Abstract

The second half of the 20th century has been marked by rapid advances of research methods in real problems’ solving, with rapid progress of the Information Technology (IT) and important structural and institutional changes that shaped a new landscape of the corporate and economic environment towards globalization of markets and trade. There is a converging tendency of overcoming the conventional sense of “Scientific Method” (SM) and increasing use of systems research and models in dealing with the “historical challenge” of corporate adjustment to business, economic and technologic environment.

The scope of this paper is firstly to help removing a series of myths, misconceptions, faults and contradictions, common in transitory periods. The interest is the right use of methods in adjusting to the new environment, with focus in the Logistics method, enriched to the “Supply Chain Management” (SCM) and further movement to the “Business Process Re-engineering” (BPR) [see more, Malindretos, George (2001, 2002)]. Attention is given to the combined use of Quantitative Methods (QNMs) and Qualitative Methods (QLMs) and increasing use of mixed methods [see, e.g. Halwes, Terry Dr. (2000), Shapiro, Jeremy F. (2001)]. In addition, it is presented a model built-up for simultaneous maximization of the users’ satisfaction and cost minimization, which has successful application in certain Greek corporations.

Scientific Method

It is broadly accepted that our era is characterised by a “challenge” of adjusting to a new corporate and technology environment. During phases of major transformations, it is advisable to go back to the “frontiers of knowledge” [see e.g., Wilson, E. Bright (1952), Kuhn, Thomas (1962)].

In this framework belongs the clearance of the “dust” from long use and misuse of words and terms. The Quantitative Methods (QNMs) contain two component parts, the “quantitative” and “method”, with asymmetrical attention to the “quantitative” term. Speaking about method, interest is focused upon the so-called “Scientific Method” (SM). Science is the mastering of things of the real world, by
knowledge about the truth. It has been noticed that “science has never been thoroughly studied scientifically, so we have quite an array of different answers to this question, some of them accurate and some of them ridiculous and worse than useless” [e.g. Hawle, Terry Dr. (2000)]. The term Method drives to Dialogue on methodology in science which is clouded, as the phrase SM is used in two different ways. The one is very general, as a process of improving understanding. Although vague, it is considered as a powerful definition, since it leaves room for criticizing dogmatic clinging to beliefs and prejudices, or appreciating careful and systematic reasoning about empirical evidence. The other is the traditional sense, and supports that there is a unique standard method, which is central to identity of the science. In effect, scientific progress requires many methods, so there is not a unique standard method, though taught as a straightforward “testing hypotheses derived from theories in order to test those theories”. The more acceptable definition of SM is a process by which scientists, collectively and over time, endeavour to construct an accurate (that is reliable, consistent and non-arbitrary) representation of the real world. The popular “hypothetico-deductive” standard method is excluding consideration of the process of discovery in science. Rather, research is defined as a penetrating process of learning and understanding the substance of actual things and facts, by use of different methods. The research process incorporates formulation of a research issue and construction of a conceptual framework, by using all available information sources [see more, Walker, David A. (2000)]. Once there is not a unique SM, researchers seek for ways of continually improving themselves within the world around us (in a feed-back process of continuous “Research & Development”).

The QNMs have a number of attributes, such as: they employ measurable data to reach comparable and useful results, assume alternative plans for achieving objectives, plan data, concerning observations’ collection, configuration and elaboration by statistical and econometric stochastic methods, check data reliability, choose appropriate sampling method, use carefully the estimates of the parameters for forecasting and planning purposes, etc. since they derive from ex-post data concerning past.

Processing

Main turning points in the pace of use of QNMs are mentioned: the “scientific management revolution” of the early 90ies, initiated by Frederic Taylor, the so-
called “keynesian revolution”, the Operational Research originated during the Second World War, followed by post-war developments of QNMs for decision-making, notably the simplex method for solving linear programming problems and many more methodological developments, within the OR and advance of Logistics. As complexity rose, attention moved to the dynamic interface among processes in a chain to offer a definite output. In effect, it is (re)located in the thinking of Logistics and the SCM, extended more recently to the BPR. Processes contain activities and are related among each other for specific ends. The processing of real problem’s solving involves the following steps:

- **Identification** of corporate environment and uncertain conditions
- Existence of **Independent Management Units** (IMUs)
- **Integrated approach** of actual situations
- **Implementation** of Scientific Approach

**Risky Decisions**

Processing is primarily a matter of understanding that the new reality is exogenously given, irreversible and one-way pace. Open-minded “cost/benefit analysis” overcomes hesitation and postponement and produces synergy effects in due course, whereas the cost of inaction may be insuperably higher than the action now. Critical role has the timing for the problem of “competitiveness” in an uncertain environment, incorporating the probability distributions of the variables considered into the analysis. Decision-making under uncertainty conditions is an analytic framework of searching for:

- **Optimal strategies**, as acts from all possible courses of action ($A_i$ s), choices under control of the decision maker.
- **Various possible outcomes**, states of nature or events to be identified ($E_j$ s), beyond the control of the decision maker.
- **Determination of the pay-off function** by describing different combinations of acts and events and the resulting consequences ($V_{ij}$ s), the pay-off resulting from the $i$th strategy and the $j$th event. A pay-off is a conditional value – a conditional profit, loss or, may be, a conditional cost. In building up a pay-off matrix, the alternative courses of action and the possible outcomes (events) must be clearly determined.

The trade-offs among decisions under uncertainty, within “cost/benefit analysis”, uses a number of basic principles, as parts of the decision matrix [Vohra N. D.
(1990)]: the Laplace Principle (highest mean value or lowest average cost), the Maximin or Minimax Principle (choice of the maximum from a set of strategies with minimum pay-offs, adopted by pessimistic decision makers), the Maximax or Minimin Principle (choice of the maximum from strategies with the highest pay-offs, adopted by optimistic decision makers, the Hurwicz Principle (choice somewhere between the extreme pessimism of the maximin and the extreme optimism of the maximax principle), the Savage Principle (choice of action that minimizes the maximum opportunity losses from the so called “regret table”), the Maximum Likelihood Principle (considering first the event that is most likely to occur and choice of the course of action which has the maximum conditional pay-off.), the Bayesian Decision Rule (an extension of the optimal strategy choice by calculation of the expected pay-offs by using posterior probabilities, as additional information about events is acquired), and the Expectation Principle (the optimal choice represents the strategy with the highest expected pay-offs, calculated by multiplying the pay-off values with their respective probabilities and adding up these products). A decision problem involving $n$ events and $m$ strategies, the expected pay-offs, $EP$, can be expressed as follows:

$$EP_j = \sum_{i=1}^{n} p_i a_{ij} \text{ with } j = 1,2,\ldots,m$$

The choice in decision making under risk conditions depends on a series of objective and subjective factors, to mention a few: information, enough knowledge of technology possibilities, attitudes against risk, etc. Just faster and cheaper data communication is not enough for gaining competitive advantage [Shapiro, Jeremy F. (2001), p. 36]. Decision Support Systems (DSS), Analytical Information Technology (AIT) and Decision Trees (DT) are helpful in decision-making. The methods for creating and analysing models, incorporating multiple scenarios and more explicit treatment of uncertainty, involve two overlapping disciplines: stochastic programming and a relatively new field of strategy analysis called scenario planning [See more, Schoemaker, P. J. H. (1993), Georgantzas, N. C., and W. Acar (1995)].

The risks of errors in estimates and predictive power of the SMs are higher in phases of structural changes to adjust in an irreversible new world around us. SM aims at assisting the adjustment process, that is a matter of philosophy and conceptual framework e.g. the management that serves the fundamental economic
axiom, by eliminating the misconceptions and co-ordinating effective mobilization of total available resources.

Testing hypotheses leads to either confirmation or rejection of a hypothesis. Theories, which cannot be tested, because, they have no observable ramifications, do not qualify as scientific theories. If the predictions are found to be in disagreement with new experimental results, the theory may be discarded as a description to reality, but it may continue to be applicable within a **limited range** of measurable parameters. For example, the “laws” of classical mechanics (Newton’s Laws) are valid only when the velocities of interest are much smaller than the speed of light that is in algebraic form: \( v/c < 1 \).

For a large part of human experience, the “laws” of **classical mechanics** are widely, usefully and correctly applied in a large range of technological and scientific problems. Yet in nature we observe a domain in which \( v/c \) is not small. Such cases are more accurately described through the equations of Einstein’s **theory of relativity**. Experimental tests have shown that relativistic theory provides a more general and therefore more accurate description of the principles governing our universe, than the earlier “classical” theory. Relativistic equations reduce the classical equations in the referred limit, and classical physics is valid only at distances much larger than atomic scales:

\[
x > 10^{-8} \text{ m}
\]

A description, which is valid at all lengths, is given by the equations of **quantum** mechanics. **Errors** in experiments have several sources: measurements’ accuracy, non-random or systematic error, due to factors, which bias the results.

**Trend towards integration**

The marriage of IT with Logistics and SCM, along with OR models, systems analysis, models building, optimisation (maximization and minimization processes), linear programming, etc. has been especially useful in producing important “synergy effects” by using modelling systems [Shapiro, Jeremy F. (2001), Robinson, A. G., and D. M. Dilts (1999]. Method and technology, including software development, without much of an underlying **plan**, and the **system** design is cobbled together from many short-term decisions. This actually works pretty well as the system is **small**, but as the system grows, it becomes increasingly difficult to add new features to the system. **Engineering methodologies** have not been terribly successful and are considered bureaucratic. Specific improvements are mentioned
the “lean production” [Womack et al (1990)] and “agile methodologies” [Goldman and Preish (1991)]. They provide a useful compromise between no process and too much process, to gain useful results.

Useful elements of the abovementioned methods are also used extensively as parts of the knowledge infrastructure, within the framework of the Logistics discipline and its advance to the SCM. Logistics, from warehousing, transportation and distribution, advanced towards integration of the corporation, to encompass all business processes for the purpose of creating value to the customer [Gattorna, J. L., and D. W. Walters (1996)].

The effective use of QNM and the QLM is incorporated anymore to the particular conditions at company level, so that to serve the overall management functions (chart 1).

![Chart 1: Integrated feedback of IMUs](image1)

The creation of a dynamic feedback process of adjustment is founded on total Chart corporation organization restructuring and is seeking for performing strategies, within SCM (chart 2).

![Chart 2: Processes Re-organization](image2)

The corporate processes are classified in core processes and non-core processes, which may be assigned to third parties (known as 3PL).

![Chart 3: Quality aspect of Logistics](image3)
Because, the main corporate objective has gradually removed to the “customer’s satisfaction”, based on the observation that the cost of gaining a new customer is many times the cost of keeping one.

The complete Logistics reorganization operates as a catalyst in supporting the criteria of time-cost-services quality to customers, for creating value to them.

Further advance to BPR is performing in cases where corporate adjustment requires putting everything under scientific doubt, not excluding the management itself [Champy, H. (1995)]. It was raised and extended rapidly in application and deepened from various respects [Malindretos, G. (2001)].

BPR as a “revolution”, involves radical “brainstorming” and is tested at application level, through learning by experience and diffusion of the benefits. A question is still whether it is a matter of strategy, organization, management competence, etc. (chart 4).

Without looking for a universal method, it is a streamlining of business processes, re-inventing new selected “core processes” and “value-adding activities” by proper use of Logistics, ABC, etc.

BPR is seeking for sets of flexible rules, adjustable to particular corporate circumstances - since perfect methods to be used as panacea, simply do not exist. “Downsizing”, considered one of the myths of the reengineering, is not inevitable (Tenner & De Toro, 1997: 232). Managers are impelled to alleviate tensions, by allowing variation and personnel motivation to improve financial and operating performance [Bennet & Heblund (2001)].

**A model of continuous consumer satisfaction**

Within the framework of Logistics and SCM, an integrated model was built-up and applied successfully to a few Greek companies. The ABC has allocated recorded costs to customers and products data. It helped identifying the profitability order and evaluating the service quality to be provided. Different combinations of customers and products are categorized by a specific range or value of profit and in

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**Chart 4 – Integrated Re-engineering Strategy**
a second stage, corrective coefficients are applied for maximum satisfaction of customers (table 1).

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Table 1 – Coefficients of order satisfaction

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www.nsrl.rochester.edu, Appendix E: Introduction to Scientific Method.