

The Analytic Hierarchy Process Embedded in
an Information Systems Development Methodology

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Abstract

The strategic planning of information systems has been considered as a critical issue to the growth or survival of companies. Senior management are expected to involve in the planning phase of information systems. But there has been few tools used in planning information systems to make objectives and scope of the system clear.

The authors propose to apply the AHP to development of information systems; especially, in the planning phase for establishing objectives and information requirements for the system in question. Specifically, we have applied the AHP in the System Study and Evaluation Phase of PRIDE, an information systems development methodology. A hierarchy chart which describes the structure of the project is constructed and is refined and evaluated through every activity of the this phase. This process provides management, users of the new system and development team with communication means for sharing the common understanding of the objectives of the system among them. The procedures of the system study with the AHP in a real project will be illustrated.

1. Needs for IS Planning Tool

In spite of its importance for management of corporations, planning of Information systems (IS) has been paid less attention than technical development of IS, and very few techniques for information systems planning(ISP) have been known and used by senior management. On the other hands, management has began to feel the needs to involve in development of information systems as strategic use of IS has been considered to be critical issues to the survival of companies.

Management involvement in planning of information systems requires new tools which describe issues clearly in terms of management, evaluate objectives of development projects, and provide management and IS department with effective communication tool between them. Few authors have pointed out the needs (Lederer & Mendelow, 1986; Stegwee & Van Waes, 1990). Most textbooks of systems design adopt the SDLC (system development life cycles) approach. They define SDLC on condition that the objectives of IS development have been set and given by management, and overlooked the planning stage which should be accomplished before SDLC begins. The conventional tools for systems design (Kendall, 1987, for example) deal with technical matters rather than management aspects. They deal with what is required and how it is computerized. We need to help consider why it is required.

We would like to focus on the planning stage of IS and proposes to use the Analytic Hierarchy Process in developing IS, especially, in the planning stage. Mitchell & Wasil (1989) also applied the AHP to ISP and we have used in a different way. We have considered to apply the AHP to development of IS with help of PRIDE-ISEM, a methodology for systems development. As we assume the readers have known the AHP(Saaty, 1977), no description on the process will be made here (for tutorial, see Harker, 1989). In the next section PRIDE-Information Engineering Methodology is outlined, and then the planning phase of the PRIDE-ISEM will be proceeded using the AHP in the following section.

2. A System Development Methodology and the AHP

PRIDE(PROfitable Information by DEsign through phased planning & control) is a family of products for information systems development emphasizing information resource management (Bryce & Bryce, 1988), a hundred and more major Japanese corporations have been using under the contracts with PRIDE Japan, Inc. in addition to much more users in North America and other parts of the world, with Mylt Bryce & Associates, Inc. The Information Systems Engineering Methodology(ISEM) is one of PRIDE products, and a structured methodology for designing and building information systems, which consists of nine phases:

- Phase 1: System Study and Evaluation
- Phase 2: System Design
- Phase 3: Sub-system Design
- Phase 4-I: Administrative Procedure Design
- Phase 4-II: Computer Procedure Design
- Phase 5: Program Design
- Phase 6: Computer Procedure Test
- Phase 7: System Test
- Phase 8: System Operation
- Phase 9: System Audit

Phases 1 through 5 explode or decompose the system to be developed and the latter phases implode or integrate the system as Figure 1 illustrates.

Throughout the entire phases there are various decision problems to which we can use the AHP. It is assumed that a general business policy for developing a system has been given by management before starting the project. To set up general policies or scenarios of the future for corporations, the AHP methodologies shown by Saaty and Kearns(1985) will be useful.

In this paper we would like concentrate on Phase 1 of the life cycle and propose to apply the AHP. Phase 1 is actually a planning phase and of vital importance. The objectives of IS are identified, information requirements to attain the objectives are reviewed, and the design approach and development schedule of the project are set up in this phase. If we use the AHP in this phase, the above activates are done with hierarchies which explains the structure of issues, and evaluations which gives priorities to items of importance. Management will understand why it is required rather than what is required. Thus the AHP will enable management to engage in planning activities. How the AHP can be used to enhance the IS development methodology will be described in the next section.

3. The AHP Embedded in PRIDE

Phase 1, System study and evaluation, provides the basis for following phases, and of course, the new system. As written before, we concentrate on this phase. The following activities are to be accomplished:

- Activity A: Develop preliminary scope of project
- Activity B: Analyze current systems
- Activity C: Survey information needs
- Activity D: Prepare information requirements & project scope
- Activity E: Review information requirements
- Activity F: Develop System approach & feasibility
- Activity G: Prepare system evaluation

Activity H: User/management review of system approach & evaluation

Throughout this phase the development team works closely with users and management. We propose to use the AHP, especially hierarchies, as vehicles which interfaces between management and development personnel.

At the beginning of this phase, we recommend to create a hierarchy which presents the structure of issues to be dealt with by developing information systems. The objectives are identified first, and areas to be covered by the new system are determined, and then alternative plans are developed using the result of AHP evaluations in the course of activities. We need different hierarchies from activity to activity in this phase. Thus, we redefine hierarchies several times as activities proceed in an evolutionary way, we may call it, as depicted by the Figure 2. A series of hierarchies made in this phase provide management and IS department with a new tool to discuss fundamental issues of system development. We will illustrate how the AHP is used in this phase taking a case of a chemical corporation for example.

3.1. Hierarchy to Identify System Objectives

A chemical corporation in Japan which specializes in fine chemical products wanted to enhance their business through constructing an integrated information system. The products are highly scientific or technological, high-polymer material used chiefly as raw material in various industries. Most of them are made to order. This business is a developing and rather new business for this company and has not been well established nor computerized so much. The management decided to raise the profitability of this line of products by developing an information system to support the business activities.

A hierarchy to identify the objectives of the development project was created at Activity A as shown by Figure 3. This looks like simply a list of objectives. After some discussion we judged the first four objectives dominate the rest and selected as the major objectives for the new system without evaluating priorities through pairwise comparisons. We considered that the minor objectives will be attained as byproducts of major objectives.

3.2. Areas to be Covered by New System

After analysis of information requirements in Activity D, areas to be covered by the new system were enumerated and the hierarchy to give priorities to alternative areas were constructed and evaluated by Expert Choice as shown by Figure 4. This hierarchy consists of three levels. To enhance the fine chemical business was our goal and the four objectives selected already are

at level 2. The areas to be covered by the new system were at level 3 and they are as follows (only capitalized letters are shown in Figure 4 as Expert Choice allows up to eight characters and spaces for labels of nodes):

MarKeT NEEDs --- systematic acquisition of market needs
Research & Development IS --- building a network for
information of development, production & technologies
Quality SYSTEM --- information system for quality
inspections
A/C RECEiVable --- effective support of controlling account
receivable
PROFIT Analysis --- systematic analysis of profits
AGENCIES --- collecting inventory data of sales agencies.

Figure 5 shows the overall evaluation of the areas to be covered. Priorities on research and development, and quality dominate the other areas. This reflects our products are high-technological material for industrial uses.

3.3. Alternative System Plans

Referring to the result of the above evaluation, the development staff constructed three alternatives of system plans. Effect of these alternative plans were analyzed and the hierarchy of Figure 6 were built for the final management review in this phase. As it was recognized that restrictions in development and transfer from the current system to the new should also be taken into consideration, functional objectives and restrictions were placed at level 1 and details of these at level 2. Level 3 consists of the three alternatives of system plans as follows:

Plan X --- General system which integrate production, sales and logistics.
Plan Y --- System which covers production, and raw material control.
Plan Z --- System which covers sales, distribution, and profit control.

This hierarchy was evaluated in the usual manner and Plan Z was selected for actual development.

4. Benefits from the AHP

Constructing hierarchies, both management and IS staff could structure issues in IS planning more clearly than before and have the common understanding of the system to be developed.

This enables both parties make better communication not only in planning IS but also in the entire course of development. Until now, users and IS personnel could communicate well following the procedures of PRIDE, but it was rather difficult for management and IS staff to communicate because there were few tools which dealt with management aspects of IS planning and development. Imbedding the AHP in the planning and development as described in this paper management are able to be involved in IS planning easier than before.

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Figure 1: System Structure and Methodology
 (Bryce & Bryce, 1988, p.152)

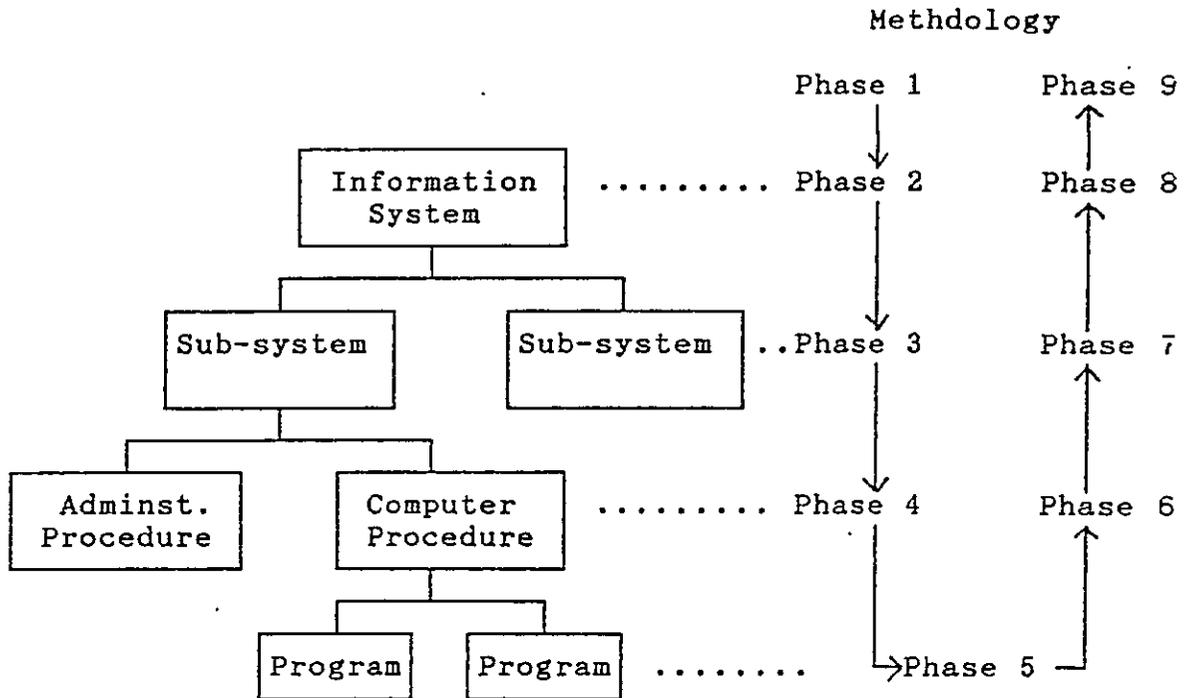


Figure 2: System Study Phase and Evolutionary Use of the AHP

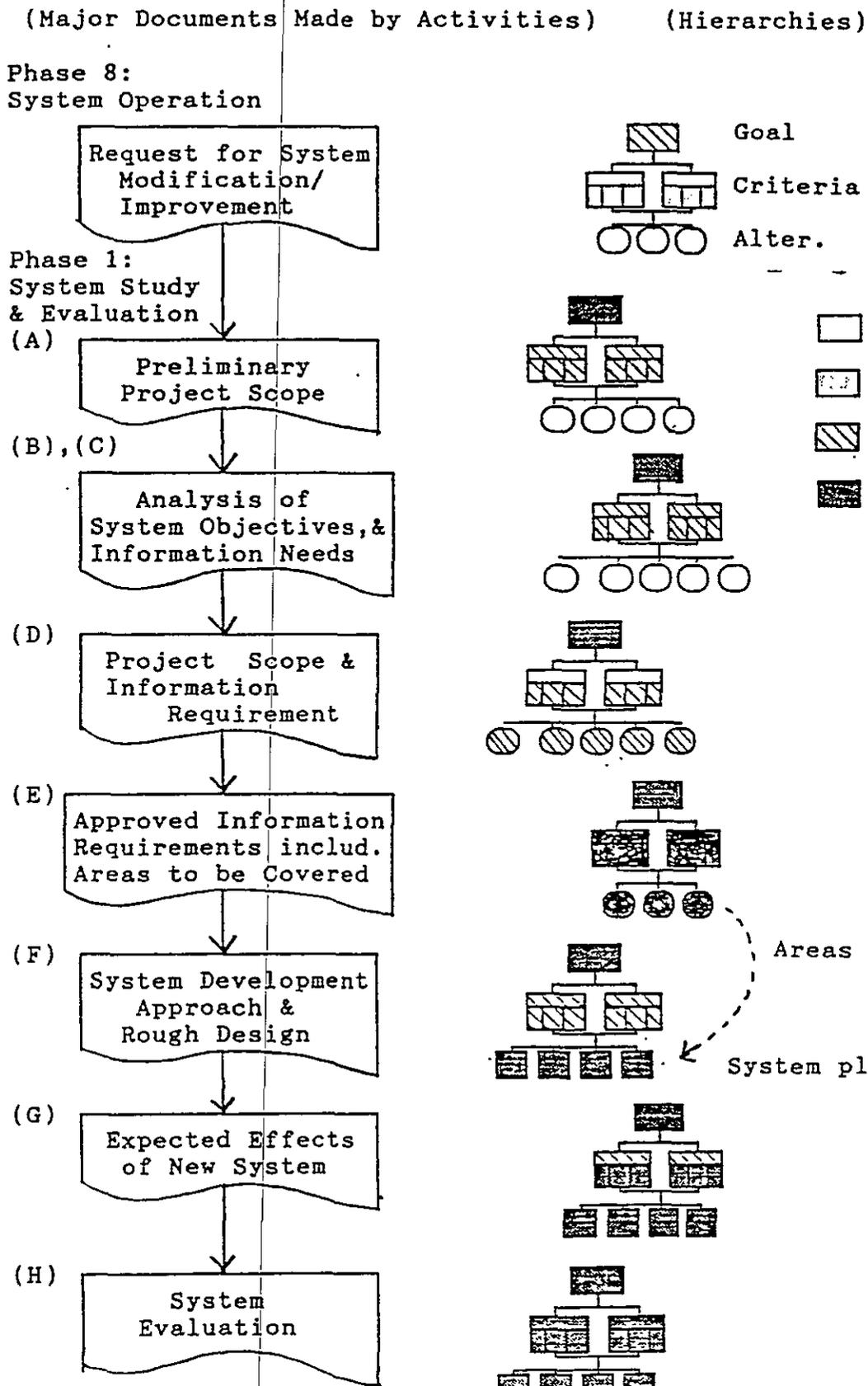


Figure 3: Hierarchy for Identifying Objectives

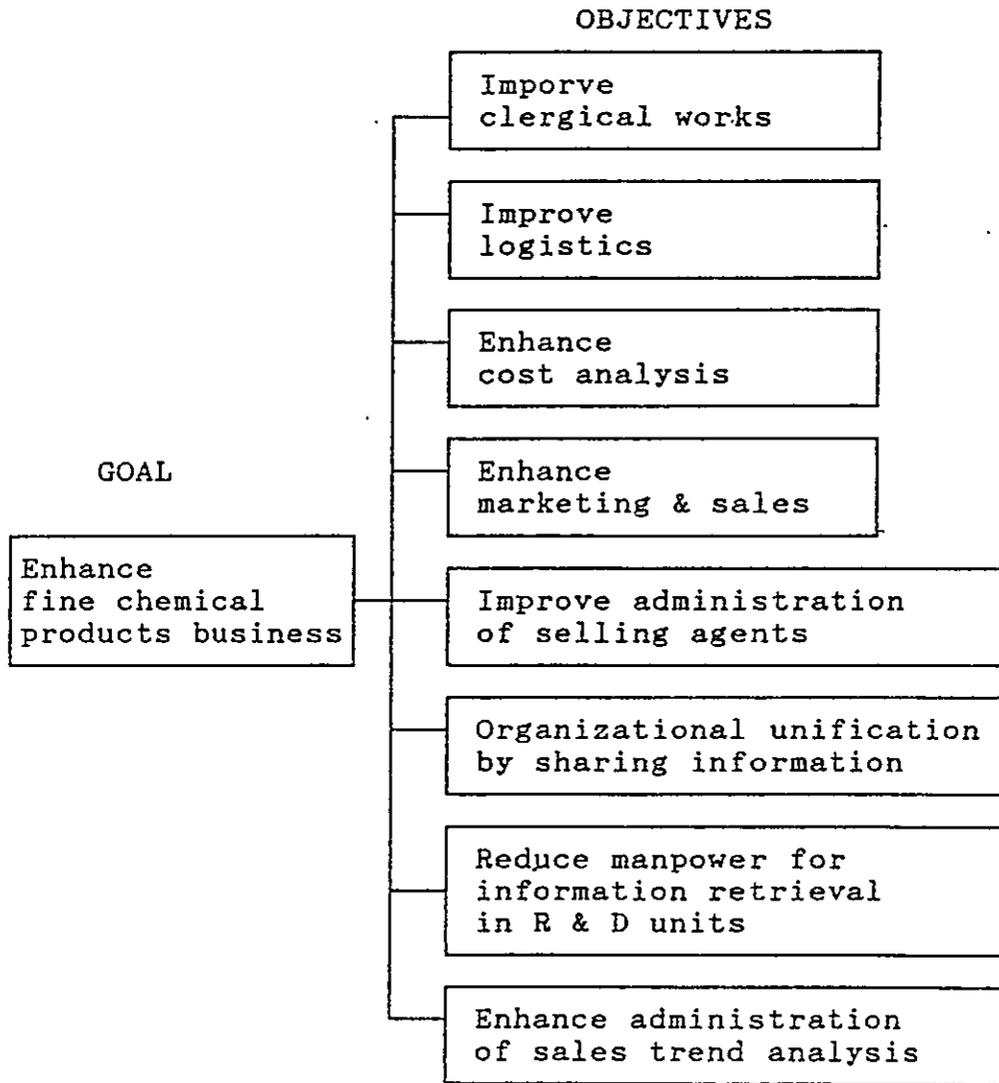


Figure 4: Hierarchy for Selecting Areas to be Covered

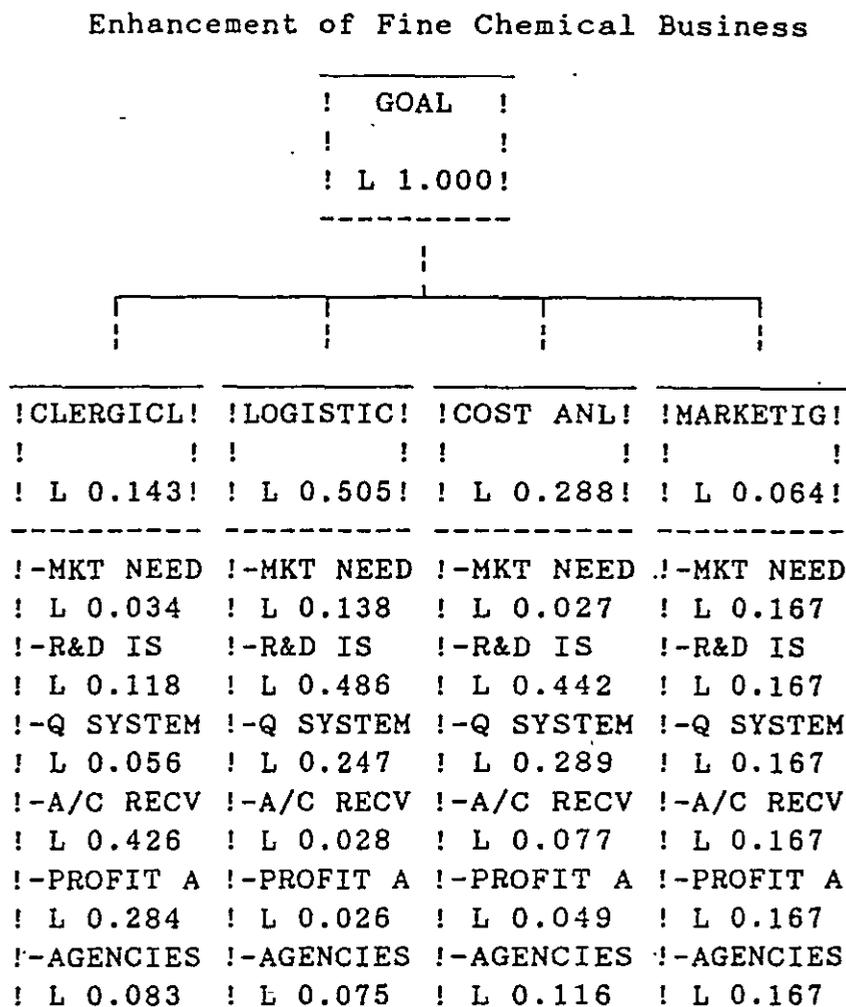


Figure 5: Overall Evaluations of Areas to be Covered

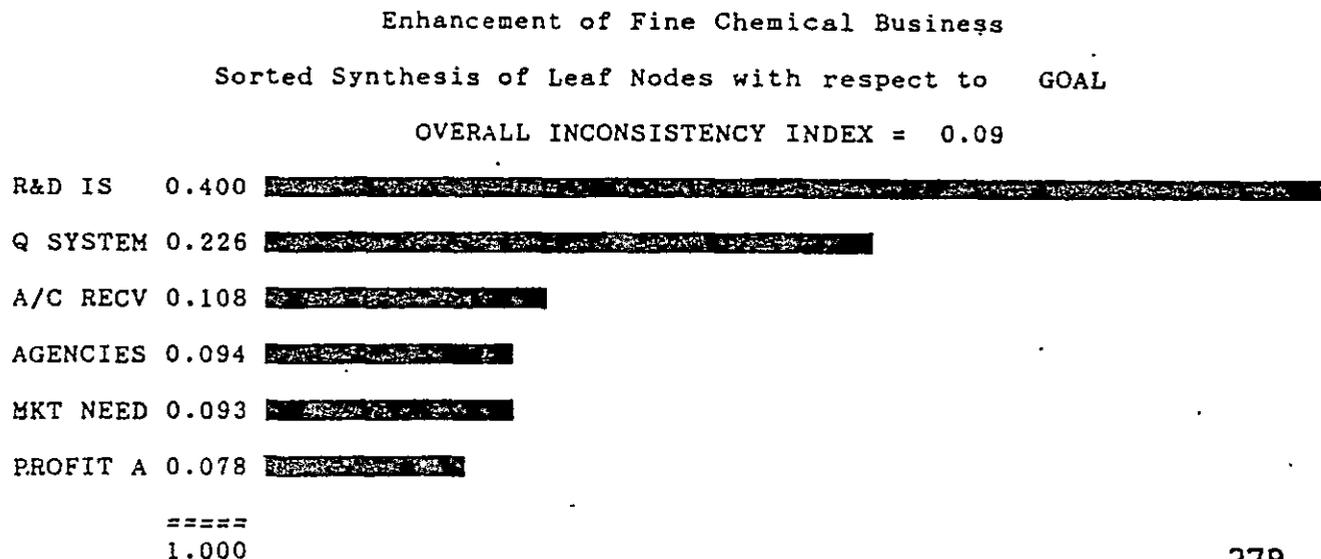


Figure 6. Hierarchy for Selecting System Plan

