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Improvement Strategies for Logistics Management – TOC Approach

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Abstract

This study applied the Theory of Constraints for discussing logistics issues of national research institutions and understanding the core issues. The purpose of this paper was to discuss the reengineering of national research institutions, improvements to logistics management processes, and to raise competitive power under the current environment. First, core issues were fully understood, and then hierarchy analysis was applied to determine the weights of factors affecting issues for analysis of future development trends in order to provide logistics management recommendations. The findings indicate that the most effective incentive scheme was the establishment of a logistics managerial department, of which the logistics management factors of the current system structure had the highest influential degree, followed by performance index and organizational culture. In this study, many initiative schemes were proposed through personal brainstorming. In the future, other initiative schemes could be developed in this manner, and from different standpoints, other improvement methods could be proposed. The national research institution system is large, and involves many operational processes; thus, many constraints are established in order to avoid malpractice. In actual execution, operational flexibility is lower due to the constraints, thus, excessive operation costs are often wasted.

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How to create a balance between the prevention of malpractice and elevation of efficiency to reduce omissions and increase administrative efficiency will pose challenges for decision makers. The Theory of Constraints focuses on the communication and coordination among approvers, builders, and decision makers. If the three departments are in communication, processes will become easier; if not, their discussions and good faith interactions will be important, and patience will be an indispensable factor, which can facilitate communications.

Keywords: Information System, Information Management, Theory of Constraint, Logistics Management, Analytic Hierarchy Process

JEL Classification: L87, L91, N70

1. Introduction

For the purposes of sustainable competitive survival and the development of enterprises, organizational structure must be partially or entirely adjusted, with continuous study and innovation, improvements to organizational activity performance, organizational reforms, and enterprise reengineering in order to assist enterprises to more effectively accomplish goals (Huang, Kwan, and Hung, 2001). To ensure the competitiveness of strategies, internal core processes of organizations must be redesigned so that labor force, resources, and financial resources can be effectively utilized. Logistics management is a crucial step for cost reductions and structure upgrades, which are key factors to enterprise success (Chan and Chin, 2007). The establishment and enhancement of a logistics management system allows enterprises to run in a low-cost and highly-efficiency manner, increasing their overall competitive power. Some studies have integrated logistics management into electronic systems (Qiu, Tang, and Xu, 2006), suggesting the increasing importance of logistics management.

Logistics management includes organizational plans that coordinate and control logistics works in a systematic manner based on scientific principles in order to provide various sectors with the right materials, in the right quantity, at the right time, at the right place, for the right price. Tam (2008) discussed the logistics management improvement plans of the UK and Hong Kong building industries. Material demands planning is used to confirm order time points (Lea, 2007). Logistics simplification is an important factor in an organization's improvements in efficiency (Fernandes, Filho, and Bonney, 2009), and logistics analysis can ameliorate the operating activities of companies (Binder, 2007). In the past, many methods, such as the QC 7 methods, Crisis Management, the SWOT Method, System Dynamics, The Fifth Discipline, and the Theory of Constraints (TOC) were applied by Taiwanese enterprises in the analysis of a system's status quo or to solve problems. Introduced by Dr. Goldratt (1990), TOC is a systematic thought process, using a logical thought architecture to verify the cause and effect relations of overall systems, and facilitating the understanding of interactions between causes and effects through communications, discussions, and analysis, and providing a problem-solving method.

In recent years, research institutions and manufacturers of various countries have shifted the pursuit of development of top technologies into a reduction of product manufacturing costs, increase in logistics management capabilities, and efficient logistics supply. Greater attention was paid to contributing to the national economy and industry, such is the future development trend. Past studies utilized system analysis methods to discuss the defects of organizational logistics management systems in order to assist organizations in determining issues and improving enterprise processes (Rhee, Cho, and Bae, 2010; Shih, Hung, and Lin, 2010; Shih, 2010; Kasemeset and Kachitvichyanukul, 2010; Park et al., 2008; Lee et al., 2007; Da, 2005; Lockamy, 2003). This study employed TOC to investigate a top national research institution in Taiwan. First, core issues were fully understood, and then hierarchy analysis was applied to determine the weights of factors affecting issues for analysis of future development trends. The purpose of this paper was to discuss the reengineering of national research institutions, improvements to logistics management processes, and to raise competitive power under the current environment.

2. Literature Review

With the development in science and technology, and in face of keen competition in international markets and rapid changes of operating environments, greater attention has been paid to reengineering enterprises (Luo and Tung, 1999). In practice, organizational production processes refers to the processes of transforming resource input into output (Hennings, 1987), and cooperation and coordination between different departments that cause issues. Enterprises should conduct radical redesign changes to deal with the rapid changes of environments. The key point of enterprise reengineering changed from internal management needs to external customer needs. Radically redesigned work process flows, product research and development, and customers are required to create innovation opportunities. Hammer and Champy (1993) defined the processes of reengineering as, "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as costs, quality, services, and speed". Hammer and Champy (1993) considered that enterprises should change their thought concepts, break past success mould, start over again, and accept different operating architectures in order to satisfy customer needs. Bennis (1969) emphasized that enterprises should know environment changes and take suitable actions to deal with environment shock.

System dynamics, also called industrial dynamics, is an analysis method proposed by Professor Jay W. Forrester, Massachusetts Institute of Technology, for discussing the interactions of departments. System dynamics explores organizational dynamic behavior characteristics, analyzes internal information feedback of organizations and finds influence within the system structures and policies of organizations or enterprises on the growth and stability of the system through computer simulations. In systems analysis, the key point is the understanding and degree of control within the system structure; thus, in the view of system needs, useful information and effective combinations can be collected to explain related phenomena representing the actual system. Any decision of the system must be made according to the related information. The system information affects decisions and actions controlled by the decision and action, as well as affecting situations of system developments, thus, a cyclic process is formed. System dynamics aims to display the dynamic behaviors of enterprise systems and is widely used in system implementations; for example, Park et al. (2008), used system dynamics as an architecture to establish a dynamic labor force demand system. Also, Lee et al. (2007) adopted the systems dynamic concept and developed a basic customer loyalty system based on RFID.

The Fifth Discipline is a system analysis method developed by Senge (1990) according to systems thinking, and it derived from the system dynamics introduced by Forrester. Systems thinking includes a series of simulation methods, tools, and philosophies used for discussions regarding relations between action forces that are considered common processes. The Fifth Discipline integrates Personal Mastery, Improving Mental Models, Building Shared Vision, and Team Learning, and underlines self-learning and improvements, and discusses interactions between individuals and groups. From the overall system perspective, causes that hamper development of organizational systems were identified to find solutions (Flood, 1998). Da (2005) developed multi-agent systems based on the Fifth Discipline.

TOC, as introduced by Goldratt (1986), considers that any organizational system has constraints during development. According to the definition given by Goldratt, a constraint is anything that prevents the system from achieving its entire goal, and applies cause and effect logics to represent relations between entities. TOC emphasizes that an organizational system conducts a collection of inference thinking, then applies cause and effect relations analysis through scientific and logical verification methods, and pursues both local optimization, and the optimization of overall organizational systems, and breaks hierarchical constraints to achieve the optimal goals. Some studies applied the theory of constraints to enterprise reengineering, such as Tanner and Honeycutt (1996), which used TOC for analysis of organizational process flows and bottlenecks. Lockamy (2003) also established a strategic cost management system, including organizational goals and internal and external demands and capabilities based on TOC. Linhares (2009) employed TOC for the discussion of product portfolios, while Rhee, Cho, and Bae (2010) developed a system of improving bank organization process efficiency according to TOC.

By comparing three thought processes, system dynamics focuses on current situations embodied by mathematical formula and uses a computer for simulation. Participants should be capable of operating computers and have mathematical foundations. The Fifth Discipline places emphasis upon inference, and analysis results are expressed by models, suitable for common participants, who only have knowledge of the basic modules and can modularize the current situations, such as, systems thinking analysis of problems. The TOC application has no special requirements of participants, and they merely know the environment to be discussed; any persons can quickly master it. It applies to any environmental difficulties anticipated, identifies the current situations of the system and problems through discussion, and determines the cause and effect, and problem solving direction. This study applied TOC for analysis of current situations of the national research institution and on the planning of its future development direction.

Table 1 Comparison of thought process methods

Method / Comparison factor	System Dynamics	The Fifth Discipline	Theory of Constraints
Auxiliary tool	Computer	N/A	N/A
Analysis method	Computer simulation	Inference model	Three processes
Foundation of mathematics	Required	N/A	N/A
Computer operations	Required	N/A	N/A
Analysis of existing situations	Existing mathematization	Existing modeling	Existing cause and effect
Use	Difficult	Medium	Easy

3. Research Method

3.1. Theory of Constraints

The research method for this paper was TOC, which was the thought process of problem solving, focused on three questions, and employed five logic trees as tools for solving problems in the system. TOC has three fundamental questions for analysis of problems, namely, what items to change? What to change items into? And how to cause the change?

1. What items to change?

Core problems needed to be identified. Starting from the problems and using interaction between adverse factors as premises to clarify problems through cause and effect relations and determine all possible core problems through a current reality tree (CRT) as the change direction.

2. What to change items into?

A solution policy should be prepared using a scheme evolved from a conflict resolution diagram (CRD) in order to determine the preliminary problem-solution approach. Intermediate objectives were set through an improved concept of CRT to establish a future reality tree (FRT) in line with the cause and effect relations of the overall objectives; then, the questions of what to change items into would be answered.

3. How to cause the change?

An implementation plan needed to be prepared to determine the potential issues associated with various intermediate goals through FRT during the fulfillment of key goals. The prerequisite tree (PT) analysis was utilized for establishing an alternative scheme, where a transition tree (TT) would be employed for the integration of all feasible measures and preparation of a specific feasible scheme.

TOC has five analysis steps (Goldratt, 1994; Dettmer, 1997; Scheinkopf, 1999); the details are shown in Figure 1.

Step 1: Undesirable effects (UDEs) preventing system development needed to be listed to establish CRT using cause and effect relations. The current overall system situations were understood in order to determine core problems and accomplish the purpose of what items to change.

Step 2: Anticipated desirable effects were set according to core problems in Step 1, where demands and prerequisites of the goals were listed. CRD was constructed, and any conflicts of breaking prerequisites were considered through brainstorming in order to influence the current environment, satisfy demands, and accomplish incentive scheme of anticipate desirable effects.

Step 3: The incentive scheme of Step 2 was combined with desirable effects (Des) to construct FRT based on cause and effect relations in order to accomplish the purpose of what to change items into.

Step 4: After setting improvement direction goals, constrains affecting improvements were listed. Solution methods that can break relative constraints were provided to serve as the intermediate goals of incentive scheme. PT was constructed through timeliness, and cause and effect relations; consequently, milestones of incentive scheme could be established.

Step 5: Constraints affecting improvement were transformed into action rules and intermediate transition goals, and progressive TT was constructed through cause and effect relations. System organization could employ the procedures for improvements and accomplishing incentive schemes; hence, desirable effects could be achieved, and the purpose of how to change items could be supported.

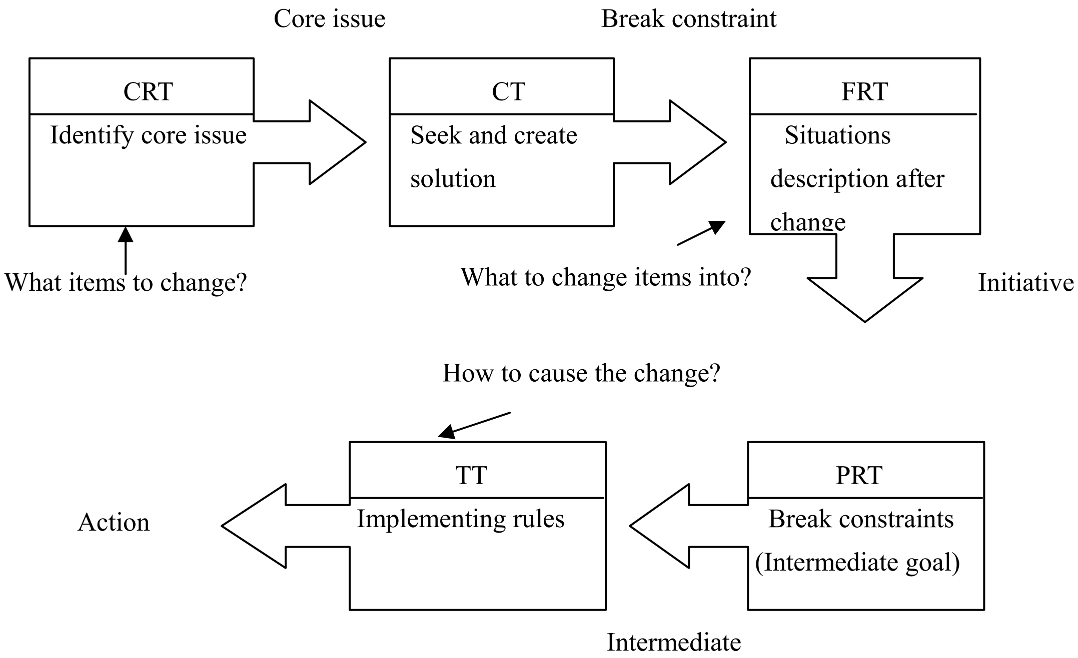

Figure 1 Theory of Constraints and Correlation (Dettmer, 1997)

3.2 Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) developed by Saaty (1980), is a quantitative and qualitative technique for multiple criteria decision making. It has been widely employed in multiple criteria management problems (Bernasconi, Choirat, and Seri, 2010), and can systematize and assess complex problems in order to provide more information for decision makers to reduce risk of decision errors. AHP can construct complex factor relations and employs pairwise comparisons to determine the importance of various factors. Thus, it can be used for discussions on priority of decisions, the construction of a decision assessment model, determining factor importance, and planning strategies. Presently, the studies of logistics management focused on the selection of materials and equipments (Chakraborty and Banik, 2006; Chan, Ip, and Lau, 2001). AHP has five analytic steps, which are described as follows (García-Cascales and Lamata, 2009; Meade and Sarkis, 1999; Saaty, 1996).

(1) Problem definition: Problem scope was defined, and literature analysis or focus groups were employed for determining important factors that were affecting problems. In dealing with complex problems, assume that humans cannot simultaneously compare more than seven items; thus, elements of each layer shall not exceed seven.
(2) Construction of hierarchy structure: All possible affecting factors needed to be identified. Focus groups, questionnaire surveys, and factor analysis were utilized for the construction of hierarchy structure of problems, including criteria and sub-criteria, as illustrated in Figure 2.

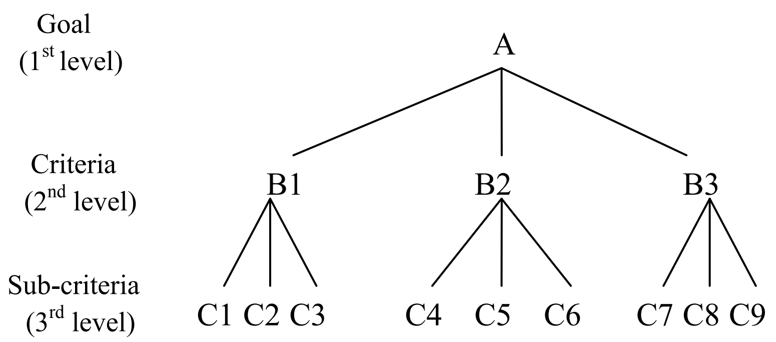

Figure 2 Hierarchy Structure Diagram

(3) Questionnaire design and survey: Experts were invited to conduct a 9-scale pairwise comparison for criteria and sub-criteria of each layer; assuming there were n factors, n(n-1)/2 times of comparison were needed. According to the results of the questionnaire survey, a pairwise comparison matrix was constructed, as expressed in Eq.(1). Eq.(2) shows the standardized comparison matrix and averaged row vectors. Eigen values and Eigen vectors of the comparison matrix needed to be determined. Eq.(3) was employed for the determination of Eigen values.

$$A=\left[a_{ij}\right]=\begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & 1_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \tag{1}$$

$$W_i' = \frac{1}{n}\sum_{j=1}^{n}\frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \quad \text{i, j=1,2,…n} \tag{2}$$

$$\lambda_{max} = \sum_{j=1}^{n} \frac{W_j}{W_i} \tag{3}$$

(4) Consistency verification of hierarchy: This was employed to evaluate the consistency of comparison relations between criteria and sub-criteria. The value of pairwise comparison was the subjective values determined by decision makers, through a consistency index (CI), as seen in Eqs.(4) and (5). Table 2 is the reference table of RI; if the overall hierarchy structure's CR>0.1, this meant that correlation between hierarchy elements had problems, and pairwise analysis should be conducted again.

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{4}$$

$$CR = \frac{CI}{RI} \tag{5}$$

Table 2 RI Reference Table

Total number of hierarchy elements	1	2	3	4	5	6	7	8
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41
Total number of hierarchy elements	9	10	11	12	13	14	15	
RI	1.45	1.49	1.51	1.48	1.56	1.57	1.58	

(5) Identify factor weights: if overall hierarchy structure passed consistency verification, weights of criteria and sub-criteria could be determined, which could serve as important reference for decision analysis of management.

4. Case Analysis

This study investigated the national research institution. From the standpoint of logistics management planning, internal situations were analyzed, including logistics, storage management, research and development, manufacturing, finished products, control of semi-finished, and transport of final products. The research method utilized TOC for determining core problems and problem-solving methods. In CRT, the importance of factors can be found by using AHP, the description is as follows.

4.1 Current Reality Tree

First, a focus group method was implemented to analyze work processes and exchange ideas with directors and relevant personnel of all departments in order to understand the overall environment. Then, three types of eight UDEs were concluded as follows:

(1) The existing system structure was not flexible: UDEs factors included excessive equipments, high gross value, and lack of a management system for finished and semi-finished products, and complete cost computation method.
(2) Ill-timed performance indicators: UDEs factors included high inventory (value and volume), low stock turnover, and high purchase costs (unit price and frequency).
(3) Civil servant organization culture: USDs factors included quality of items cannot meet requirements (right quality), items cannot meet requirements (right time).

Industry, official, and university experts were invited to make pairwise comparisons according to three criteria and assessment factors, and conduct consistency verification after constructing a pairwise comparison matrix to judge the confidence of the comparison results. According to Eq.s(4) and (5), if RI was smaller than 0.1, weight calculation would follow.

Table 3 Influential Degree of Undesirable Effects

Criteria	Weight	Assessment factors	Weight
Existing system structure	0.457	Quantity and gross value of equipments	0.362
		Product management systems	0.433
		Cost calculation methods	0.205
Performance indicators	0.325	Inventory and total values	0.403
		Stock turnover	0.361
		Purchase costs	0.236
Organizational culture	0.218	Item quality	0.38
		Item time schedule	0.62

As shown in Table 3, with reference to the suggestions made by the nine experts, system structure (0.457) had the greatest influence on the research institution. For example: in the process of development, the equipment and materials of the research institution were not available due to changes or termination of plans, and obsolete tools or equipment shall be destroyed or sold according to regulations; however, some obsolete equipments and items can be used continuously, and destroying causes waste. Thus, the current system should be adjusted. For the establishment of performance indicators (0.325), if no fair and objective evaluation criterion was provided, the performance of various parts could not be measured. For organizational culture (0.218), the research institution only engaged in research and development in the past; currently, due to evolution and environmental changes, it was responsible for the production of expertise and the development of science and technology. Therefore, it shifted from focusing on time, and not costs, to coordination of cost control and efficiency to improve research and manufacturing. If management system reengineering was not timely, its competitive power would be difficult to increase.

In the existing system structure, product management system (0.433) had the highest importance. The logistics management system of the functional departments of the research institution was not complete, resulting in many warehouses, high inventory costs, and difficulty in knowing the item flow. In addition, some key parts had high self-made costs and needed purchases, but due to restricted goods of countries or ordered goods of manufacturers (orders could be scheduled into the production period only when minimum batch quantity was satisfied), purchase period was long and acquisition was difficult (purchase system was strict to avoid malpractice). Therefore, suitable inventory should be ensured for contingency use. In the performance indictor, the inventory and total value (0.403) had the greatest importance, as bills of materials (BOM) of developed finalized products and planned products were not incorporated into the logistics management system. As a result, item informatization levels of the functional departments were inconsistent. Logistics information could not be exchanged, which affected mutual support of items. Therefore, items inventory should be managed. In regard to item qualities, item time schedule (0.62) had the highest importance. Item management system of the research institution had not been put into practice, and some special units were self-financed and self-operated, and after purchase, the items were not subject to inventory management; completion of acceptance meant completion of requisition. Some basic units had many bookless items. The items units could not master item process flow; thus, this factor had the highest degree of influence.

4.2 Conflict Tree

The core problem of logistics management was "inflexible current system architecture", "ill-timed performance indicators", and "civil servant organizational culture"; these were related to "elevation of competitive advantages". How to elevate the overall competitive advantages of research institution and maintain the position of the institution in the sharply competitive market was the anticipated desirable goal. To achieve this goal, consideration was given to two needs, one was task needs, real time schedule pressures, and convenience of items, and the other was management needs, such as cost considerations and management methods. To meet task needs, time schedule pressures, and convenience of items, stocks needed to be prepared in advance; to satisfy management needs, attention needed to be paid in order to reduce work costs. However, the two perquisites were mutually exclusive; and thus, this has become the puzzle of the research institution. CRT consisted of the following steps:

(1) To elevate the competitive advantages of the institution, the task needs and management needs must be satisfied.
(2) To meet task needs, inventory of more items was required.
(3) To meet management needs, the fewer the items were, the better it was.
(4) To seek a suitable reference environment and incorporate its assumptions which were different from the actual environment, inconsistencies between the two necessary conditions were eliminated in order to accomplish the anticipated desirable goal. Incentive schemes of four solution assumptions were proposed, as listed in Table 4.

Table 4 Conflict Tree (Incentive Seeking Schemes)

Process guidance	Reference environment	Assumptions	Incentive scheme
AB	No time schedule or item use pressure	No managerial responsibility	Centralized item management
AC	No cost or efficiency issues	No procedure management	Centralized purchase management
BD	No stocks and no deficiency of items	Material supply chain	Sign open contract
CD’	No stocks and no increase in costs	Warehouse is in another location	Virtual warehouse

With reference to the above incentive schemes, specialized division of purchase, delivery, and inventory management of items can increase efficiency of work, in which cooperation relationships and management methods of suppliers was one of the key factors that directly affected the overall competitive advantages of the institution. Thus, the "establishment of a special logistics management department", "establishment of fund system", and "make the best of Information Technology (IT)" were the incentive schemes for improving the competitive advantages of the institution. To ensure item purchase, a special department should be responsible for goods interactions between item inventory management and suppliers; thus, the establishment of a dedicated logistics management department was the most effective incentive scheme for improving competitive power of the institution, as indicated in Figure 3.

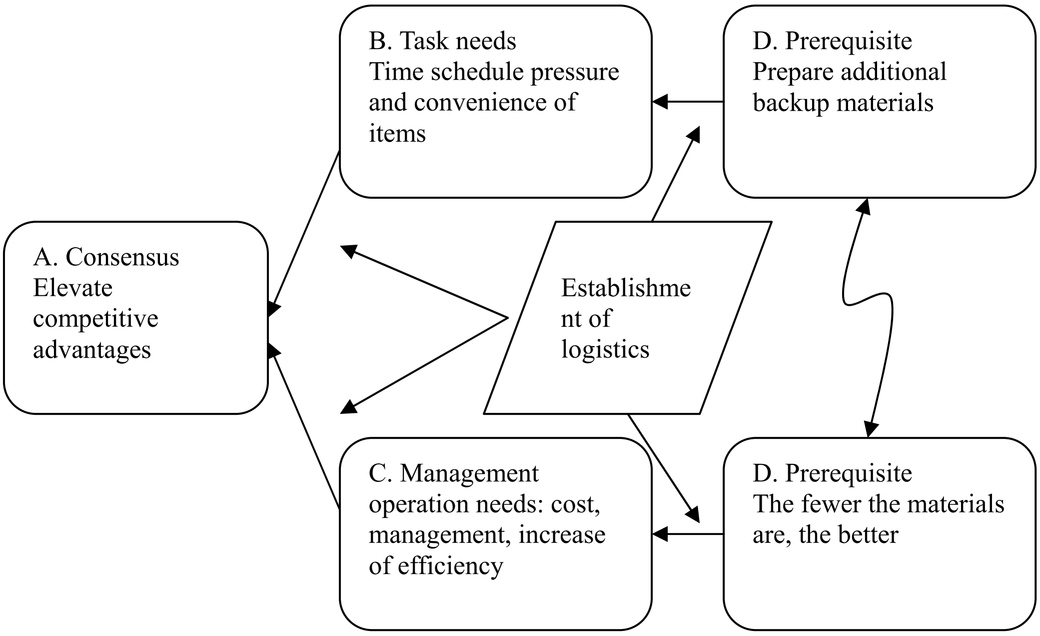

Figure 3 A dedicated logistics management

4.3 Future Reality Tree

From the last section, an important conclusion can be made, in order to elevate the competitive advantages of the institution, a logistics management department should be established to solve the current issues of the research institution and transform UDEs into Des, as summarized in Table 5. Desirable goals, UDEs, and deduced incentive schemes were employed to establish an FRT based on cause and effect relations. Attention should be paid to factors causing adverse impacts in order to determine solutions, which were incorporated into FRT. Based on the deduced results, the establishment of a logistics management department could reduce existing inventory and work costs, and increase management efficiency and competitive advantages of the institution.

Table 5 FRT

Des	UDEs
■ Reduce inventory ■ Reduce quantity of unnecessary equipments ■ Increase stock turnover ■ Quality of items to meet customer needs ■ Time schedule of items to meet customer needs ■ Production quality, time schedule to meet customer needs ■ Quality of R&D, and time schedule to meet customer needs ■ Establish management system for finished and semi-finished products ■ Reduce purchase costs ■ Establish standard cost computation method	■ Too-high inventory ■ Excessive quantity of equipments and high total value ■ Low inventory turnover ■ Item quality cannot meet needs ■ Time schedule of items cannot meet needs ■ Quality and time schedule of production cannot meet customer needs ■ Lack of management system for finished and semi-finished products ■ High purchase costs ■ Lack of complete cost computation method

4.4 PRT

After the establishment of PRT, future development of the research institution had a logical direction. In the future, detailed actions would be required to achieve goals set out in the initiative scheme. In the performance of the initiative schemes, various constraints preventing performance of plans may occur, and all possible constraints would be identified to seek solutions as intermediate goals. Intermediate goals are regarded as milestone of initiative schemes, which are followed in proper sequence until the accomplishment of all initiative schemes are realized, as shown in Figure 4.

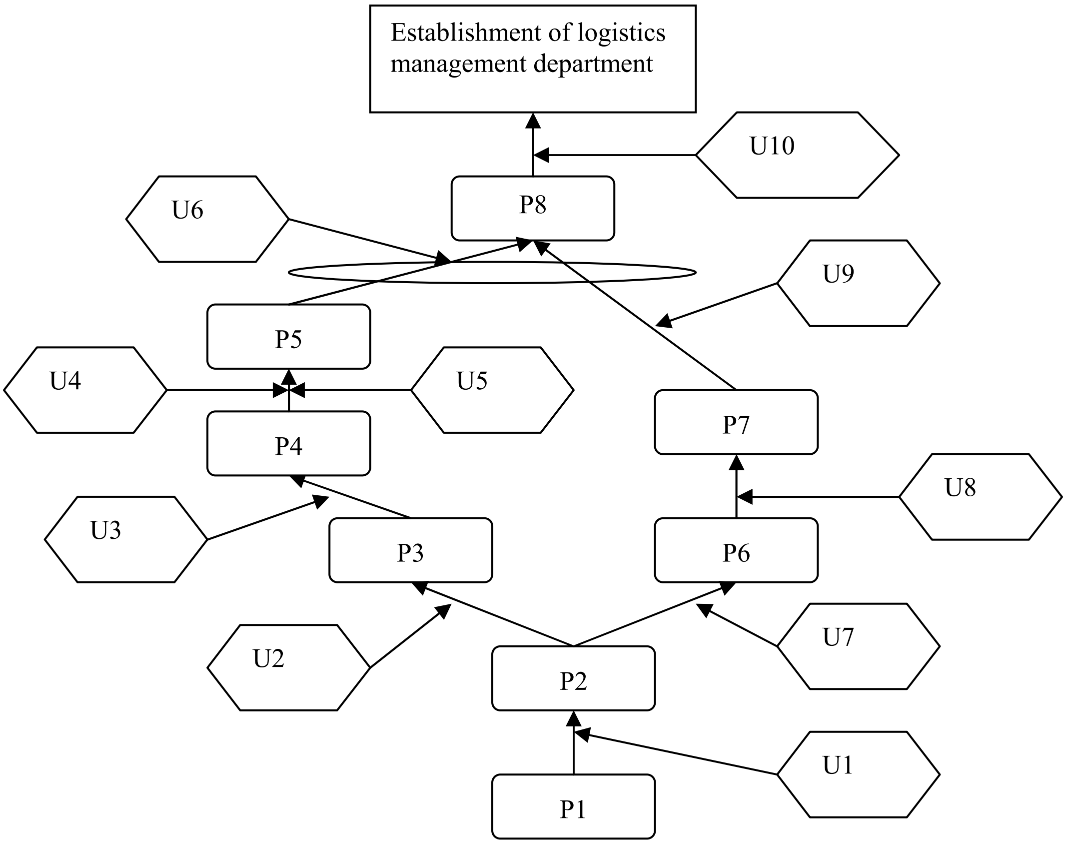

Figure 4 PT

The case PT had eight intermediate goals as follows; P1: the establishment of a lean logistics team, P2: the establishment of a central project team of each institution, P3: the implementation of a central logistics management organization, P4: consistency of business contents and labor force, P5: overall management planning of departments, P6: identify responsibilities for future works, P7: the preparation of work contents and standard work procedures, and P8: confirm a demonstration team, and promote lean logistics work. Case PT had ten UDEs factors: U1: lack of participation of all institution departments into a lean logistics team, U2: undefined logistics organizational architecture, U3: insufficient human power, U4: concerns of items demanders, U5: inconsistent logistics data informatization level, U6: skepticism regarding the feasibility of logistics management, U7: cognitive differences of work categories of logistics management, U8: undefined standard works, insufficient professional knowledge of personnel, and U9: no suitable performance measurement indictors, resulting in low morale of employees.

4.5 Transition Tree

Elevation of overall competitive advantages was a desirable goal, and establishment of dedicated logistics management was the prerequisite; various constraints must be broken in order to accomplish initiative schemes. Thus, action solutions of relative constraints were prepared and regarded as action criteria to be put into practice. In combination with intermediate goals, complete improvement details were established to accomplish initiative scheme, as illustrated in Figure 5. Case TT action criteria were as follows.

T1: Current performance measurement indicators were examined and compared with actual situations.
T2: Differences between the current situation and indicators should be pointed out, and performance indicators should be corrected or increased in order to achieve the effects of appraisals and rewards.
T3: Small-scale testing of new processes and criteria should be carried out to gradually expand test scope.
T4: Corrections should be made to enhance the feasibility of the new system during testing.
T5: Awards should be given to employees who participate in the

establishment of the new system, thus, increasing the morale of employees and building a good example for others.

T6: To increase the confidence of employees for the new standards and processes, methods could be designed for awards in education and training.

T7: Small-scale testing should be conducted first, and then the test scope could be expanded according to sequence, thus, gradually building confidence.

T8: Corrections should be made to continuously improving and enhancing the feasibility of the new system during testing.

T9: Existing operational specifications should be reviewed and compared with actual situations.

T10: Any improper areas should be corrected, defects should be remedied, and consultations should be made with operators in a timely manner.

T11: After reaching agreements, drafts of the operational specifications should be prepared and issued to all departments.

T12: All departments should provide assistance during the review and proof-read final drafts.

T13: Operational specifications should be correlated and built into manuals, and issued to related departments.

T14: During execution of the above procedures, education and training should be provided, corrections should be made in a timely manner; thus, correct operational knowledge could be created.

T15: Investigations of logistics management definitions of all departments should be conducted.

T16: The lean logistics team should make overall plans and coordination, hold meeting, and enter into discussions to reach a consensus on the promotion of logistics management.

T17: All departments should propose cognitive categories of logistics management.

T18: Senior management directors should participate and guide the institution to pay attention to the logistics team.

T19: Lean concepts should be built, and lean awareness of institutional personnel should be fostered through education, meetings, lectures, visits, and activities.

T20: Items demanders should list difficulties and inconveniences of the overall management of items.

T21: Based on the above information, actual situations should be checked, and corrective measures should be proposed in a timely manner.

T22: After the completion of the above steps, descriptions of item departments, and proper education and training should be provided.

T23: Informatization degrees of logistics should be investigated.

T24: Common informatization standards should be prepared.

T25: Existing labor force structure of understaffed departments should be investigated.

T26: Business volumes should be considered.

T27: The human resource structure of other companies in the industry should be referred to in order to fully reflect human resource needs.

T28: Reasonable labor force allocations should be prepared.

T29: Data of industrial logistics management structure should be collected.

T30: Concepts of logistics management organization should be built.

T31: Through site visits, experience effects could be gained, and impressions could be deepened.

T32: A logistics management consulting company should be appointed to help with the planning and coordination of organizational issues.

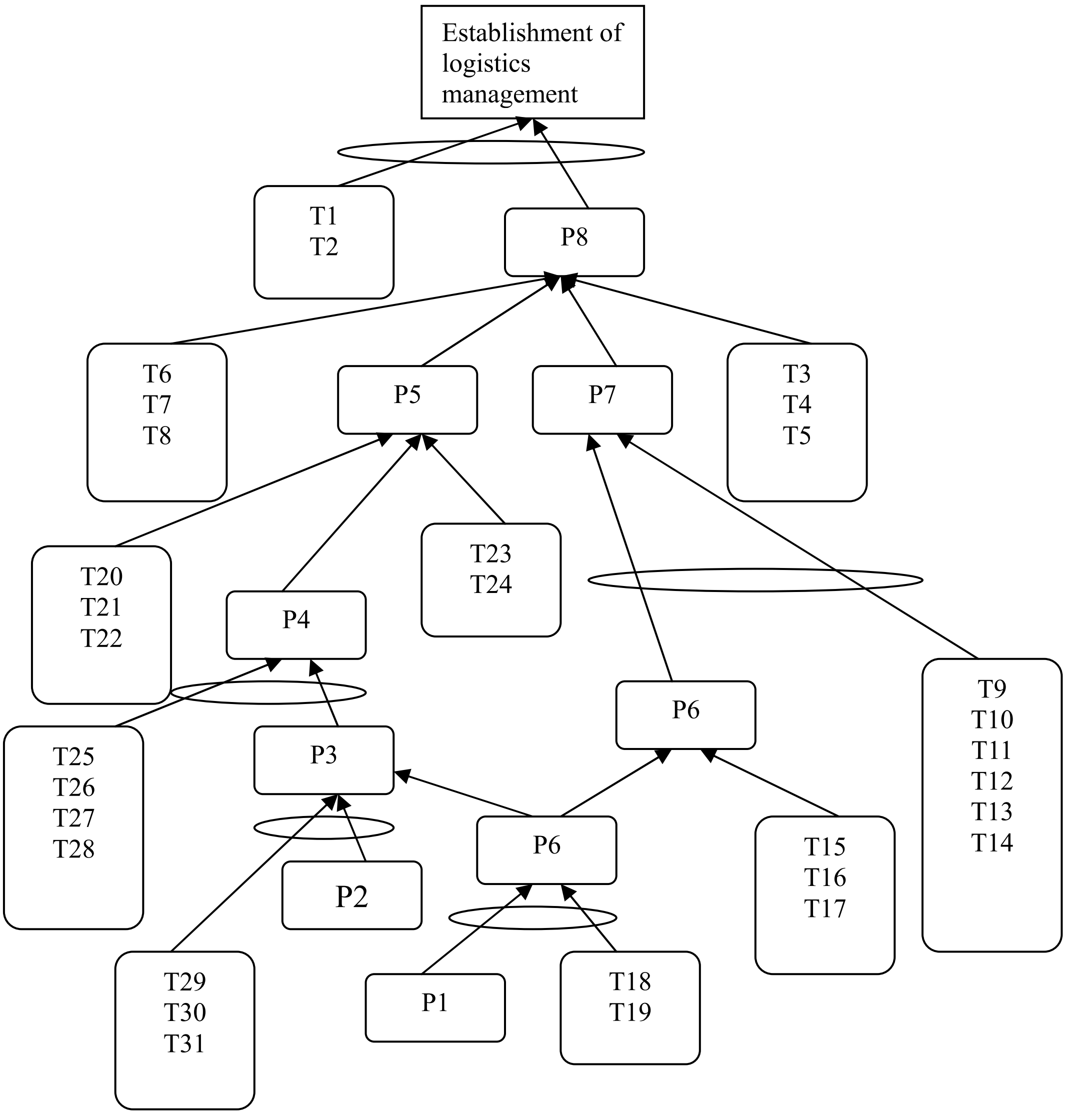

Figure 5 TT

5. Conclusions

Organizations should apply different methods to seek reengineering, such as 5 force analysis, SWOT, etc.. From the perspectives of strategies or any others, it was hoped that the organization could have breakthrough developments through this discussion. This study applied TOC, originated from the systems thinking method, which focused on communication, discussion, and analysis, and identified cause and effect relations through brainstorming to increase the confidence and persuasion in problem solving. This study discussed the current situation of national research institutions, and further explored the current systems of national research institutions. In this case, “inflexible organizational system”, “ill-timed performance indicators”, and “civil servant organization culture” were the core problems that affected the current situation of the national research institutions. For the above three core problems, “elevation of institution competitive advantages” was the future goal of the national research institutions. The findings indicate that the “establishment of logistics management department” was one of the methods to solve the current issues of logistics management of the national research institutions. By doing so, specialized management could be implemented for items to reduce the pressure on time schedules and items, thus, satisfying the task needs of the national research institutions. In addition, centralized purchases can reduce costs.

Due to the natural differences of the research institutions, their understandings of logistics management are different. In the future, specialized organization, such as logistics management, will be established for overall planning and coordination to avoid faults of logistics management. Through the establishment of a logistics management department, improper effects of the system can be determined. Thus, the reduction of inventory and increased stock turnover can increase the management efficiency of finished and semi-finished products, while unified planning, purchases, and reduction of purchase costs can increase the competitive advantages of the institutions. Establishment of a logistics management department can effectively control item requisition and allocation, and accomplish material preparation analysis, which indirectly controls time schedules to meet customer needs. Better receiving inspections and stock controls can facilitate effective management, and are the basic works of material quality assurance; and the establishment of a logistics department can provide high-quality services and elevate the competitive power of the institutions.

This study presented the following suggestions.

(1) In this study, many initiative schemes were proposed through personal brainstorming. In the future, other initiative schemes could be developed in this manner, and from different standpoints, other improvement methods could be proposed.

(2) This study focused on how to reduce item costs of the national research institutions, and how to improve item quality and time schedules to meet customer needs. No deeper analysis was conducted for the areas other than item costs, and how to increase quality and time schedules of production, and research and development to meet customer needs. These areas should be studied in the future.

(3) The national research institution system is large, and involves many operational processes; thus, many constraints are established in order to avoid malpractice. In actual execution, operational flexibility is lower due to the constraints, thus, excessive operation costs are often wasted. How to create a balance between the prevention of malpractice and elevation of efficiency to reduce omissions and increase administrative efficiency will pose challenges for decision makers.

(4) The Theory of Constraints focuses on the communication and coordination among approvers, builders, and decision makers. If the three departments are in communication, processes will become easier; if not, their discussions and good faith interactions will be important, and patience will be an indispensable factor, which can facilitate communications.

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