HIERARCHIC INFORMATION STRUCTURE DESIGN FOR CORPORATE FINANCIAL MANAGEMENT SIMULATION SOFTWARE

Samir Chakraborty

TransCanada Telephone System,
410 Laurier Ave. W., Ottawa, Ontario, Canada K1P 6H5

ABSTRACT

Managing a corporation for strategic success is defined as the Corporate Management Process. It is primarily a process of identifying and minimizing constraints on the resources of the corporation and is in fact a problem solving activity. A key element of the Corporate Management Process is the management of the financial resources of the corporation. This is also a problem solving activity, defined as the Corporate Financial Management Process. Simulation software based on hierarchically defined information structures are used extensively as part of this process.

1. INTRODUCTION

The prime task of a corporation's management is clearly the act of efficiently and effectively marshalling the resources of the corporation. This in turn results in the prime ongoing managerial effort being: to manage corporate constraints.

We define this effort as the Corporate Management Process, a key element of this is managing financial constraints. This in itself is a problem solving activity defined as the Corporate Financial Management Process. It is an integral part of and closely intertwined with the Corporate Management Process.

Three basic general systems concepts underlie our approach to the Corporate Financial Management Process. The concept of the Generalized Managerial Problem Solving Methodology is used to model and structure the generic elements of both the Corporate Management Process and the Corporate Financial Management Process.

The concept of the Process Hierarchy Framework is used to model and structure the information used during simulations in the two processes. These models are embedded in software and used for simulation during various stages of the Corporate Financial Management Process.

Finally, the concept of the Corporate Management Process is used to model, structure and define the specific elements and dynamics of the Corporate Financial Management Process.

During both processes, once the relevant information has been structured using the Process Hierarchy Framework, with simulation techniques, it is possible to pretest many alternative business/financial plans in searching for the most advantageous business opportunities.

Section 2. reviews the Relevant General Systems Concepts. Section 3. briefly outlines the Corporate Financial Management Process and its hierarchic information structures and some software design considerations while Section 4. provides some concluding remarks.

2. RELEVANT GENERAL SYSTEMS CONCEPTS

2.1 THE HIERARCHY OF EPISTEMOLOGICAL LEVELS OF SYSTEMS

Relevant information concerning the corporate Management Process is modelled, structured and simulated using the Process Hierarchy Framework which is based on the Hierarchy of Epistemological Levels (e-levels) of Systems (16). This concept of the hierarchy of e-levels is based on the theory that any object of interest (automobile, planning process, the brain, a computer system, etc.) can be viewed by an examiner at different selected levels of knowledge (e-level) about it. Thus, a given object of interest maybe defined/described by a hierarchy of systems based on the levels of knowledge one wishes to view the object at (see Table I). A higher e-level system entails all knowledge of the corresponding systems at any lower e-level and contains some additional knowledge which is not available at the lower e-levels.

2.2 THE GENERALIZED MANAGERIAL HIERARCHY OF EPISTEMOLOGICAL LEVELS OF SYSTEMS

The hierarchy of e-levels of systems when applied to an organization/company/Process in a general managerial context is redefined as in Table II (3, 4, 5, 7).

Proceedings of the 1982
Winter Simulation Conference
Highland * Chao * Madrigal, Editors

82CH1844-0/82/0000-0557 $00.75 © 1982 IEEE

The managerial system defined on the Process/company at an e-level is defined as the set consisting generally of the following two subsets of management information.

The first subset ( ) generally represents the relatively time-invariant/"static" dimensions of the Managerial System. The second subset ( ) generally represents the ( ) relatively time-variant/ "dynamic" dimensions of the Managerial System.

At any given e-level beyond 3, an Operational System set can be defined as = ((Lower e-level system), (Managerial System))

2.3 THE PROCESS HIERARCHY FRAMEWORK

The concept of the Generalized Managerial Hierarchy of Epistemological Levels of Systems when applied to any company, results in the definition of the company using a framework based on the hierarchy of Processes within the company.

The Process Hierarchy Framework can take on various forms depending on the problem solving application (6, 7, 8, 9, 11, 12, 13, 14, 15) one is interested in. This section shows the Process Hierarchy Framework in its role for the Corporate Information Structure.

2.4 THE CORPORATE INFORMATION STRUCTURE

2.4.1 Logical Structure

The Process Hierarchy Framework is used to model, structure, simulate and communicate the information during the Corporate Management Process. It is described as in Table III.

2.4.2 Information Set - Contents

The contents of the Corporate Information Structure Set at a given Process Hierarchy Level/ Structure-Level is defined, generally, by two subsets:
(a) Unit-Names Subset.
(b) Unit-Description Subset.

The Unit-Names subset is a Collection of descriptive names or phrases, one for each of the units, which are the building blocks at the given Process Hierarchy Structure level, of the larger unit.

The Unit-Descriptions subsets at a given structure level are broadly categorized to consist of two subsets each:

- Static Information Subset.
- Dynamic Information Subset.

2.4.2.1 Static Information Subset

The Static Information subset of the Unit Description set generally consists of the categories of information (or subsets), regarding the Unit at a given Structure-Level as described in Table IV.

2.4.2.2 Dynamic Information Subset

The Dynamic Information Subset of the Unit-Descriptions set generally consists of the categories of information (or subsets) regarding Unit at a given Structure-Level as described in Table V.

2.5 THE GENERALIZED MANAGERIAL PROBLEM SOLVING METHODOLOGY

The next concept is that of the Generalized Managerial Problem Solving Methodology (1, 2).

The Problem Solving focus on the "object" of our interest requires the integrated application of two disciplines:

(a) A systematic, manageable, complete and efficient way of attacking the problem/"object" of our interest.

(b) A createable, available, reliable and maintainable framework for storing information regarding the problem/"object" of our interest.

TABLE I

The Hierarchy of Epistemological Levels of Systems

Epistemological Level (e-level)	System Name
0	Source System
1	Data System
2	Generative System
3	Structure System
4	Metasystem
5	Meta-Metasystem

TABLE II

The Generalized Managerial Hierarchy of e-levels of Systems

e-level	System Name	Contents of System Set
0	Source	(Variables, space-time resolution level)
1	Date	(Source Systems, activity matrix)
2	Micro	(Data Systems, time-invariant relations/ generating behaviour)
3	Functional	(Micro Systems, coupling variables/ relations)
4	Operation -I	(Functional Systems, Managerial System-I)
X	Operation - Y	(Operation - (Y-1) Systems, Managerial System - (Y))

TABLE III

Process Hierarchy Framework: Corporate Information Structure

Process Hierarchy Level	Unit/Set Name	Contents of Information Set at Given Structure Level
0	STEP	(Function, STEP Description)
1	METHOD	(STEPS, METHOD Desc.)
2	PROCEDURE	(METHODS, PROCEDURE Desc.)
3	SUBSYSTEM	(PROCEDURES, SUBSYSTEM Desc.)
4	SYSTEM	(SUBSYSTEMS, SYSTEM Desc.)
5	PROCESS	(SYSTEMS, PROCESS Desc.)
6	COMPANY	(PROCESSES, COMPANY Desc.)

TABLE IV

Static Information Set: Corporate Information Structure

(General Introduction,
Goals,
Markets,
Products/Services
Objectives,
Strategies,
Budgets,
Subunits, Building Blocks for Main Functions,
Functions Relationships - Sequence Schematic,
Key Decisions, Measurements,
Key Planning Areas,
Key Results Areas,
Key Activity Cycles,
Approvals and Controls,
Results,
Organization Structure,
References to Operating Information Sources.)

TABLE V

Dynamic Information Set: Corporate Information Structure

(Operating Unit Objectives,
Operating Unit Organization Structure,
Unit Budget,
Unit Work Program,
Unit Manpower Plans,
Unit Results,
Unit Constraint Resolution Areas,
Unit Job Description,
Unit Notes,
Unit References)

TABLE VI

Conceptual Model Relationship: The Generalized Managerial Problem Solving Methodology	Process Activity Steps The Corporate Management Process
	Strategic Planning:
(1) Preliminary Analysis	(1) Develop Futures Scenarios
(2) Synthesis	(2) Determine Corporate Issues
(3) Analysis	(3) Develop Strategic Direction for the Corporation.
(4) (a) Constraint Identification & Minimization (performance of)	(4) Develop detailed Strategies/Plan Recommendations & Alternatives for implementing Strategic Direction.
(b) Design Modification & Test	
	Strategic Decision Making:
(5) Constraint Identification & Mini - mization (finalization of)	(5) Decision Making on Recommendations.
	Strategic Implementation:
(6) Implementation	(6) Implementation of Recommendations
(7) Monitoring & Maintenance	(7) Maintenance & Monitoring

Given the existence of Item (b), which is described in Section 2.4, the main activity steps in the Generalized Managerial Problem Solving Methodology are briefly summarized in Table VI.

2.6 THE CORPORATE MANAGEMENT PROCESS

The Generalized Managerial Problem Solving Methodology is used as the model for defining the Corporate Management Process (10). The Corporate Management Process is viewed as a macro-problem solving activity focusing on the corporation as a whole, and its activity steps are as shown in Table VI (15).

3. THE CORPORATE FINANCIAL MANAGEMENT PROCESS

3.1 GENERAL

The Corporate Financial Management Process (15) is a key component of the Corporate Management Process and focuses on the financial resources of the corporation. In a grossly simplified sense, the earning power of the corporation is the ultimate financial measure by which further investments (debt or equity) in the corporation is justified by those who provide the investments. Thus the management of the financial resources of the corporation is the prime (externally viewed) function of the Corporate Financial Management Process.

The Corporate Financial Management Process is primarily concerned with the: Planning for; Selecting/Determining of; Acquisition/Disbursement of; Recording and Reporting on the financial assets/resources of the corporation, in an effective and efficient manner.

3.2 THE PROCESS

The specific model, structure and operational dynamics of the Corporate Financial Management Process (see Table VII) is directly derived from that of the Corporate Management Process and its activity steps are as briefly summarized in Table VII.

3.3 THE INFORMATION STRUCTURES

The information structures used for key parts of the Process during the modelling and computer simulation activities are derived from one or more elements of the Process Hierarchy Framework - Static Information Sets and Dynamic Information Sets as shown by the following examples. They are finally integrated as shown by the hierarchy merge in Table XIV.

Thus, the Revenue Forecast Model uses the hierarchies of markets (Table VIII, IX) and the hierarchies of the products/services (Table X, XI) to structure its revenue information and perform simulation runs. Among the many simulation variables in this highly complex model are: net/main station gain, inward/outward movement, intra/inter toll messages, general economic/demographic factors, revenues by market segmentation and product/service hierarchies, etc.

The Expense Budget model (Table XIII) uses the ZBB concept applied to the organizational elements of the Process Hierarchy Framework defined on the company. The hierarchy of "decision units" and their "increments" for the ZBB applications match the Process Hierarchy based organization structure of the company. The simulation variables include: manpower, salaries, travelling, miscellaneous expenses, loadings, productivity improvement programs and their savings impact, inflation etc.

TABLE VII
Structure & Logical Equivalency

The Corporate Management Process	The Corporate Financial Management Process
Strategic Planning:	Financial Planning:
(1) Develop Futures Scenarios	(1) Develop Financial Environment Scenarios
(2) Determine Corporate Issues	(2) Determine Financial Issues
(3) Develop Strategic Direction for the Corporation	(3) Develop Strategic Financial Direction for the Corporation
(4) Develop detailed Strategies/Plan Recommendations & Alternatives for implementing Strategic Direction. This includes the Corporate Business Plan and support plans- marketing, financial, technical, etc. Extensive use is made of various models and simulation runs performed, for impact/ contingency analysis.	(4) Develop detailed Strategies/Plan Recommendations & Alternatives for implementing the Strategic Financial Direction. This includes the Corporate Financial Plan and support Plans - Corporate Budget, Construction/(Capital) Budget, Expense Budget, etc. These plans are modelled and simulation runs performed for impact analysis.
Strategic Decision Making:	Financial Decision Making:
(5) Decision Making on Recommendations	(5) Setting specific Financial Targets, and Plans to be executed in the planning period.
Strategic Implementation:	Financial Implementation:
(6) Implementation of Recommendations	(6) Implementation of Financial Plans including Budgets, Financing, Purchases, Audits, Payments, etc.
(7) Maintenance & Monitoring	(7) Recording, Reporting, Controlling the Financial transactions of the corporation.

NOTE

Both processes are highly dynamic, interactive, iterative, formal/informal, non sequential and use simulation models for impact/contingency analysis.

TABLE VIII

The Market Information Structure - Hierarchy: Revenue Model

Residential Market:
- Metropolitan Sector:
  - Sub-Metro Segment:
    - Customers By Location:
      - Specific Customers:
- Non-Metropolitan Sector:
  - ----------

Business Market:
- Resource Sector:
  - ----------
- Construction Sector:
  - ----------
- Manufacturing Sector:
  - See Table IX for more detail.
  - ---------- etc.

TABLE IX

Business Market - Manufacturing Sector - Hierarchy: Revenue Model

Business Market:
- Manufacturing Sector:
  - Food and Beverage Segment:
    - Meat and Beverage Segment:
      - Customers Ottawa/Region X:
        - Specific Customer Name and Characteristics:
- Fish Products Subsegment:
  - ----------
- Fruit and Vegetable Products Subsegment:
  - ----------
- Dairy Products Subsegment:
  - ----------
- Feed Products Subsegment:
  - ----------
- ---------- etc.

TABLE X

The Services/Products Information Structure - Hierarchy: Revenue Model

```
Business - Information Handling:
    Business Group - Telecommunications:
        Group Services - Toll:
            ------------------------

        Group Services - Terminals:
            Service/Product Families - Single Access Terminals:
                ------------------------------------ etc.
            Service/Product Families - Multiple Access Terminals:
                Service/Product Lines - Large Terminal Systems:
                    Product - PABX System A1 (See Table XI)
                    ------------------------ etc.
                ------------------------------------------- etc.
            ------------------------------------------------ etc.
```

TABLE XI

Large Terminal Systems - Product and Feature Hierarchy: Revenue Model

SYSTEM:	PABX SYSTEM A1	PABX SYSTEM A2
Technology:		
System Size Features:		

Console Features:		

Station Instrument Types:		
------------------------ etc.		
Special Instruments:		
Key Systems:		
Electronic Instruments:		
------------------------ etc.		
Station Operating Features:		

Traffic Analysis, Control and Routing Features:		
------------------------ etc.		
Common Equipment and Control Features:		

------------------------ etc.		
---------- etc.		

TABLE XII

The Construction Budget Hierarchy (Capital Related)

```
Construction Budget:
     Basic Growth Programs:
          Station Equipment Programs:
               Routine Estimates:
                    Routine Jobs:
                         Routine Work Orders;
                              Green Sheets:
               Specific Estimates:
                    Specific Jobs:
                         Specific Work Orders:
                              Green Sheets:
          Switching Equipment Programs:
               ----------
          Loops Equipment Programs:
               ----------
          Facilities Equipment Programs:
               ----------
          General Equipment Programs:
               ----------
          Building & Land Programs:
               ----------
     Major Growth Programs:
               ----------
     Discretionary Programs:
               ----------
     Contract Programs:
               ----------
     Contingency Programs:
               ----------
     Expense Programs:
               ----------
```

TABLE XIII

The Expense Budget Hierarchy (People Related)

```
Company:
     Division:
          Departments:
               Sections:
                    Groups:
                         Decision Units:
                              Individuals:
                                   Salaries Expenses:
                                   Travelling Expenses:
                                   Miscellaneous Expenses:
     Division:
          ----------
     Subsidiaries:
          ----------
```

TABLE XIV

The Financial Hierarchy Merge

Income Statement and Balance Sheet:

- Corporate Budget:
  - Expense Budget:
  - Construction Budget:
  - Other Expenses:
- Revenue Forecasts:
- Financing Plan:
  - Source and Use of Funds:
  - Debt:
  - Equity:
  - Etc.

NOTE

The Financial Hierarchy Merge is a key part of the Corporate Business Plan/Corporate Strategic Plan (9, 10, 11).

The Construction (Capital) Budget Model (Table XII) uses the ZBB concept in addition to Portfolio Management applied to the product/service elements of the Static Information Set and the Dynamic Information Set of the Process Hierarchy Framework defined on the company. The resulting hierarchy of "decision units" and "increments" of the Construction Budget is actually the hierarchy defined by: projects, programs (& phases), estimates, jobs, work orders, etc. The simulation variables include the construction budget programs by category: basic growth, growth, discretionary, contract, contingency for the various classes of plant: station, loops, switching, facilities, data, special services, general equipment. This also cross-indexed by key planning area and product/ service segmentation hierarchy. Further, simulations for risk analysis use EPS, NPV, PWAC, Benefit Index, etc., variables.

In setting up the Corporate Budget Model (Table XIV), the hierarchy of the Expense Budget is matched with that of the Construction Budget requirements and "other" revenue and expense items. The simulation variables include the various budget variables and other income statement, balance sheet, use of funds, cash flow and financial planning variables (incl. debt/equity, payout ratio, etc.)

Thus, the models based on the Process Hierarchy Framework provides a well connected hierarchy merge and powerful mechanism (Table XIV) for viewing via simulations, the inherent interrelationships between the many different causal elements that define the Corporate Financial Management Process.

3.4 INPUTS/OUTPUTS

The Corporate Financial Management Process receives several key inputs and generates outputs based on the extensive use of models and simulation runs, essential for the effective and efficient management of the company.

These inputs to the process in addition to the traditional operational accounting ones, include: the Corporate Business Plan and the Corporate Economic Outlook and Forecasts, Corporate Marketing Plan, Corporate Technical Plan, Corporate Regulatory Plan, Corporate Information Systems Plan, Corporate Human Resources Plan, Expense Budgets, Construction Budget, Corporate Provisioning (costs) Plan, etc.

The approved ouputs of the process in addition to the traditional accouting/disbursing/ recording/reporting ones, include: the Coprorate Financial Plan, Corporate Budget, Expense Budget, Construction Budget, Financing Plan, Audit Plan, Financing (EDP) Systems Plan, Annual Reports, etc.

3.5 CORPORATE INFORMATION STRUCTURE SOFTWARE-DESIGN CONSIDERATIONS

In this section we briefly highlight the key factors that influence the design of the simulation software for the Coporate Financial Management Process. The tranditional descriptions of the database structure, programming concepts and other important software principles that apply are not rehashed here.

3.5.1 Users/Designers Needs

The operational software design of the Process Hierarchy Framework based Corporate Information Structure and its financial managment elements has to meet the requirements of both the users and designers.

Thus, in general, this Process Hierarchy Framework, which is the basis of our Corporate Financial Management Information Structure, satisfies the following criteria:

(1) is universal, unrestricted and compatible with any language.

(2) allows "all" information regarding the Company/ Process to be included.

(3) allows various levels of knowledge to be expressed fully and accurately.

(4) represents the hierarchical nature of the information generating mechanisms.

(5) allows synthesis and analysis to be performed on the information contained in it.

Specifically, the users will require that the Information Structure be capable of:

(a) describing different organizational and managerial dimensions.

(b) varying the formats of inputs and outputs.

(c) varying the number and type of variables in the structure.

(d) allowing for the access, use and update (addition/deletion) of discrete subsets of the Information Stucture.

The designers (software) needs focus on the ability to:

(1) design and operate components/subsets of the Information Structure independently.

(2) add/modify/delete components/subsets to the Information Structure without having to redesign the whole.

3.5.2 Constraints on Information Contents

The need the users and designers (software) have in common is the ability to change with ease the scope and depth of the Corporate Information Structure. This ability to say "expand/ contract" the Corporate Information Structure is a function of the following constraints on the information contents:

(a) Limiting the number of variables that have to be described.

(b) Limiting the number of coupling relationships between subsets.

(c) Ensuring that subsets describe complete functional relationships and not share them between subsets.

(d) Ensuring that the number of subsets that have to be activated to describe one subset, is limited.

These constraints are of prime importance to the users who in fact determine the scope and depth of the information required. Depending on the judgement applied, both the design and the use of the Corporate Information Structure can be made simple or complex.

3.5.3 Software Design Guidelines

Given the users/designers needs and the constraints on information contents, the following are some of the prime thrusts and guidelines to be used during the design of the software for the Corporate Information Structure:

(a) Proper definition of components/subsets that will define the boundaries of the Names and Descriptions subsets. This activity is not merely a question of asking users what subsets they can do without, because they may tend to over/under state their requirements and not anticipate their own future needs. It is in fact a highly focused activity where one initially searches for minimal number of subsets and then for the minimal number of incremental subsets that will describe the Information Structure.

(b) Identifying, separating and codifying those portions of subsets or subsets themselves that are relatively time-variant and time-invariant. This allows for the isolation of the relatively time-variant portions or subsets and for the design of well defined interfaces between these subsets and the rest. This results in some loss of structure generality but enables the structure to be a lot more efficient in its operation and modification for specific application.

(c) Using an access/use - instruction set and variables in the Names and Descriptions subsets that in fact make the Information Structure behave like a "virtual-machine" for its users.

(d) Defining components/subsets of the Information Structure such that:

- they can be invoked and used independent of each other.

- they are hierarchically ordered where each level of the hierarchy provides testable and usable subsets. This is in fact assured by the use of the Process Hierarchy Framework which uses the rules that:

  (1) level 0 contains the subsets that use no other subsets (e.g., the STEP).

  (2) level i ($i \geq 1$) contains the subsets/components that use at least one subset at level i-1 and no subset at a level higher than i-1.

- that subsets (X) use other subsets (Y) under the conditions that:

  (1) subset X is essentially simpler than subset Y, which it uses.

  (2) subset Y is not significantly more complex because it is not allowed to use subset X.

  (3) there is a useful subset containing subset Y and not subset X.

  (4) there is no subset containing subset X and not subset Y.

(e) Testing the subsets for completeness and logical consistency while aiming for their minimal number.

3.6 PROCESS RESPONSIBILITIES

The operating responsibilities assigned to the Corporate Financial Management Process are generally divided up between the functions of the Controller and the Treasurer. Depending on the nature of the organization, some of these functions can also be allocated to other parts of the organization. Prime inputs and direction are received from the Strategic Planning Process (9).

3.7 PERFORMANCE INDICATORS

There are a host of performance indicators that are simulated to directly reflect on the Corporate Financial Management Process. These include the so called "acid tests" of business performance and the "acid tests" of management performance (10).

The ones briefly mentioned here are those that we believe simulate and reflect (in a grossly simplified sense) the earning power of the corporation, as seen by potential investors. It is to maximize this earning power that the Corporate Financial Management Process is aimed.

These indicators include: Current Ratio, Percentage Composition of Current Assets, Quick Ratio, Receivables Turnover, Inventory Turnover, Debt to Net Worth, Times Interest Earned, Times Dividend Earned, Earnings Per Share, Price to Earnings Ratio, Payout Ratio, Return on Residual Earnings, Operating Ratio, etc.

4. CONCLUSIONS

The Corporate Financial Managment Process is a key part of the Corporate Management Process of a corporation. Its focus is the financial resources of the corporation and the associated planning, selecting/determining, acquisition/disbursement, recording/reporting/control, and financial systems upgrade required to meet corporate objectives.

Three general systems concepts among others enable us to better model, simulate, analyze and manage this Process. These concepts impact the Process design, its dynamics, information structures and software design, allocation of responsibilities, inputs/outputs, etc.

These concepts are:
(a) The Generalized Managerial Problem Solving Methodology
(b) The Process Hierarchy Framework
(c) The Corporate Management Process.

These concepts have been selectedly applied to modelling and simulating other corporate management activities including Strategic Planning, Organization Redesign and Change, Market Planning, Budgeting, Hardware Systems Design etc., in a mid sized, capital/technology intensive Canadian telecommunications company since 1977.

5. REFERENCES

(1) Chakraborty, S., "A Managerial problem Solving Methodology." In G.J. Klir (ed.), Applied General Systems Research. New York: Plenum Press.

(2) _____, "Preliminary Analysis in Managerial Problem Solving." In F. Pichler (ed.), Progress in Cybernetics & Systems Research -Volume VII. Washington, D.C.: Hemisphere Publishing.

(3) _____, "A Hierarchy Theoretic Approach to Structure Management Information." Proceedings - International Computer Symposium - 1978. The Chinese Academy of Sciences, Republic of China: Taipei.

(4) _____, "A Process Hierarchy Framework for Management Information Systems Design." Proceedings - 12th Hawaii International Conference on Systems Science. Hawaii: Honolulu.

(5) _____, "Information Structures for Management Process Problem Solving." Proceedings - 15th IEEE International Conference On Communications. New York: IEEE Press.

(6) _____, "Why Managers Avoid Planning and What Top Management Can do About It." Planning Review, Volume 7, #3, May.

(7) _____, "Hierarchic Information Structure Design for Management Process Problem Solving." In R.F. Erricson (ed.), Improving the Human Condition: Quality & Stability in Social Systems. New York: Springer-Verlag.

(8) _____, "A General Systems Approach to Redesigning Corporate Organization Structures." In B.H. Banathy (ed.), Systems Science & Science. Louisville: SGSR Press.

(9) _____, "The Strategic Planning Process: A General Systems Approach." Proceedings - Fifth European Conference on Cybernetics & Systems Research. Austrian Cybernetic Society, Austria: Vienna.

(10) _____, "The Acid Tests ofManagement Performance -A Systems View," in G.E. Lasker (ed.), Applied Systems and Cybernetics. Oxford: Pergamon Press.

(11) _____, "The Corporate Business Plan - A Systems Theoretic Approach." Proceedings - 1980 IEEE International Conference on Cybernetics and Society. New York: IEEE Press.

(12) _____, "Hierarchical Information Structures for Market Planning Software." Proceedings -The International Computer Symposium - 1980, The Chinese Academy of Sciences, Republic of China: Taipei.

(13) _____, "Developing Marketing Plans: A General Systems Approach. "In W.J. Reckmeyer (ed.), General Systems Research and Design: Precursors and Futures. Louisville: SGSR Press.

(14) _____, "Hierarchy Theoretic Structures For Computerized Market Planning Software." Proceedings - The Third Hungarian Computer Science Conference, The Hungarian Academy of Sciences, Hungary: Budapest.

(15) _____, "The Corporate Financial Management Process: A Problem Solving Activity." Proceedings -The 1981 SGSR - SER Conference. Louisville: SGSR Press.

(16) Klir, G.J., "Identification of Generative Structures in Empirical Data". International Journal of General Systems. 3:d:89-104.

NOTE

This paper does not necessarily reflect the views of the author's organization.