Winter 12-19-2001

Designing a Fourth-Party E-Commerce Logistics Center: A Benefit, Cost and Risk Analysis

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Using AHP and ANP models

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November 2001

Acknowledgement: This research is funded by the Research Grant Council of Hong Kong.

ABSTRACT

The global trend of e-commerce and use of information technology is transforming the business structure of many industries and the air cargo industry is no exception. The requirement for information integration is unprecedented in the air cargo industry. The Hong Kong Government (via Airport Authority) has initiated efforts to establish a high-tech logistics center, which could allow the leasing of both information infrastructure and physical facilities without requirement of ownership. Like any public infrastructure project, a vast amount of investment is required and there is a vast amount of risk involved as well. The success of such a center depends on the commitment of three parties: the Hong Kong Government, the Investors, and the Users. While each party plays an important role towards the center's success, their interests might differ and in some cases be conflicting. In this paper, we evaluate the benefits, costs, and risks of such a logistic center using a series of Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP) models. It is shown that the proposed models can be used to examine the sharing of benefits, costs and risks such that a design agreeable to all parties can be determined.

(Key words: Fourth-party logistics center, E-commerce, infrastructure project, benefit-cost-risk analysis, AHP, ANP)

1. INTRODUCTION

E-commerce and use of information technology are transforming business structures of many industries and the air cargo industry is no exception. However, the Hong Kong air cargo industry comprises of many small-and-medium third-party service providers who are unlikely to be able to afford the vast amount of capital expenditure required. The Hong Kong Government (via Airport Authority) has initiated the establishment of a high-tech logistics center, which could allow the leasing of both information infrastructure and physical facilities by third-party service providers.

To process an air cargo shipment, a massive amount of information is required. Such information includes data on shipment, ground carrier, customs, airline, global network, as well as logistics activities. It is extremely important for shippers, buyers and air cargo service providers to be able to track and trace the safety, status, location, and delivery time of the shipment. Leung, Cheung, and Hui (2000) has argued that with cooperation among industry agents and with e-commerce as an enabler, the air cargo industry can form an e-commerce community network, which enables agents of the industry to develop and engage in logistics integration (Figure 1).

(Insert Figure 1 here)

Here, different Users can share their information on the community network to seek and negotiate with new customers or partners, plan and control their logistics processes, and to process fulfillment transactions. Such a community network would be owned and managed by the logistics center. The center functions as a fourth-party agent for third-party logistics service providers, who in turn provide logistics service to companies. Client companies or agents of the industry can simply plug in and engage in logistic e-commerce activities.

1.1 Government, Investors, and Users

The Government, Investors, and Users are important parties involved in the fourth party logistics center (Figure 2). The Government has an important role in selecting the appropriate investors, safeguarding the center's neutrality and in regulating the economic interests of the Investors and Users. Investors are external companies who will design, finance, build and manage the center. Users include shippers, forwarders, airlines, integrators, terminal operators, warehouse operators, distributors, ground carriers, etc. They are the customers of the center. The various forms of ownership are an important design choice. Government-owned company, service and management contract, leases and concession contract, BOT, BOOT, BOO, private company are common options for public-private involvement in large projects (Gresham and Shlaudeman 2000). Not only does the form of ownership decide the allocation of interests and control-power between different parties, it also affects the incentives and behaviors of the parties.

(Insert Figure 2 here)

Other than ownership designs, there are also many design issues on the various features of information infrastructure and the scale of physical facilities (Figure 3). The features of information infrastructure can range from stand-alone transactions to full information integration at the industry level. The desirability of individual designs depends on the level of involvement between Investors, Users and the Government. If both the Government and the Users take on minor roles, the Investors would assume all the risk and be unlikely to venture into a large-scale commitment. Investors' commitment would likely differ, if the Government supports the establishment of the center by giving land subsidy and tax shelters. Both the Government and Investors would likely be enthusiastic if Users of the industry show commitment of support by assuming a portion of the center's ownership (via their

professional associations such as forwarders association, shippers association, trucking associations, etc.). The Government or Investors could provide loans to these associations, secured by their member's future patronage of center. Each individual design of the logistics center has it own sets of benefits, costs and risks for each party.

(Insert Figure 3 here)

The success of such a fourth-party e-logistics center depends on the commitment of the Hong Kong Government, Investors, and Users. While each party plays an important role towards the center's success, their interests might differ and in some cases be conflicting. No one single party would like to assume the inherent vast risk and the need to have risks shared among concerned parties is critical to the success of the center. However, a systematic approach to address risks sharing is missing in the literature. A main reason for this void is largely due to the formidable task of evaluating tangible and intangible risk elements inherent in such an infrastructure project.

In this paper, we evaluate the benefit, cost, and risk of a fourth-party logistic center in Hong Kong using Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP) models. Developed by Saaty (1980), AHP is a widely used multi-criterion decision theoretic that can incorporate both objective and subjective information. AHP first breaks the problem into a hierarchy of attributes and sub-attributes. Typically, the overall goal is at the top with the choice alternatives at the very bottom. The relative importance of sub-attributes with respect to a given attribute is determined by using ratio scales and paired comparisons. Then, the methodology respectively aggregates weights of sub-attributes at a lower level to form weights at a higher level. The final result would be the relative importance of each alternative with respect to the overall goal. An important feature of AHP is its capability to evaluate intangibles, a feature due to its use of relative preferences and ratio scales. When

there exists relationships between attributes in the same level or of different levels, ANP must be used (Saaty 1996).

2. BENEFITS, COSTS, AND RISKS TO GOVERNMENT , INVESTORS, & USERS

In this section, we provide benefit, cost, and risk models in the form of either AHP or ANP for each individual party.

2.1 Benefits to Government

The Hong Kong air cargo industry is in need of innovation and technology to compete regionally and worldwide. The IT infrastructure for air cargo will enhance Hong Kong's strategic role of being a high-tech knowledge-based service economy. The transportation sector in Hong Kong contributes substantially to the GDP of Hong Kong providing employment to a significant percent of the population. Job creation takes place in several ways: jobs for the center itself, jobs from expansion of peripheral industries, and jobs from the incremental economic growth that the industry creates. The Government will have extra tax revenue, and in the situation where land is leased to investors, the Airport Authority will also receive rental income. Figure 4 shows an ANP model depicting the benefits to the Government. The directed arc represents inner-dependency (Saaty 1996). Table 1 gives the descriptions of the criteria.

(Insert Figure 4 here)

2.2 Costs to the Government

The Hong Kong Government adopts a laissez faire policy and is not likely to form joint venture with Investors. While the Government does not invest in the logistics center, it does incur certain costs. Firstly, new constructions of supporting facilities in the airport are needed. The Airport Authority will have to expend efforts in identifying and selecting Investors. It needs to form an administrative entity to monitor the development and

construction of the center and to safeguard the center's neutrality during its operation. The Authority must design a contingency plan in the event that the logistics center does not perform in accordance to specifications either in the construction phase or in the operation phase. Contingency cost can be a significant cost item. Figure 5 shows the AHP model according to the costs of the Government. Table 2 gives the descriptions of the criteria.

(Insert Figure 5 here)

2.3 Risks to the Government

For any infrastructure projects, the Government needs to address the risk of failure and its consequences. It must address whether the macro economic environment supports the long-term establishment of the center. An important risk is related to the issue of regulating air cargo infrastructures. It must evaluate the risk of not being able to properly monitor the development of the center as well as the risk of not being able to safeguard the neutrality of the center. The risk of improper contingency measures is another risk consideration. The Government's involvement can be a market interference issue, which needs to be carefully examined. Moreover, the Government's contractual commitment should be judicious, balancing unnecessary fiscal burden with prudent commitment to helping the air cargo industry. Figure 6 shows the ANP risks model. Table 3 gives the descriptions.

(Insert Figure 6 here)

2.4 Benefits to Investors

The primary direct revenue will come from users' rental fees. This revenue source will largely depend on the volume of users who lease the service. As the third party information infrastructure is an e-commerce platform for the industry, there are many revenue generation prospects from the platform. The platform will likely be the central source of market activities, through which Users obtain their business and it could be developed into a major

regional market to be linked with other international networks. The potential income from data mining activities on the platform can be substantial. There are also opportunities in developing partnerships with other electronic businesses as well as partnerships in Asian and China logistics. Figure 7 shows the ANP model for benefits of Investors. Table 4 gives the descriptions of the criteria.

(Insert Figure 7 here)

2.5 Costs to Investors

During the initial preparatory stage, investors incur the costs of designing, bidding, and business development. In the development phase, Investors incur major costs in the construction of the physical facilities as well as the installation development of the IT infrastructure. The amount of investment varies greatly with the scale of the physical facilities. Similarly, the IT infrastructure design also dictates the amount of investment required in the acquisition of hardware and software. Major investment will be needed for IT-skilled human resource both in the development and the maintenance of the IT infrastructure. Financing cost is a major cost item in such a large project. The opportunity cost of investing in the project should be taken into account as well. When the center is in operation, there would be direct and indirect costs of operating the center. Figure 8 shows the AHP model according to the costs of Investors. Table 5 gives the descriptions of the criteria.

(Insert Figure 8 here)

2.6 Risks to Investors

The overall risk that Investors must address is the risk of not able to achieve the targeted return during the planning horizon. There are several categories of risk factors that could contribute to this overall risk: construction, economic, competition, e-commerce, regulatory,

and level of acceptance by Users. Construction risks involve the risk of having cost over-runs and the risk of not able to build the center according to the technical specifications. The principal economic risk is that of slow growth in Pearl River Delta, a production hinterland of Hong Kong where a major portion of air cargo via Hong Kong originates and destines. Competition is also a major risk concern. Regionally, while Hong Kong is a major air cargo hub in Asia, competition from major cities such as Shanghai, Guangzhou and Singapore will be keen and could take away a significant portion of business from Hong Kong. Within Hong Kong itself, other 3rd party logistic centers may be constructed in Hong Kong competing for air cargo shipments.

Obviously, the success of the center depends on the number of Users that lease the infrastructure. The uncertainty on the level of User satisfaction is a critical risk factor that is related to the quality, reliability, pricing, and neutrality of the services provided. But the highest risk is at the IT front, which is also the feature of the most profitable potential. Today, competition for B2B e-commerce platforms is fierce and such platform for aviation logistics is no exception. This is the main attraction for the Users but there is a great deal of uncertainty regarding its success and failure as well as its competition. The risk of the Government over-regulating the logistic center is a plausible concern. Figure 9 shows the AHP model according to the risks of Investors. Table 6 gives the descriptions of the criteria.

(Insert Figure 9 here)

2.7 Benefits to Users

Logistics agents are primary Users of the center. The overall planning and control of operations are improved due to better coordination of shipments. Users will be able to provide better inventory control, and have more effective coordination of integration and consolidation of air cargo. Waiting time during transit will be minimized and unnecessary

intermediaries will be eliminated as well. The resulting shipping process is streamlined, alleviating unnecessary costs in space, handling and inventory. The quality and reliability of delivery is likely to be improved. With tracking and tracing, Users can update the status of shipments in process, notice problems immediately and prescribe solutions effectively. Outsourcing IT capability as well as physical facilities allow logistics service provider to concentrate on their innovation of processes.

(Insert Figure 10 here)

Via the third party infrastructures, logistics agents can customize their services as well as introduce innovative services at low costs. And with strategic partnerships, Users become very flexible to adapt their services to the dynamic market. From a technology perspective, the Users of the center would enjoy benefits such as scalability, security, accessibility and user friendliness. Interoperability might also be developed. Figure 10 shows the AHP Model according to the benefits of logistics agents. Table 7 describes the criteria.

2.8 Costs to Users

Startup costs for the Users include the membership fees of the center. To be connected to the IT infrastructure, initial investment will have to be made on interfacing or hook-up devices. Users will need to recruit or train IT-skilled staff to become conversant with the operating environment of the IT infrastructure. Once the connection is made, Users would incur transaction cost as well as leasing cost of the physical facilities. Figure 11 shows the AHP model according to logistics agents' costs and Table 8 gives the descriptions of the criteria.

(Insert Figure 11 here)

2.9 Risks to Users

For a third-party e-logistics center, a great deal of users' business information is processed through the center. A User's major concern is whether the center will be capable of providing secure information processing. Also, since competing companies will be using the same facilities, neutrality of the center is of paramount importance. Further, once the e-logistic platform becomes the central market of air cargo shipments, Investors would control the market and may levy unreasonable leasing charges. Users should seek guarantee of neutrality as well as a reasonable pricing policy. While the third-party center means the availability of IT and physical infrastructure, it also means that the playing field is now leveled. Some Users might lose their previously established competitive edge. The process of change is risky in itself. It is common that the employees object to new ideas and new technology. Figure 12 shows the ANP model according to logistics agents' risks. Table 9 gives the descriptions of the criteria.

(Insert Figure 12 here)

3. RISK SHARING IN CENTER DESIGN: AN ILLUSTRATION

In the preceding sections, we have provided Benefits, Costs, and Risks models for Government, Investors, and Users. In this section, we illustrate how a design of logistics center can be selected using these models. Firstly, it is important to point out the difference between AHP and ANP. In general, two attributes are independent if they are unrelated (e.g. color and smell of food) and are dependent when they are related (e.g. taste and temperature of food). In the latter case, the preference determination between the two attributes requires assessment of the extent of dependency between them. Problems with dependency may be implemented using an AHP framework if the decision-maker is capable of factoring in all the interactions and can directly provide preferences between attributes. For example, when assessing the relative importance between taste and temperature of food, the decision-maker

can somehow incorporate the impact that these two attributes have on each other with respect to a certain criterion and can come up with their relative preference. However, if the decision-maker is not capable of doing so, ANP should be used. Within an ANP context, the property of having interactions between a cluster of sub-attributes is called *innerdependency*, and those between attributes of different hierarchy is called *interdependency* (Saaty 1996). There is no interdependency in our formulations.

3.1 Solution Methodology of Aggregating Benefits, Costs and Risks in ANP and AHP

A commonly used methodology of ranking alternatives based on Benefit-Cost-Risk is to determine the ratio of (benefits)/[(costs)×(risks)], where the values inside the brackets are the corresponding weights from solving individual networks or hierarchies (Expert Choice 1998). This method has two implicit assumptions. First, it assumes that the criteria of benefits, costs and risks are equally weighted. Second, it assumes that the alternatives are relatively close in terms of scale. These two assumptions are not realistic for our problem. Here, the relative importance of benefits, costs and risks potentially varies with respect to individual situations. The differing scale of the alternatives is an important feature as well.

Alternatively, we construct an aggregated benefit-cost-risk model for each party (Figure 13). The purpose is to have benefits, costs and risks as three primary criteria under the overall goal, and to attain their weights by pairwise comparisons. Here, to be able to compare benefits with costs and risks, we need to seek the decision-maker's preferences in terms of their relative importance. For example, we would ask questions such as "With respect to the overall goal of User, what is the relative *importance* between benefits and costs in designing the center?" For preference determination for sub-attributes under costs and risks, the questions would be designed such that the relative importance of the respective sub-attributes would correspond to their relative levels of positive contributions.

(Insert Figure 13 here)

3.2 Aspects in Determining an Agreeable Solution

There are three aggregated benefit-cost-risk models, representing the interests of the Government, the Investor and the Users. Different parties might not prefer the same design and we need to examine how to adjust the design such that we can arrive at a design that satisfies every party. While solving the problem, there are four possible scenarios:

1. An agreeable solution is found immediately. An agreeable solution is a design that attains the highest priority for every party.

2. There is no immediately agreeable solution but such a solution can be obtained if a design can be acceptably modified. The acceptable ranges of design changes are provided by the decision-makers.

3. There is no immediate agreeable solution but an acceptable solution – one that attains satisfying priority weights or is a close choice to the top-ranked design – can be obtained immediately or after acceptable modification.

4. No agreeable or acceptable solution exists.

For the last three scenarios, sensitivity analysis is helpful in identifying the critical design elements, as well as examining the risk sharing between different parties.

3.3 A Solution Procedure based on Sensitivity Analysis

A solution procedure (Figure 14), based on sensitivity analysis, to determine an agreeable solution is now provided. Sensitivity analysis assesses that how the change of data input affects the result. Thus we can adjust some model parameters purposely, and change the results of AHP and ANP models in desired direction. There are two popular forms of sensitivity analysis: the one-factor-at-one-time approach and the scenario analysis

(Groenendaal and Kleijnen 1997). The first approach is more suited in our problem, because it is relatively easy to be interpreted and understood while the scenario analysis might require too many data inputs.

(Insert Figure 14 here)

For AHP, we use a sensitivity analysis approach developed by Triantaphyllou and Sánchez (1997). The performance measures under individual criterions are examined one by one. The sensitivity of a performance measure is determined by its smallest relative modification that would change a potential agreeable solution to the top choice. We then make acceptable modifications on the design. To ensure that the modifications do not make the design undesirable to other parties, their impacts on the performance measures of other parties are examined. Since the ANP formulations in our current problem only involve innerdependency, we construct individual supermatrix for these clusters and attain the limiting priorities of their sub-criterions. The limiting priorities become the weights of the sub-criterions. The ANP models are now in AHP form and we could perform sensitivity analysis in a similar fashion.

Using the solution procedure, we might find that there is no feasible solution based on the original designs. We can introduce a new set of design alternatives, which are likely to be feasible, since our understandings of the problem must be improved during the procedure. On the other side, it is also possible to find several agreeable or acceptable solutions. If it is the case, we can exclude the infeasible solutions, and retain the priority weights using the original comparisons between the remained designs. Judgement can be made based on the new priority weights.

We apply simple rules to certain steps in order to improve the efficiency of the procedure. For example, at Step 2, we examine modified designs that have a relatively high

geometric mean of the scores. A high value of the mean implies that there are no extremely low scores, and the design is likely to be acceptable to every party. At Step 3, we examine designs that are unlikely to be accepted, in order to exclude any infeasible designs as soon as possible. At Step 8, when examining the impacts of design modifications, we only refer to the sensitivity performance measures.

4. AN ILLUSTRATIVE NUMERICAL EXAMPLE

To illustrate the conflict-resolving procedure, we develop the following numerical example. There are three types of designs in this example. We contrive paired comparisons according to abridged benefit-cost-risk models. The problem is solved with the following iterations (Figure 15):

(Insert Figure 15 here)

Iteration 1. Design B is the top choice for the Government, Design C for the Investor, and Design A for the Users. Here, Design C is to be examined at first. Of the three parties, Users are most unlikely to agree with it. Sensitivity analysis for Users shows that the performance measure of Design C under the criterion User Management is the most critical. A 32% increase could make Design C the top choice. Here, an electronic network that is highly compatible with the Users' legacy systems can be designed for Design C. This modification reduces risks of Compatibility and Resistance-to-Change, which are major sub-criterions of User Management. It has no major negative impacts on the performance of Design C for any party. Such modification is acceptable. Hence, Design C is agreeable to Users.

Iteration 2. For Government, the performance measure of Design C under Service Economy is the most critical, which requires a 26% increase to give Design C the top ranking.

However, to achieve this increase, we need to adopt innovative e-commerce measures and latest information technologies for Design C. It raises Users' risks of New Technology and Security, and the performance measures of Design C under these criteria are quite sensitive. The modification seems to be infeasible.

Iteration 3. The performance measure of Design C under Economic Growth is the next most critical for Government. It requires an increase of 40%. However, the performance measure can only be increased as much as 30%, by enlarging the scale of the center within an acceptable range. With the 30% increase of the measure, the priority weight of Design C for Government is very close to that of the top choice. Its priorities for Investor and Users are not obviously affected. Hence, Design C is acceptable to Government with the modifications. It is now an acceptable solution to all three parties

Iteration 4. We continue the solution procedure to examine whether Design B is an agreeable solution. Users are examined first. Sensitivity analysis shows that the most critical performance measure requires a 38% reduction to make the priority weight of Design B exceed that of the original top choice (Design A). However, with this change, Design C attains the top ranking instead of Design B. The next most critical performance measure for Users requires a 48% change, which is unacceptable. Design B is neither agreeable nor acceptable to Users.

Iteration 5. Design A is the last design to be examined. For Government, the most critical performance measure requires a change as large as 62% to make the priority weight of Design A higher than that of the top choice. Moreover, this change gives Design C the top ranking. Design A is not a feasible solution.

All design alternatives have been examined, and the solution procedure stops as there is no further agreeable solution. With acceptable modifications, Design C attains satisfying priority for every party.

5. CONCLUSION

A fourth party e-logistics center can enhance the competitiveness of the Hong Kong air cargo industry, especially in this era of e-commerce and globalization. The Government, Investor and Users play important roles in the development and operation of such a center. It is important to select a center design that satisfies all three parties. This selection task is a challenging one as there are a multitude of tangible and intangible attributes.

In this paper, we provide a series of AHP and ANP models that can be used to evaluate various design alternatives. These models identify and organize the major attributes of the benefits, costs and risks to the Government, Investor and Users. They provide a conceptual framework for the design problem. The three principal parties might differ in their criteria of center selection and a conflict resolution or risk-sharing approach is needed to seek convergence. Here, we introduce a solution procedure based on sensitivity analysis. It examines the risk-sharing problem, and leads to an agreeable solution by modifying the original center designs within acceptable ranges. Such use of AHP and ANP to resolve conflict between different parties has received little attention in the literature.

In general, the evolution of web-based information technology has reached the stage where e-commerce activities and e-business processes are intertwined online, creating a genre of websites that are both marketplaces and management platforms. For the air cargo logistics industry, such platforms can take the form of a 4^{th} party e-logistics infrastructure. They allow logistics service providers to outsource their e-commerce and e-business needs. An important aspect in designing such an infrastructure is the assessment of the platform's

benefits and costs, as well as the judicious sharing of risks among interested parties. We believe the present work has provided a framework as well as a solution methodology for such an endeavor.

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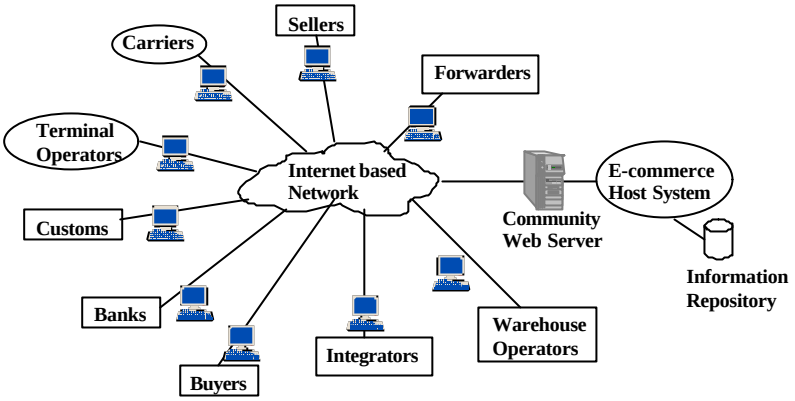

Figure 1. A Schematic Framework of Logistics Community Network

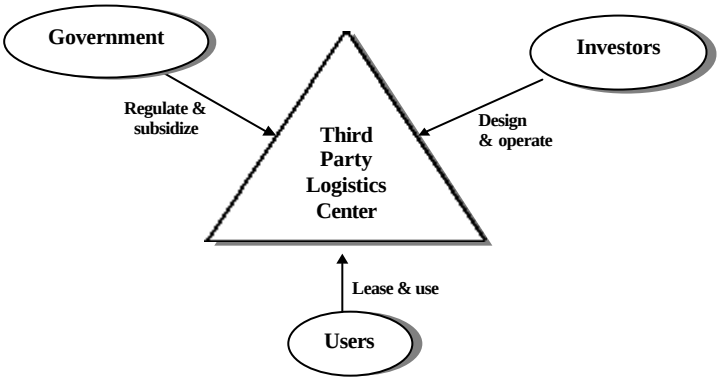

Figure 2. Major parties involved

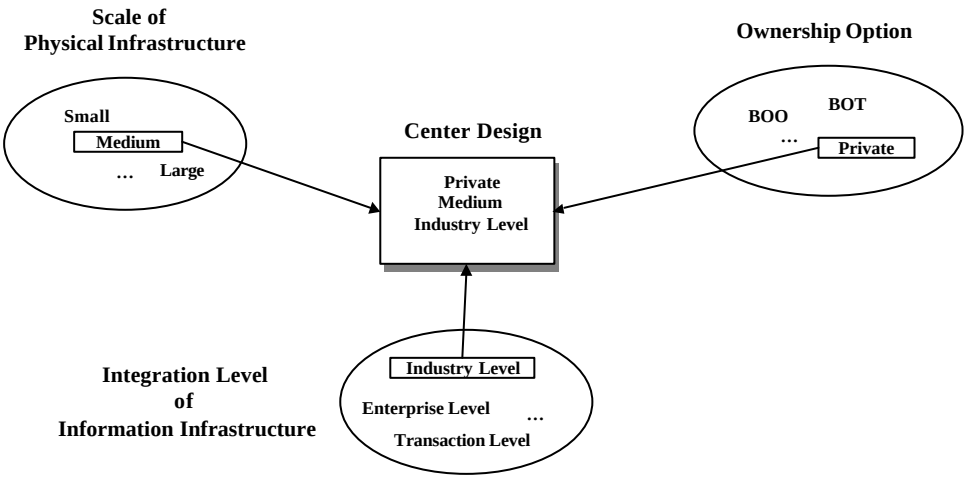

Figure 3. Design Choices for the Center

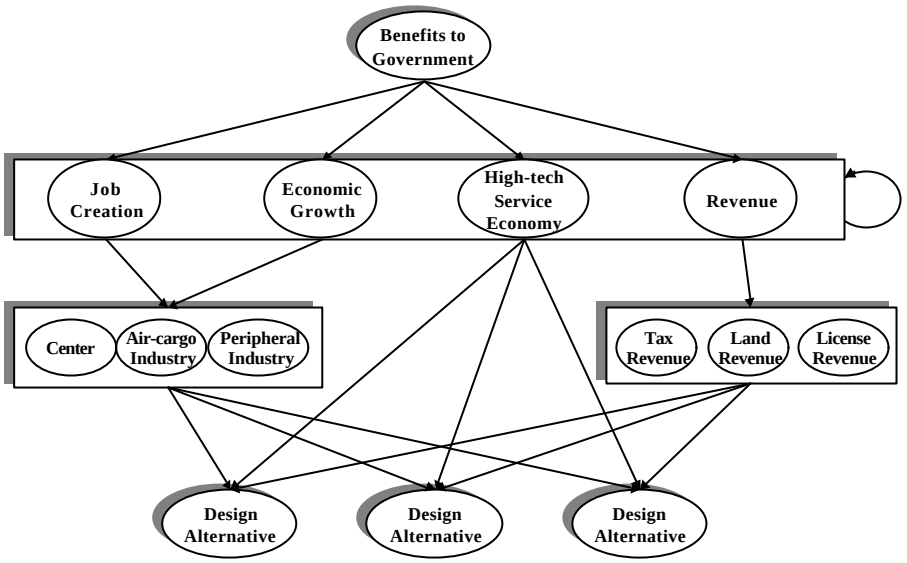

Figure 4. ANP Model for the Benefits to Government

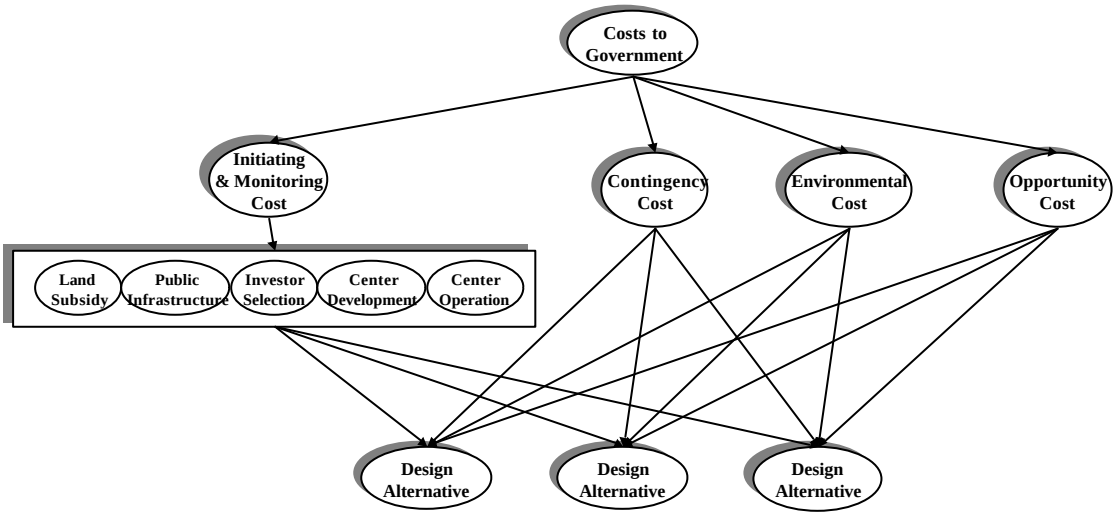

Figure 5. AHP Model for Costs to the Government

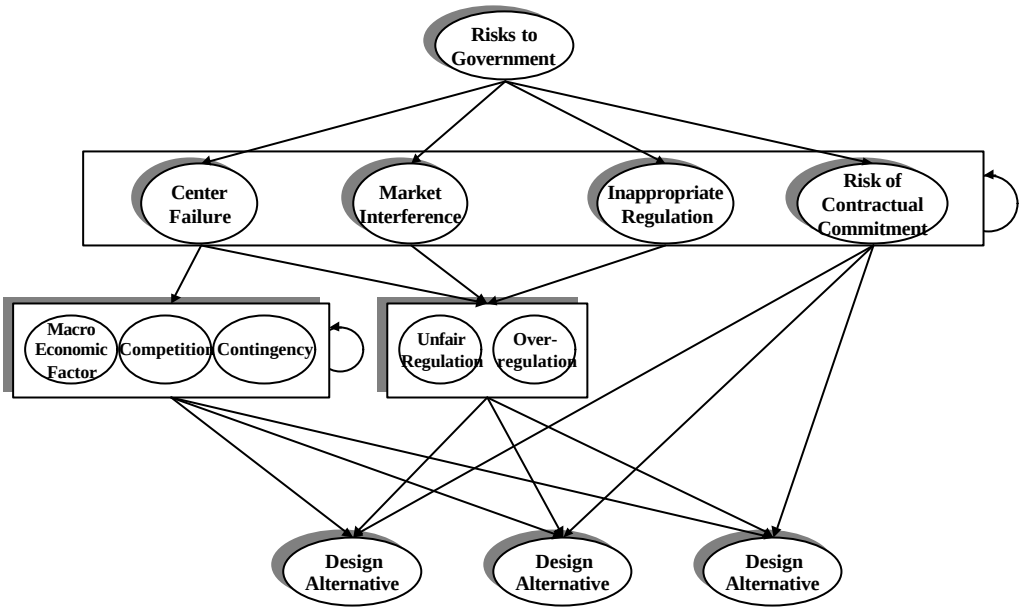

Figure 6. ANP Model for Risks to the Government

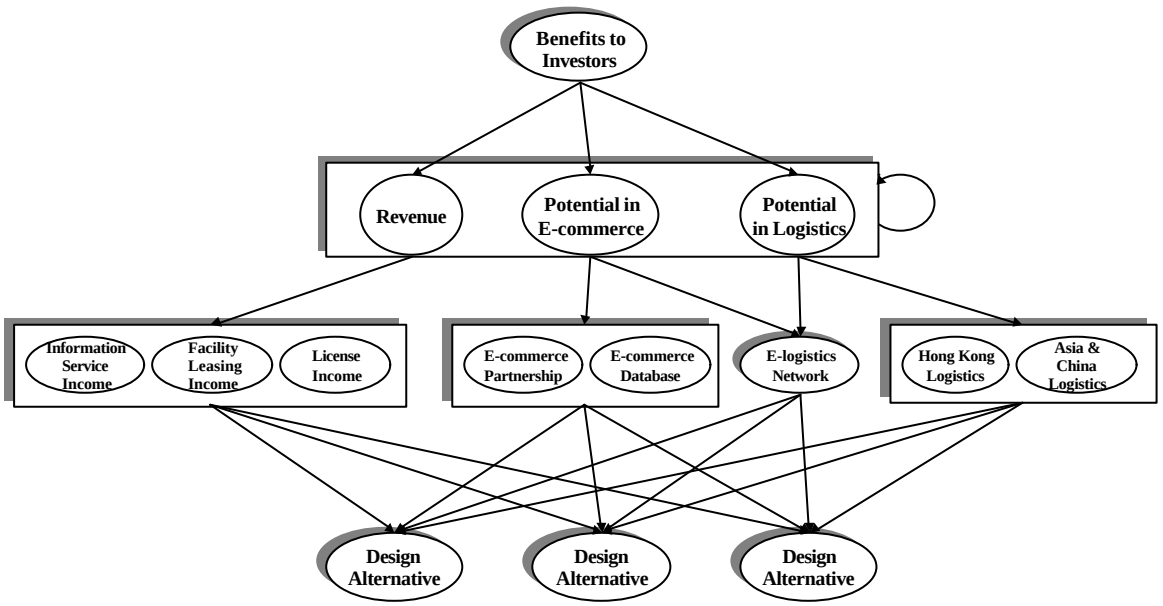

Figure 7. ANP Model for Benefits to Investors

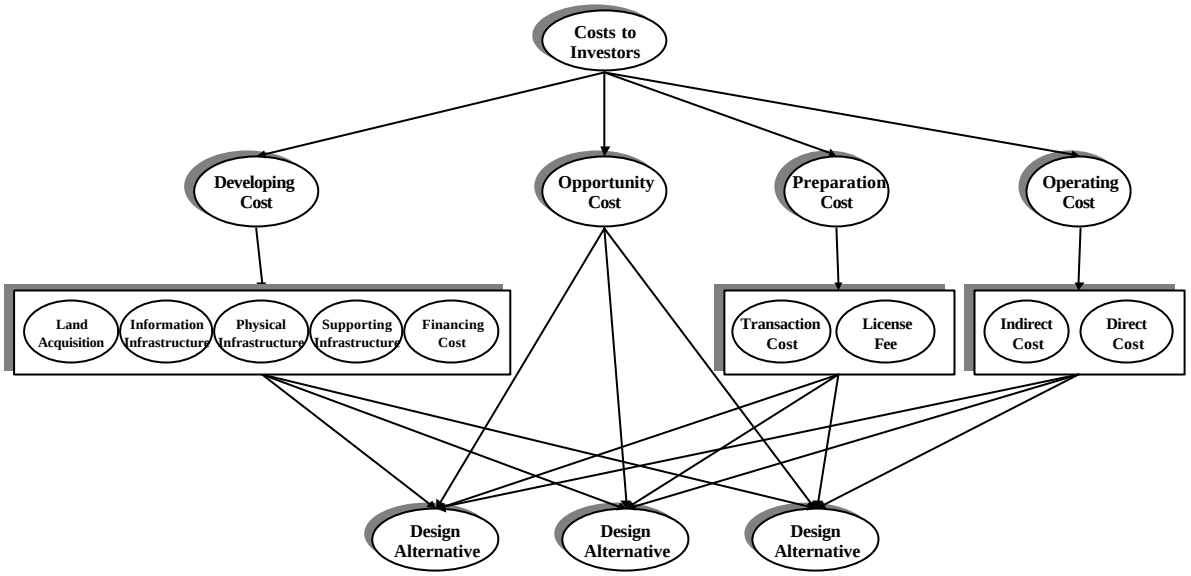

Figure 8. AHP Model for Costs to Investors

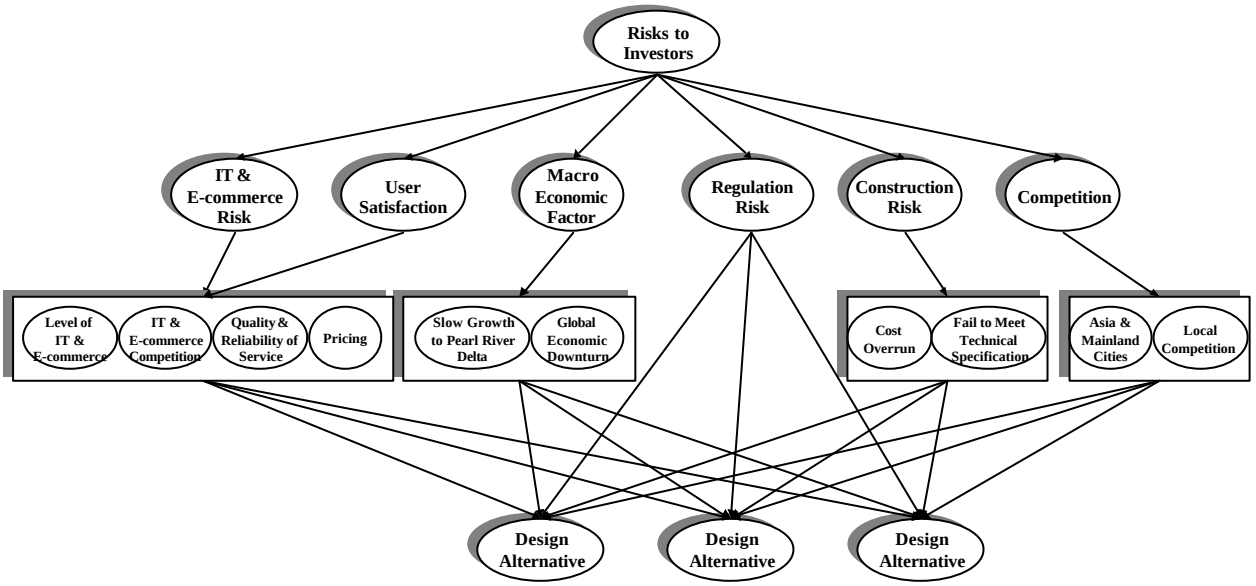

Figure 9. AHP Model for Risks to Investors

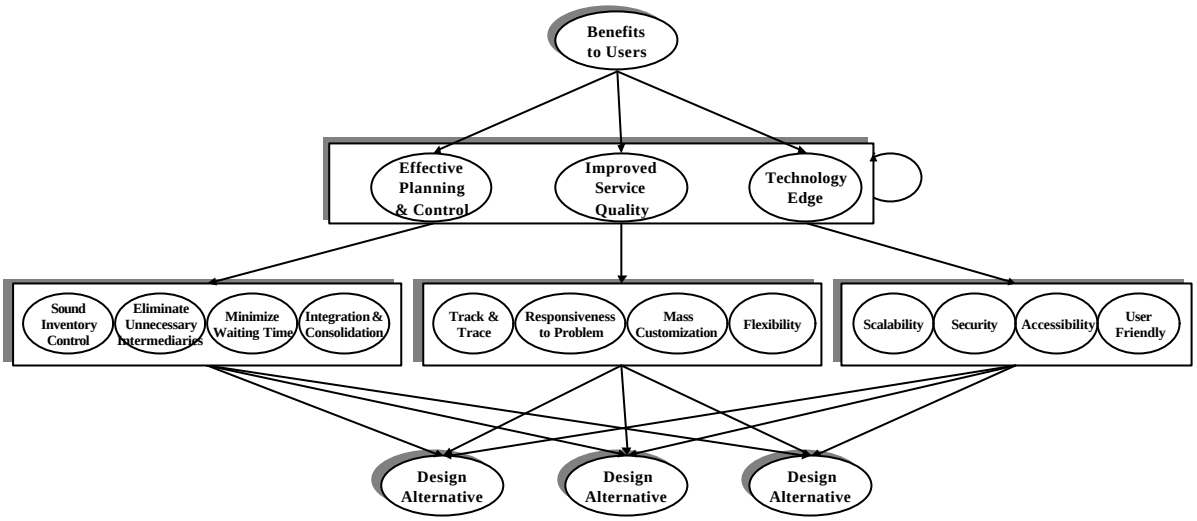

Figure 10. ANP Model for Benefits to Users

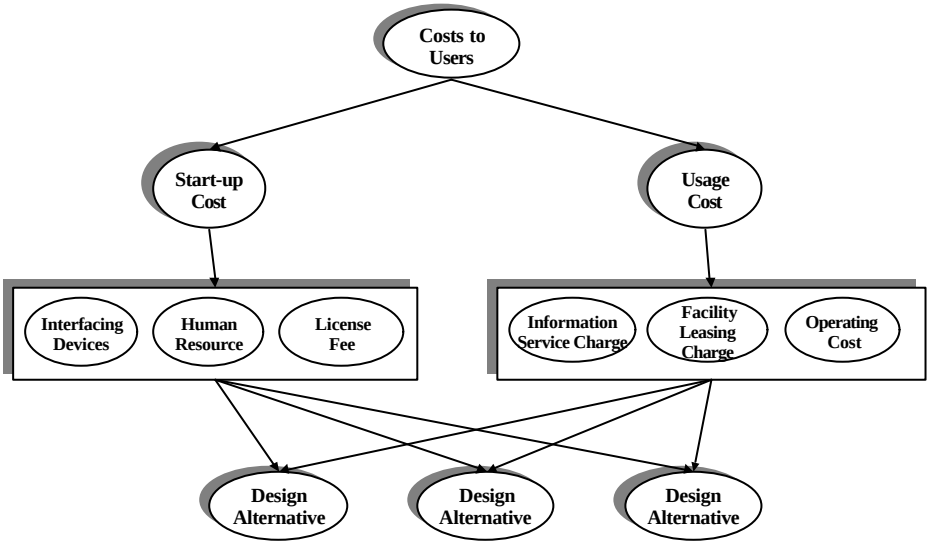

Figure 11. AHP Model for Costs to Users

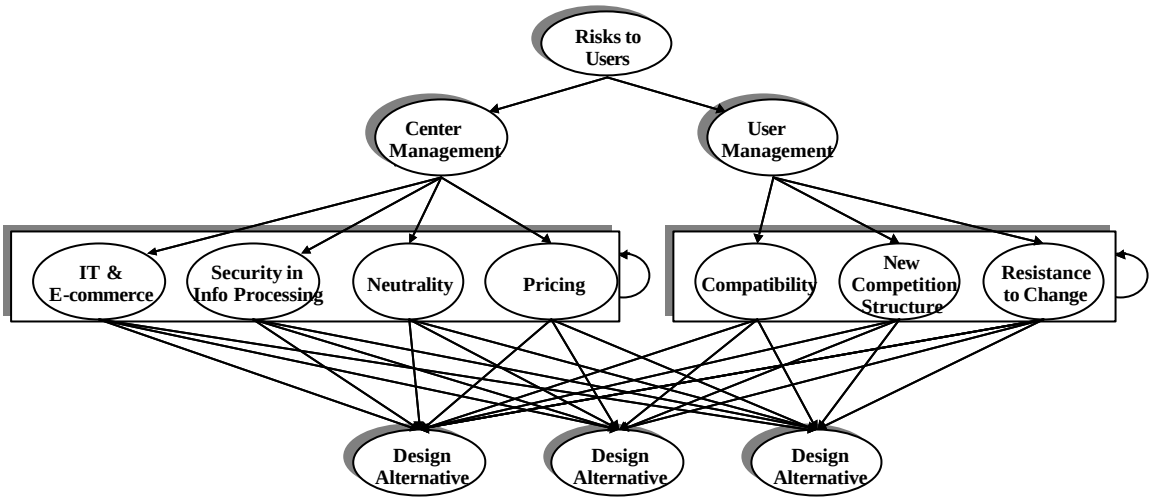

Figure 12. ANP Model for Risks to Users

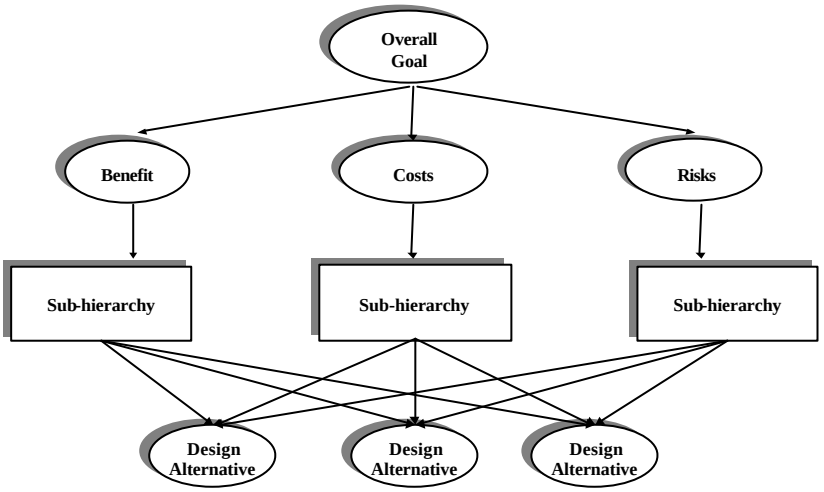

Figure 13. Aggregated Benefit-Cost-Risk Model

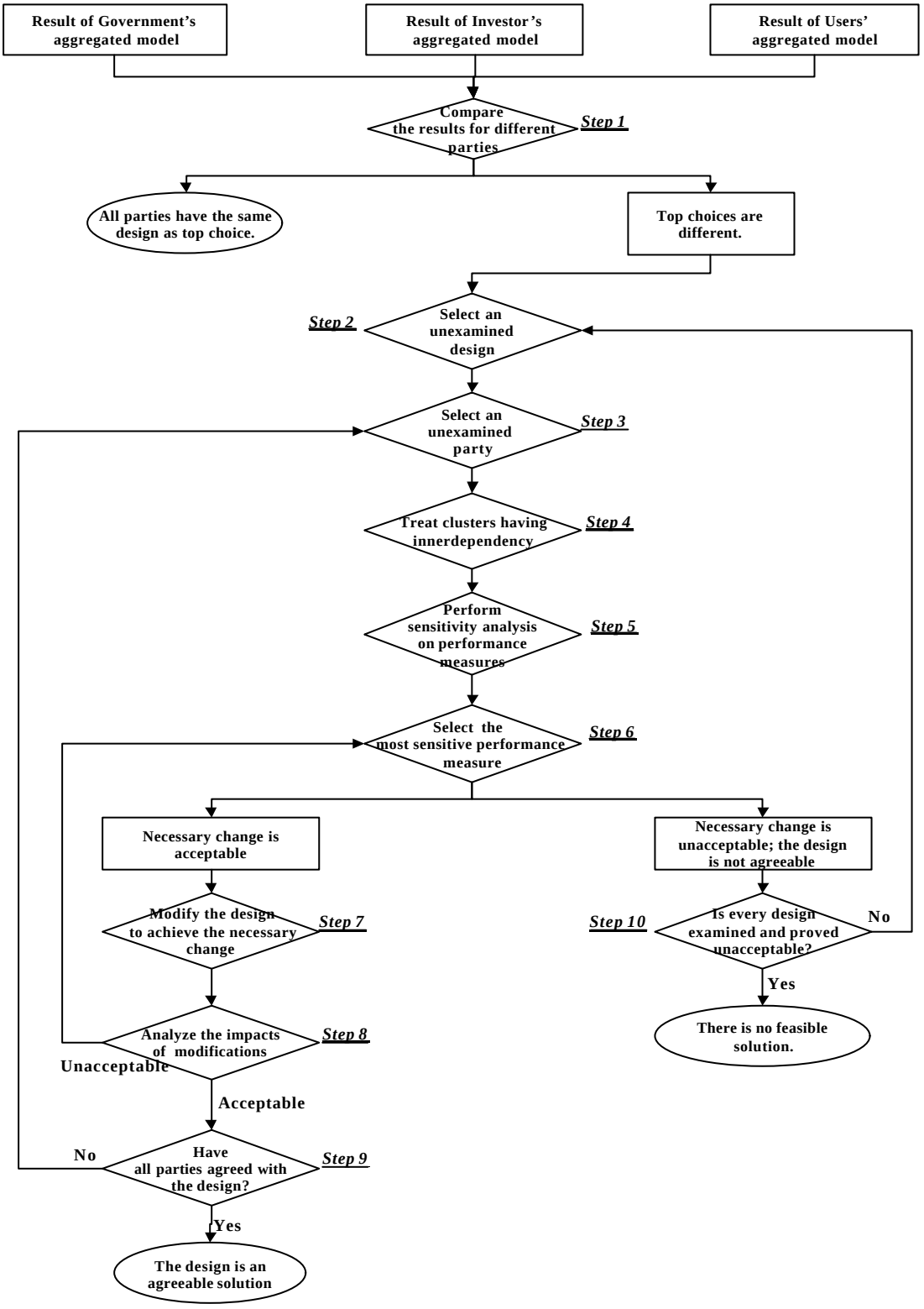

Figure 14. Procedure to Determine the Agreeable Solution

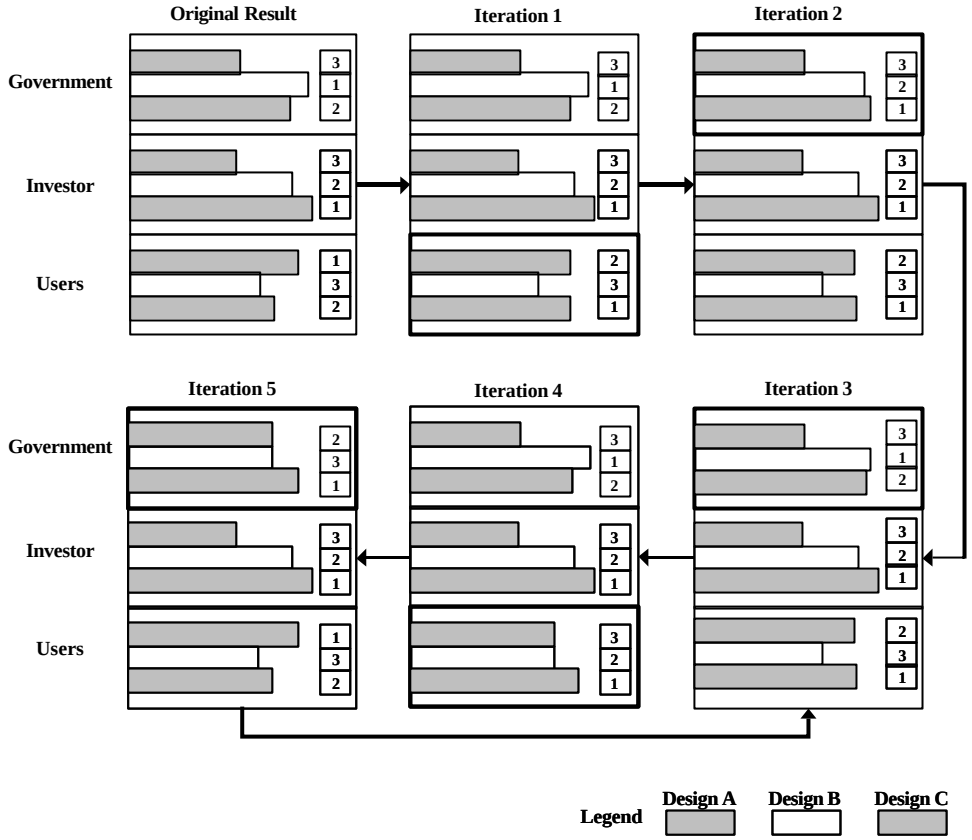

Figure 15. Iterations in Converging the Choices of Different Parties

Table 1. Benefits to the Government	
Criteria	**Description**
Job Creation	New job opportunities from the logistics center.
Economic Growth	Overall Economic Growth of Hong Kong.
- Center	Center's contribution.
- Air Cargo Industry	Contribution by corresponding development of air cargo industry.
- Peripheral Industry	Contribution by corresponding development of peripheral industries, such as real estate and telecommunication industries.
High-tech Service Economy	Contributes towards Hong Kong's strategic role of being a high-tech knowledge-based service economy.
Revenue	Government's revenues that directly come from the center.
- Land Revenue	Incomes due to land sale or rental.
- Tax Revenue	Tax collected over the revenue of logistics center.
- License Income	Payment from selected Investors for the right of building and operating the center.

Table 2. Costs to the Government	
Criteria	**Description**
Contingency Cost	Cost in the provision of contingency measures.
Initiating & Monitoring Cost	Expenses in initiating the center and monitoring its construction and operation.
- Land Subsidy	Subsidy in the sale or rental of land to Investors.
- Public Infrastructure	Construction of supporting public infrastructures, such as transportation system and telecommunication network.
- Investor Selection	Cost of selecting Investors and examining center designs.
- Center Development	Cost of monitoring the construction and further development of the center.
- Center Operation	Cost of monitoring the regular operation of the center.
Environmental Cost	Noise, pollution, etc.
Opportunity Cost	Opportunity lost for alternative usage of the resources (land and people)

Table 3. Risks to the Government	
Criteria	**Description**
Center Failure	Risk of project failing.
- Macro Economics Risk	Downturn of global or regional economies.
- Competition	Risk due to competition.
- Contingency	Risk of unsuccessful contingency measures.
Market Interference	Government interference in the free market.
Inappropriate Regulation	Risk of not providing proper regulation.
- Unfair regulations	Neutrality
- Over-regulations	Over-regulating brings difficulty to the running of center, while inadequate regulating is open to abuses.
Risk of Contractual Commitment	Contractual commitments may bring unnecessary fiscal burden to the Government and taxpayers.

Table 4. Benefits to Investors	
Criteria	**Description**
Revenue	Investors' incomes from the center.
- Information Service Income	Revenues of offering information infrastructures to Users.
- Facility Leasing Income	Revenues of leasing physical facilities to Users.
- License Income	License income from Users.
Potential in Logistics	Business potential in logistics from the center.
- Hong Kong Logistics	Opportunities in the Hong Kong logistics industry.
- Asia & China Logistics	Opportunities in the logistics industry of Mainland and other Asian regions.

Potential in E-commerce	Business potential in e-commerce from the center.
- Partnership	Partnerships with Users and operators of other e-commerce platforms.
- E-commerce Database	Business potential from data mining of logistics-related information.
- E-Logistics Network	Business potential from developing the center's information infrastructure into a vertical e-logistics network.

Table 5. Costs to Investors

Criteria	Description
Preparation Cost	Investors' costs in the preparation phase.
- License Fee	Fees to Government for permission to construct and operate the center.
- Transaction Cost	Costs of designing, bidding, negotiating etc.
Development Cost	Investors' costs in the development of the center.
- Land	Rental or purchase cost of land.
- Information Infrastructure	Cost of establishing information infrastructures offered to Users, including hardware and software.
- Physical Infrastructure	Cost of building the physical infrastructures offered to Users.
- Supporting Infrastructure	Cost of other necessary infrastructures, such as management information system for internal use.
- Financing Cost	Cost of financing the investment.
Operating Cost	Operating costs of the center.
Indirect Cost	Overheads and other indirect costs.
Direct Cost	Direct operating cost of the center.
Opportunity Cost	Opportunity lost for alternative usage of the resources.

Table 6. Risks to Investors

Criteria	Description
Macro Economic Risk	Global and regional macro economic risk.
- Slow Growth to Hinterland	Risk of economic downturn in Pearl River Delta.
- Global Economic Downturn	Risk of global economic downturn.
Construction Risk	Risks incurred in the construction process.
- Cost Overrun	Construction cost exceeds budget.
- Fail to Meet Specifications	Failure to meet the designed technical specifications.
Competition	Competition in logistics business is fierce.
- Asia & Mainland Cities	Competition from major competitors such as Guangzhou and Shanghai.
- Local Competition	Competition from similar projects in Hong Kong.
Users Satisfaction	Users' satisfaction level with the center.
IT & E-commerce Risk	The uncertainty as well as attractiveness of IT & E-commerce.
- IT & E-commerce Level	Whether the designed IT & E-commerce level is desirable.
- E-commerce Competition	Competition for e-commerce is fierce.

- Quality & Reliability	Quality & reliability of services offered by the center.
- Pricing	Risk of inappropriate pricing.
Regulation Risk	Risks of regulatory problems.

Table 7. Benefits to Users

Criteria	Description
Effective Planning and Control	Efficiency of logistics operations
- Inventory Control	Able to develop effective inventory planning for client companies.
- Eliminate unnecessary intermediaries	Efficient information avoids unnecessary intermediaries.
- Minimize waiting time	Use the integrated information system to forecast and plan their work, thus reducing waiting time at interfaces.
- Integration & Consolidation	Allow effective coordination of integration and consolidation of shipments.
Improved Service Quality	Quality of services is improved.
- Track and Trace Accuracy	Accuracy in monitoring shipments and logistics services.
- Responsiveness to Problems	Minimize human errors, damage and theft, and can identify problems and prescribe solutions quickly.
- Mass Customization	Flexibility in customizing processes to meet customers' different requirements at low cost.
- Capacity Flexibility	Virtual partnerships create more options to deliver goods.
Technology Edge	Help Users establish their high-tech capability.
- Security	Users' information will be protected by the technology of authentication, authority and audit.
- Accessibility	Easy accessibility.
- User Friendship	Ease of use.
- Scalability	System upgrading is economical.

Table 8. The Costs to Users

Criteria	Description
Startup Cost	Users' costs to start using the center.
- Interface devices	Investments on compatible mechanisms to use the center.
- Human Resource	Recruiting and training of new staff.
- License Fee	Payment to Investors for use of the center.
Usage Cost	Users' costs to use the center's infrastructures.
- Information Service Charge	Payment to use the information infrastructure of center
- Facility Leasing Fee	Payment to use the physical facilities of center.
- Operating Cost	Additional operating cost related to the using the center's facilities.

Table 9. Risks to Users	
Criteria	**Description**
Center Management	Users' risks from the center.
- E-commerce	Uncertainty regarding e-commerce.
- Security	Security of information processing at the center
- Pricing	Uncertainty on the future pricing policy of the center.
- Neutrality	Uncertainty on the center's neutrality.
User Management	Users' risks from themselves.
- Compatibility	Incompatibility in integrating with the center's management as well as infrastructure.
- New Competition Structure	The center changes the competition scenarios.
- Resistance to Change	Resistance by employees of Users.