Failures and successes of quantitative methods in management

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Abstract

About 60 cases of both failures and successes of quantitative methods
in management, collected in industry, business and government in the
Netherlands, are analyzed for features determining either their
failure or their success.

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1. Introduction

Soon after the origins of OR/MS, when the literature about the subject began to grow, a sort of hate-love relationship arose between the literature and the real world. Much of the ado in the literature never penetrates into the real world – it is not useful. Much business in the real world never penetrates into the literature – it has too little news value (mathematicians call this trivial), or too much, for the competition. On the other hand, the literature and the real world need each other, because OR/MS is an applied science. The area of interpenetration should be handled with care, to keep OR/MS up in the air. It is represented by the shaded area of figure 1, which I call the diabolo model of the literature and the real world.

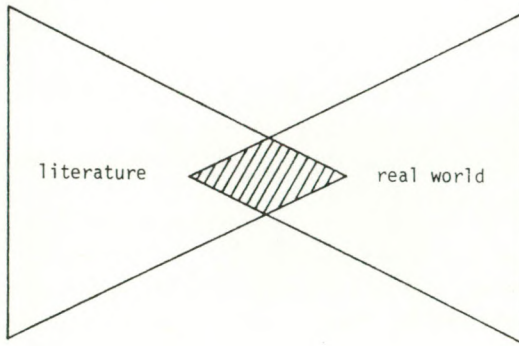Figure 1. Diabolo model of the literature and the real world of OR/MS.

A paper in 1965 by Churchman and Schainblatt [5] triggered off a branch of literature, which concerns itself with the interpenetration of the literature and the real world. It is called implementation research. Many authors write about a gap [e.g., 21], which may be caused by a time lag or, unfortunately, by repulsion [36].

At least three books have been devoted to implementation research
[7, 14, 33]; the European Working Group on "Methodology of OR" is much
involved with implementation [16, 23]; Schultz and Slevin [34] started a
column on "Implementation Exchange" in Interfaces. Wysocki [41] describes
a bibliography of 276 publications in 1979, which is progressing at an
increasing speed. Milutinovich and Meli [26] review 350 publications.

Implementation research can either take the literature as its object
[4, 24, 25, 30], or the real world. An indirect view is taken by the
review articles of implementation research, the surveys of the surveys,
so to speak [13, 26, 41].

Implementation studies dealing with the real world may be based on
a) experience,
b) questionnaires,
c) interviews,
d) case studies.

Ad a. Authors' own subjective experience is a perfectly legitimate
basis for empirical studies, provided the author is an expert and an
authority. Much of the vast Interfaces literature on implementation is
based on experience [3, 6, 9, 10, 22, 29, 31], but also scientifically more
prestigous publications accept subjective papers based on experience [5, 7,
12, 27]. Of course, some authors speculate about more exotic paradigms,
like transactional analysis [20], Zen [28] or anthroposophy [8].

Ad b. Questionnaires are often mailed, especially by Americans, to either
members of OR/MS societies or firms, e.g. [19]. The problem with mail surveys,
though, is probable biases of the results due to low response rates, e.g.,
31%[1], 24% [11], 35% [17], 33% [35], 37% [39].

Ad c. Interviews usually have much higher "response rates" and allow
a more in-depth analysis and testing of hypotheses, e.g. [2, 15, 37, 40].

Ad d. Case studies allow perhaps still more penetrating analysis of
implementation problems, although their statistical significance varies.
Lockett and Polding [18] analyze three case studies, Roberts [32] four,
Alter 56 and Bean and Radnor 43, both in [7].

This paper is based on 58 cases [38]. The order of presentation is as
follows. First the collection of 36 case studies, containing the 58 cases,
is described (section 2); next the question of biases in the samples of the
cases and of the reasons for failures or successes is discussed (section 3);
then the results are presented (section 4). Section 5 consists of a summary
and conclusions.

2. 36 case studies of failures and successes

The original object of collecting between thirty and forty case studies
in industry, business and government was not to do implementation research
but to celebrate the 25th anniversary of the Netherlands Society of
Operations Research (NSOR). The collection of 36 case studies was publis-
hed in a popular Dutch paperback edition and is translated by B.A. Knoppers
for an English edition by Wiley [38].

363 members of NSOR (98% of the personal membership) plus 50 Flamish-
speaking members of the Belgian Society for the Application of Scientific
Methods in Management (SOGESCI/BVWB) were invited by telephone to write
a contribution. This cascaded into 200 statements of interest, 70 promises
and 36 actual papers, 34 of which are Dutch and 2 Belgian.

The instructions to authors were rather rigourous. We wanted concise,
well-readable, non-technical contributions of less than 3000 words (the
most severe constraint). Each contribution should introduce the OR activi-
ties at the author's firm/institution and describe two cases, one of which
should be a failure, the other a success. Each case should describe the
problem, the approach, the results, the reasons why the results were
negative in one case and positive in the other, and conclusions. It was
left to the imagination of the authors to decide if a case were a failure or a
success; we merely indicated that in case of a failure the costs of the
project outweigh the benefits and in case of a success it is the other way
round.

The reason that we obliged authors to write about a failure was that
we believe that one man's fault is another man's lesson. In the literature,
it might even be attractive to focus, unlike Interfaces, on failures rather
than successes. Some potential authors dropped out because they could not
find, or were not allowed to write about, a case that failed. A few others
could not find a successful case! Still others had been working on just
one big project in the past few years. In that case they were asked to
write about the one project, but showing both sides of the medal, the par-
tial failures and the partial successes, the trials and errors, the pit-
falls and snags.

The 36 contributed case studies together describe 58 different cases. Naturally, it was stressed for the general reader that failures and successes were supposed to occur in equal proportions in the book, but not in reality!

After the event it was realized that the collection of cases could be used to do implementation research. This amounted merely to analyzing the reasons given for failures and successes by the authors themselves. But before we do that, we have to discuss the question of representativity of the sample.

3. Biases in the sample?

The case studies can be classified according to three dimensions, viz. according to (a) problem areas, (b) techniques employed and (c) sectors of the economy.

Table 1 presents the number of failures and successes by problem areas dealt with. The only significant difference between the number of failures and successes seems to be in routing and scheduling.

Table 2 presents the number of failures and successes by techniques employed. Wedley and Ferrie [40] conjectured that (a) projects in which managers participate have more success, (b) managers participate more in linear programming projects, hence, (c) linear programming projects are more often successful. This conjecture is not borne out by our data. The only striking difference between failures and successes is in combinatorial optimization, probably because of the complexity of the models (cf. next section).

Table 3 presents the percentage distribution of the case studies by sectors of economic activity, compared to the percentage distribution of total labour volume in the Netherlands and of the membership of the Netherlands Society of Operations Research. The distribution of case studies over sectors corres-

Table 1. Number of failures and successes by problem areas dealt with

Problem area	Number* of	
	failures	successes
market research	4	5
production, inventory planning	4	6
routing, scheduling	9	4
location, allocation planning	4	6
financial, organizational planning	6	6
social, regional planning	7	7
various	2	2
	36	36

*If one project was described, it was counted on both sides.

Table 2. Number of failures and successes by techniques employed

Technique employed	Number[*] of	
	failures	successes
linear, mixed-integer programming	7	9
non-linear programming	1	4
combinatorial optimization	11	3
simulation	8	9
statistics	3	2
ad hoc, various	6	9
	36	36

[*]If one project was described, it was counted on both sides.

Table 3. Percentage distribution of Dutch labour volume, NSOP membership and case studies, by sectors of economic activity

Sectors of economic activity	Dutch labour volume[*]	NSOR membership[**]	Case studies analyzed
I. Agriculture	5.8	0.5	2.8
II. Manufacturing industry	30.1	21.2	27.8
III. Business services	48.8	31.0	30.6
IV. Government	15.4	47.3	38.9
(of which Education)	(5.2)	(32.8)	(19.4)
	100	100	100

[*] Source: Netherlands Central Bureau of Statistics, "Labour volume by sectors and branches of industry, year averages in person-years", 1981.
[**]Source: [37].

ponds fairly well with the distribution of NSOR membership, especially if one takes into account that we have discouraged academics to contribute, asking them twice if their case study concerned a real life problem and not an "academic" problem. If we compare the distribution of case studies with the distribution of total labour volume in the Netherlands, we see that the quartary sector, Government, and academia in particular, is over-

represented and the tertiary sector, Services, is underrepresented in the case studies. This may be partly caused by the fact that there are many small-scale firms in Services with too small-scale problems (cf. next section).

Our collection of case studies is far from being a random sample from all quantitative methods applied in management in the Netherlands. There may be biases in the distribution over problem areas, techniques employed, or sectors of economic activity. There may be biases in the size distribution of the firms/institutions represented, although the sizes range from the numbers 2 and 23 on the Fortune 1981 list of largest industrial companies in the world (Royal Dutch/Shell Group and Philips' Gloeilampenfabrieken, respectively), down to the one-man consultancy firm of B.A. Knoppers. There may be biases in the authors, approached through the NSOR membership, because the NSOR membership is dominated by its 36% mathematicians and 21% econometricians [37]. There certainly are biases due to the required 50-50 proportion of failures and successes, to the requirement that cases should have sufficient news value for the readers, to confidentiality restrictions or, alternatively, to propaganda considerations (of consultants, academics).

But what really matters here is not possible biases in the collection of case studies, but possible biases in the reasons given for failures or successes of cases. Then we have to realize that the question about reasons for failures or successes was open-ended - there was no preconceived exhaustive list of reasons - and that the answers were given by the OR/MS consultants who did it, not by their managers or clients, even though the authors were obliged to admit failures. Therefore, we have to expect, and take account of, two kinds of biases in the reasons given for failures or successes:

1) a bias away from self-evidences to the authors, e.g. "we had sufficient know-how, computer facilities, software available";
2) a bias away from self-indictments of the authors, e.g. "we did not have sufficient know-how, we did not sell our project properly".

Concluding, we hardly see any reason that the biases in the sample of cases would cause biases in the sample of reasons given for failures or successes, but we expect some biases in the latter sample due to neglect of self-evidences and the fact that the judges are involved in the judgements.

4. Reasons for failures and successes

I classified the reasons given for failures and for successes independently and I realize that classifying open-ended statements from case studies is a subjective job. Fortunately, the base material is available [38], so the job can be replicated! I had expected that the reasons given for failures would be the opposites of the reasons given for successes. This turned out to be true to a limited extent.

Tables 4 and 5 present the reasons given for failures and successes. The order by which they are presented is: (a) orientation towards the client, (b) towards the OR/MS consultant and (c) towards the relation between the two, and, within these orientations, roughly "top-down".

Table 4. Reasons given for failures

Code	Number of times mentioned	Reason
a) Client-oriented		
F1	4	organizational resistance to change
F2	7	organizational changes
F3	7	data deficiency
F4	5	"data" uncertainty
F5	1	problem too complex
F6	6	problem too small-scale
	30	
b) OR/MS-oriented		
F7	1	project mismanagement
F8	3	progress too slow
F9	1	too much tackled at once
F10	7	model too complex
F11	5	computer-time excessive
	17	
c) Relation-oriented		
F12	3	lack of higher management support
F13	7	insufficient user involvement
F14	6	insufficient user understanding
F15	1	OR/MS-man involved too late
F16	15	mismatch of model and problem
	32	
	79	

Table 5. Reasons given for successes

Code	Number of times mentioned	Reason
a) Client-oriented		
S1	13	savings or profits
S2	11	improved decision making
S3	3	good (use of) data
S4	1	problem large-scale
	28	
b) OR/MS-oriented		
S5	3	progress quick
S6	3	step-by-step procedure
S7	9	single, clear model
S8	5	flexible model
S9	3	good software or technique
	23	
c) Relation-oriented		
S10	6	support from higher management
S11	14	good cooperation with user
S12	9	model and results made plausible
S13	6	user-friendliness
S14	1	good model fit
	36	
	87	

If we scrutinize tables 4 and 5, some reasons for failure or success may be termed pairs of opposites, viz., F3-S3, F6-S4, F8-S5, F9-S6, F10-S7, F12-S10, F13-S11, F14-S12, F16-S14. More interestingly, some reasons do not have counterparts, viz., F1, F2, F4, F5, F7, F11, F15 and S1, S2, S8, S9, S13. Moreover, among the pairs, it happens that one reason occurs frequently but its opposite rarely, notably, F6-S4 and F16-S14.

So much for semantics. If we now make pragmatic remarks about the results in tables 4 and 5, naturally we refer to subjective, implicit hypotheses or expectations, either refuted or borne out by the results.

Everybody is free, though, to make his own observations.

- Organizational changes (F2) are a frequent reason for failure we
  had not thought of. However strong the resistance to change (F1)
  may be, organizational changes, like reorganizations or transfers
  of clients, kill projects.
- Problem too small-scale (F6) rightly is a reason for failure of projects
  - and probably is an innumerable number of times the reason to refrain
  from starting a project at all.
- Project mismanagement (F7) and too much tackled at once (F9) are rare
  self-indictments that are supposedly underrepresented.
- Model too complex (F10) - hear, hear!
- Computer-time excessive (F11), not expected by me after three decades of
  explosive growth of computer power.
- User involvement (F13, S11) or, what is more, user understanding (F14,
  S12) and ease of use (S13) are still more crucial than I had thought.
- Mismatch of model and problem (F16) was a frequent reason of failure
  that I could not think of naming otherwise. It was using the wrong
  standard "solution" or tailoring the wrong ad hoc model. Happy consequence:
  there remains work to be done by OR/MS workers.
- Benefits in the form of money (S1) or improved decision making (S2) are
  rather tautological reasons for success - and forgotten self-evidences
  in the opposite case.
- Simple, clear, flexible models that progress quickly but step-by-step
  (S5, S6, S7, S8) - hear, hear!
- Good model fit (S14) - a self-evidence usually forgotten unless the re-
  verse is true (F16).

5. Summary and conslusions

An analysis has been made of reasons given for failures and successes
in 36 case studies, describing 58 cases, collected from Dutch industry,
business and government at the occasion of the 25th anniversary of the
Netherlands Society of Operations Research [38]. All authors were supposed
to describe one failure and one success, and to give reasons for them.
   The main conclusions from the results are:
- there is still a lot of OR/MS work to be done, building models that
   fit problems better;
- quick and clean work, cutting out simple and flexible models, leads to
   success;
- a soft, friendly approach, involving and informing the user, is crucial.

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