Standard Approach for ex ante Evaluation on R&D Program

: Exercises from Preliminary Feasibility Study

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01 Introduction

Preliminary Feasibility Study(PFS)

- Done on government programs → Official process in budget planning
- Done by a public research institute → Not a political debate but a rational analysis
- Done on newly proposed programs → Ex-ante evaluation
- Done on a large program: budget over 50 billion KRW → Not a simple analysis but a multi-criteria analysis
- Not a easy task
  - Predict and measure the future results is challenging due to the uncertainty and unpredictability
  - Need systematic approach with solid data and proper decision making tool

History of PFS

- 1999 : PFS was introduced to enhance cautious decision making in large-scale construction project. (Measurement and standard: benefit cost analysis)
- 2001 : Analytic Hierarchy Process replaced B/C analysis as major tool in order to reflect multiple-criteria
- 2006 : PFS on R&D program was tried. (R&D program with large facilities or equipments)
- 2008 : PFS on R&D program came to be mandated.
- 2012 : Standard guideline for implementing PFS on R&D program was released.

Target of PFS

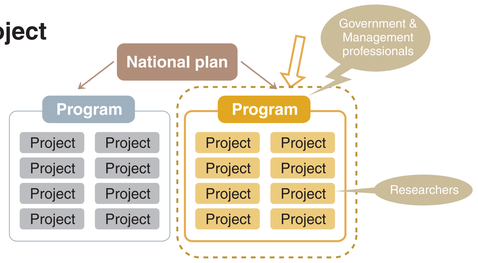
- Construction programs
- Information and telecommunication infrastructure programs
- R&D infrastructure programs
- Pure R&D programs → Scope of this research
- Social welfare
- Health-care
- Education, Labor, Environmental protection

Process of PFS

Organize Research Team → Identify Issues → Correlate issues with analytic items → Analyze & evaluate each item → Synthesize expert judgments of each item → Finalize & Report

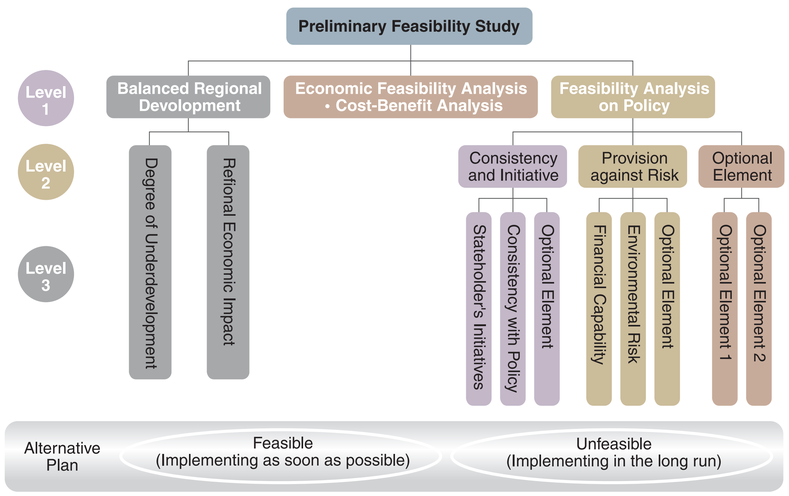
National Plan, Program, Project

- In the case of R&D, program is intermediate unit which bridge a national plan and projects

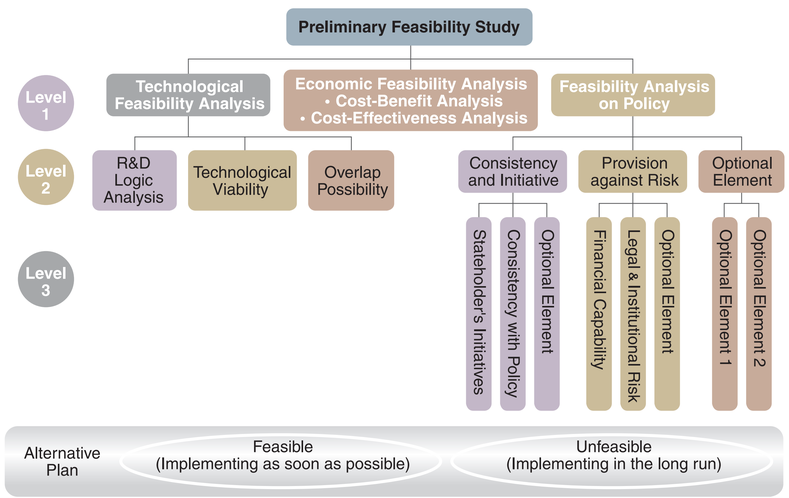


02 Structure for PFS

AHP Basic Structure of PFS in SOC sector



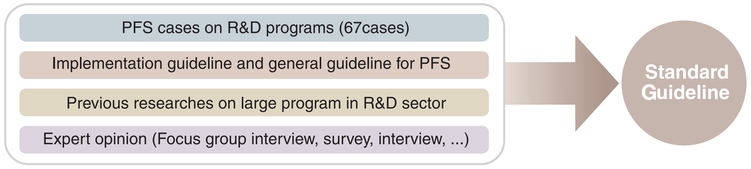
AHP Basic Structure of PFS in R&D sector



03 Overall structure of Standard Guideline

Preparing a Standard Guideline for R&D

- Government R&D program is aggregation of diverse activities with uncertainties and latent or indirect effectiveness
- Maintain the consistency among research teams is important (official process for government budgeting)
- Practical cases are helpful to understanding of abstract contents



04 How to Correlate Main Issues

How to Correlate Main Issues

No	Main issues in feasibility study	Technology a	Technology b	Technology c	Policy d	Policy e	Economy
1	Are issues clearly addressed in the program?	○					
2	Will this be the best strategy for the issues?	○					
3	If it is delayed, can any severe problems emerge?	○	○				
4	Are participants and their interests investigated beforehand?	○		○			
5	Are outcomes illustrated in detail and is it possible for them to be controlled?	○					
6	Is the process of planning comprehensible to taxpayers?	○			○		
7	Can the proposed activities contribute to attaining the program objective?	○					
8	Do risks fall within permissible levels?	○	○			○	
9	What makes the proposed program valid?	○					
10	Is the program cost estimated economically?	○		○			○
11	Are additional values identified with certainty?	○					○
12	Do resources lead to the expected outcome in a way that can be concretely demonstrated?	○					
13	Is the validity of the program presented in a clearly comprehensible manner?	○					
14	Is every assessment within the program balanced, objective, and transparent?	○					
15	Why should the central administrative agency support the program?	○			○		

Summarized Items for Analysis

- R&D Logic Analysis (a)
  - Detailed logic analysis on examined R&D programs
  - Explain what is proposed program, why proposed program is valid, how investment results in wanted outcome, and who are private beneficiaries and public beneficiaries.
- Technological Viability (b)
  - Understand the position of examined programs in the technology-related fields
  - Consist of trend analysis and competitiveness analysis
- Overlap Possibility (c)
  - Redundancy analysis
  - Deliberate on more economical structure on examined programs including do-nothing case.
- Consistency and Initiative (d)
  - Understand the position of examined programs in the whole governmental policy.
- Provision against Risk (e) - Identifying risk included in examined programs.

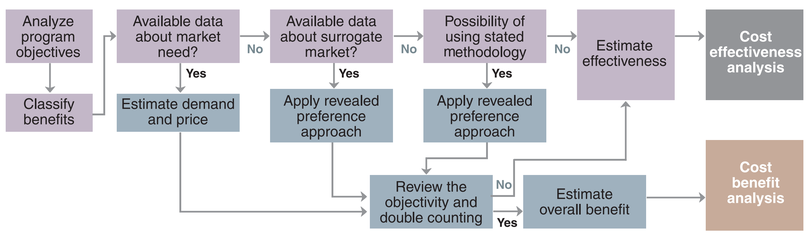
05 Spillovers and their applications

Category	Definitions and Examples	Application
Knowledge Spillovers	Knowledge used by another without full compensation 1) Reverse engineering of products 2) Firm abandons R&D effort but related knowledge is accessible to other economic factors 3) Publications 4) Patent disclosures 5) Researcher mobility	Possible to apply E/C analysis
Market Spillovers	Market dynamics cause some of the benefits 1) Superior quality or performance of new or improved product 2) Lower production costs	Possible to apply B/C analysis
Network Spillovers	If the economic value of a new technology is caused by the development of a set of related technologies	Possible to be considered as Special consideration

Category	Include in B/C	Exclude from B/C
Increase in Benefits	1. Value added by adopting new technologies into new product 2. Value added by technology transfer	1. Knowledge spillovers 2. Network spillovers 3. Regional development 4. Enhancing market power 5. Enhancing national prestige 6. Other stimulated effects
Decrease in Cost	1.Cost savings in time and resources for production or research 2. Reduction of social cost from natural disasters, diseases and environmental pollution	

Flow Chart for Economic Analysis

- In order to enhance the consistency in adapting various methodologies, priorities are set with respect to available information

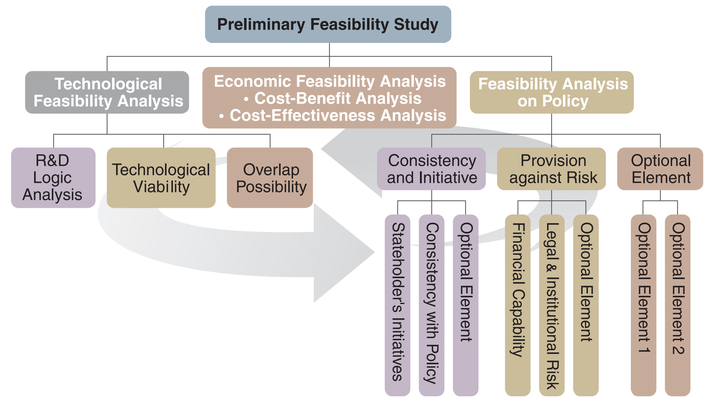


06 Logic Analysis : R&D Logic Analysis

Elements for Analysis	Assessment Questions
Proper Planning Process	1. Did unbiased and diverse professionals participate in planning process? 2. When the program was planned, was the priority setting suitably applied for technology selection? 3. Were technological demands investigated as they related to the program subject? 4. Was planning completed before PFS?
Proper Objectives	1. Is it clear why and how the R&D program was promoted? 2. Are those who benefit from the R&D program outcome targeted? 3. Are issues discovered by appropriate surveys or experts' experiences? 4. Are there clear rationales between program objectives and corresponding issues? 5. Are the potential improvements offered by the program presented clearly? 6. Are there any balanced measures for identifying program objectives? 7. Are proper baselines established for evaluating program performance? 8. Is there a rational priority decision model for investigating detailed activities in the program? ※Option 1 (in case of R&D subsidy): Are various alternative strategies reviewed before considering a government R&D program? ※Option 2 (in case of system development): Are mission and concept designs completed in comprehensive way?
Proper Logistics	1. Can detailed activities contribute to achieving program objectives?(Has a rational WBS been applied to program?) ※Option 3 (in case of system development): Is WBS composed comprehensively according to core technology? ※Option 4 (in case of research facilities and equipments): Are research facilities and equipments mission-oriented, effective, and systematic? 2. Does the WBS dictionary exist and is it appropriate? 3. Are there any performance-indexes for detailed activities? Are they specific, measurable, attainable, realistic, and timely? 4. Is time spent for detailed activities estimated practically? 5. Are there any logical errors in the schedules?
Proper Delivery System	1. Are central administrative agency's roles delegated by law? 2. Are balanced standards applied to choose the principal research institute? 3. Is the program's management system efficient? Does it enable attainment of objectives?

Relationship between Criteria

- There are interactions between output and input of criteria



07 Discussions and Concluding Remark

Analysis on Player and Judgment Base

- AHP of PFS can be understood as expert judgments supported by objective and balanced analysis. Accordingly, it is important who is participated and what is basis for judgment.
  - System revision: 24 cases before 2008, 60 cases after 2008
    * PFS on R&D program came to be mandated 2008
  - Major experts participated : economists
  - Major evidence for judgment : B/C analysis as a sole in economic feasibility analysis

Research Question

- The judgment of expert group is identical
- The role of major evidence for judgment is identical

Experts	evidence	Mandatory PFS Before	Mandatory PFS After
Major	Major	7	17
	Others	1	-
Others	Major	-	22
	Others	16	21

Acceptance Ratio	Experts	evidence
Major	80.0%	76.1%
Others	62.7%	57.9%

Analysis

- Comparison(One Way ANOVA)

ANOVA	Accepted Cased F-number	Accepted Cased Prob > F	Rejected Cases F-number	Rejected Cases Prob > F
System revision	1.56	0.2175	0.19	0.6663
Expert group	**15.74**	**0.0002**	0.04	0.844
Evidence(B/C)	0.5	0.4841	**6.05**	**0.0212**

- There is not enough information to determine which expert group or evidence is more appropriate
- Although there is no difference between expert groups in rejection ratio, major expert group exhibit differently in accepted cases.
- Program, with B/C ratio lower than 1, can be distinctly recognized as unfeasible, but B/C ratio higher than 1 cannot guarantee program's feasibility.

Concluding Remark

- The standard guideline is appropriate for decision making on government R&D investment
- More researches are needed to enhance the solidity of PFS in R&D sector

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