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Paper Title: SYSTEM DYNAMICS MODELING of the INSTALLATION and REPAIR FIELD FORCE at BELL ATLANTIC CORPORATION

Lev Gogish, Bart Burns, John Lastowka

ABSTRACT

This paper discusses an initiative focused on improving the quality of information used in decision-making processes in Bell Atlantic Corporation. This effort was initiated by comments of the Chairman and CEO of Bell Atlantic Ivan Seidenberg about the significance of installation and repair problems as a core of reliable customer service and the reputation of Bell Atlantic. In general, the goal of this project is to help make clear the system of causal interrelationships and interacting feedback loops inside Bell Atlantic which determine profitability, sustainability, and prosperity of the Corporation. The deliverables are explicit and testable models of dynamic behavior of the Corporation under given circumstances and policies.

Part 1 describes dynamic structures for modeling service provisioning in a large telecommunication company. As a service

provider, such a company is under various pressures from markets, competitors, technology and quality standards. These pressures are increasing continuously. As a consequence, time pressure on employees (management and union) and load on field technicians continuously rises, which brings about negative effects. Those negative effects need to be compensated by improving the field force skill and effectiveness, by increasing operational management capacity, and by modernizing testing tools. The current model contains more than 100 parameters and 25 equations. This model helps to explain company behavior over time.
This part describes the map and the main parameters of the model. The map is implemented using the STELLA(*) software. Simulations based on this model demonstrate customer growth under various circumstances. Those circumstances include the impact of new technological and service innovations, human factors, and network capacity.
The map contains six sectors. Each sector is a submodel which characterizes certain aspects of a telecommunication company. The sectors are the capital sector, the corporate work force sector, the customer sector, the technology sector, the corporate policy sector, the operational culture sector, the operational work force sector and the learning sector. All sectors are interrelated.
The main parameters of the model are accumulations, driving forces, boundary conditions or some substantial things or concepts which affect the company's behavior over a period of time.
Driving forces in the customer sector are the following:

1) quality force,
2) price force,
3) market force,
4) equipment force,
5) competitive force,
6) maintenance force.

The external variable influencing the customer sector is "customer market". The main internal influential force in the customer sector is the maintenance force. The maintenance force is a complex of field technicians and operational management, their experience and training, their skill and testing equipment, etc.
Each of the accumulations should be considered as an aggregation of many subvariables. For instance, customers of a telecommunication company are:

1) residential customers,
2) small business customers,
3) big business customers,
4) Internet customers,
5) data customers,
6) government customers, etc.

In the future, each customer could be considered as a discrete parameter. Such a map will contain as many individual customer sectors as there are types of customers. The same applies to the other accumulations.
The present model provides a basis for further integration of company data, business facts, and management experience. Using this basis, increasingly more correct simulations of company behavior could be developed in the future.
[* STELLA: Structural Thinking and Experimental Learning Laboratory, developed by Barry Richmond for System Dynamic modeling on PCs.]

Part 2 describes dynamic structures for simulation of part of the maintenance force in a large telecommunication company like Bell Atlantic, namely the operational force. As a service provider, such a company might have a problem meeting installation and repair quality standards which are continuously increased. As a consequence of continuous technological and service innovation -- time pressure on employees (management and union) and load on field technician continuously rises, which bring about some negative effects. On the other hand, the rise of competition encourages the turnover of the most experienced field techs and managers.
The negative effects should be compensated by intelligent company policy which is embodied in the variable "coherence of corporate policy". Intelligent policy is crucial for long-term prosperity and sustainability of a telecommunication company.
The model of the operational force described in this part allows us to simulate various scenarios over time under given conditions. Such conditions include influences of competition, new service/technology implementation, union contracts, early retirement offers, etc. The further development of the model depends on specific information about the company. Such an information might be elicited from the company's data bases and from its management. The more the model contains such specific information, the better it will simulate the behavior of the field force.

Part 3 discusses a model of new service implementation in a large telecommunication company. New service implementation is a complicated and stressful process which depends on many factors. This part describes the feedback loop structure and dynamic model of such a process. The model simulations demonstrate generic scenarios over virtual time. Such simulations show the nonlinear behavior of customer growth, market behavior, and so forth - and the relationship of these variables to the amount of system bugs, the experience of the operational work force, and other conditions. This model contains minimal parameters, accumulations and flows. As such, it allows us to clarify the structure of main feedback loops which determine the dynamic properties of the implementation process. Thus, the model facilitates and encourages systems thinking as well. In the future, this model could be used to adapt company financial strategy by optimization of expenses among system testing, personnel training, and marketing.

Part 4 describes emergent learning centers in Bell Atlantic. Learning centers emerge under conditions of continuous technological innovations, aggressive competition, accumulation of capital resources, and the presence of authentic leaders. Learning centers occur as a response to the real needs of improving installation and repair services. During the last three years, experience at Bell Atlantic has shown that learning centers are effective in many ways:

1) they carry out advanced training of field technicians,
2) they evaluate testing tools and working conditions, and
3) they assume a leading role in solving marginal problems.

The learning center is an informal network, catalyzed by authentic leaders. Such a network includes field technicians, management, technical support specialists, vendors, and even business customers. This network of skills gives rise to the capacity to solve marginal problems - the inevitable but unpredictable, difficult, and anomalous

problems which constantly occur in an industry of exponential innovations - telecommunications.
As an informal entity, the learning center is of great importance, because it enhances cooperation and mutual trust between employees and improves the social capital of a company.

Part 5. The variety and complexity of installation and repair problems, with which the field force of a telecommunication company deal, have been increasing dramatically for the last decade.
This is the result of the continual growth of technological complexity and innovation flow in telecommunications. The complexity of field operations are specifically high during the implementation of new services.
As such, the field force should become cross-trained and get skilled in a variety of problems. The continuously increasing training time inevitably brings about significant expenses because of the reduction of available service time. This problem is becoming considerable.
To enhance the productivity of the field force and simultaneously decrease training time, a specific training strategy is proposed in this part. This strategy is based on two concepts:

1) field force differentiation, and
2) intensive cooperation among its parts.

Such differentiation is not the result of some bureaucratic process, but instead arises around support for voluntary learning.
This learning process could be tuned to the learning capacities of individuals. Thus, field techs should find their own places in informal structure, which further promote their learning, training, and skill enhancement.
Following their learning capacities, field techs are subdivided on two groups: a basic group and a small advanced group. These groups, spread over an operational area, form a kind of informal structure, an informal network. This network consists of local units or teams.
Each team consists of a number of field techs from the basic group around their advisers or mentors from the advanced group.
Such an informal network creates many opportunities: Training time can be shortened. Work force skill enhanced. Training expenses decreased. However, high social capital and coherence of corporate culture are prerequisites.
To make clear the advantages of such a strategy, various approaches were used. These include an operational model of workforce training strategy and some simple mathematical micro models of cooperation. These models help give insight into how to optimize the effectiveness of the workforce and catalyze the evolution of cooperation under a given load of service problems.
All models lead to the same conclusions:

1) Creation of a learning environment for those who want to learn more and to help the others -- should be the goal of corporate policy.
2) Differentiation, based on distinguishing learning capacity of individuals, and cooperation between them is the proper way to get a more efficient and productive field force.
   The idea being to recognizing and support authentic leaders, while providing fundamental support for learning and cooperation across the field force.
3) As a first step of cooperation, field techs could be subdivided into two groups, based on their learning capacities: a basic group and a

small advanced group.

4) The informal network (based on local teams of field techs from the basic group together with their mentor from the advanced group), provided active cooperation inside of teams and between them, could enhance the effectiveness of customer service.
5) The rate of cooperation, based on mutual trust and personal will to cooperate, is more significant for solving the installation and repair problems than training time.
6) Further development of the informal structure of the field workforce would promote further enhancement of customer service.

Part 6 discusses, through the eyes of a seasoned expert field technician, what the field force really needs to handle installation and repair problems effectively in terms of technology, training, and management. It makes clear what the information dilemma means for field techs, what kind of jobs they perform, what testing tools and applications are the most helpful, what kind of training they have and need to have, and what conditions are necessary for intelligent management of field-force.

This project helps to improve the understanding of the interrelationships between the main variables such as customers, quality of service, maintenance force, profitability, and so on. In addition, this project gives the opportunity to start a process of multifunctional correlation of data from various corporate data bases. Such databases contain the data which could provide insight into customer dynamics, trouble dynamics, technological/service innovations, testing tools/systems, field force experience/training, human factors, company policy, expenses and revenues, etc. The complexity of such a project is real, but this project can provide real tools for decision-makers.