Risk Management and Decision Analysis

Seokho Chi*

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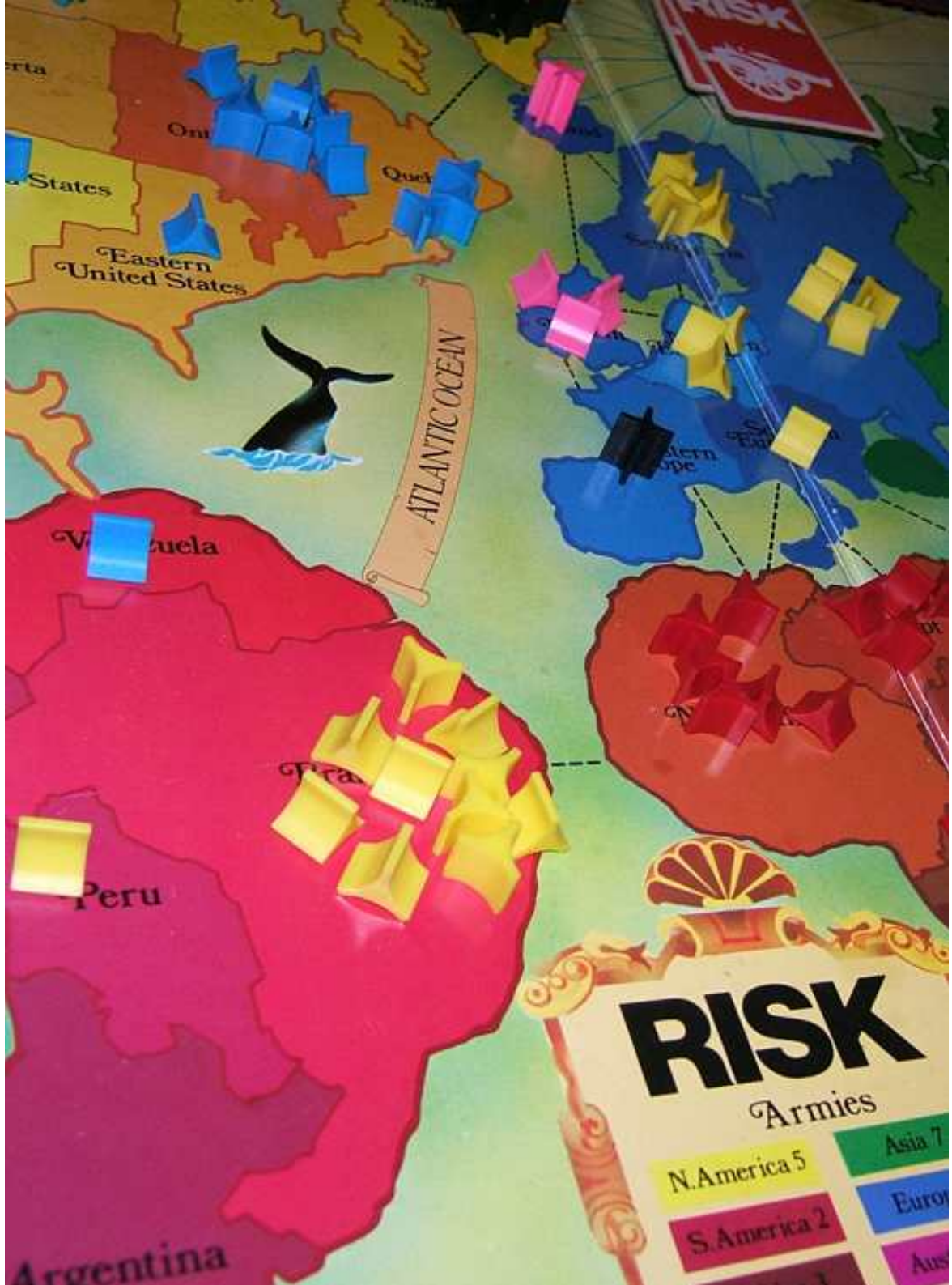
Overview

- Course Introduction
- Risk Management & Decision Analysis



ICE Breaking!!

1. Name
2. Job / Affiliation / Major
3. Interests
4. Others

Class Survey!

Course Outline

1. Objectives

- To introduce students to the concept of risk management and decision analysis and to their use in the construction industry
- To introduce students to the use of basic risk modeling technique
- To introduce students to various types of decision analysis tools

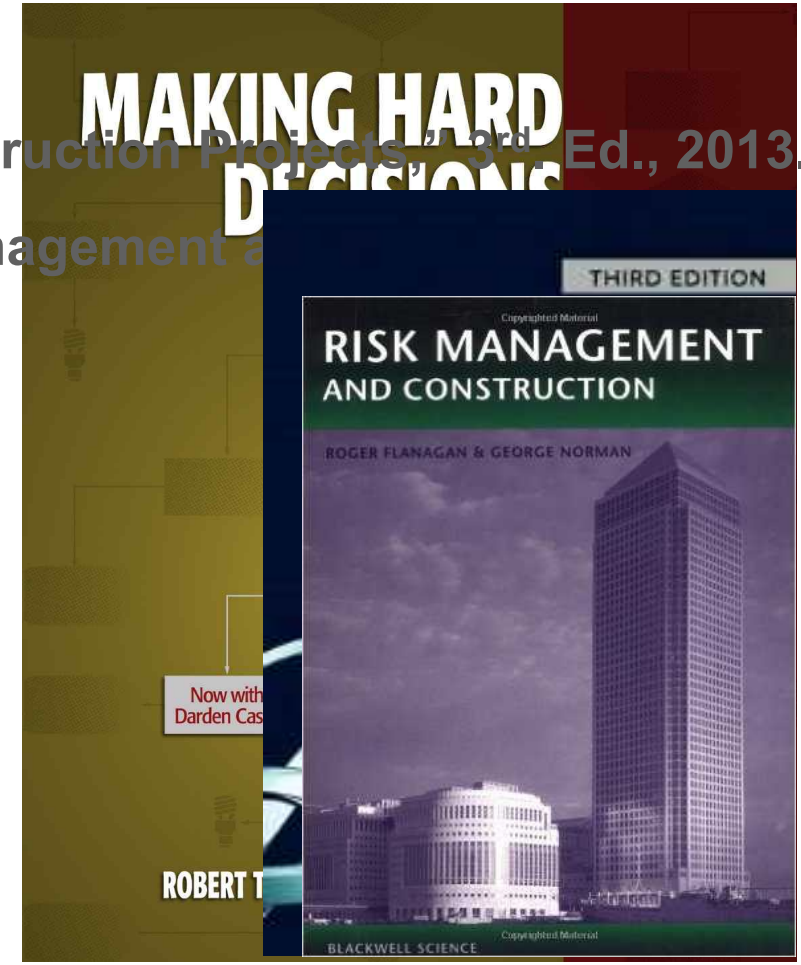
2. Grading Plan

Attendance	Assignment	Mid-term exam	Team Project
10%	20%	35%	35%

Course Outline

3. Recommended Reference

- Clemen, R. T., and Reilly, T. “Making Hard Decisions with Decision Tools,” 3rd. Ed., 2014.
- Smith, N. et al. “Managing Risk in Construction Projects,” 3rd. Ed., 2013.
- Flanagan, R., and Norman, G. “Risk Management a 1993.



Course Topics (see syllabus)

- Week 1: Introduction to Risk Management
- Week 2: Structuring Decisions / Modeling the Structure of the Problem
- Week 3: Decision Making Rules
- Week 4: Group Presentation: Paper Review #1
- Week 5: Project Risk Management
- Week 6: Group Presentation: Risk Identification

  Modeling Uncertainty I: Probability Theory, Measurement
- Week 7: Modeling Uncertainty II: Data Fitting, Subjective Assessment
- Week 8: Mid-term Exam
- Week 9: Group Presentation: Paper Review #2

  Multi-Criteria Decision Making
- Week 10: 어린이날
- Week 11: Mid-Term Group Project Report and Presentation
- Week 12: 부처님오신날
- Week 13: Modeling Uncertainty III: Simulation
- Week 14: Risk Prediction, Communication, and Visualization / Limitations and Future Perspectives
- Week 15: Final Group Project Report and Presentation

Semester Group Project (see handout)

PART II

RISK MANAGEMENT & DECISION ANALYSIS


jtbc
jtbc 뉴스룸


jtbc

Introduction

해외플랜트 수주, 1분기 소폭 증가…2분기도 이어갈 듯

파이낸셜뉴스 | 기사입력 2013-04-04

올해 1·4분기 해외플랜트 수
2800만 달러를 기록한 것으로

이처럼 올해 해외플랜트 수주
에서의 대형플랜트 수주와 유
있기 때문이다.

2·4분기에도 세계경기 회복에
수주실적이 증가세를 이어갈

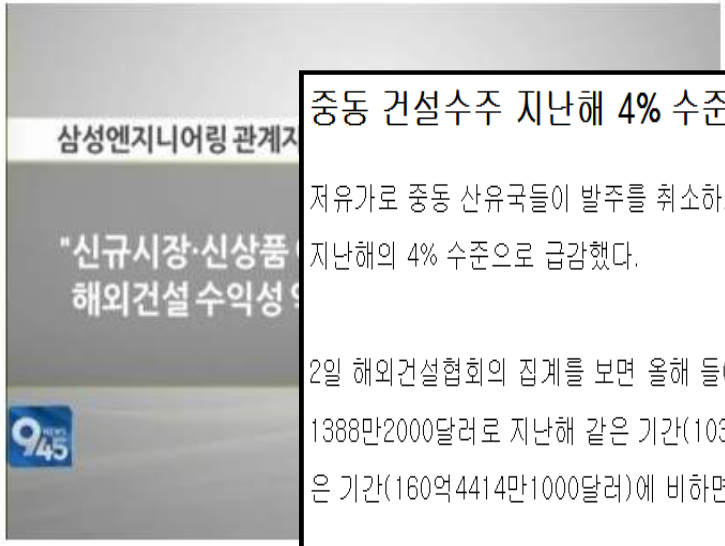
산업통상자원부와 한국플랜
유럽의 대형 해양플랜트와 비
도했다고 밝혔다.

지역별로는 노르웨이의 대형
었고, 아시아권 수주도 증가세
변화 양상을 보였다.

설비별로는 오일·가스 수주액
각각 137.5%, 78.8% 늘었지만
다.

대형건설사 잇단 어닝쇼크…저가 해외수주 '부메랑'

SBS CNBC | 기사입력 2013-04-17 07:42



〈앵커〉

대형건설사들이 어렵사리 수주한 해
니다.

국내 건설부동산시장의 침체로, 해외
고 있습니다.

중동 건설수주 지난해 4% 수준 해외건설 수주 총액은 '반토막'

저유가로 중동 산유국들이 발주를 취소하거나 연기하면서 올 1~2월 중동지역 해외건설 수주액이 지난해의 4% 수준으로 급감했다.

2일 해외건설협회의 집계를 보면 올해 들어 지난달까지 국내 건설사의 해외건설 수주액은 총 50억 1388만2000달러로 지난해 같은 기간(103억8940만8000달러)의 48.3%에 그쳤다. 이는 2014년 같은 기간(160억4414만1000달러)에 비하면 3분의 1에도 못미치는 수준이다.

특히 과거 우리 해외건설의 텃밭이던 중동에서의 수주가 급감했다. 지난 1~2월 중동에서 따낸 수주액은 총 8763만8000달러로 지난해 같은 기간(23억7243만4000달러)의 4%, 2014년(129억4977만5000달러)의 0.68%에 불과하다.

〈김준기 기자 jkkim@kyunghyang.com〉

What is Risk?

- **Think about at least five risks which people can confront in daily life.**
- **Please categorize them into natural disasters and personal risks**
  - Natural disasters: affect many people dramatically
  - Personal risks: every day risks that most of us face

What is Risk?

- **Risks in All Aspect of Our Life: Life is Full of Uncertainty!!!**
  - **Personal Risk**

Financial Risk	Physical Risk	Social Risk	Career Risk
✓Over spent ✓Stock investment ✓Bankruptcy	✓Health ✓Accident	✓Repeated failure ✓Loss of reputation ✓Social rejection	✓Satisfaction? ✓Success?

- **Decisions by government or business leader can result in risks for millions of people.**
- **The strategic decisions are often fraught with peril** (위험투성이)
  - **ex. Leading company's loss of big market shares or bankruptcy because of poor decisions**

What is Risk?

- **Dictionary Definition**
  - To Expose to the Chance of Injury or Loss (Oxford English Dictionary, 2012)
  - Possibility of Undesirable Outcomes
- **Similar concepts:** bad consequence, loss, crisis, uncertainty?
- **Common Usage**
  - "Risk" is referring exclusively to negative effects
  - "Uncertainty" includes both upside and downside
- **Definition of PMBoK®** (*the Guide to the Project Management Body of Knowledge*, PMI, 5th Ed., 2012)

  "Project risk is an uncertain event or condition that, if it occurs, has a positive or a negative effect on a project objective … Project risk includes both threats to the project's objectives and opportunities on those objectives."

Why is Risk Analysis important?

- **Example: Cause of Death**

  다음의 리스크 중 어느 경우 우연히 사망할 확률이 더 높다고 생각하는지?

  1) Fire?
  2) Auto Accident?
  3) Suicide?
  4) Murder?
  5) Tornado?
  6) Bee sting?
  7) Falling Down?
  8) Drowning?
  9) Earthquake?

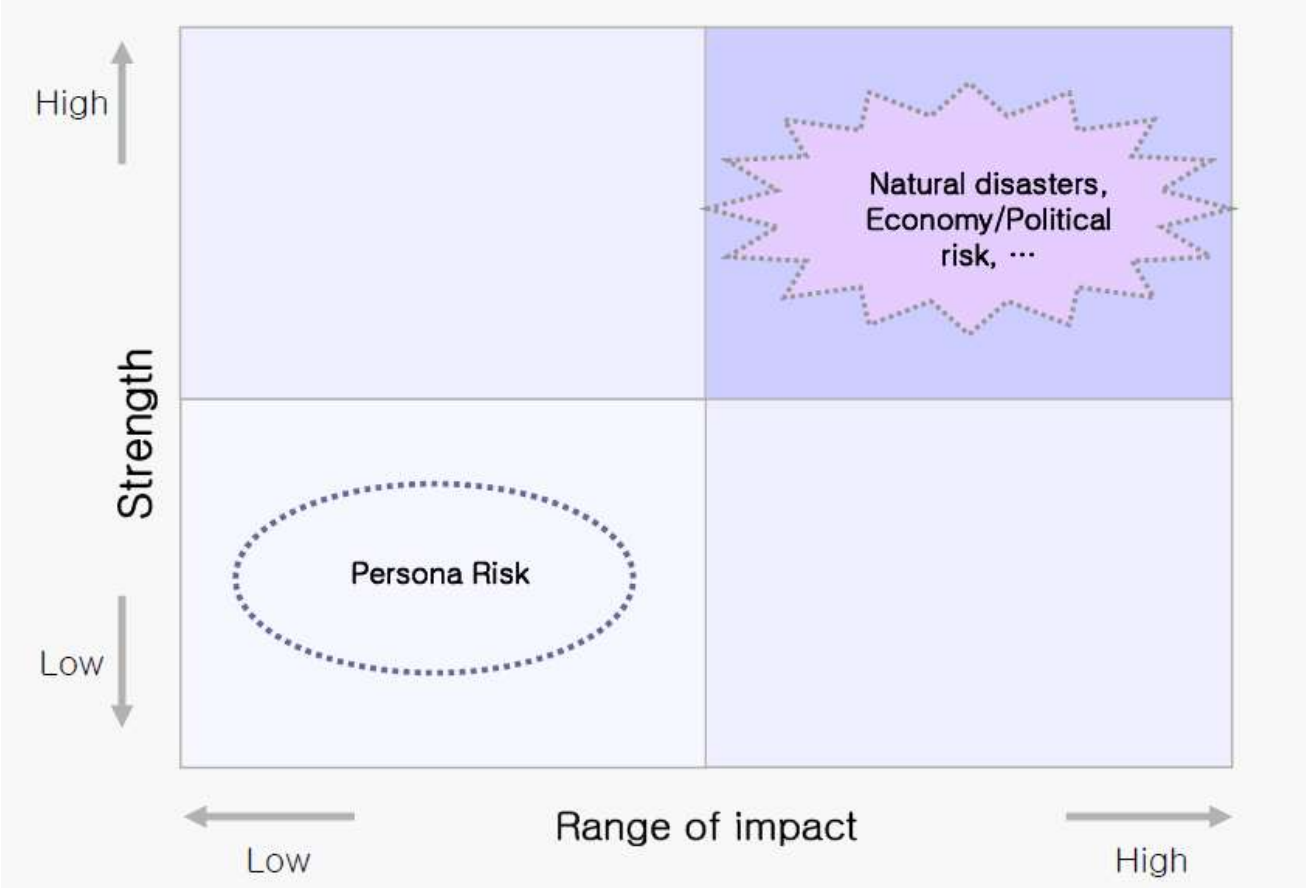
Why is Risk Analysis important?

- **Life is Full of Uncertainty!!!**
  - **Example: Cause of Death Statistics** (WHO 2005)

Cause of Death	Lifetime Odds
Heart Disease	1 / 5
Cancer	1 / 7
Accidental Injury	1 / 36
Intentional Self-harm (suicide)	**1 / 100**
Motor Vehicle Accident	**1 / 121**
Falling Down	1 / 246
Murder	1 / 325
Drowning	1 / 1,081
Fire	1 / 1,179
Air Travel Accident	1 / 5,704
Lightening	1 / 56,439
Tornado	**1 / 60,000**
Bee Sting	**1 / 68,931**
Earthquake	1 / 120,161

Why is Risk Analysis important?

- **Degree of Strength and Scope of Impact**



Why is Risk Analysis important?

- 리스크 또는 미래에 닥칠 불확실한 사건에 대한 인간의 판단은 다음과 같은 인식적인 편견으로 인해 판단에 한계를 가진다고 함
  - Availability
  - Representativeness
  - Anchoring and Adjusting
  - Overconfidence
  - Wishful thinking
  - Loss aversion, ……..

  지금까지 밝혀진 편견의 종류가 약 80여 종류에 달함

(Cognitive Psychology, Sternberg & Mio, 2008)

Why is Risk Analysis important?

- **Risk is an integral part of all Decisions made in the real world.**
  - 대부분의 의사결정 상황은 불확실한 리스크와 관계되어 일어나는데,
  - 이 때, 리스크에 대한 판단의 왜곡 현상이 생기게 되어 의사결정의 방향에 영향을 미침
  - 또한, 인간의 두뇌는 일정량 이상의 정보를 처리하는데 한계가 있음
  - 따라서, 좋은 의사결정을 하기 위해서는 판단의 왜곡현상을 줄이는 과정과
  - 의사결정 상황과 관련된 정보/조건들을 정리하는 과정이 필수적임
  - 이를 위해 **문제를 분해하고 구조화하는 과정이 요구**됨

Motivating Example #1

- **Case of Petro Corporation**
  - Petro Corporation is a company founded to wildcat(시추) in the Middle East oil fields.
  - Petro has a nontransferable short-term option to drill on a certain plot of land.
  - Two recent dry holes elsewhere have reduced Petro's net liquid assets to $130,000, and William Snyder, president and principal stockholder, must decide whether Petro should exercise its option or allow it to expire.
  - It will expire in two weeks if drilling is not commenced by then.
  - Snyder has three possible choices:
    1) Drill immediately
    2) Pay to have a seismic test(탄성파 시험) run in the next few days, and then, depending on the result of the test, decide whether or not to drill
    3) Let the option expire

Motivating Example #2

- **Case of Multinational Products Inc.**
  - Multinational Products Inc. is conducting an investigation of the possibility of investment in the new market.
  - Decision situation: whether to invest alone or go in as a joint venture with ATC Inc. has not been resolved.
  - Decision objectives
    1) Maximizing ROI
    2) Minimizing entry risk
    3) Enhancing long-term relationships with business partners
    4) Stabilizing profits…

Discuss how you can analyze the risky decision problem?

Why are Decisions Hard?

- Dynamic and Complex Process
- Uncertainty/Risk of Key Elements
- Multiple Options/Alternatives
- Multiple Objectives
- Different Perspectives/Stakeholders – Multiple decision makers
- Sensitivity/Instability

What is a Decision?

- **A Decision is**
  - A present action to achieve a future outcome
  - A process by which a person or group identifies a choice to be made, gathers and evaluates information about alternatives, and select from among the alternative (Carroll & Johnson, 1990)
  - An irrevocable(변경할 수 없는) allocation of resources, in the sense that it would take additional resources, perhaps prohibitive in amount, to change the allocation

- **A Decision Maker is**
  - An authority with power to allocate an organization's resources

What is a Decision?

- **Characteristics of Decision-Making Process**
  - Decision making involves actions
  - The courses of action must be feasible
  - There must be set of courses action, which means that there is more than one course of action
  - Decision making involves selecting one from several courses of action, which usually implies the limitation of resources, and
  - Decision making is an act, which means that a choice among courses of action must not be passive or done by default

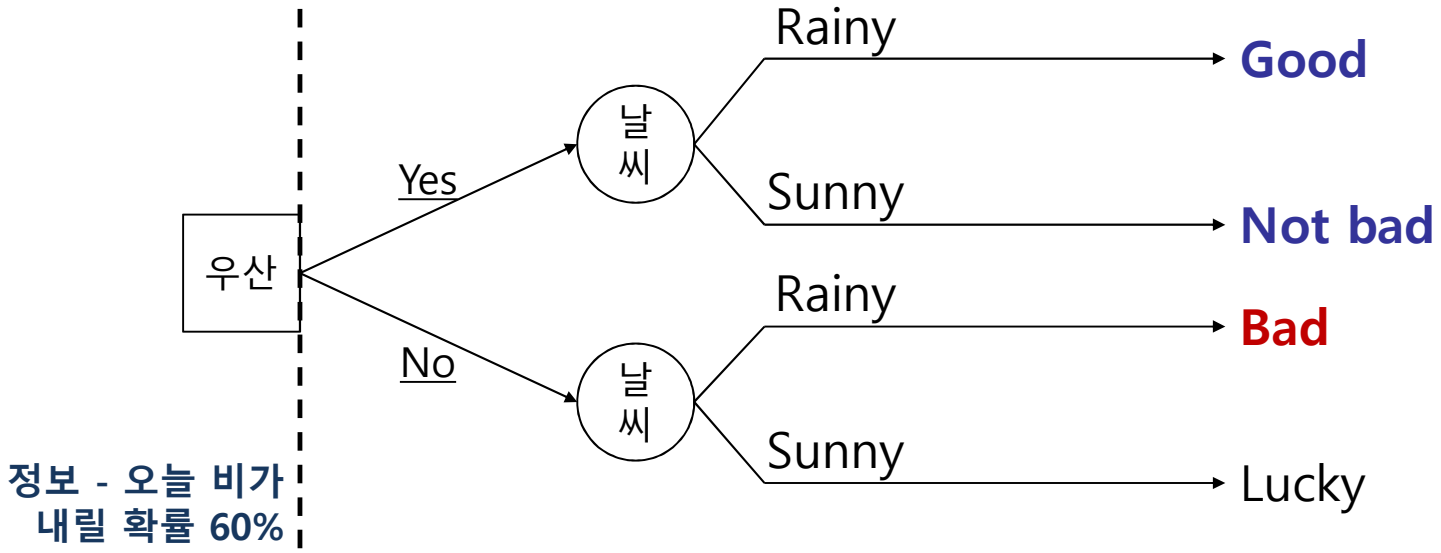
Course of action: A set of intended actions through which one intends to achieve a goal

What is a Decision?

- **Decision-Making Methods**
  - Intuition
  - Experience, Rules-of-Thumb(대략적인/경험적인 양상)
  - Analytic/Systematic Approach such as “**Decision Analysis**”

Decision Analysis and Risk Management

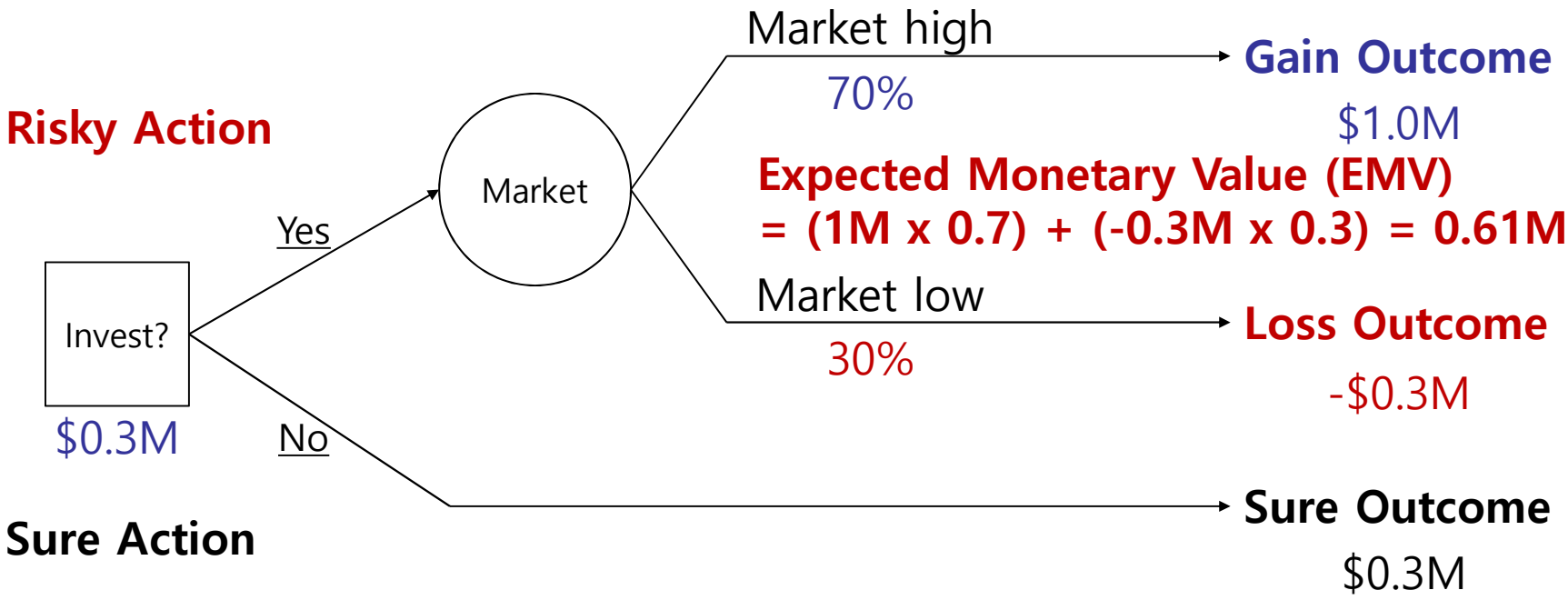
- **Ex: Weather Forecast & Umbrella**
  - 출근할 때 일기예보에서 비올 확률이 60%라고 한다면, 우산을 가져갈 것인가?



Decision Analysis and Risk Management

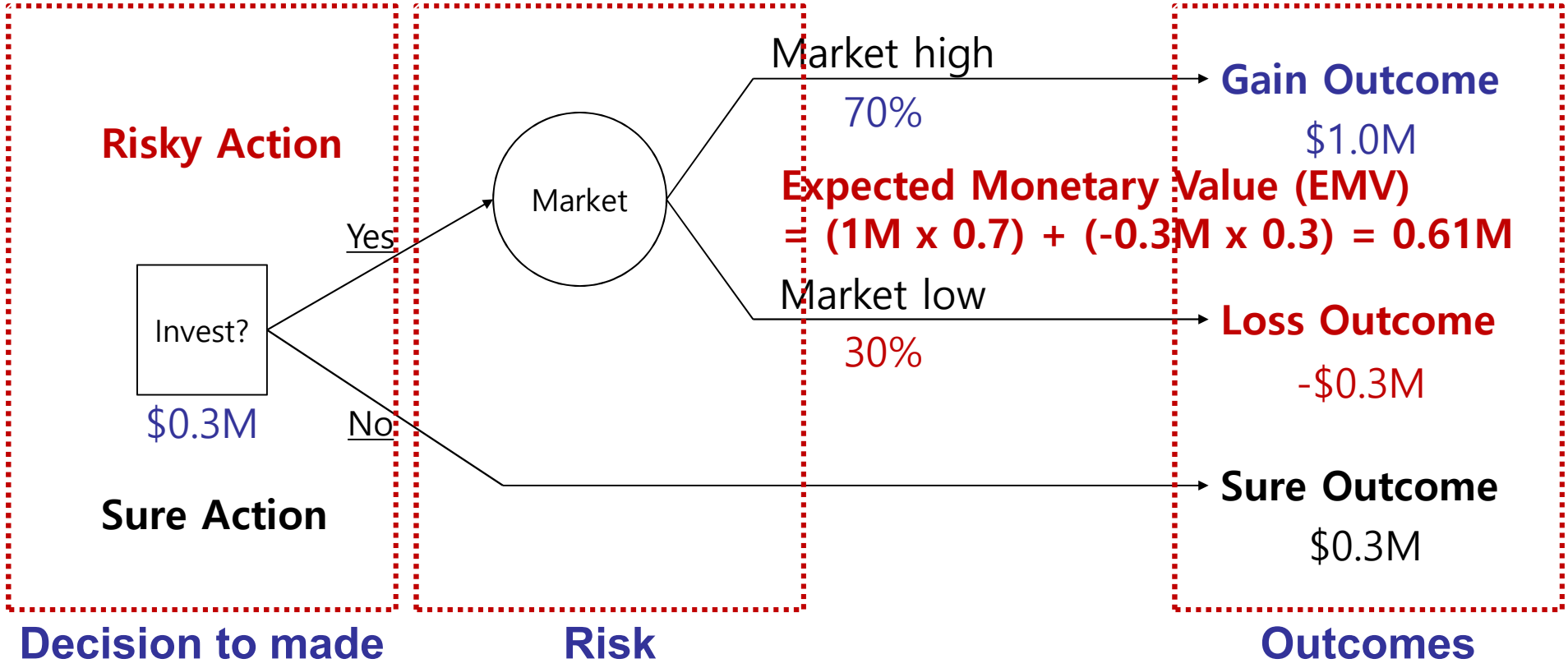
- **Ex: Investing in Stocks**

  - 주식시장에 투자를 고려할 경우의 상황



Element of Decision Problems

- **Inherently, Involving Risks**
- **3 Elements: Decision to made, Risks, Outcomes**



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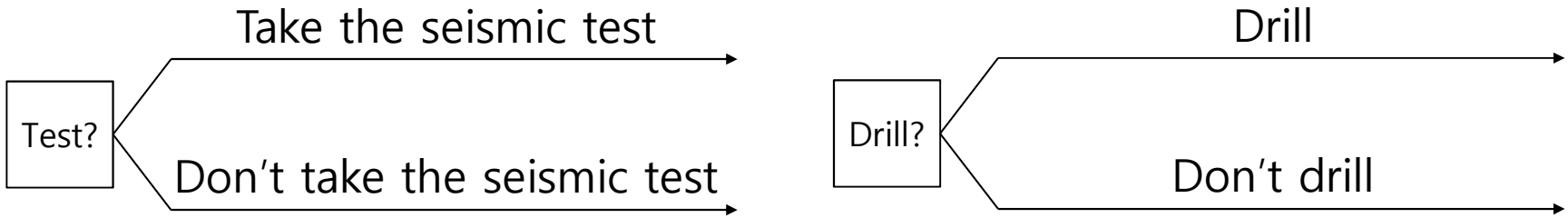
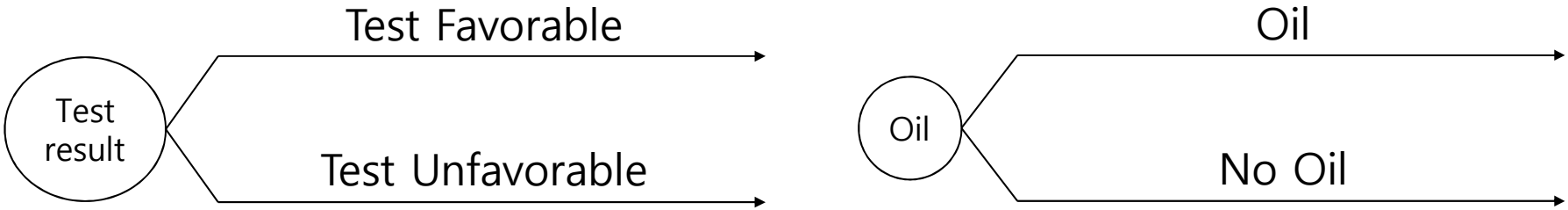
Motivating Example #1 (cont'd)

- **Case of Petro Corporation**
  - In order to decide which of the three choices he will make, Snyder must resolve the following two decisions:

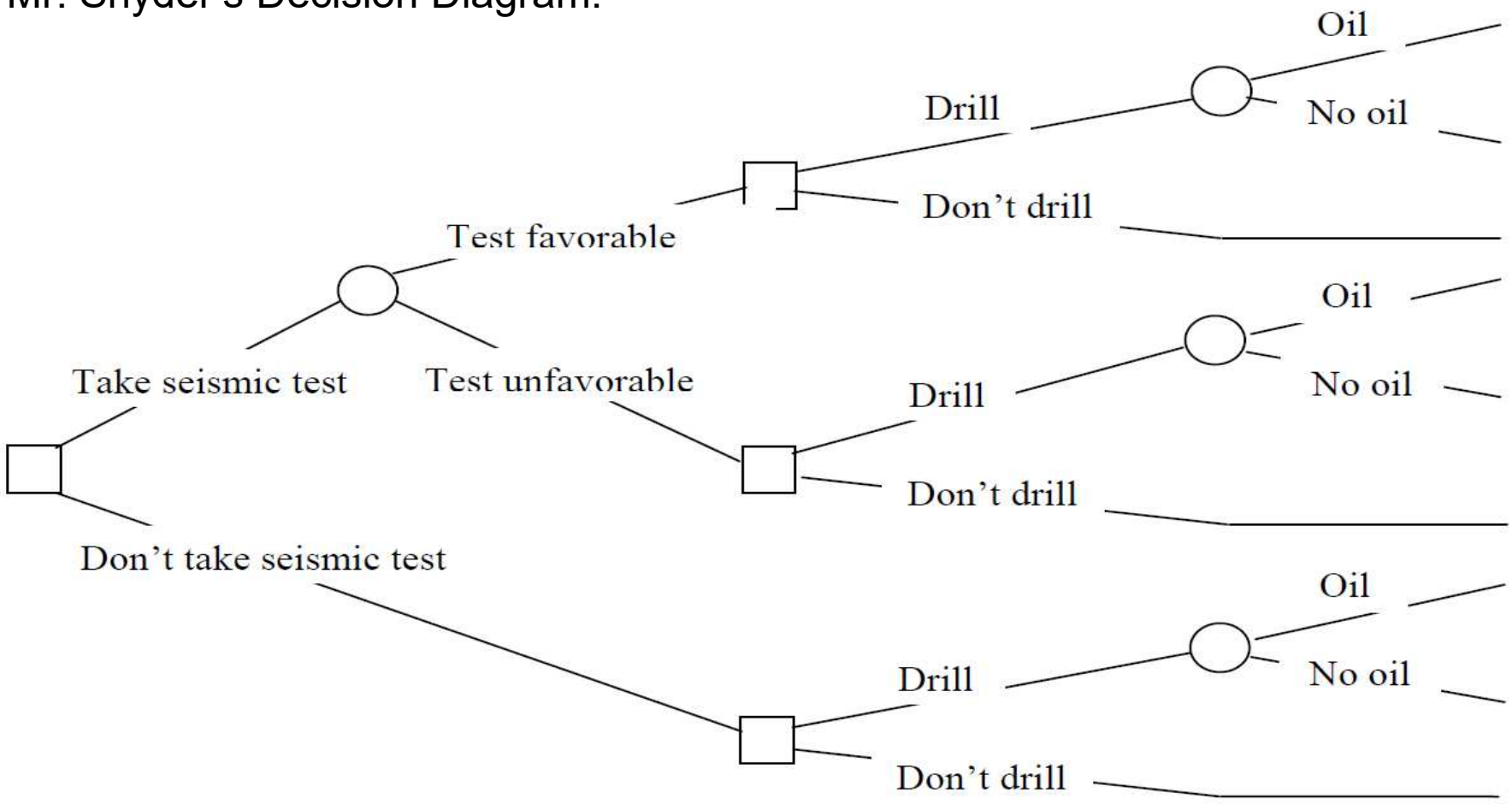


  - He also faces two uncertainties that will affect his choices; these are:



Motivating Example #1 (cont'd)

- **Case of Petro Corporation**
  - Mr. Snyder's Decision Diagram:



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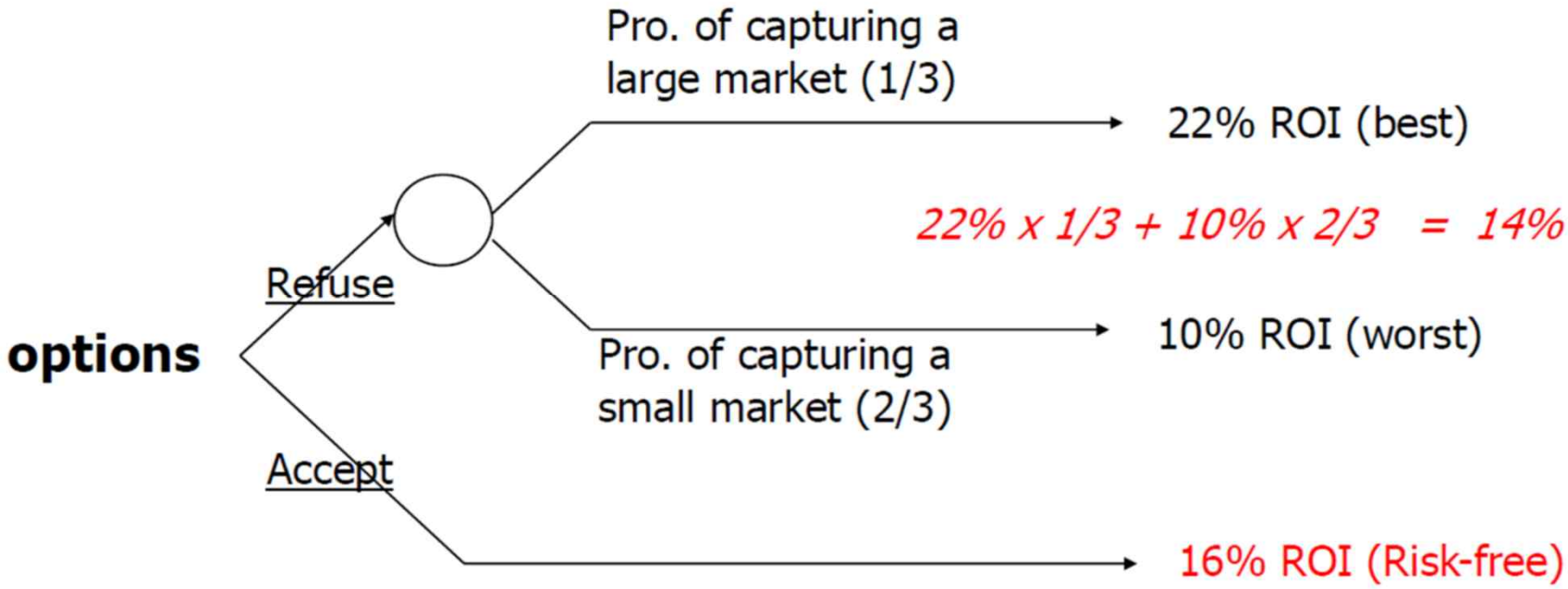
Discuss how you can analyze the risky decision problem?

Motivating Example #2 (cont'd)

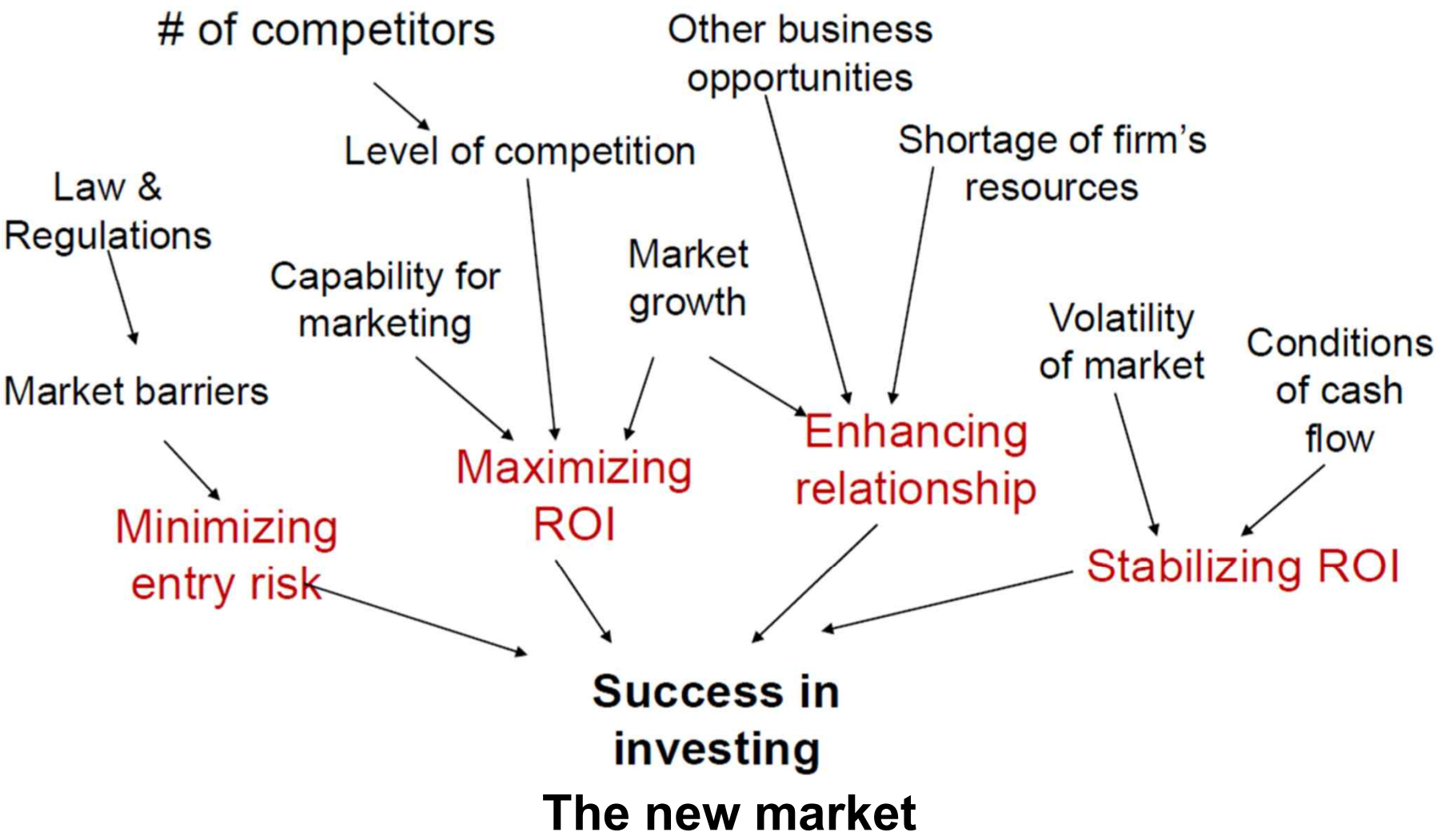
- Case of Multinational Products Inc.



Do you believe this simplification?

- To have more factors correlated each other
- To have more decision criteria

Motivating Example #2 (cont'd)



Lessons learned from simple cases

- **Series of decision context**
  - Seismic test? → Drill?
  - Entry or Not (invest?) → How to (single or J/V?)
- **Uncertainty due to lack of Information**
- **Decision objectives and decision outcomes**
  - Minimizing the cost, Maximizing ROI, …
  - Expected Monetary Value (EMV), Expected ROI (%), …
- **How to represent decision situation?**
  - Objectives, Decisions to make, Risks involved, Outcome/Consequence
- **How to compare decision alternatives?**
  - EMV ($) or Utility (relative value) …

But, lots of limitations!!

- Often, **ONLY** taking one objective (i.e., minimizing costs) among the various conflicting multi-objectives
- Involving **ONLY** one risk variable
- Not reveal the **relationships** between various risks
- Costs (or ROI) assumed are also suspected to **uncertain**!
- Do you really want to make a final decision based on the "**expected monetary values**" or "**expected ROI**"?

Why are Decisions Hard?

- Dynamic and Complex Process
- Uncertainty/Risk of Key Elements
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Decision Analysis

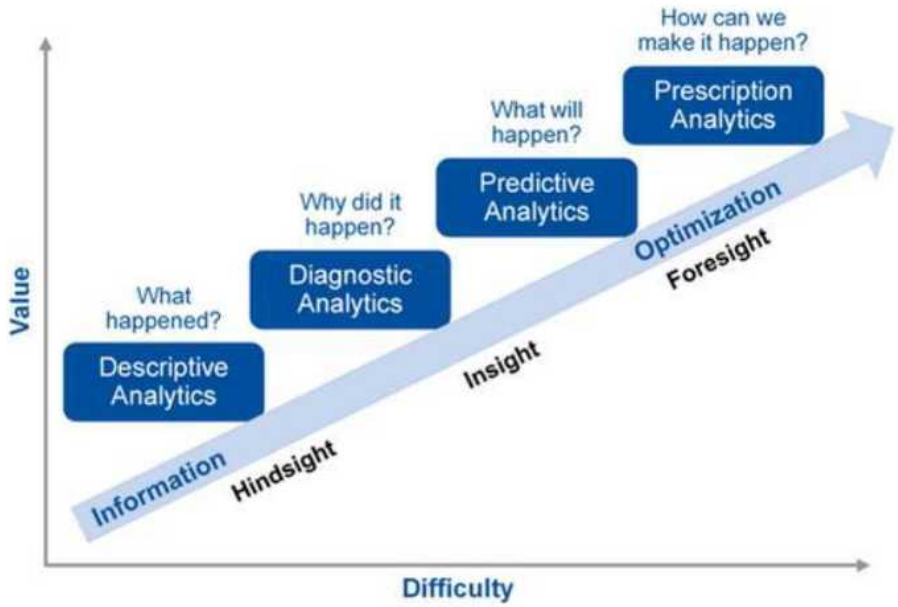
- **Definition of Decision Analysis (DA)**
  - **Prescriptive approach** for people who want to think hard and systematically about decision problem
- **Comments on DA**
  - A DA does not only provide a solution, but also insight into: Situation; Uncertainty; Objectives; Tradeoffs
  - A DA is an information source: Should **not replace the decision maker but support** him/her
  - The main purpose of DA is to yield **insights and understanding** about the decision problem rather than to impose an ‘optimal’ solution
  - DA can only yield a **recommended course of action**

Decision Analysis: Three Contracting Approach

- **Normative Approach**(규범적) – 어떻게 의사결정이 이루어져야 하는지에 관한 이론
  - to analyze decision tasks to present the optimal way to behave (what people should do to make a decision?). It proposes that decision makers follow a highly rational procedure for making decisions
- **Descriptive Approach**(기술적) – 실제로 어떻게 의사결정이 이루어지는지에 관한 이론
  - To predict and explain the ways that people actually do behave when they make decisions
- **Prescriptive Approach**(처방적) – 규범적, 기술적 이론을 기초로 어떻게 오류를 보정하고 판단을 향상할 수 있는가에 초점
  - to suggest the pragmatic(실용적) guideline to help people make better decision such as a multi-criteria decision making approach, which still concerned with the normative aspect of decision making

Decision Analysis: Three Contracting Approach

- **Descriptive** Analytics(묘사적 분석): 과거나 현재에 **어떤 일이 발생했는지**에 대한 분석. 과거의 비즈니스 활동 결과를 이해하고 추세를 발견하며 활동의 성과를 모니터링하는 데 쓰임
- **Diagnostic** Analytics(진단적 분석): 과거나 현재에 **발생한 사건의 원인**에 대한 분석. 데이터 간의 관계를 발견하고 왜 특정 결과가 발생했는지를 설명
- **Predictive** Analytics(예측 분석): 미래에 **어떤 일이 발생할 것인가**에 대한 분석. 미래의 상황에 대해 예측하거나 알려지지 않은 결과의 가능성을 파악하기 위해 활용
- **Prescriptive** Analytics(처방 분석): **앞으로 무엇을 해야지** 비즈니스에 도움이 될 것인가에 대한 분석. 제한된 자원을 효율적으로 할당하여 최상의 대안을 찾기 위해 활용



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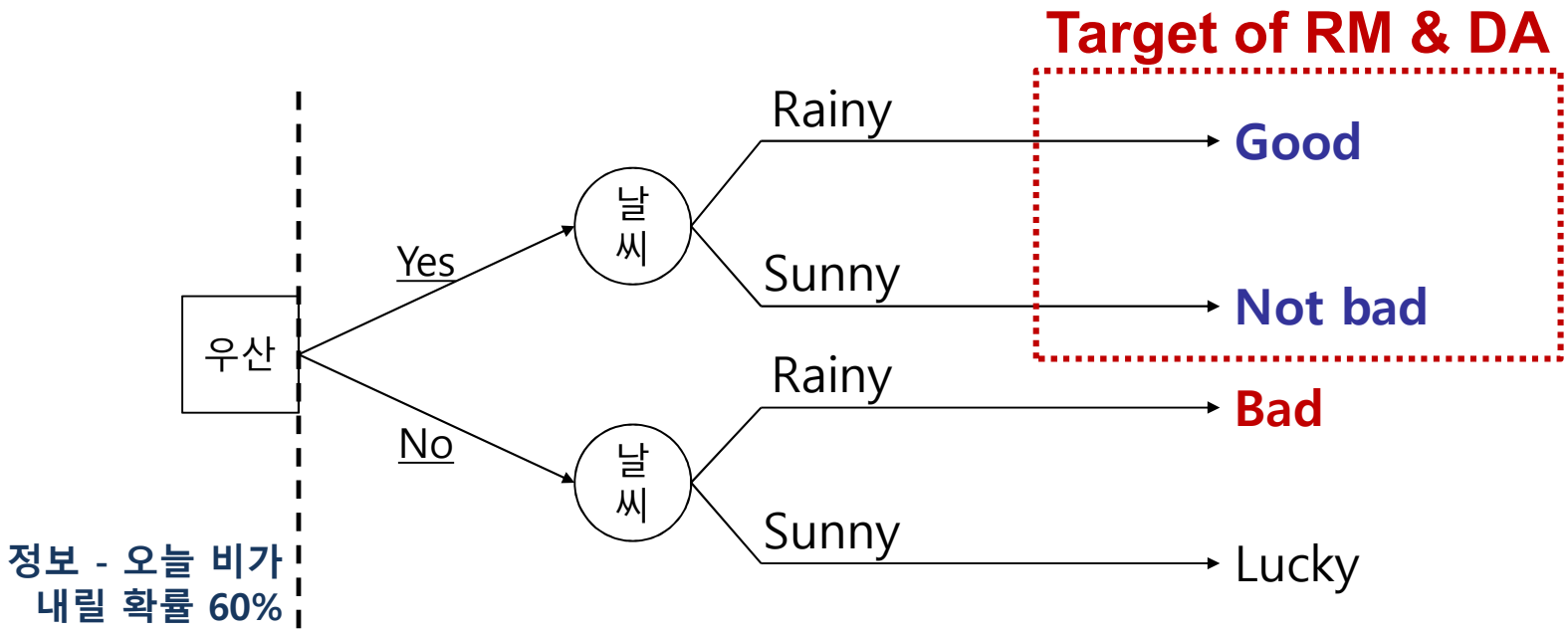
Decision Analysis and Risk Management

- **Ex: Weather Forecast & Umbrella**
  - 출근할 때 일기예보에서 비올 확률이 60%라고 한다면, 우산을 가져갈 것인가?



Why Study Decision Analysis?

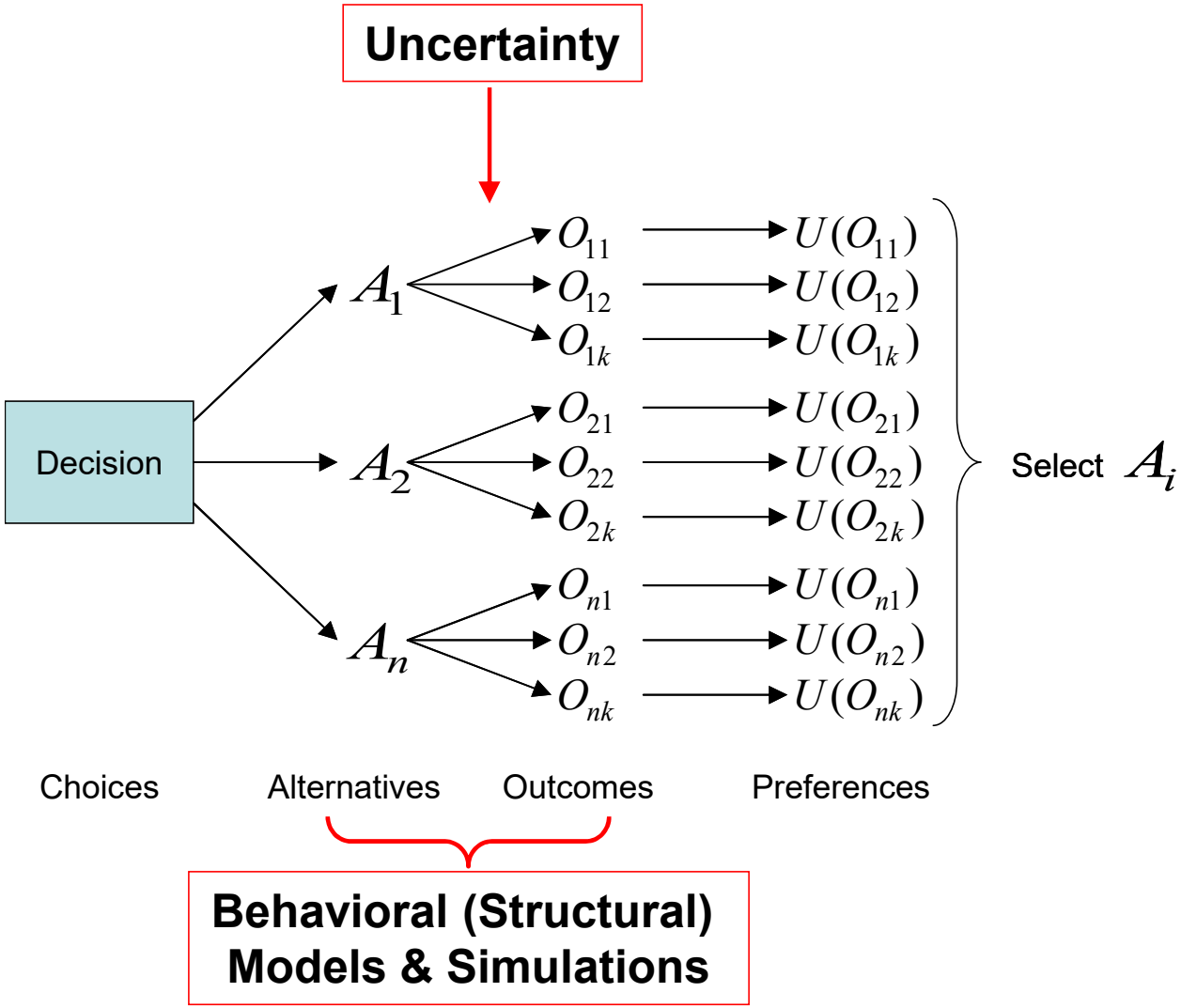
- **Decision Analysis**
  - Supplies methods for organizing decisions
  - Allows identification of important sources of uncertainty
  - Forces representation of uncertainty
  - Supplies a framework for dealing with multiple objectives
  - Provides modeling formalism to study decision problems
  - Leads to better decisions
    - ✓ Decisions are consistent
    - ✓ No surprises due to thorough study of the problem
    - ✓ Performance of decision making is better on average

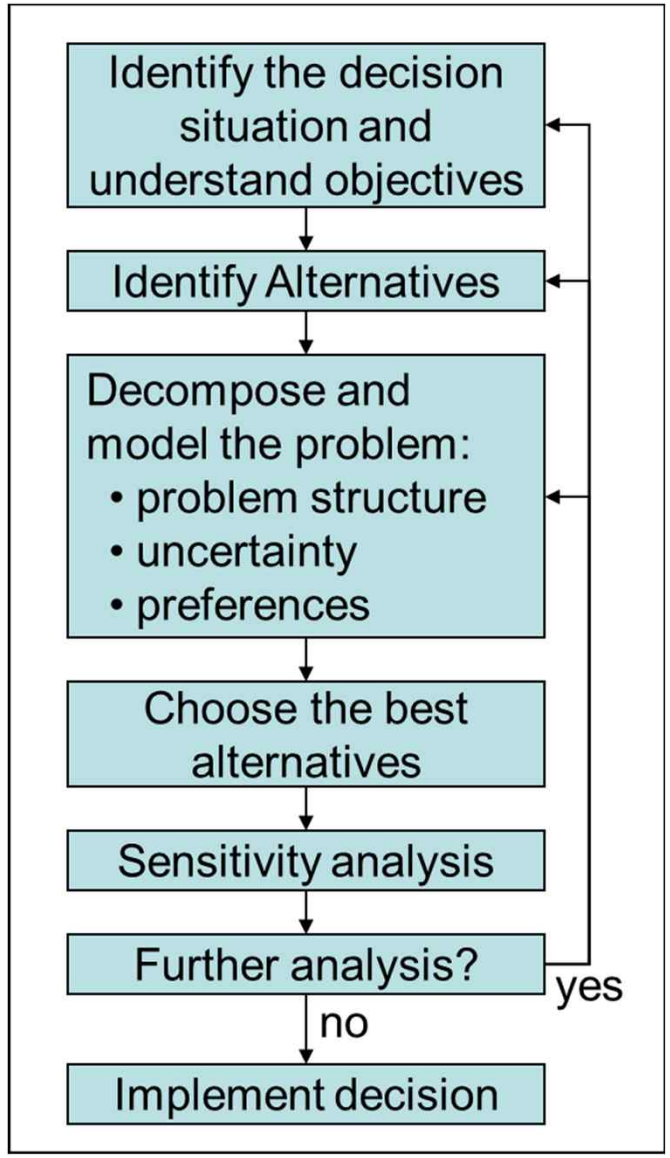
Decision Analysis & Intuition

- **Rationality**(합리성)
  - The basic assumption is rationality
    - ✓If the decision maker is prepared to accept a set of axioms(자명한 이치) then the decision indicated by the analysis should be preferred
- **Conflicts between analysis & intuition**
  - Perhaps:
    - ✓Analysis failed to capture some aspect of problem

      Or
    - ✓Intuitive preferences were only partly formed or were inconsistent
- **Exploring this conflict can lead to deeper insights and understanding about the decision problem**

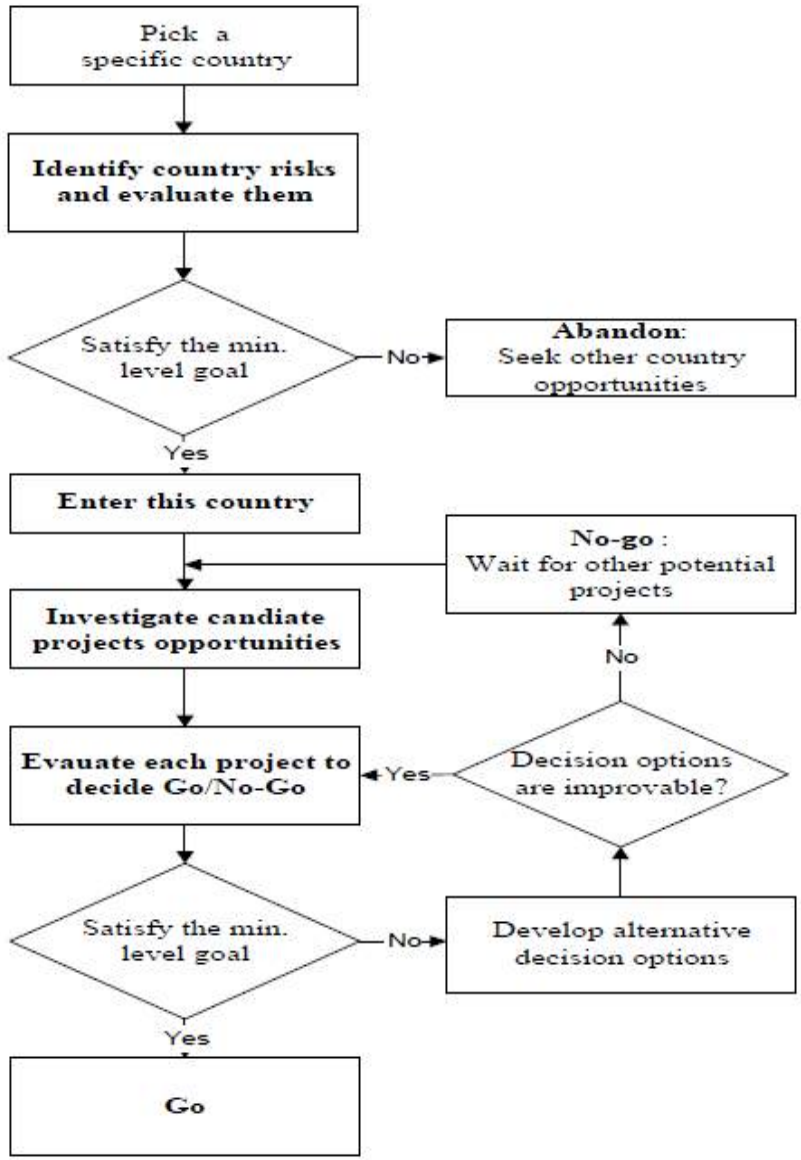
Decision Analysis Process





Cases of Decision-Making

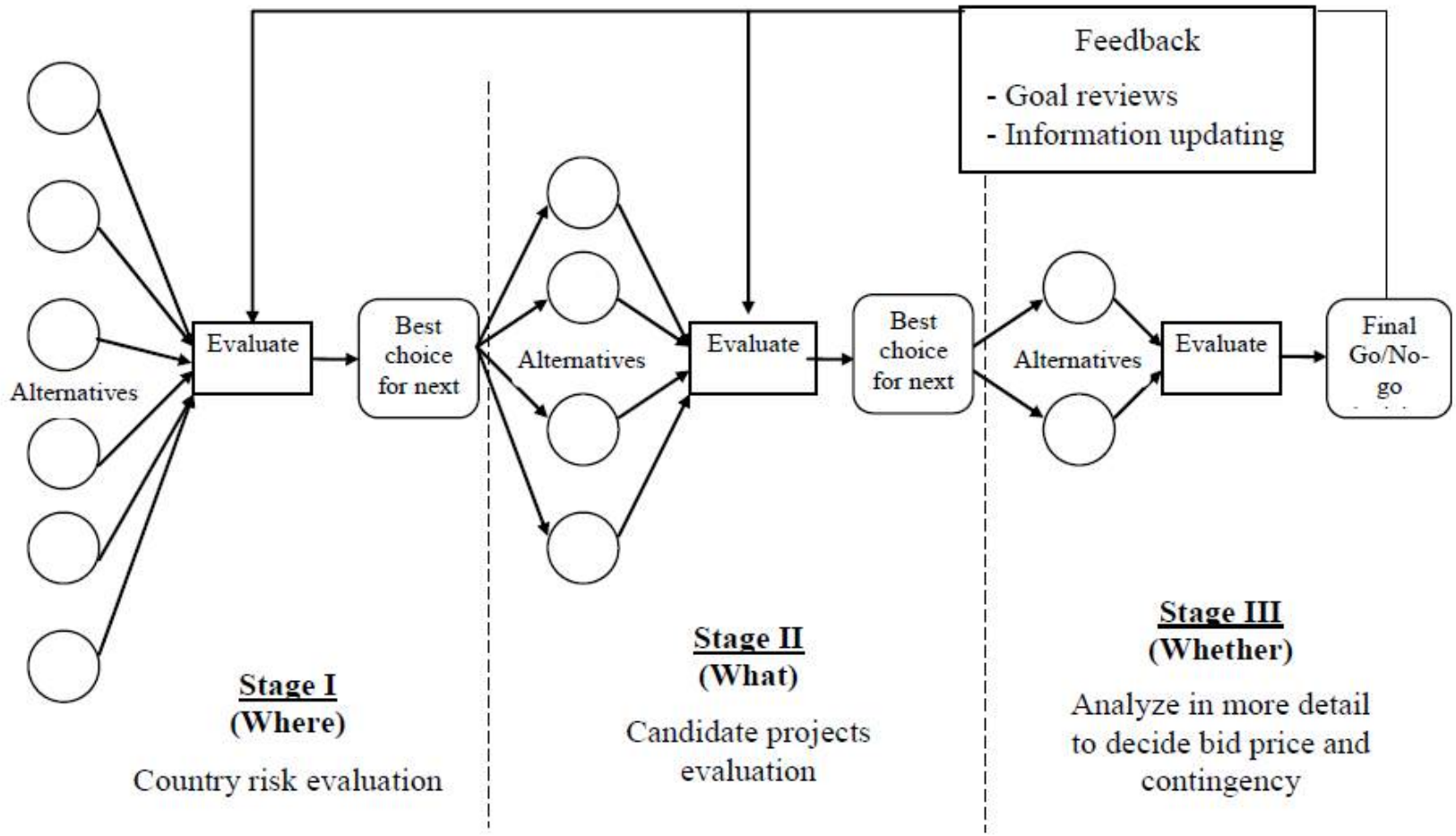
- **Making bid decision for overseas projects**
  - Where?
  - What?
  - Whether? (Go or No Go?)
  - ➢ **Multi-sequential dynamic decisions involving various uncertainties**



Source: Han et al. (2001) ASCE J. of Const. Eng. and Mgmt., 127(4).

Cases of Decision-Making

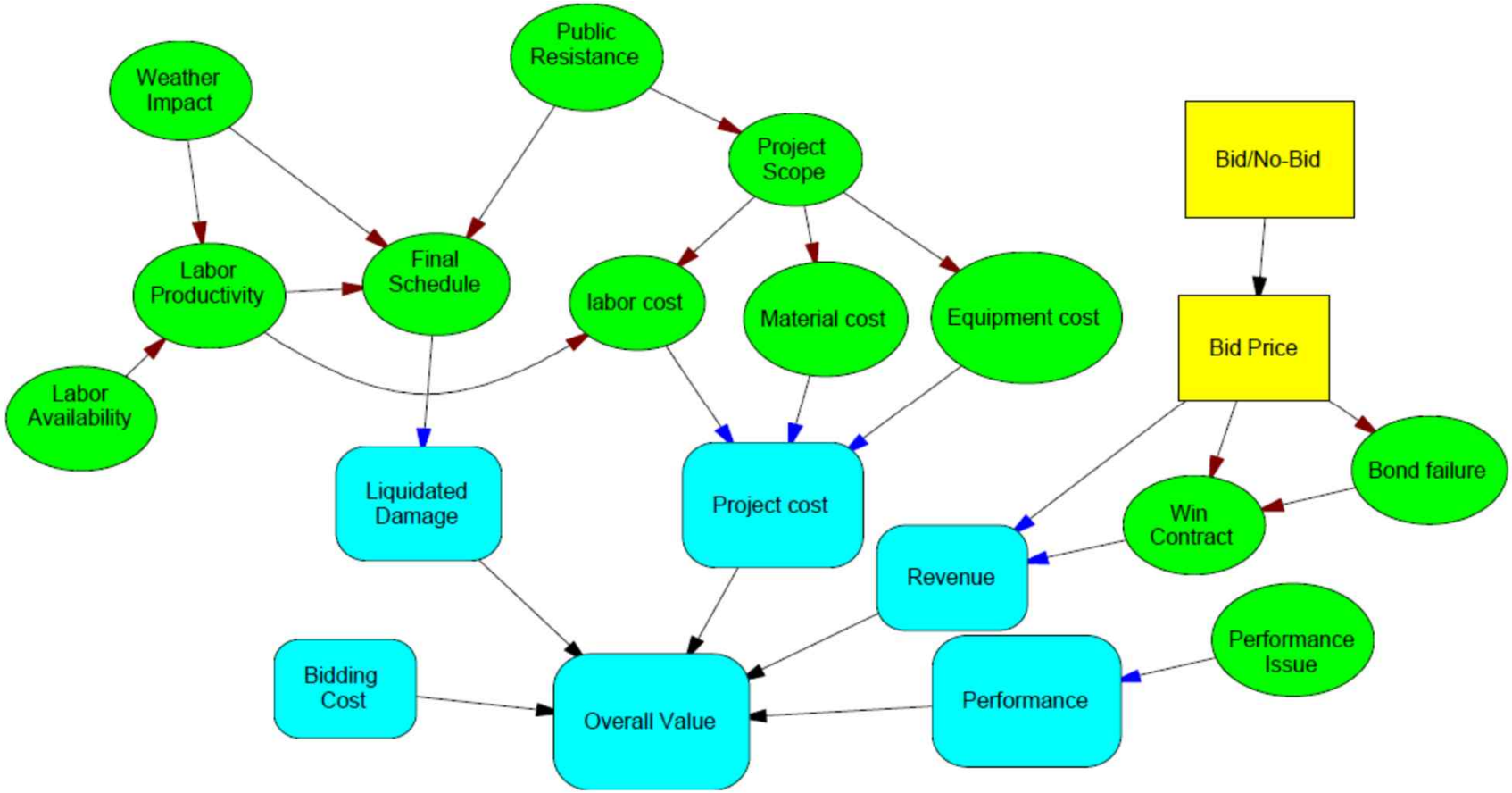
- **Making bid decision for overseas projects**
  - ➢ **Multi-sequential dynamic decisions involving various uncertainties**



Source: Han et al. (2001) ASCE J. of Const. Eng. and Mgmt., 127(4).

Cases of Decision-Making

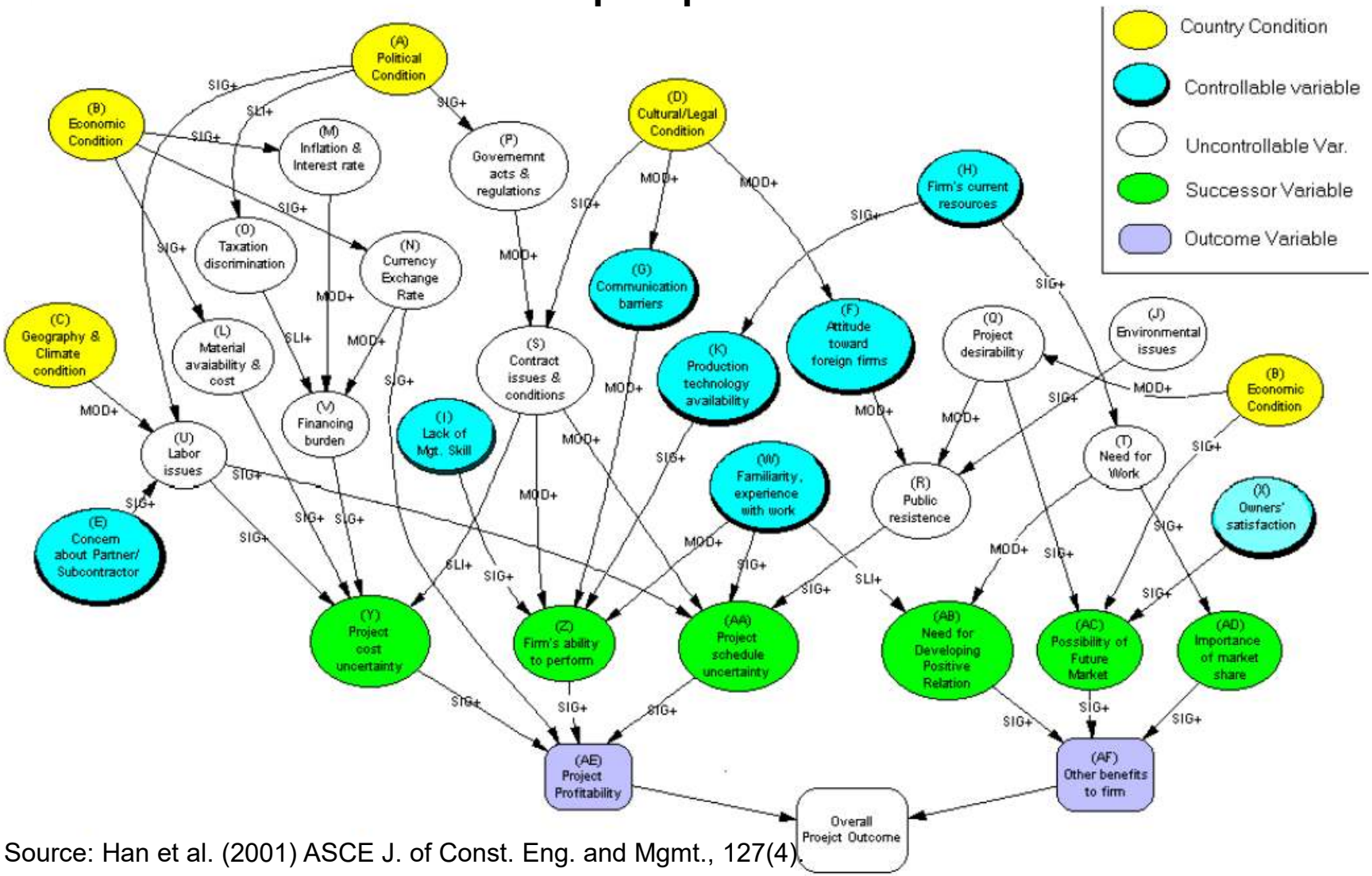
- Making bid decision for overseas projects



SIG: Impact significantly
MOD: Impact moderately
SLI: Impact slightly

Cases of Decision-Making

➢ Cause-and-Effect Relationship Map for State III



Source: Han et al. (2001) ASCE J. of Const. Eng. and Mgmt., 127(4).

What is a good decision?

- **Clarity**(명확성)
- **Predictability via scientific approach**(예측가능성)
- **Minimize Risks through effective strategies**(불확실성 최소화)
- **Minimize individual biases**(편견 최소화)

Q & A