

APPLYING THE THEORY OF CONSTRAINTS TO INCREASE ECONOMIC VALUE ADDED: PART 2—IMPLEMENTATION

M. Smith and P. Pretorius

Department of Engineering and Technology Management
University of Pretoria
pieter.pretorius@eng.up.ac.za

ABSTRACT

This article describes a way to implement the holistic approach of the Theory of Constraints (TOC) which will lead to an increase in the Economic Value Added (EVA) of a business. The approach consists of two parts: the adoption of the holistic approach, and the implementation of a new company strategy. The pitfalls in implementing a holistic approach are discussed. The elements of a company strategy that is compatible with the holistic approach are described.

OPSOMMING

Hierdie artikel beskryf 'n metode hoe om die holistiese benadering van die Teorie van Beperkinge (TVB) te implementeer met die doel om die Ekonomiese Toegevoegde Waarde (ETW) van 'n besigheid te vermeerder. Die benadering is tweeledig: die ingebruikneming van die holistiese benadering, en die implementering van 'n nuwe besigheidsstrategie. Die moontlike probleme in die implementering van die holistiese benadering word bespreek. Die elemente van 'n besigheidsstrategie wat versoenbaar is met die holistiese benadering word beskryf.

1. INTRODUCTION

The Theory of Constraints (TOC) is a holistic (systems) approach to manage a company [1]. This article discusses the actions management have to take to manage the company according to the holistic approach of TOC. In the first part of this article [2], it is shown how to increase the Economic Value Added (EVA) of a company by applying TOC. It is specifically shown that the following actions must be taken to create the desired effect of increased EVA in the business [2]:

- the company decides to manage according to TOC principles, and implements the decision to manage according to TOC principles;
- the implementation of a new company strategy compatible with TOC principles, consisting of:
 - the company finds new ways to market its current offerings;
 - the company expands its offerings;
 - the company chooses market segments where the probability of a simultaneous downturn is small; and
 - the company follows a strategy of segmenting markets, not resources.

2. DECIDING TO IMPLEMENT TOC

The first step to increase the EVA of the company by applying the principles of TOC, is to introduce the TOC management approach into the company. This is however, also the most difficult step. There are two conflicting ways to approach the TOC implementation, illustrated in Figure 1.

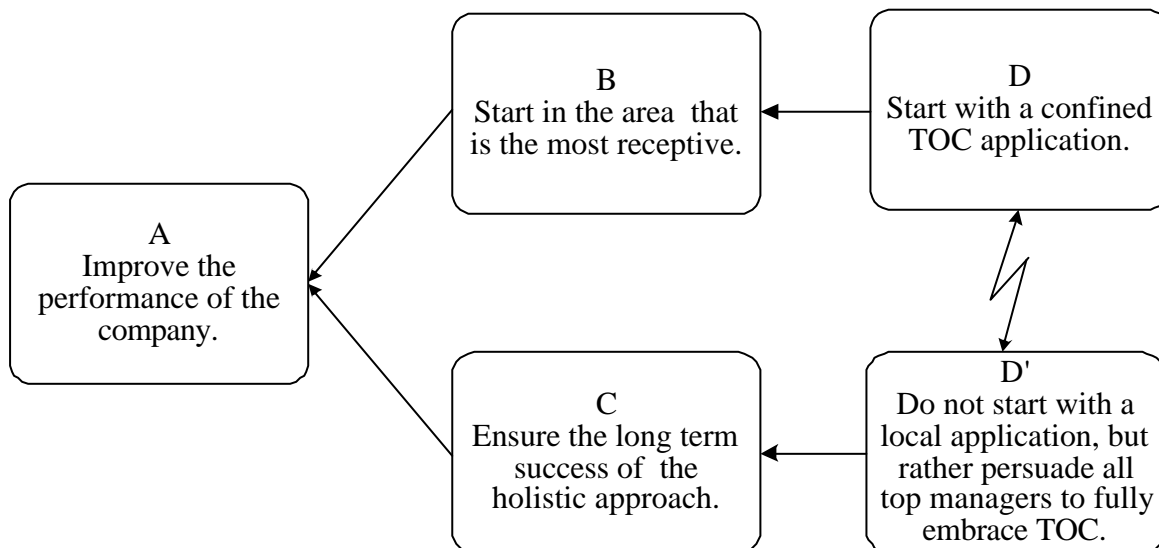


Figure 1. Starting a process of ongoing improvement conflict (Based on [3])

The illustration in Figure 1 is called an evaporating cloud [4]. The inventor of the evaporating cloud, Eli Goldratt, explains it as follows:

“The Evaporating Clouds method does not strive to reach a compromise solution, rather it concentrates on invalidating the problem itself. The first attack is made on the objective itself asking, ‘Do we really want it?’ . . . let’s assume for now that the objective has been checked and verified. Yes, we do want to achieve this specific objective. Is the only way open to turn to the avenue of compromise? The answer is definitely not. What we have to remind ourselves of, is that the arrows in the Evaporating Clouds diagram, the arrows connecting the requirements to the objective, the prerequisite to the requirements and the arrow of conflict, all these arrows are just logical connections. One of the most basic fundamentals of logic is that behind any logical connection there is an assumption. In our case, most probably it is a hidden assumption. . .The Evaporating Clouds technique is based on verbalizing the assumptions hidden behind the arrows, forcing them out and challenging them. It’s enough to invalidate even one of these assumptions, no matter which one, and the problem collapses, disappears” [5].

The evaporating cloud in Figure 1 is read as follows: in order to improve the performance of the company (A), it is necessary to start in the area that is the most receptive (B). And, in order to start in the area that is the most receptive (B), the company must start with a confined application of TOC (D). Also, in order to improve the performance of the company (A), it is necessary to ensure the long term success of the holistic approach (C). And, in order to ensure the long term success of the holistic approach (C), one should not start with a local application, but rather persuade all top managers to fully embrace TOC (D’).

Consider first the approach of starting with a local application (A–B–D). Why should this be a problem? Consider the chain analogy of the company illustrated in Figure 2.

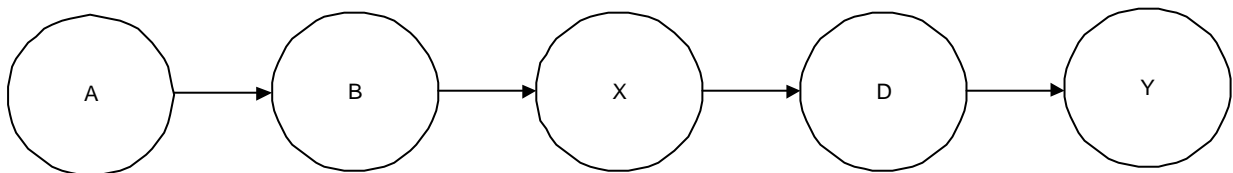


Figure 2. Local implementation of TOC (Based on [6])

The illustration depicts an operation with departments A, B, X, D and Y, with the arrows indicating the direction of the flow of work. Assume department X is the constraint of the company. The manager in department X implements a TOC application in the department. Since the correct implementation of a TOC application can lead to an order of magnitude improvement in the performance of the department, department X will not be the constraint after the implementation. The constraint has now moved to a downstream department Y. Suddenly everyone is pointing fingers at department Y. From the perspective of department Y, everything was running well until department X improved. Now the whole company is pointing fingers at department Y for not delivering fast enough. Also, department X understands the holistic approach, therefore they will realise that the only way for the company to improve now, is for department Y to improve. Will department Y listen to department X if they tell them to improve? Department X is the cause of all their problems, therefore there will be tremendous resistance to outsiders who do not understand the department to tell them how to run their department. Therefore, to start a local

implementation of a TOC application in the constrained department cannot ensure that the company is starting with a successful process of ongoing improvement [6].

Assume now department X is not the constraint of the company. The manager in department X implements a TOC application in the department. The department experiences an order of magnitude improvement. If the department is not the constraint, can the throughput of the company be increased by the improvement? No! How can the improvement be converted into a bottom line result for the company? Only by reducing the excess capacity, i.e. retrenching all the people sitting idle. If people get laid off in the department which has improved the most, will anyone ever try to improve something in the company again? No! Therefore, to start with a local implementation of a TOC application in a non-constrained department cannot ensure that the company is starting with a successful process of ongoing improvement [7]. Please note that it is not impossible to start an improvement process based on TOC by starting with a local implementation, only very difficult:

“I found out that in order to succeed at this approach, a determined, visionary, ‘champion’ is a necessary condition. Unfortunately this is not sufficient. The difficulty of going against a deeply rooted culture (and the ‘cost culture’ is a deeply rooted one) is immense. In most cases the champion, while succeeding to generate more and more impressive results, was also acquiring more and more the reputation of a TOC-fanatic. With every step forward, the difficulty of achieving the next step grows. In most cases the champion became so frustrated that s/he either stopped trying or simply left the company. There were cases where, after a long while, the resistance broke. My observation is that to reach that stage the champion must be not only determined, but also charismatic. Well, how many visionary, determined and charismatic, leaders exist? By far fewer than the existing number of organizations. Can we teach a person to become a visionary, determined and charismatic, leader? Maybe, but I don’t know how” [8].

It is the above arguments that caused Goldratt to remark *“local implementation of an (sic) holistic approach is an oxymoron” [9].* This view is supported by Forrester [19] where he remarks that

“When company growth is considered, over 90% of the variables lay in the top-management influence structure, leadership qualities, character of the founders, how goals of the organization are created, and how the past traditions of an organization determine its decision making and its future”.

In another publication, Forrester [20] expands on the system characteristic that makes local implementation difficult: *“... another inadequately appreciated general characteristic of systems lies in the high resistance to policy changes. Perhaps as many as 98 percent of the policies in a system have little effect in its behavior because of the ability of the system to compensate for changes in most policies”.* These statements imply that local implementation will most probably not work, as policy changes can only be defined and implemented top-down from a global perspective – policies are not defined and implemented bottom-up. Thus if top-management can appreciate the systemic nature of an organisation and define and implement policy changes that will cause the correct behaviour from people, then these policy changes will have an effect on the system (organisation) as a whole.

The second branch of the evaporating cloud in Figure 1 thus seems more promising: in order to improve the performance of the company (A), the long term success of the holistic (top-down) approach must be ensured (C). And, to ensure the long term success of the holistic approach, it is necessary to persuade all top managers to fully embrace TOC (D').

The problem is now to be able to persuade the whole top management to use the principles of TOC. Is this easy? No, since the application of the holistic approach, assumes that the management in the company has undergone the paradigm shift from the “cost world” to the “throughput world” [3].

In order to ensure that all top managers fully embrace the TOC approach, the following necessary conditions apply [8]:

- “all top management of the organization already have a deep understanding of TOC;
- all top management of the organization are already convinced that TOC is the way to run their company;
- all top management of the organization are already willing to devote the time (days) to devise the TOC strategy and tactic for their organization; and since so many top managers, even if they are personally convinced about something are still sceptical about the chances to bring all their peers to agree, lets add another requirement:
- all top management of the organization know a TOC expert personally and have trust that this expert has the facilitation skills needed to guide them”

The first necessary condition can be achieved through training of top management in the principles of TOC. Meeting the second necessary condition of having all top management convinced of TOC’s applicability follows naturally from achieving the first necessary condition. The third and fourth necessary conditions are achieved through a workshop where the top management uses the intuition they have built up from the training, and with the help of a facilitator, devise the strategy of the company. The agenda for this workshop is as follows [11]:

- **Agree on “what to change.”** This is done by building the current reality tree of the company. The current reality tree “is a logical structure designed to depict the state of reality as it currently exists in a given system. It reflects the most probable chain of cause and effect, given a specific, fixed set of circumstances” [1]. The current reality tree is built with full participation from each manager by allowing each manager to create an evaporating cloud for a conflict within his/her domain. Each manager presents his/her cloud to the rest of the group. These clouds are then used to create the generic cloud that illustrates the core conflict in the company. The three-cloud technique (see [12]) is used to create the generic cloud. In practice the insights obtained from the creation of the generic cloud are profound enough that it is not necessary to write down the full current reality tree of the company. By creating the generic cloud that contains the core conflict in the company, and agreeing on the content of it, true consensus is reached about the core problem of the company. As long as this core problem is not addressed, the company cannot start a true process of ongoing improvement.
- **Agree on “to what to change to.”** This is done by creating the future reality tree of the company. The future reality tree “is a sufficiency-based logic structure designed to

reveal how changes to the status quo would affect reality—specifically to produce desired effects” [1]. To find the direction of the solution, it is necessary to find the injection that will evaporate the generic cloud [12]. (An injection is “a condition, circumstance or action that doesn’t exist now” [13].) This is done by verbalising the assumptions underpinning the logic of the generic cloud. Once the injection is found that will evaporate the generic cloud, each manager examines the specific cloud he/she has drawn, and finds the injection that will evaporate the specific cloud. The injections that are needed to generate a specific solution for the company are then presented by each manager. Usually the insights gained by creating the injections, are enough that it is not necessary to write down the full future reality tree of the company. Instead, the management can concentrate on the specific injections needed for the generic future reality tree in the Goldratt Satellite Program viewer notebook [7].

- **Agree on “how to cause the change.”** A detailed plan for causing change is usually created through a prerequisite tree and a transition tree. A prerequisite tree *“is a logical structure designed to identify all obstacles and the responses needed to overcome them in realising an objective. It identifies the minimum necessary conditions without which the objective cannot be achieved”* [1]. A transition tree *“is a cause-and-effect logic tree designed to provide step-by-step progress from initiation to completion of a course of action or change”* [1]. In this case, the prerequisite tree is constructed by allowing each manager to, in turn, contribute one obstacle to achieving the injections of the future reality tree. This process is continued until there are no more obstacles contributed. The result is usually a list of thirty to fifty obstacles. Each manager then contributes the intermediate objective(s) that will overcome the obstacle(s) he/she has listed. The intermediate objectives are then turned into an intermediate objective map by identifying the time sequence and logical relationship between the intermediate objectives. The tasks to be performed to reach each intermediate objective are assigned to specific managers. From the intermediate objective map, the plan can be directly translated into a classical project management presentation, such as a PERT chart.

By executing the actions to reach the intermediate objectives agreed to by the management of the company, the company has started managing through a holistic approach (management through the application of TOC principles). The company has then implemented the first action necessary to increase EVA described in [2].

3. DEFINING A NEW COMPANY STRATEGY COMPATIBLE WITH TOC PRINCIPLES

If the company has started managing according to TOC principles, then it means that the company has chosen as its goal to “make money now as well as in the future,” supported by the necessary conditions to “provide a secure and satisfying environment to employees now as well as in the future,” and to “provide satisfaction to the market now as well as in the future” [4]. The company has started a process of ongoing improvement, and in order to make money now as well as in the future, improvements must be converted to the bottom line. If a well planned strategy is not followed, the company will soon face the conflict illustrated in Figure 3, as continuous improvement often result in creating excess capacity in non-constraints, or overall excess capacity when the constraint moves to the market.

The evaporating cloud in Figure 3 is read as follows: In order to put the company on a process of ongoing improvement (A), it is necessary to induce people to improve (B). And, in order to induce people to improve (B), it is necessary not to lay off people (D). Also, in order to put the company on a process of ongoing improvement (A), it is necessary to convert local improvements into bottom line results (C). And, in order to convert local improvements into bottom line results (C), it is necessary to lay off people in the departments which have improved the most (D').

The connection B–D has the underlying assumption that if people’s security and satisfaction are not guaranteed, it will be impossible to induce them to improve. The assumption between C–D' is that if an improvement is not made on the constraint, throughput cannot increase, therefore operating expenses or investment needs must reduce in order to have a bottom line impact. In most cases, improvement efforts create more excess capacity at non-constraints. If this excess capacity is labour, the only way to create a bottom line improvement is to lay off the excess people. Therefore the department that has improved the most, will be penalised the most.

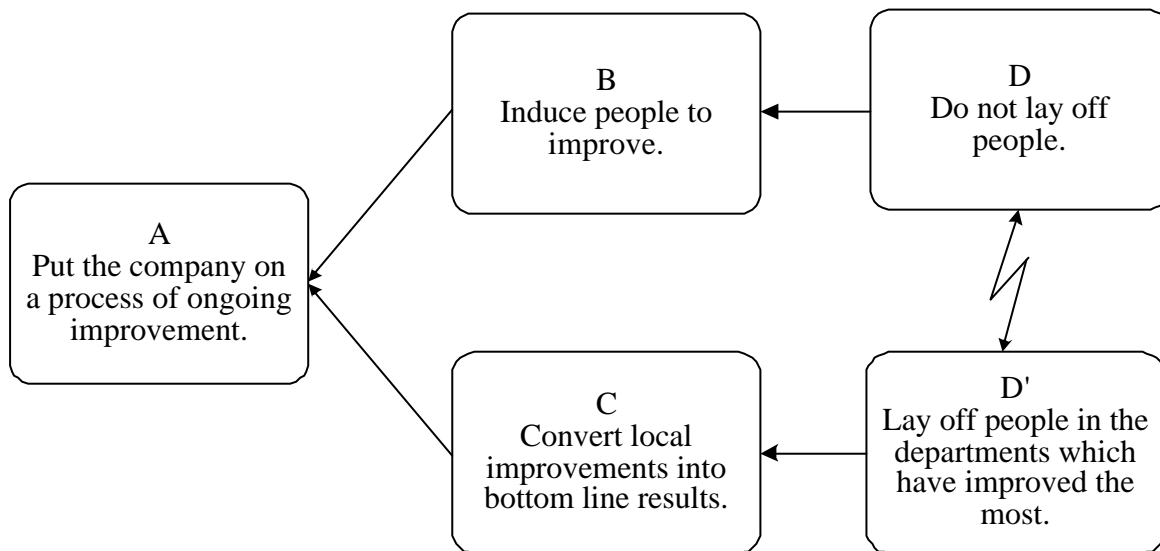


Figure 3. Conflict inherent in ongoing improvement [7]

The evaporating cloud in Figure 3 therefore reveals the core conflict between the goal and necessary conditions for the success of the business: the need to satisfy the market now as well as in the future, implies continued improvement of the business (entity A), the need to convert improvements to the bottom line is part of the goal of the business (entity C), and the security and satisfaction of employees are represented by having job security (entity D).

Strategic management is defined as “the set of decisions and actions that result in the formulation and implementation of plans designed to achieve a company’s objectives” [14]. In order to prevent the conflict in Figure 3, the company must design a strategy that evaporates the cloud, i.e. the strategy must be such that the goal and necessary conditions are satisfied at the same time. The other condition that a strategy must satisfy, is to reduce the risk due to the inherent uncertainty of the future: “we shouldn’t ever build a strategy based on a market forecast” [4].

The strategy the company should implement, which is based on TOC principles and which satisfies all of the above mentioned conditions, consists of the following elements [4]:

- **Develop a decisive competitive edge.** The company's competitive edge can lie in its products, or in the way it offers those products to the market. The implementation of TOC concepts allows the company to gain an advantage over competitors due to the flexibility and speed with which the company can react. However, products can easily be imitated, and to develop new products can take a long time. The company has therefore to concentrate on its current product line most of the time. The company can have a competitive edge in marketing its product by designing an unrefusable offer, also called a Mafia offer [7], [15]. In this case, the company examines undesirable effects created for the customer or customer's customer when buying or using the product. By building the current reality tree, and examining the root causes of the undesirable effects experienced by the customer, the company can take action against root causes which lie within the company's span of control. By eliminating these root causes, the market's perception of value of the product can be significantly raised without physical product changes. Since the root causes are usually wrong policies and assumptions, it is very difficult for competitors to imitate the offering without understanding why these policies and assumptions are wrong. By following this process, the company implements one of the actions described in [2]: the company finds new ways to market its current offerings. Also, by understanding the market's perception of value, the company can create new offerings to satisfy that perception of value and therefore implement another of the actions described in [2]: the company expands its offerings.
- **Find ways to segment the market.** A market is segmented if "you can sell exactly the same product at two different prices to two different markets without having either market impacted by the other" [16]. Different market segments have different uses for the product, and different perceptions of value of the product, therefore it is possible to have different prices without the market segments affecting each other. The company must be active in many segments of the market to ensure that competitors cannot catch up, or not catch up in all segments at once. The company must choose the market segments in such a manner that the probability of many of them dropping in the same time period is small (i.e. diversifying against the risk of a downturn [17]). Even if the company has a dominant edge in a segment, it should not take the entire segment, as this will move the constraint to the market which exposes the company to the statistical fluctuations of demand. If a lucrative segment is up, the company can concentrate on that segment, and leave some of the less lucrative segments to competitors. When the segment goes down, the company shifts focus to the segments that are up. By segmenting its markets correctly, the company implements an action described in [2]: the company chooses market segments where the probability of a simultaneous downturn is small.
- **Create flexibility.** The company creates flexibility by ensuring that each employee is serving (or can serve) more than one market segment. To achieve flexibility, it is important to segment the market, and not the work force. Should a downturn happen in one segment, the company can concentrate its resources in another segment. Therefore it is not necessary to lay off people if there are enough market segments and enough

flexibility in the resources. By creating flexibility, the company implements another action described in [2]: the company follows a strategy of segmenting markets, not resources.

To manage the company according to TOC principles, therefore requires that the above mentioned strategy is implemented. Once the company has implemented this strategy, and all decisions are made according to a holistic approach, the desired effect of increased EVA will emerge as a result.

4. CONCLUSIONS

Care must be taken when deciding to implement TOC management principles. This is because a local implementation of TOC does not guarantee a successful implementation in the long run. Success with a TOC implementation can be achieved through a top-down approach where the management of the company formulates a new strategy based on TOC principles. Such a strategy is built on three pillars: to develop a decisive competitive edge for the business, to segment the market and to create flexibility of resources. This strategy will ensure that the company satisfies the goal (“make money now as well as in the future”) and the necessary conditions supporting the goal (“provide a secure and satisfying environment to employees now as well as in the future” and to “provide satisfaction to the market now as well as in the future”). In the final instance, it must be remembered why TOC is implemented, namely to increase EVA using a TOC approach, as described in Part 1 of this article [2].

5. FUTURE RESEARCH

In this article, the current thinking in TOC claims that the top-down approach is the only successful way in the long-term of implementing TOC in a company. The current research in the field of TOC (see [18]) is to develop a method through which a relatively low-level manager can motivate his/her whole company to change to a holistic management philosophy, something which has not yet been achieved.

REFERENCES

- [1] H. William Dettmer. Goldratt’s theory of constraints: a systems approach to continuous improvement. American Society for Quality, Milwaukee, 1997.
- [2] Malan Smith and Pieter Pretorius. Applying the theory of constraints to increase economic value added: Part 1—Theory. Submitted to *South African Journal of Industrial Engineering*, February 2002.
- [3] Eliyahu M. Goldratt. Forum letter #2. E-mail to POOGIforum members, 12 February 2000.
- [4] Eliyahu M. Goldratt. *It’s not luck*. Avraham Y. Goldratt Institute, Pretoria, 1994.
- [5] Eric Noreen, Debra Smith, and James T. Mackey. *The theory of constraints and its implications for management accounting*. North River Press, Great Barrington, 1995.
- [6] Eliyahu M. Goldratt. Forum letter #8. E-mail to POOGIforum members, 12 February 2000.
- [7] Eliyahu M. Goldratt. Goldratt satellite programme viewer notebook. 1999.
- [8] Eliyahu M. Goldratt. Forum letter #3. E-mail to POOGIforum members, 12 February 2000.

- [9] Eliyahu M. Goldratt. Forum letter #7. E-mail to POOGIforum members, 12 February 2000.
- [10] Eliyahu M. Goldratt. Forum letter #4. E-mail to POOGIforum members, 12 February 2000.
- [11] Eliyahu M. Goldratt. Forum letter #5. E-mail to POOGIforum members, 12 February 2000.
- [12] Malan Smith and Pieter Pretorius. Exposing the false paradigm used in management decision making. *South African Journal of Industrial Engineering*, Vol 12 No 2, May 2001.
- [13] H. William Dettmer. *Breaking the constraints to world-class performance*. American Society for Quality, Milwaukee, 1998.
- [14] John A. Pearce and Richard B. Robinson. *Strategic management: formulation, implementation, and control*. Irwin/McGraw-Hill, Boston, 6th edition, 1997.
- [15] Debra Smith. The measurement nightmare: how the theory of constraints can resolve conflicting strategies, policies and measures. St. Lucie Press/APICS series on constraints management. St. Lucie Press, Boca Raton, 2000.
- [16] Gerald I. Kendall. *Securing the future: strategies for exponential growth using the theory of constraints*. St. Lucie Press/APICS series on constraints management. St. Lucie Press, Boca Raton, 1998.
- [17] William F. Sharpe, Gordon J. Alexander, and Jeffery V. Bailey. *Investments*. Prentice Hall, London, 5th edition, 1995.
- [18] Eliyahu M. Goldratt. POOGI forum letter #12. E-mail to POOGIforum members, 3 January 2001.
- [19] Forrester, J.W. *The Beginning of System Dynamics*. Banquet talk at the International meeting of the System Dynamic Society, Stuttgart, Germany. July 13, 1989.
- [20] Forrester, J.W. *System dynamics and the lessons of 35 years*. Unpublished manuscript. 1991.