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Proceedings of the 3-rd
Polish-Finnish Symposium
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Warszawa 1989

Secretary of the Conference
dr. Andrzej Stachurski

Wykonano z gotowych oryginałów tekstowych
dostarczonych przez autorów

ISBN 83-00-02543-X

INTERACTIVE HEURISTICS VS. OPTIMIZATION AS PLANNING STRATEGIES.

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ABSTRACT.

Planning tools have traditionally been built as optimization models, as we intuitively find in some sense optimal plans easier to defend than loosely coupled ideas based on intuition and experience. Reality is, however, more complex than that: optimization is based on the belief that we can trace and formulate an internal logic which determines key elements of the planning problem. This internal logic is not always clear: some of its elements may be uncertain or imprecise, or we may miss some decisive elements. It may also be the case that a mathematical formulation of the internal logic leaves out some essential qualitative element.

With so-called DSS-generators we have introduced interactive heuristics as a means for handling essential relationships in planning problems. Heuristics can deal with an imprecise internal logic of planning problems: we can handle imprecision and uncertainty, and we can replace missing elements with bridging rules. Nevertheless, heuristics is not an ideal tool for handling planning problems as most users find interactive heuristics tedious and inefficient after some time, and also find it disturbing that they cannot be sure about the quality of the solution.

Obviously this is the place for a good compromise between interactive heuristics and optimization. In this paper we present and discuss a financial planning model which makes use of both interactive heuristics and an optimization algorithm. We compare the effectiveness of the two approaches, and suggest an integrated approach which combines the two.

Keywords: Planning, interactive heuristics, optimization.

1. Introduction

Management is a strange field of research, as there is very little of accepted theories, but a strong demand for well-structured, up-to-date, relevant information and advanced, extensive, validated knowledge as a basis for planning, problem-solving and decision making. This is thought to ensure that the risk for bad or dumb decisions, poor problem-solving and inadequate planning is minimized.

High-quality information and advanced knowledge are typically products of instruments, which have been developed and used in strictly controlled research processes. Most of us believe that better information and more solid knowledge is a guarantee for better management, and we hesitate to make decisions or solve problems unless we have guarantees for the validity and reliability of the information or the knowledge to be used.

Then it is rather surprising to learn (cf McCormack, Waldron, Iacocca) that most managers insist on handling the actual management process without interference from theoretical frameworks or research results. They insist that decisive success factors for a manager are personality, experience, strategic ability, intuition and many degrees of freedom in their choice of actions; all these factors have one characteristic feature in common - they cannot be validated. Hence, they should not be allowed to form the basis for generalizing statements or principles of management.

Here we will construct and work with a proper conceptual framework, and strive to handle management problems in a systematic and theoretically acceptable way.

Let us concentrate this paper to a specific domain, formed by the topics and theoretical constructs of planning, problem-solving and decision making in senior level management; let this domain be the **M(anagement)-domain**.

The substance of the M-domain can be described with a collective set of common wisdoms, which give the domain the following characteristics (modified and adapted from Drucker (1985) and McCormack (1986)):

* the nature of systems: as a company matures, systems and structures are allowed to take root, and like weeds in a garden they begin to choke the life out of the organizations that seeded them; responsibility is passed along and down and around, and eventually, when it finally reaches the guy who is actually supposed to do something, someone has invariably forgotten to tell him the reason.

* think small: there is no other feeling like the "small feeling" in business; it's not just the excitement, although that is certainly part of it; it is more a sense of the immediacy and importance that everything takes on, the feeling that what you do from day to day matters, and that generates a desire to do even more.

* don't let structures run the operation: good management must resist both the internal and external pressures to force new business into the old holes, simply because those holes already exist; once a company allows structure to run its operation, it is only a few missed opportunities away from total stagnation.

* entrepreneurial strategies: being "fustest with the mostest", i.e. aiming at leadership, if not at dominance of a new market or a new industry; "hitting them where they ain't", or creative imitation, i.e. understanding what an innovation represents better than the people who made it and who innovated; finding and occupying a specialized "ecological niche", i.e. obtaining a practical monopoly in a small area; changing the economic characteristics of a product, a market or an industry.

* think flexibility: your employees have to see the tangible proof not only that the structure is flexible, but that this flexibility works to their advantage and their self-interest.

* reserve the right to be arbitrary: the prime responsibility of a CEO is to the company itself and to the people who work for it; the CEO should provide awareness for growth and protect the future, and the best decisions for doing this are not always the fairest or the most popular.

* don't let policies stifle the operation: if structures create a drag on business momentum, then outdated, outmoded policies create a drag on the business itself.

* big businesses don't innovate: the new, major innovations of this century did not come out of the old, large businesses of their time; it is not size that is an impediment to entrepreneurship and innovation; it is the existing operation itself, and especially the existing successful operation; entrepreneurship is not "natural", it is not "creative", it is work.

* manage unconventionally: managing a mature company is not just a constant process of breaking out of archaic structures and antiquated policies; the irony is that a mature company gains momentum by pushing against the flow of the existing momentum; don't just look for opportunities to do the unexpected; create them; aggressively pursue change; make managing an

active verb.

* practise systematic innovation: a purposeful and organized search for changes, and a systematic analysis of the opportunities such changes might offer for economic or social innovation; there are seven sources for innovative opportunity: the unexpected, the incongruity, process need, changes in industry or market structure, demographics, changes in perception, mood and meaning and new knowledge.

* manage with confidence: it takes a very confident person to be a good manager, confidence in the people who work for you and enough confidence in yourself to overcome ego problems; managers have got to be able to build up people and give them responsibilities, to find ego gratification in training, directing and overseeing others.

* delegate what you can, not what you want to: people hold on to a task because they like doing it, or want to do it, or are afraid not to do it, and they will pass down some other task because they find it distasteful or "beneath them" or have rationalized that it is not the best use of their time; all sorts of business considerations have to be weighed when determining what should and should not be delegated.

* hire people smarter than yourself: the smarter you make the people who work for you look, the smarter you are going to look as a manager; then don't sell yourself, sell your company.

* take five hours to save five minutes: managers would rather do most of the job themselves than take the time to teach someone else to do it for them; they feel they could be most effective if everyone else would just get out of their way; these managers don't understand that in teaching someone else to do their job they are freeing up their own time for more important tasks and greater responsibilities.

* management philosophies don't work: once you factor in human beings - egos and personalities - even the most sensible theories begin to fall apart; be flexible and strive for consistency; flexibility is not just rethinking your business, it must extend to all aspects of management.

* manage for consistency: next to profitability, the most important goal a company should strive for is consistency; if flexibility is the means, then consistency of performance and growth is the end; flexible, responsive management virtually guarantees consistency, inflexibility causes erratic behaviour.

* dealing with employees: what happens when policy meets personality? no two people are motivated in precisely the same way or by exactly the same things, and no individual works on a totally even keel; pay the employees what they are worth; make them feel they are important, yeat make them think for themselves; separate office life from social life; don't demand from

your employees anything that you aren't demanding from yourself; get to know the people two levels down from you, that's where your future is going to be, and it will give a better idea about the present.

* go for profit: many companies who are busy buying new businesses and bringing in new management teams haven't even tested the outside edge of their profitability; one way to lose profits is to fall prey to the big-kill syndrome, i.e. commit to huge deals they know going in are at best break-even propositions; business decisons are often based on impressing certain people; bad corporate decisons are made because a company would rather look good than be good.

* know your competition: there is a major difference between competing in business and competing in sports: the idea is to win, but in business there is no end to the game; there are no insurmountable leads; the competition always has time to catch up; business competition is a constant, ongoing, active process of domination; and, don't sue the bastards.

We can probably agree on three things: (i) the material compiled from just two experienced (even "street-smart") executives/authors is a very rich description of the substance of the M-domain; (ii) the principles described are not easily systematized or developed into generally accepted management principles; (iii) it is no easy task to create conceptual frameworks for tackling the M-domain in systematic and scientifically acceptable ways. Nevertheless, we will try just that, and then formulate the main methodological differences between interactive heuristics and optimization.

2. Some observations on conceptual frameworks for the M-domain.

Peter Checkland (1985) describes research in management as attempts at "rational intervention in human affairs", i.e. we study activities in management as purposeful human actions, or (in Churchmans words) we can always ask "what intellectual framework would in logic make this particular action meaningful?". We want to find descriptions and explanations of management activities which establish some logical pattern between accepted propositions about reality and given/wanted objectives. This proposition is classical, it represents practical syllogism.

In Devil's Dictionary there is rather a negativistic definition of "rational" as "void of all delusions save those of observation, experience and reflection". This gives us, however, some useful insight: the "rational intervention in human affairs" should be systematically derived from validated knowledge and empirical, thoroughly tested experience.

A rational intervention is a complex and demanding endeavour because the management context is, in Keynes' words "... in too many aspects, not homogeneous through time". Let us support

this endeavour with a framework for discussing the issues involved proposed by Peter Checkland (1985), cf fig 1:

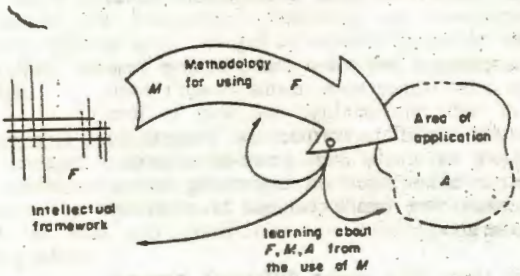

Fig. 1 The organized use of rational thought (Checkland).

The intellectual framework F could simply be some linked ideas, or is in its most demanding form a metatheory of theoretical frameworks for management. The methodology M prescribes how the framework should be applied in A, the area of application (here: the M-domain), and initiates and supports learning processes about all three elements: the framework, the M-domain and the methodology itself.

Let us next compare and show the differences between two established intellectual frameworks for the M-domain: analysis and appreciative systems.

"By this theory, we learn to appreciate precisely what a sound mind feels through a kind of intuition often without realizing it. The theory leaves nothing arbitrary in choosing opinions or in making decisions, and we can always select, with the help of this theory, the most advantageous choice on our own. It is a refreshing supplement to ignorance and feebleness of the human mind.

If we consider the analytic methods brought out by this theory, the truth of its basic principles, the fine and delicate logic called for in solving problems, the establishments of public utility that rest on this theory, and its extension in the past and future by its application to the most important problems of natural philosophy and moral science, and if we observe that even when dealing with things that cannot be subjected to this calculus, the theory gives the surest insight that can guide us in our judgment and teaches us to keep ourselves from the illusions that often mislead us, we will then realize that there is no other science that is more worthy of our meditation."

This lengthy quotation (cf Howard (1988/p 679)) shows Laplace's argumentation in 1812 on why probability theory surpasses intuition as a means for tackling complex problems with uncertain alternatives. It can almost as such serve as an appropriate

argument for the use of an analytical framework in the M-domain: imprecise (even feeble) statements of management principles, as demonstrated in the quotations listed in section 1, should be replaced by basic principles and a theory of the same magnitude as Lapalace's probability theory. Then it would be appropriate to derive management principles, which could give "... the surest insight that can guide us to keep ourselves from the illusions that often mislead us ...".

The use of an analytical framework is known as decision analysis (cf Howard (1988)), optimizing or hard systems thinking (cf Checkland (1985)), analysis or the analytical paradigm (cf Carlsson (1984)). The methodology M(a) for applying an analytical framework to the M-domain has been a de facto standard in management for planning, problem solving and decision making for several decades. Here we will use a formulation proposed by Howard (1988/ pp 680-681), which is very illustrative:

"Our intention is to apply a sequence of transparent steps to provide such clarity of insight into the problem that the decision-maker will undertake the recommended action. The first step of formulation (i) fits a formal model to the decision-maker's opaque real situation. We call this formal representation of the problem a "decision basis" ... The decision basis must (ii) be evaluated by a primarily computational process to produce the alternative that is logically consistent with the basis and therefore recommended. Then we (iii) perform an appraisal of the analysis to gain insight into why the recommended alternative is not only logically correct, but so clearly persuasive that the person will act accordingly. The appraisal may well reveal some shortcomings of the analysis, requiring (iv) a refinement of the formulation to assure that it is truly appropriate to the problem. At some point, the appraisal step will show that the recommended alternative is so right for the decision-maker that (v) there is no point in continuing the analysis any further."

The same methodology M(a) was described by Checkland (1985) as the notion of "optimizing the structure and behaviour of systems and maintaining them in that state", which is based on the assumption that any human activity could be regarded as a goal-seeking system. Then M(a) can be condensed to (i) define the system of concern, (ii) define the system's objectives and (iii) engineer the system to meet those objectives. Howard's (1988/p 682) description of "a good decision" contains the same substance: "A good decision is an action we take that is logically consistent with the alternatives we perceive, the information we have, and the preferences we feel."

Then we can summarize: optimization aims at providing "the surest insight" into a problem to guide decision making.

Everybody will agree with the objective of optimization - the point of argument raised by a considerable number of critiques is how to reach this objective. Simon (1960) was among the first to abandon optimization, and pointed out that the abstraction from reality, which is necessary to allow the construction and use of

mathematical models, would convince both the model builders and the model users that the simplified problem was the problem they actually wanted to solve. Here Checkland (1985) raises the main point in his criticism of optimization: the problem solving is a search for an end already known to be desirable. Simon actually discussed this point by observing that in real life the goals change all the time, but he still insisted that goal seeking is useful for analytical purposes.

The principle of goal seeking, or goal seeking behaviour, explores and implements a situational or internal logic of a problem. This logic serves as a basis for systematizing and generalizing knowledge gained in the problem solving process, and allows us to apply insights to other, similar problems. The situational/internal logic is much simpler than real-life situations in which different logics, associated with different actors, different perceptions and different experience, are in continuous interaction. The following illustration of the substance of the M-domain (cf fig. 2) supports this point:

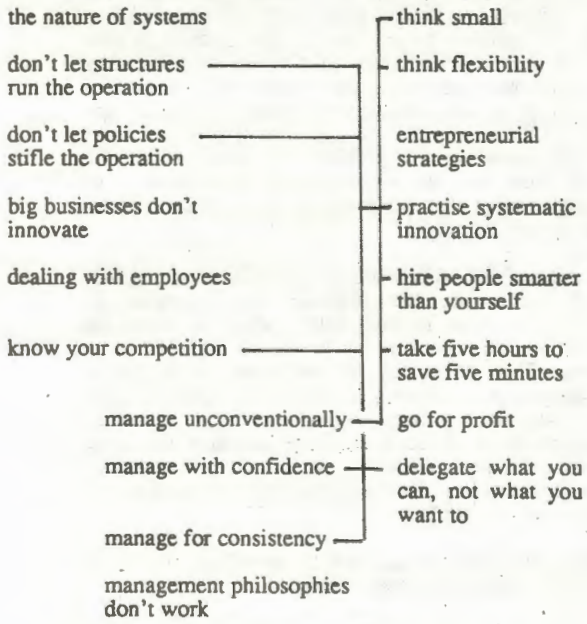

Fig. 2 The logics of the M-domain.

It seems clear that simplification and abstraction are necessary in order to find the situational/internal logic of the M-domain, but Checkland maintains that goal seeking is the wrong principle

and proposes the concept of relationship maintaining, formulated and introduced by Sir Geoffrey Vickers, as more appropriate for the complexities of the modern M-domain.

Vickers was "a reflective advisor and manager" who after his retirement in 1955 from a most distinguished professional career (the V.C. as an officer with the Sherwood Foresters during the First World war, twenty years as a partner in a firm of corporation lawyers in the City of London, as Head of Economic Intelligence at the Ministry of Economic Warfare and the Joint Intelligence Committee during the Second World Wa, and as a member of the National Coal Board responsible for manpower, training, education, health and welfare) spent his retirement on the process of making sense of 40 years' experience of what he called governance: (i) the exercise of judgement, (ii) the weighing of moral issues, and (iii) the creation of form.

Vickers rejected goal seeking as an adequate model of human behaviour for understanding the social processes of governance. He was totally opposed to the use of quasi-natural science in decision-making and policy making (cf 1970/pp 102-106), and wanted to introduce the principles of systems research:

> Science has vastly helped to order and extend our appreciated world but it has not led us out of it into an "objective" world, independent of all human viewpoints and values. ...
>
> Science contributes first the faith that the real world out there is regular; and that it is knowable, to an extent which only experience can decide, by the method of science. It contributes, further, a method which, I have suggested, is only a rigorous extension of the method by which most of our knowing is gained. It contributes finally an attitude, born of its faith and its method. All three have powerfully affected our appreciative system as well as changing our appreciated world. ...
>
> The method, fruitful as it has been, has limitations. It is limited first by the kinds of subject matter to which it is applicable. ... its greatest later successes have been in the fields of physics and chemistry, where relatively stable (or identically repeatable) atomic and molecular systems will equally abide an indefinitrely extended series of strictly comparable experiments. ...
>
> When the objects of its attention are men and societies the method is further limited by the fact that much of our knowledge of these is inescapably drawn from a source which is not open to physical scientists and which would horrify them if it were. All the words in any language which refer to human experience have meaning only in so far as those who use them have themselves had the experience to which they believe those words apply. ... The knowledge on which they

> rely in this field is thus differently derived, differently experienced and differently validated, in so far it can be said to be validated at all. ... the method by which science escapes this limitation (the method of abstraction) imports limitations of its own. ... it is questionable how far, in the psycho-social field, an abstraction can develop in scientific thinking which does not influence or even supersede the models of general appreciation. ...
>
> The method is further limited by being analytic. So great a harvest has been yielded by the analytic method that it may seem unreasonable to rate this as a limitation. It remains true that tyhe activity of the appreciative system is a syntehsizing and integrating activity. How far this depends on prior analysis is a question which has still to be answered. ...
>
> Until less than fifty years ago scientific faith assumed that the order which it was exploring was something to be discovered in the real world, not something to be imposed on that world by the human mind. Hypotheses might indeed be invented but they were acceptable only when, validated by the methods of science, they proved to be discoveries. ... By contrast, the facts of human life are embarrassingly fluid. ... Order is created, rather than discovered, imposed rather than induced.

These lengthy quotations are motivated by the fact that Vickers' text cannot be summarized, neither surpassed in elegance. Vickers' alternative to goal seeking is the appreciative system:

> I use the word appreciation to describe the joint activity which we call knowing and which we sometimes suppose, I think mistakenly, to be a separable, cognitive activity which is "value-free". Since these readinesses are organized into a more or less coherent system, I speak of them as an appreciative system. I sometimes refer to their state at any point of time as their appreciative setting and to any act which expresses them as an appreciative judgement. The appreciative world is what our appreciative system enables us to know.

Checkland proposes his soft systems methodology as the means (that is M, cf fig 1; let us denote the corresponding methodology for the appreciative system as M(as)) for transferring Vickers' insights in governance to real world applications. One of the present authors has argued that M(as) is effectively made operational with methods (interactive heuristics) developed for decision support systems and expert systems, and slowly being forged into a comprehensive methodology (Carlsson (1988)).

Let us then summarize: the program for interactive heuristics in the M-domain is to provide (i) means (normally computersupported) for taking action in a problem situation; (ii) conceptual models relevant for discussing and reformulating the problem situation; (iii) possible alternatives for action, which are systematically

desirable, culturally feasible and accomodate conflicting interests (cf Checkland); (iv) learning processes, which both develop its means and the program itself.

In the next section we will compare interactive heuristics with optimization in a financial planning model, in order to get at least a preliminary indication of the differences.

3. Interactive heuristics vs optimization.

Let us in the following consider a financial planning model, which has been constructed with a so-called DSS generator, i.e. a macro-level modelling langauage (IFPS).

The model has the following features:

* the financial planning task is described in a near-natural language, which makes it easy for a model-user to find out what happens in the model, even if he is a novice- or occasional user;

* the situational or internal logic of the task is easily found;

* the planning task can be tackled with a series of experiments, which the model user can design and carry out himself;

* the model can be run with several different sets of data;

* the modelling langauage is equipped with a set of functions and routines which allow even a novice user to carry out complex and advanced calculations.

```
\ model simplan

columns 1..5

\ Profit and Loss Statement

sales=data,sales price*xsales volume
production costs=data,production unit cost*xproduction volume
inventory change=data,production unit cost*(xsales volume-xprod-
uction volume)
\
sales margin=sales-sum(production costs thru inventory change)
\
selling expenses=data,promotion unit cost*xpromotion volume
depreciation=data,furndep*(previous furniture+xfurninvestment)+'
                buildep*(previous buildings+xbuildinvestment)+'
                machdep*(previous machinery+xmachinvestment)
interest=data,intrate*(previous long term debt+xnew loan-xrepay-
ment)
taxes=data,tax rate*(sales margin-sum(selling expenses thru
interest))
\
net income=sales margin-sum(selling expenses thru taxes)
\
```

```
\ Balance Sheet
\
\ (i) Assets
\
cash=data,previous+accrecproc*(previous   sales-sales)+accpayproc*'
     (production costs-previous production costs)+sales-production
costs-'
     interest-selling expenses+xnew loan-xrepayment-investment-
-taxes-'
     xdividends+xnew issue
accounts receivable=data,previous+accrecproc*(sales-previous sales)

materials=data,previous-inventory change
\
total current assets=sum(cash thru materials)
 \
buildings=data,(previous+xbuildinvestment)*(1-builddep)
furniture=data,(previous+xfurninvestment)*(1-furndep)
machinery=data,(previous+xmachinvestment)*(1-machdep)
\
total assets=sum(total current assets thru machinery)
\
\ (ii) Liabilities
\
accounts payable=data,previous+accpayproc*(production costs-pre-
vious production costs)
long term debt=data,previous+xnew loan-xrepayment
common stock=data,previous+xnew issue
retained earnings=data,previous+net income-xdividends
\
total liabilities=sum(accounts payable thru retained earnings)
\
\ supporting variable definitions
\
investment=xfurninvestment+xbuildinvestment+xmachinvestment
\
\ data input section
\
\ (1) constants
\
furndep=data
builddep=data
machdep=data
sales price=data
production unit cost=data
promotion unit cost=data
intrate=data
tax rate=data
accrecproc=data
accpayproc=data
\
\ (2) decision variables
\
xsales volume=data
xproduction volume=data
xpromotion volume=data
xfurninvestment=data
xbuildinvestment=data
xmachinvestment=data
xnew loan=data
xrepayment=data
xnew issue=data
xdividends=data
^Z
```

A typical report with the system is designed to show all essential features of the planning task, and can be built as follows:

SIMPLAN

	1	2	3	4	5
sales	2100.00	2100.00	2100.00	2100.00	2100.00
productions costs	1425.60	1425.60	1425.60	1425.60	1425.60
inventory change	0.00	74.40	74.40	74.40	74.40
sales margin	674.40	600.00	600.00	600.00	600.00
selling expenses	412.50	412.50	412.50	412.50	412.50
depreciation	54.60	100.53	86.96	76.64	68.67
interest	36.00	49.07	48.57	48.07	47.57
taxes	85.60	17.05	23.39	28.25	32.07
net income	85.70	20.84	28.58	34.53	39.20
Balance Sheet					
(i) Assets					
cash	344.30	515.08	675.02	830.59	982.86
accounts receivable	231.00	231.00	231.00	231.00	231.00
materials	190.80	116.40	42.00	-32.40	-106.80
total current assets	766.10	862.48	948.02	1029.19	1107.06
buildings	745.40	690.37	639.74	593.16	550.31
furniture	14.00	21.60	28.44	34.60	40.14
machinery	122.00	88.90	65.73	49.51	38.16
total assets	1647.50	1663.34	1681.93	1706.46	1735.66
(ii) Liabilities					
accounts payable	136.10	136.10	136.10	136.10	136.10
long term debt	495.70	490.70	485.70	480.70	475.70
common stock	1000.00	1005.00	1005.00	1005.00	1005.00
retained earnings	15.70	31.54	55.13	84.66	118.86
total liabilities	1647.50	1663.34	1681.93	1706.46	1735.66

With interactive heuristics it is possible to carry out experiments with decisive factors, and trace the effect on essential elements of the planning situation (the "what if"-mode):

	1	2	3	4	5
sales	2100.00	2467.50	2899.31	3406.69	4002.86
production costs	1425.60	1686.96	1948.32	2209.68	2471.04
inventory change	0.00	398.66	881.96	1562.01	2484.89
sales margin	674.40	381.88	69.03	-365.00	-953.06
selling expenses	412.50	464.06	522.07	587.33	660.75
depreciacion	54.60	100.53	86.96	76.64	68.67
interest	36.00	49.07	48.57	48.07	47.57
taxes	85.60	-104.31	-264.86	-484.67	-778.52
net income	85.70	-127.48	-323.71	-592.37	-951.52
cash	344.30	643.65	1198.63	2139.57	3618.50

```
 Case
xsales volume=100,previous*1.175
production unit cost=15,previous+2.75
promotion unit cost=10,previous*1.125
  What If Solution                    VIEW MODE    Model C:SIMPLAN.MOD
```

or to select some desired development profile (no taxes during years 2-5) and select some factor (interest) to achieve this development (the "goal-seeking"-mode):

	1	2	3	4	5
sales	2100.00	2467.50	2899.31	3406.69	4002.86
production costs	1425.60	1686.96	1948.32	2209.68	2471.04
inventory change	0.00	398.66	881.96	1562.01	2484.89
sales margin	674.40	381.88	69.03	-365.00	-953.06
selling expenses	412.50	464.06	522.07	587.33	660.75
depreciation	54.60	100.53	86.96	76.64	68.67
interest	32.50	-182.72	-540.00	-1028.97	-1682.47
taxes	85.60	0.00	-0.00	0.00	-0.00
net income	89.20	0.00	-0.00	0.00	-0.00
cash	344.30	771.13	1649.83	3183.14	5613.60

In this fashion interactive heuristics allows a model user to apply all his creativity, and express it in a mode he understands himself.

In contrast, optimization will focus on one specific aspect of the planning task, and find an optimal solution for this aspect. The optimization is a "black box"-routine for all but specialists, even if the model itself can be fairly readable with modern modelling tools (IFPS/Optimum; cf Case 1, with the objective to maximize cumulative dividends using the variables denoted with an "x" as decision variables):

(2) DECISION VARIABLES

Periods:	1	2	3	4	5
XSALES VOLUME	100	97.50	97.50	97.50	97.50
XPRODUCTION VOLUME	95.04	100	100	100	100
XPROMOTION VOLUME	41.25	41.25	41.25	41.25	41.25
XFURNINVESTMENT	10	0	0	0	0
XBUILDINVESTMENT	5	25	25	25	25
XMACHINVESTMENT	5	0	0	0	0
XNEW LOAN	10	0	0	0	87.24
XREPAYMENT	15	58.92	9.046	14.98	0
XNEW ISSUE	0	50	0	0	0
XDIVIDENDS	0	10.50	10.50	10.50	111.6

(3) CONSTRAINTS

MARKET SHARE	-42	0	0	0	0
OUTPUT	4.960	0	0	0	0
LOANS	4.300	63.22	72.27	87.24	0
INVESTMENT LIMIT	5	0	0	0	0
SOLIDITY	-23.91	144.6	199.0	267.7	102.0
GROWTH	16.48	0	0	0	0
STOCK YIELD	-10	0	0	0	101.1

OBJECTIVE SET

CUMDIVIDENDS	0	10.50	21	31.50	143.1

MODEL SIMPLAN (Case 1)

Periods:	1	2	3	4	5
PROFIT AND LOSS STATEMENT					
SALES	2100	2100	2100	2100	2100
PRODUCTION COSTS	1426	1500	1500	1500	1500
INVENTORY CHANGE	0	-37.50	-37.50	-37.50	-37.50
SALES MARGIN	674.4	637.5	637.5	637.5	637.5
SELLING EXPENSES	412.5	412.5	412.5	412.5	412.5
DEPRECIATION	54.60	99.63	85.58	75.07	67.10
INTEREST	36	43.68	42.77	41.28	50
TAXES	85.60	36.76	43.49	48.89	48.56
NET INCOME	85.70	44.93	53.15	59.76	59.35
BALANCE SHEET					
(I) ASSETS					
CASH	344.3	414.4	471.1	517.9	557.5
ACCOUNTS RECEIVABLE	231	231	231	231	231
MATERIALS	190.8	228.3	265.8	303.3	340.8
TOTAL CURRENT ASSETS	766.1	873.7	967.9	1052	1129
BUILDINGS	745.4	708.8	675.1	644.1	615.5
FURNITURE	14	12.60	11.34	10.21	9.185
MACHINERY	122	85.40	59.78	41.85	29.29
TOTAL ASSETS	1648	1680	1714	1748	1783
(II) LIABILITIES					
ACCOUNTS PAYABLE	136.1	143.5	143.5	143.5	143.5
LONG TERM DEBT	495.7	436.8	427.7	412.8	500
COMMON STOCK	1000	1050	1050	1050	1050
RETAINED EARNINGS	15.70	50.13	92.78	142.0	89.77
TOTAL LIABILITIES	1648	1680	1714	1748	1783
SUPPORTING VARIABLE DEFINITIONS					
INVESTMENT	20	25	25	25	25
DATA INPUT SECTION					
(1) CONSTANTS					
FURNDEP	.1000	.1000	.1000	.1000	.1000
BUILDDEP	.0800	.0800	.0800	.0800	.0800
MACHDEP	.3000	.3000	.3000	.3000	.3000
SALES PRICE	21	21	21	21	21
PRODUCTION UNIT COST	15	15	15	15	15
PROMOTION UNIT COST	10	10	10	10	10
INTRATE	.1000	.1000	.1000	.1000	.1000
TAX RATE	.4500	.4500	.4500	.4500	.4500
ACCRECPROC	.2000	.2000	.2000	.2000	.2000
ACCPAYPROC	.1000	.1000	.1000	.1000	.1000

4. Conclusions.

As we have tackled the M-domain with several conceptual frameworks, and also have proposed alternative principles for planning, problem-solving and decison making in senior level management, it seems appropriate to conclude with a taxonomy of the key concepts.

Problems in the M-domain can normally be organized in three fairly well-defined categories: well-structured, ill-structured and semi-structured problems.

Well-structured problems are abstract constructs of (i) a logically clear and precise problem formulation, identifying (ii) cause-effect relations between essential elements, where (iii) the information on the elements and the relations is sufficiently precise and certain.

Ill-structured problems are the opposite of well-structured problems: they have (i) no definite problem formulation, (ii) the elements identified in the formulation are probably only symptoms of some underlying cause-effect relations, but interact in a confusing way, and (iii) the information on the elements and the relations is imprecise and uncertain.

Semi-structured problems are composed of the previous two categories, with elements of both.

It is easy to conclude from Vickers' discussion that the problems contained in the M-domain are mostly semi- and ill-structured, with an emphasis on the ill-structured problems, and with an occasional well-structured problem to brighten the day of analytically bended people.

With this structure, let us compile a (preliminary) taxonomy of key elements.

M-domain:	Well-struct	Semi-struct	Ill-struct
Analysis	Goal seeking		
Systems research		Soft systems	Appreciative systems

Fig. 3 The elements A (the M-domain) and F.

Checklands' "soft systems"-methodology is classified as dealing with semi-structured problems on the basis of his discussion (cf

Checkland (1985)), in spite of his claim that he is implementing appreciative systems. The decisive element is his use of "root definitions", which do not belong to an appreciative system.

With the elements A and F decided, let us then find the corresponding M(a) and M(as):

M-domain:	Well-struct	Semi-struct	Ill-struct
Optimization	Decision Analysis		
Interactive heuristics		Decision Support Systems	Expert Systems

Fig. 4 The elements A and M (M(a) and M(as)).

The classification of DSS and ES is tentative and needs further corroboration, but should serve as a basis for systematic researchn efforts.

Let us proceed in the (new) tradition of management research: the only fail-proof way not to succeed, is not to try (as there are so many who do not even try ...).

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