprint Project - Strategic Level:

13. **How is the current global footprint conceived for the manufacturing network? (And, which company officers were involved in conception of this project?)**
14. **What is the need of current global footprint project?**
15. **How is the global manufacturing footprint strategically aligned?**
16. **What are the target markets of the global footprint (scale, scope and niche market)?**

The Global Footprint Project - Implementation Level:

17. **What are the implementation strategies of the global footprint project?**
18. **What are the benefits of leveraging the global footprint, and how might they be maximised?**
19. **How are new investment projects measured, to assess if they will satisfy the objectives of the global footprint project?**
20. **What are the different phases of project evaluation in the global footprint project?**
21. **How is the global footprint project monitored?**
22. **What are the reasons behind setting up 2010 targets in global footprint project? (Please rank them according to their importance).**
23. **How will seamless global order management be achieved throughout the global footprint project?**

Individual Manufacturing Investment Project Perspective:

24. **What are the supporting projects required in (a) installing additional capacity, (b) reducing capacity, and (c) opening new plant?**
25. **What are the complexities, challenges and risk in (a) installing additional capacity, (b) reducing capacity, and (c) opening new plant?**
26. **What are the steps in analysing risk and reward in new projects?**
27. **What are the steps in project management, to integrate each project into the manufacturing network?**

9.4 Appendix 4: Preliminary Analysis of Case Study

Manufacturing system perspective	Case A	Case B	Case C	Case D	Case E	Case F	Case G	Case H
I Configuration								
a. Geographical position of value activities		●		●				
b. Geographical Position of one value activity	●		●		●	●		
c. Objective based on product	●	●	●	●	●	●		
d. Objective based on market			●	●	●		●	●
e. Objective based on capabilities	●	●	●	●	●	●	●	●
II Coordination								
a. Globally syncronised	●	●	●	●	●			
b. Locally syncronised	●	●	●	●		●	●	●
III Capabilities								
a. Resource accessibility			●					
b. Thriftiness ability/Costs cutting	●	●	●	●		●		
c. Manufacturing mobility/Flexibility		●	●	●	●			
d. Learning ability/Knowledge	●	●	●	●	●			
e. Quality	●	●	●	●	●	●	●	●
f. Delivery	●	●	●	●	●	●	●	●
g. Risks		●	●	●				

Note: Cases names are not as same as cases names in Case study chapter. It is preliminary analysis of data with respect to literature.

Business Development and Planning	Case A	Case B	Case C	Case D	Case E	Case F	Case G	Case H
I Objective of Investment								
a. Competition	●	●	●	●	●	●		
b. Market opportunities	●	●	●	●	●		●	●
c. Low costs	●	●	●	●		●		
d. Technical Flexibility			●					
e. Risk Management		●		●				
f. System Alignment or Rationalisation	●	●	●	●	●			
II Investment								
a. Investment Portfolio			●				N/A	N/A
b. Diversification	●	●	●	●			N/A	N/A
c. Minimising risks		●		●			N/A	N/A
d. Information analysis	●	●	●	●	●	●	●	●
e. Long term rationality	●	●	●	●	●	●	N/A	N/A
f. Exit analysis			●				N/A	N/A
III Types of investment								
a. Greenfield Investment	●	●	●	●			●	N/A
b. Brownfield Investment	●	●	●	●	●		●	N/A
IV Ownership								
a. Owned	●	●	●	●	●	●	●	N/A
b. Jointly owned								N/A

Note: Cases names are not as same as cases names in Case study chapter. It is preliminary analysis of data with respect to literature.

Outcome of Investment Review	Case A	Case B	Case C	Case D	Case E	Case F	Case G	Case H
I Objective of Investment								
a. Competition	●	●	●	●	●	●		
b. Market opportunities	●	●	●	●	●		●	●
c. Low costs	●	●	●	●		●		
d. Technical Flexibility			●					
e. Risk Management		●		●				
f. System Alignment or Rationalisation	●	●	●	●	●			
II Prominanat concepts- Investment								
a. Investment Portfolio			●				N/A	N/A
b. Diversification	●	●	●	●			N/A	N/A
c. Minimising risks		●		●			N/A	N/A
d. Information analysis	●	●	●	●	●	●	N/A	N/A
e. Long term rationality	●	●	●	●	●	●	N/A	N/A
f. Exit analysis			●				N/A	N/A
III Types of investment								
a. Greenfield Investment	●	●	●	●			●	N/A
b. Brownfield Investment	●	●	●	●	●		●	N/A
IV Ownership								
a. Owned	●	●	●	●	●	●	●	N/A
b. Jointly owned								N/A

Note: Cases names are not as same as cases names in Case study chapter. It is preliminary analysis of data with respect to literature.

Investment Valuation	Case A	Case B	Case C	Case D	Case E	Case F	Case G	Case H
a. Net Present Value	●	●	●	N/A	●	●	●	●
b. Real Option				N/A				●
c. Scenario analysis	●	●	●	N/A	●	●	●	●
d. Sensitivity Analysis	●	●	●	N/A	●	●	●	●
e. Capital Asset Pricing Model	●	●	●	N/A	●	●	●	●
f. Asset Pricing Model				N/A				
Risks								
a. Global	●	●	●	●	●			
b. Country	●	●	●	●		●	●	●
Drivers of risks								
a. Political environment	●	●	●	N/A	●	●	●	●
b. Economic Environment	●	●	●	N/A	●	●	●	●
c. Investment Environment	●	●	●	N/A	●	●	●	●

Note: Cases names are not as same as cases names in Case study chapter. It is preliminary analysis of data with respect to literature.

S/N	Risks	External	Internal								
			Strategic	Financial	Project	R&D	Procurement	Production	Distribution	Sales/Mkt	After sales Services
1	Currency fluctuation,	●	●		●						
2	Competition,	●	●								
3	New product failure in the market,		●			●				●	
4	New product failure due to technical problem,		●			●				●	
5	Regulations in Chemiucal industry	●	●		●	●					
6	Inflation: driven by supplier	●	●				●				
7	Oil price	●	●				●		●		
8	people				●	●		●			
9	product faliure					●					
10	Being ahead of peers					●					
11	Insolvency of supplier,						●				
12	Single source of supply						●				
13	Erosion of cost advantage				●		●				
14	Demand profile change,							●			
15	Information- accuracy,				●			●			
16	Retention of employees,							●			
17	NPI							●			
18	Low inventory turnover							●			
19	Preference of warehouse,								●		
20	High cost of warehouse								●		
21	Changes in energy price,								●		
22	Availability of vehicle								●		
23	Economy slowdown,	●								●	
24	Competitors activity,	●			●					●	
25	IPR				●					●	
26	Working capital			●	●						

Note: It is preliminary analysis of data

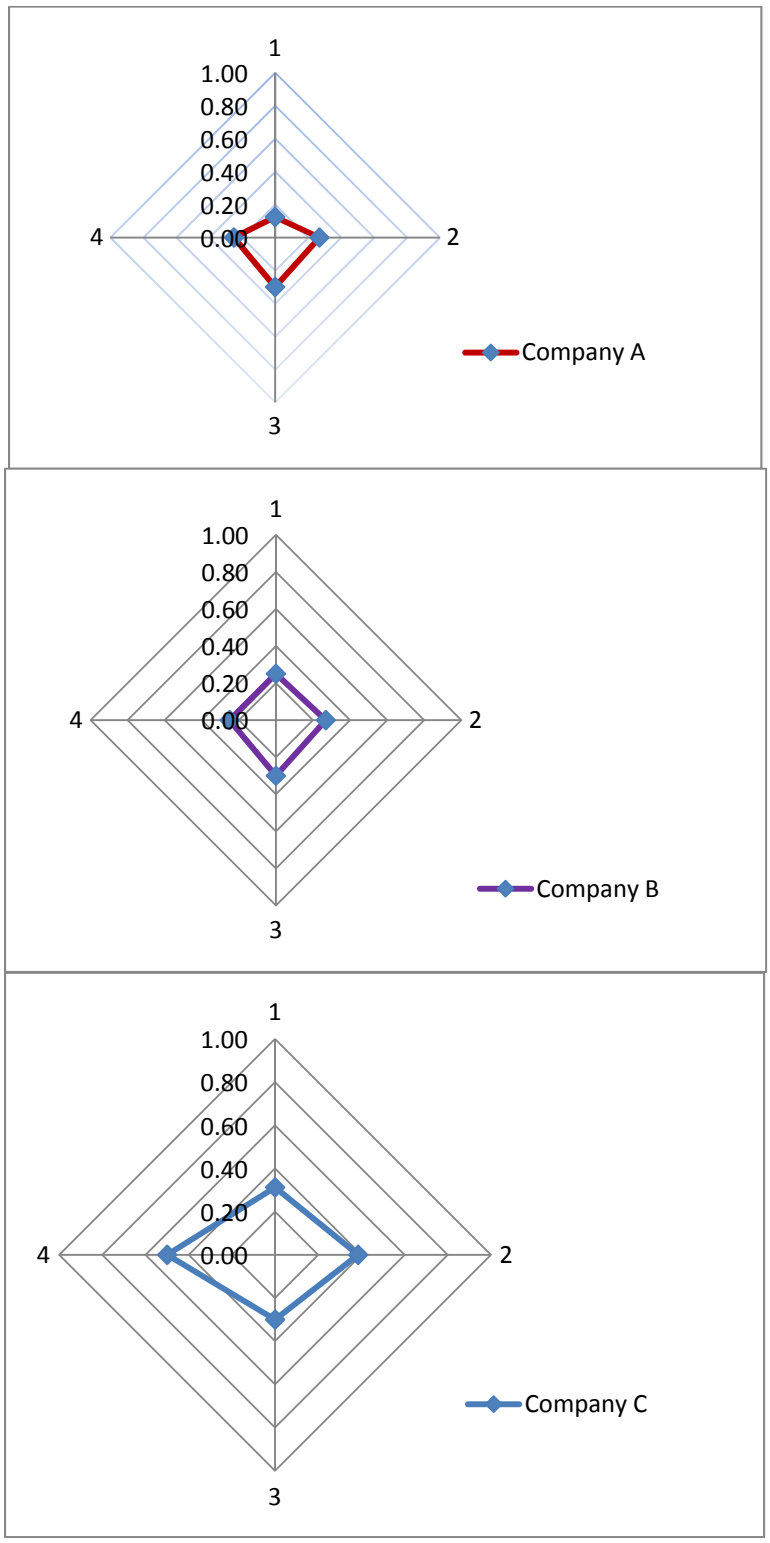
S/N	Risks	External	Internal								
			Strategic	Financial	Project	R&D	Procurement	Production	Distribution	Sales/Mkt	After sales Services
1	Macroeconomic policies	●									
2	Natural disasters due to global warming	●									
3	Political risks	●									
4	Demand	●									
5	Environmental regulations	●	●		●	●					
6	Currency/foreign exchange	●					●				
7	Complexity-driven inefficiency				●			●			
8	Business model flexibility versus competitors		●								
9	Factor cost evolution		●		●	●	●	●	●		●
10	Quality of supply base						●	●			
11	Execution on a global basis in distributed environments		●			●	●	●	●	●	●
12	Timing of transition		●		●						
13	People/talent availability		●		●	●		●			
14	Regional competition									●	
15	Social responsibility		●		●						
16	Market disruption technologies					●		●		●	●
17	Emission standards					●					
18	Labor issues				●			●			
19	Incumbent competitor reactions										
20	IP risk		●		●	●					
21	Fraud/malfeasance										
22	Oil shock and impact on transportation	●									
23	Mismatch of parts production and assembly plants							●			
24	In-expertise in finding a location especially in emerging economies for example China and India.		●								
25	Infrastructure reliability.				●	●	●	●	●		●
26	Dealer/Original Equipment Manufacturers Sourcing Practices						●	●	●	●	●
27	Impact of Acquisitions		●								
28	Litigation and Contingency		●	●							
29	Risks to Global Operations		●								
30	Market Acceptance of Products									●	
31	Exchnage rate	●	●								
32	Interest rate risk			●							
33	Credit risk		●								
34	Product response to demand					●		●		●	
35	Market Access		●								
36	Structure flow										
37	Reliability of projections – volumes, costs, capabilities			●							
38	Consistency of evaluations			●							
39	Strategic alignment		●		●	●	●	●	●	●	●
40	Organisational structure		●								
41	production concentration		●					●			
42	Information flow		●	●	●	●	●	●	●	●	●
43	Distibutor's bargain power		●						●		●
44	dealer's loyality								●		●
45	Reinvestment point-maitainence							●			
46	R&D disperson				●	●				●	

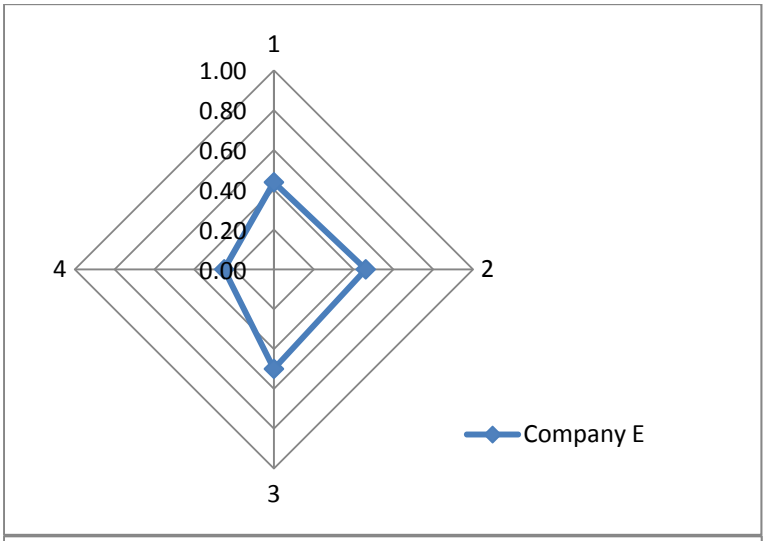
Note: It is preliminary analysis of data

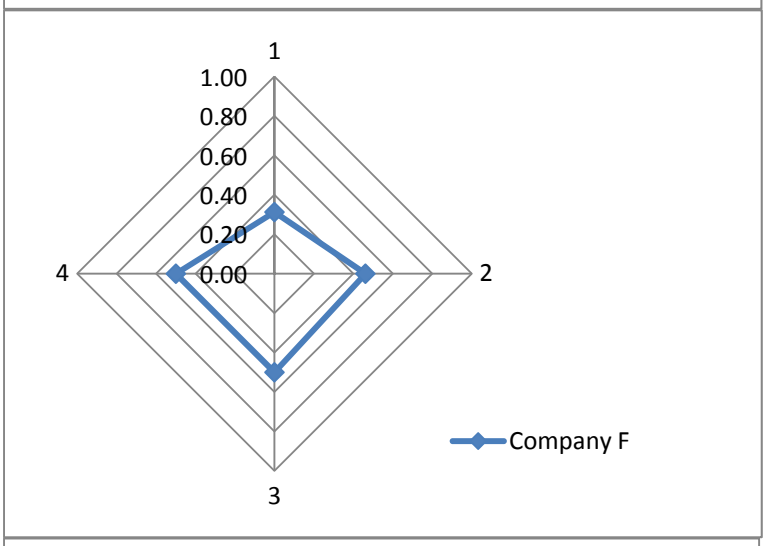
S/N	Risks	External	Internal								
			Strategic	Financial	Project	R&D	Procurement	Production	Distribution	Sales/Mkt	After sales Services
1	Raw Material and energy: Votality, distruption	●	●		●		●	●	●		
2	Market Demand- external factor: Inflation, decesaese, Natural disaster	●	●							●	
3	New strategies: global manufacturing, network transformation, footprint projects		●								
4	Share price: fluctuation	●	●	●							
5	Market risk- interest rate	●		●							
6	Credit risk			●							
7	Unable to avoid unknown liabilities		●	●	●						
8	Technology and strategies adpatabilities to emerging market		●		●						
9	Concentration of production in a single domestic region							●			
10	Uniform infratsruture design					●		●			
11	Lack of decoupling points					●		●			
12	Transportation costs						●		●		
13	Global leveraged		●								
14	Retaining market share		●							●	
15	Retaining quality				●			●			
16	Sourcing						●				
17	Common atrcteture in design and plateform							●			
18	Dilemma of short term advantage		●								
19	Speed of information system		●		●	●	●	●	●	●	
20	Right techonology, right product and right location							●			
21	Currency risk			●							
22	Corruption	●									
23	Tax	●		●							
24	Language risk	●									
25	IP risk		●		●	●					
26	Problems in repatriating the profit			●	●						
27	Disruptive technologies	●	●								
28	Lack of strategy to maintain the gross margin as NPIs go to ramp up production			●		●		●			
29	Right information at the right time		●		●	●	●	●	●	●	
30	Unproductive manufacturing system		●								
31	Visbilibity in the system		●								
32	Articulation of capabilities		●		●						
33	Product supply problem during transition				●						
34	Sustainbility- biodegradable and recycling		●			●					
35	Volatile margine and profitability		●	●							
36	less bargain power						●				
37	Oil price volatility						●				
38	customer responsiviness									●	
39	Change in life style- eating habbits					●				●	
40	maturity of retail sector										
41											

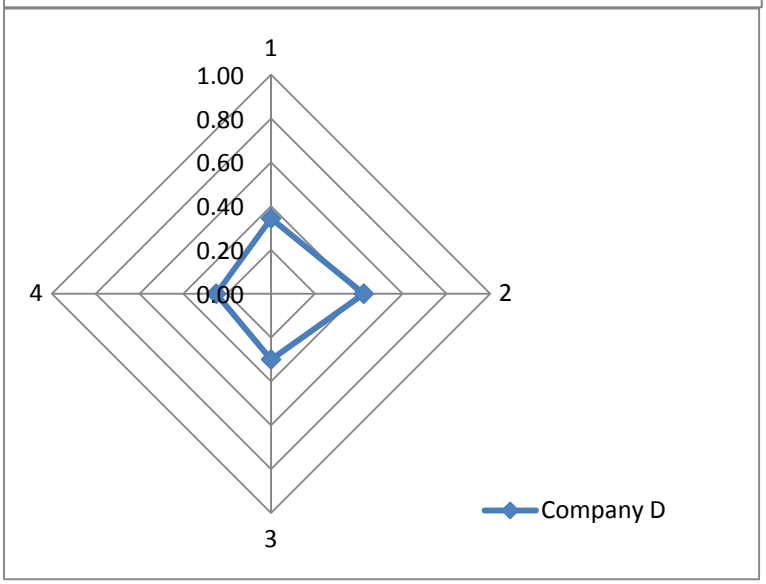
Note: It is preliminary analysis of data

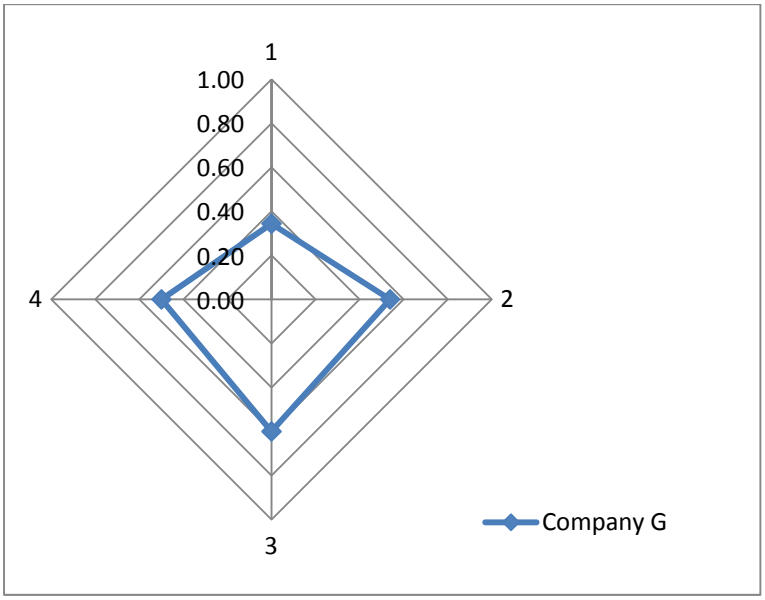
9.5 Appendix 5: Radar Chart of Individual Companies



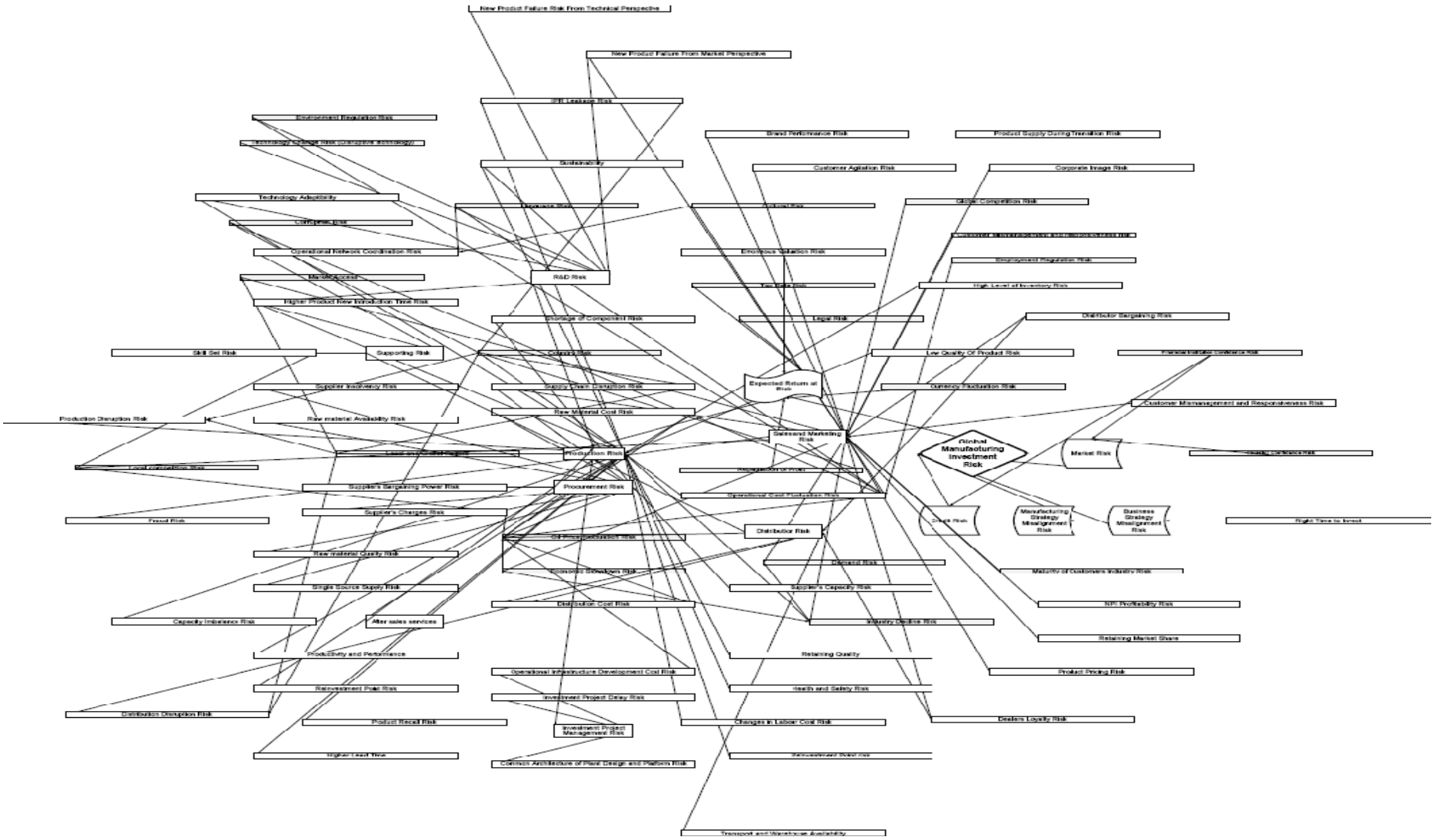

1
1.00
0.80
0.60
0.40
0.20
0.00
2
3
4
Company E


1
1.00
0.80
0.60
0.40
0.20
0.00
2
3
4
Company F


1
1.00
0.80
0.60
0.40
0.20
0.00
2
3
4
Company D


1
1.00
0.80
0.60
0.40
0.20
0.00
2
3
4
Company G

9.6 Appendix 6: Risk Categorisation 1(risk relations)



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