Image Cover Sheet

CLASSIFICATION	SYSTEM NUMBER
UNCLASSIFIED	499447

TITLE

PERFORMANCE MEASUREMENT INDICATORS FOR OPERATIONAL RESEARCH DIVISION

System Number:

Patron Number:

Requester:

Notes:

DSIS Use only:

Deliver to:

DEPARTMENT OF NATIONAL DEFENCE
CANADA

OPERATIONAL RESEARCH AND ANALYSIS

DIRECTORATE OF OPERATIONAL RESEARCH (JOINT AND LAND)

JSORT RESEARCH NOTE RN 9603

PERFORMANCE MEASUREMENT INDICATORS FOR OPERATIONAL RESEARCH DIVISION

by

I.W. Taylor
and
R. Kluchert

SEPTEMBER 1996

OTTAWA, CANADA

National Defence Défense nationale

OPERATIONAL RESEARCH DIVISION

CATEGORIES OF PUBLICATION

ORD Reports are the most authoritative and most carefully considered publications of the DGOR scientific community. They normally embody the results of major research activities or are significant works of lasting value or provide a comprehensive view on major defence research initiatives. ORD Reports are approved personally by DGOR, and are subject to peer review.

ORD Project Reports record the analysis and results of studies conducted for specific sponsors. This Category is the main vehicle to report completed research to the sponsors and may also describe a significant milestone in ongoing work. They are approved by DGOR and are subject to peer review. They are released initially to sponsors and may, with sponsor approval, be released to other agencies having an interest in the material.

Directorate Research Notes are issued by directorates. They are intended to outline, develop or document proposals, ideas, analysis or models which do not warrant more formal publication. They may record development work done in support of sponsored projects which could be applied elsewhere in the future. As such they help serve as the corporate scientific memory of the directorates.

ORD Journal Reprints provide readily available copies of articles published with DGOR approval, by OR researchers in learned journals, open technical publications, proceedings, etc.

ORD Contractor Reports document research done under contract of DGOR agencies by industrial concerns, universities, consultants, other government departments or agencies, etc. The scientific content is the responsibility of the originator but has been reviewed by the scientific authority for the contract and approved for release by DGOR.

DEPARTMENT OF NATIONAL DEFENCE

CANADA

OPERATIONAL RESEARCH DIVISION

DIRECTORATE OF OPERATIONAL RESEARCH (JOINT & LAND)

JSORT RESEARCH NOTE RN 9603

PERFORMANCE MEASUREMENT INDICATORS FOR OPERATIONAL RESEARCH

by

I.W. Taylor
and
R. Kluchert

Recommended by: _____
R. Kluchert
JSORT

Approved by: _____
G. Lafond
DOR(J&L)

OTTAWA, ONTARIO SEPTEMBER 1996

ABSTRACT

The performance of scientific functions, such as Operational Research, is considered by many to be difficult to measure. A Structured Brainstorming approach has been proposed as an efficient and effective way to examine difficult problems. At the 1995 Operational Research and Analysis (ORA) Field Station meeting, this Structured Brainstorming approach was applied to the problem of developing Performance Measurement Indicators (PMI) for Operational Research and Analysis. The exercise was conducted by the staff as a training program but the results, which focus on impact, implementability, customer satisfaction, quality and favourable external review, were presented to ORA management for their consideration. Recommendations are made for ORA management to become actively involved in assessing client satisfaction levels and determining the impact of OR studies.

RÉSUMÉ

La performance des fonctions scientifiques, telles que la Recherche opérationnelle, est considérée par plusieurs comme difficile à mesurer. Une approche de brainstorming structuré a été proposée comme une manière efficiente et efficace pour examiner les problèmes complexes. A la réunion des stations décentralisées de 1995 de l'Analyse et recherche opérationnelle (ARO), cette approche de brainstorming structuré a été utilisée pour développer des Indices de mesure de performance (IMP) pour l'Analyse et recherche opérationnelle. L'exercice a été dirigé comme un entraînement, mais les résultats, qui traitent de l'impact, la mise en application, la satisfaction des clients, la qualité et la révision externe favorable, ont été présentés aux gestionnaires de l'ARO. Des recommendations ont été faites aux gestionnaires de l'ARO de s'impliquer plus activement dans l'évaluation des niveaux de satisfaction des clients et aussi dans la détermination de l'impact des études en recherche opérationnelle.

TABLE OF CONTENTS

Page

ABSTRACT i

TABLE OF CONTENTS ii

ACKNOWLEDGEMENTS iii

INTRODUCTION 1

DETAILED FINDINGS 2

Group 1 2
Group 2 3
Group 3 5
Group 4 6

COMPARISON OF GROUPS' RESULTS 6

RESULTS OF THE IDEA WRITING 7

Impact 7
Client Satisfaction 8
Quality/Robustness of Results 9
Solutions Implemented 9
Validation or Independent Evaluation 10

CONCLUDING REMARKS 11

REFERENCES 12

ACKNOWLEDGEMENTS

The authors wish to acknowledge the efforts of the Group Leaders during our Brainstorming Sessions: Mr. Fred Cameron from the Directorate of Mathematics and Statistics, Mr. Gary Christopher from the Directorate of Air Operational Research, Dr. Phil O'Neill from the Directorate of Land Operational Research, and Mr. John Verdon from the Directorate of Social and Economic Analysis. As well, the authors would like to thank the ORA participants for their interest and input to the Sessions.

PERFORMANCE MEASUREMENT INDICATORS FOR OPERATIONAL RESEARCH AND ANALYSIS

INTRODUCTION

1. A Structured Brainstorming approach has been found to be effective and efficient at developing new, creative solutions to difficult problems (see Refs. 1,2 and 3). This process which involves mostly written rather than verbal communication avoids many of the pitfalls of normal brainstorming approaches, such as lack of focus, unequal participation, personality conflicts, etc. Using the suggested process, each individual is given equal time and each idea is given equal consideration. Participants focus on the problem not the personalities and because the process ends with an anonymous vote there is a feeling of closure and accomplishment from the process.

2. During the 1995 Operational Research and Analysis (ORA) Field Station Meeting, held 3-4 Oct, this Structured Brainstorming approach was demonstrated to the staff. We attempted to answer the very difficult question: "What Measures of Performance Should be Used to Assess Operational Research Work?" It should be noted that parts of this question were addressed in the Chief of Review Services Program Evaluation E4/89 on the Operational Research and Analysis Establishment (Ref. 4). However, this was the first attempt to measure performance that has been generated internally to the organization.

3. Four group leaders were prepared to chair the Structured Brainstorming sessions. They had been provided with some training material and had run through an example session led by the authors. The attendees at the Field Station Meeting were divided into groups with four to six members. Each group applied the same brainstorming method and worked on the

same problem. After about 90 minutes of work, the Field Station Meeting was reassembled and the findings were presented by the group leaders.

DETAILED FINDINGS

4. One of the comments made by ORA management who observed the process, was that they considered some of the original ideas to be better than the ranked short list of ideas summarized at the end of the session. Although it is important to prioritize the ideas, sometimes good ideas may be filtered out by the voting process. For this reason, we will present all of the unique ideas from all of the groups as well as their prioritized list.

Group 1

5. The first group came up with 19 ideas during their Round Robin discussion. These were then grouped into 12 unique ideas.

a. Client Satisfaction;

b. Solutions Implemented;

c. Timeliness;

d. Improvements to Operational Effectiveness;

e. Robust Applicability of Results;

f. Model Transfer;

g. Cost Effectiveness;

h. Defence Scientist Flexibility and Adaptability;

i. Number of Reports;

j. Client Base;

k. Problem Complexity; and

l. Study Quality.

6. The group was then asked to choose the five best measures for further examination. The group chose:

a. Improvements to Operational Effectiveness;

b. Client Satisfaction;

c. Robust Applicability of Results;

d. Solutions Implemented; and

e. Timeliness.

Group 2

7. The second group came up with 18 ideas during the Round Robin discussion. These were then grouped into ten unique ideas.

a. Customer/Sponsor Satisfaction;

b. Peer Recognition;

c. Sponsor Cooperative Attitude;

d. Operational Effectiveness, Cost and Efficiency;

e. Number of Requests for Advice;

f. Inclusion on Special Teams;

g. Tools/Recommendations Implemented;

h. Number of Projects Completed;

i. Breadth of Relevant Projects; and

j. Quality of Outputs.

8. They voted on this list and came up with the following prioritized short list.

a. Customer/Sponsor Satisfaction;

b. Operational Effectiveness, Cost and Efficiency;

c. Tools/Recommendations Implemented;

d. Quality of Outputs;

e. Number of Requests for Advice; and

f. Sponsor Co-operative Attitude.

Group 3

9. The third group came up with 19 ideas from the Round Robin discussion and grouped them into 10 unique measures. They had the most creative ideas in general which may have been the influence of the chairman.

a. Economy of Effort/Don't Reinvent the Wheel;

b. Impact;

c. Acceptance;

d. Implementability;

e. Volumetric;

f. Appropriateness of Method;

g. Originality and Boldness;

h. Management Assessment;

i. Peer Review; and

j. Validation by Comparison with Work Done Elsewhere/Historical Review.

10. They voted on this list and came up with the following prioritized short list.

a. Impact;

b. Validation by Comparison with Work Done Elsewhere/Historical Review;

c. Originality and Boldness;

d. Economy of Effort/Don't Reinvent the Wheel; and

e. Implementability.

Group 4

11. Unfortunately, the fourth group didn't save their list of ideas from the Round Robin discussion. However, their prioritized short list was:

a. Client Satisfaction;

b. Quality of Work;

c. Peer and External Evaluations; and

d. Qualifications of Staff.

COMPARISON OF GROUPS' RESULTS

12. There were basically eleven different ideas included in these short lists from the groups. Of these, five were suggested by more than one group.

a. Impact/Improvement to Operational Effectiveness, Cost and Efficiency;

b. Client/Customer/Sponsor Satisfaction;

c. Quality/Robustness of Results;

d. Solutions/Tools/Recommendations Implemented; and

e. Validation by Comparison with Work of Others/Historical Review/Evaluations by Peers and External Agencies.

13. We will examine these ideas in detail using the results of the Idea Writing process which was the second part of the Structured Brainstorming process.

RESULTS OF THE IDEA WRITING

14. The idea writing process consisted of identifying the Pros and Cons for each idea. We will discuss the five common ideas in order of their priority.

Impact

15. This measure coincides with our Motto: "A Posse Ad Esse" (From Problem Definition to Implementation). It represents both a measure of performance and the purpose for conducting OR research. This measure is the core reason originally behind the need for OR.

16. The advantage of measuring the Impact of our studies is that it is a client-based measure of value. It provides an incentive for OR scientists to do good work and follow-up on it. This could lead to a service-driven reward system where individual scientists are recognized for their work.

17. Among the disadvantages of this measure is that DS's may screen projects attempting to find the "big winners" and this may lead to negative DS competition. This measure may be unfair to complex problems with unknown Impact. In some studies, the Impact may not be immediately measurable or may require subjective assessment. Also, one could ask "How do we attribute impact to a specific study?" Many studies turn off bad ideas; how do we account for these? Furthermore, a study may have large impact but be of negative value (i.e. have unforeseen long-term side effects) while another study may be accurate study but have no impact (i.e. supports a decision that would have been made anyway).

Client Satisfaction

18. One scientist felt that the measurement of client satisfaction is mandatory in our client-based system. Another said that client satisfaction is the main reason we are here. By soliciting client satisfaction levels, we can develop the reputation of providing good solutions to problems and can be extremely positive to morale in the organization. Through this type of feedback, we could better understand what are our client's needs and what are their expectations from us. We would like to know if we contribute to problem definition, problem resolution, making better, more informed decisions, and facilitate the decision approval process. We would like to know if our advice is understandable and implementable. It would also facilitate senior management "buy-in". The quantification of customer satisfaction levels could be done through surveys and letters of recommendation and amount of repeat business or follow-up forms.

19. Among the disadvantages noted about client satisfaction is that "if your client isn't satisfied with your services and products they will go elsewhere". Sometimes the client does not know what he/she needs and we could become focussed on providing answers that the client wants rather than what he/she needs. This could lead to providing the "wrong result". Some people thought that customer satisfaction would be difficult to measure. Others thought that clients would be difficult to find because they are always being posted out.

Another person commented that some clients are impossible to please and that there is a risk that clients may be dissatisfied since their solution or propsal is not supported by the study result. Furthermore, clients may claim satisfaction but still not implement recommendations; "words do not meet actions".

Quality/Robustness of Results

20. A high quality and robust result will lead to long-term impact and value. The OR product should lead to implementation or action taken. This approach implies the need to consider the bigger picture instead of small unique problems. This is similar to impact and implementability. "Quality" includes many things: scientific content, innovation, accuracy, timeliness, completeness, and consistency with previous work. One person commented "emphasizing quality creates gems". Quality could be measured by citations, peer review, sponsor feedback and repeat business. One person stated that "we should use a questionnaire to sponsors to let them assess the quality from a user's point of view". This was followed up by a comment that a questionnaire or interview could evaluate whether the "delivered" was what was "expected". A final comment was that "the lack of robustness can destroy OR credibility".

21. On the disadvantage side, some people think that quality is difficult to assess and would lead to subjective judgement. Another person said that quality "does not guarantee applicability".

Solutions Implemented

22. One person wrote that this would be easy to measure. It would be a direct link with success and a direct link with customer satisfaction. More implemented solutions, more success and happier customers. It would also have a very positive effect on morale and motivation of the scientists. One person discussed the transfer of technology when our tools

are used by a sponsor. However, they have to meet the "KISS" principle. Another person suggested that our tools be developed into "commercial" products wherever they are widely applicable. We should balance this effort with a view of the speed and rapidity that we can come up with tools and implement results. We should also ensure that our studies make specific recommendations. We should investigate methods of encouraging other clients to use our tools such as briefings, conferences and user groups.

23. On the disadvantage side, many people recognized that even high quality results may not be implemented because of time and effort constraints, other priorities, or political reasons. One person noted that there may be a time lag in the implementation and this may lead to a problem in tracking the impact of the OR solution.

Validation or Independent Evaluation

24. This validation or evaluation could be included in the peer review process. It would be useful to compare our results to a historical review using a database held in ORA. Positive feedback from a respected authority would greatly enhance morale especially if an individual scientist is working alone. It could also lead to higher quality work if errors are corrected. This approach may be useful to open dialogue with other countries that have similar problems. It would also be useful to evaluate projects five years after they are completed to determine the lasting nature of their impact.

25. Finding qualified reviewers can be difficult. Reviewers from outside DND may not appreciate the fact that work with little scientific content, that is provided to the client in a timely fashion with a "good enough" answer to satisfy his or her needs, can have a significant positive impact on the organization. Consistently poor reviews could have a negative impact on morale. It would take a great deal of effort to compare the work to historical literature or the work done in other organizations, or track project impact five years later.

CONCLUDING REMARKS

26. From this short list of potential performance measurement indicators, we can see that the emphasis is placed on the impact, results, and implementability of our studies. Implicitly, client satisfaction and favourable external review would also be forthcoming from high quality studies.

27. It is recommended that ORA management get actively involved in the feedback loop by assessing client satisfaction and by documenting, possibly through an individual reward processes, the studies and scientists that are having the greatest impact. They should maintain close contact with sponsors of our projects to determine their level of satisfaction either through an end of project survey or interview. They should encourage the exchange of tools and be active in the "building" and "selling" of our products. They should continue with the peer review process with the goal of maintaining and enhancing the quality of our reports and possibly expand it to include external referees wherever possible.

REFERENCES

1. Taylor, Ivan W.; The Nominal Group and Idea Writing Techniques for Structured Brainstorming; D Log A Research Note 95/3; May 1995.

2. Delbecq, A.L., A.H. Van de Ven, and D.H. Gustafson; Group Techniques for Program Planning: A Guide to the Nominal Group and Delphi Processes; Scott, Foresman and Company; Glenview, Illinios; 1975.

3. Moore, Carl M.; Group Techniques for Idea Building; Sage Publications; Newbury Hills, California; 1987.

4. McDowell, Col. R.I. and E. Milburn; Report on NDHQ Evaluation E4/89 Operational Research and Analysis Establishment; Chief of Review Services, Program Evaluation Division, 1258-85 (DGPE); 30 April 1991.

UNCLASSIFIED
SECURITY CLASSIFICATION OF FORM
(highest classification of Title, Abstract, Keywords)

DOCUMENT CONTROL DATA
(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1. ORIGINATOR (the name and address of the organization preparing the document. Organizations for whom the document was prepared e.g. Establishment Sponsoring a contractor's report, or tasking agency, are entered in Section 8).

Operational Research Division
Department of National Defence
Ottawa, Ontario K1A 0K2

2. SECURITY CLASSIFICATION (overall security classification of the document, including special warning terms if applicable)

UNCLASSIFIED

3. TITLE (the complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C or U) in parentheses after the title)

Performance Measurement Indicators for Operational Research Division

4. AUTHORS (last name, first name, middle initial)

Taylor, I.W. and Kluchert, R.

5. DATE OF PUBLICATION (month Year of Publication of document)

SEPTEMBER 1996

6a. NO OF PAGES (total containing information. Include Annexes, Appendices, etc.)

17

6b. NO OF REFS (total cited in document)

4

7. DESCRIPTIVE NOTES (the category of document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)

RESEARCH NOTE

8. SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development. Include the address).

J3 Plans

9a. PROJECT OR GRANT NO. (if appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant.)

3551-20209

9b. CONTRACT NO. (if appropriate, the applicable number under which the document was written.)

10a. ORIGINATOR's document number (the official document number by which the document is identified by the originating activity. This number must be unique to this document.)

JSORT Research Note RN 9603

10b. OTHER DOCUMENT NOS. (Any other numbers which may be assigned this document either by the originator or by the sponsor.)

---

11. DOCUMENT AVAILABILITY (any limitations on further dissemination of the document, other than those imposed by security classification.)

(X) Unlimited distribution
( ) Distribution limited to defence departments and defence contractors: further distribution only as approved
( ) Distribution limited to defence departments and Canadian defence contractors; further distribution only as approved
( ) Distribution limited to government departments and agencies; further distribution only as approved
( ) Distribution limited to defence departments; further distribution only as approved
( ) Other (please specify):

12. DOCUMENT ANNOUNCEMENT (any limitation to the bibliographic announcement of this document. This will normally correspond to the Document Availability (11). However, where further distribution (beyond the audience specified in 11) is possible, a wider announcement audience may be selected.)

13. ABSTRACT (a brief and factual summary of the document. It may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall begin with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified) represented as (S), (C), or (U). It is not necessary to include here abstracts in both official languages unless the test is bilingual).

The performance of scientific functions, such as Operational Research, is considered by many to be difficult to measure. A Structured Brainstorming approach has been proposed as an efficient and effective way to examine difficult problems. At the 1995 Operational Research and Analysis (ORA) Field Station meeting, this Structured Brainstorming approach was applied to the problem of developing Performance Measurement Indicators (PMI) for Operational Research and Analysis. The exercise was conducted by the staff as a training program but the results, which focus on impact, implementability, customer satisfaction, quality and favourable external review, were presented to ORA management for their consideration. Recommendations are made for ORA management to become actively involved in assessing client satisfaction levels and determining the impact of OR studies.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus-identified . If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

Performance Measurement
Operational Research
Brainstorming
Customer Satisfaction

Canada

NO. OF COPIES NOMBRE DE COPIES	COPY NO. COPIE N°	INFORMATION SCIENTIST'S INITIALS INITIALES DE L'AGENT D'INFORMATION SCIENTIFIQUE
1	1	BA
AQUISITION ROUTE FOURNI PAR ▶	ORD/DSORT	
DATE ▶	26 Sep 96	
DSIS ACCESSION NO. NUMÉRO DSIS ▶		

DND 1158 (6-87)

National Defence / Défense nationale

499447

PLEASE RETURN THIS DOCUMENT TO THE FOLLOWING ADDRESS:

DIRECTOR
SCIENTIFIC INFORMATION SERVICES
NATIONAL DEFENCE
HEADQUARTERS
OTTAWA, ONT. - CANADA K1A 0K2

PRIÈRE DE RETOURNER CE DOCUMENT À L'ADRESSE SUIVANTE:

DIRECTEUR
SERVICES D'INFORMATION SCIENTIFIQUES
QUARTIER GÉNÉRAL
DE LA DÉFENSE NATIONALE
OTTAWA, ONT. - CANADA K1A 0K2