

A NOTE ON NOTIONS AROUND OPERATIONAL RESEARCH

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Abstract

In order to get a better grasp of the spread of notions adjacent to, or overlapping with, Operational Research, British, American and international organizations and university education programs are surveyed using a list of ten key concepts. It appears that professional organizations, of engineers, etc., are more nationally oriented, whereas scientific organizations are more internationally oriented. Further evidence is obtained that the professional world is not organized as science and the universities are.

1. Introduction

An investigation was made of existing associations and university programs in operational research and related fields. The following list of key concepts was used: (1) operations/ operational research, (2) management science, (3) industrial engineering, (4) systems analysis, (5) decision science, (6) cybernetics, (7) automatic control, (8) information processing, (9) econometrics, (10) scientific management. The search was limited to English-speaking, British, American and international institutions. Thus, the problem of finding equivalent concepts in other languages was avoided.

The meaning of the key concepts was taken for granted. Not only because all of them have a given image, but also because a name and, likewise, a definition may be more an intention than a reality. Hall [5, 6] revealed this phenomenon for the management sciences.

Scientific and professional fields resemble firms in several respects. Their size distribution is skew; they flourish or dwindle; they attract or lose people; they conquer and merge, or separate and start from scratch; true to the theory of monopolistic competition, they dissimulate their similarities and differentiate their products. For instance, Ackoff in his famous twin articles on the future of OR [1, 2] tells us that he called the subject of his new graduate program, "Social Systems Sciences" or S3, and that he chose this name because he could not conceive of a profession, a discipline or a society using such an awkward name, and wanted to preclude such use.

Questions raised are:

- What are the "market shares" of operational research and related fields?
- Are there differences in the organization of the scientific, academic world and the professional world of business and industry?
- What is the relation between generalistic, interdisciplinary, main fields and specialistic, monodisciplinary, subfields?

First, attention is focused on organizations in Britain, in the U.S., and international (Section 2). Next, university educational programs are reviewed (Section 3). Some questions are answered in the conclusions (Section 4).

2. Organization

The prime sources were the Directory of British Associations [7], the Encyclopedia of Associations - a guide to U.S. national and international organizations [15], and the Yearbook of International Organizations [14].

The British directory [7] lacked an index; the ten keywords applied verbatim tracked down only two associations from the alphabetically

ordered list, viz., the British Computer Society and the Operational Research Society.

The American guide [15] gives membership figures which may include individuals, firms, institutions, or other associations and should be considered an approximation. Nevertheless, Table 1 indicates the wide range of organizational sizes. Several observations can be made. (Code numbers between brackets refer to [15].) By far the largest organizations, are professional societies of engineers and managers (4458, 4793, 4772, 1898, 1921). The Association for Computing Machinery (4728), with its strange name, is the largest of 29 organizations classified under Information Processing (4722-4750). The Econometric Society (5082) is classified under Statistics (5078-5089). The American Society for Cybernetics (4439) is smaller than its name would lead one to expect. The American Institute for Decision Sciences (5281) dropped its acronym after the discovery of the Acquired Immune Deficiency Syndrome. Some specialized associations covering subfields of more general associations are of the same order of magnitude as the latter; examples are the American Production and Inventory Control Society (1899), the Planning Executives Institute (1923), the International Material Management Society (4782), the American Institute of Maintenance (1885) and the Project Management Institute (1925), as compared with the Operations Research Society of America (4883) and The Institute of Management Sciences (1912). The keyword "scientific management", which reminds one of F.W. Taylor and time and motion studies, has been encountered only once, viz. in the former name of the World Council of Management (1905).

The International Yearbook [14] includes the five Sister Federations that are coordinated by the Five International Associations Coordinating Committee (FIACC) (A3893y), see Table 2. (Code numbers refer to [14].) The number of countries in which an international association is represented gives only a weak indication of its size and importance. Nevertheless, it is significant that among the five Sister Federations, IFIP (C1828y) and IFAC (C1862) are represented in 40 or more countries, whereas IFORS (C1966), IMACS (B1174) and IMEKO (C2250) are represented in 33 or fewer countries. It has been pointed out in [13, Table 10], that IFORS had no members in the communist (or socialist, as they call themselves) countries, whereas the other four Sister Federations were well established in East-Europe. It is worth noting that "Cybernetics" and "Systems" sciences play a greater part on

the international scene (C1187, C1778, C4167, C4518, D1797, D5599, F5154, F5730, F5804, G5426), than within Britain and America. On the other hand, the engineering professions are hardly organized internationally (D3924).

3. Education

The prime sources were the handbook of higher education in the United Kingdom [8], Peterson's guides to graduate study in the United States [10, 11], and the Gourman report giving ratings of graduate and professional programs [4]. The list of keywords was also applied to the indexes of three books on management development [3, 9, 12]. Unfortunately, quantitative methods are hardly made explicit in management development programs, as "OR techniques fill the ordinary manager with a fear of mystique or a feeling of inadequacy" [12, p.326].

In the British handbook of higher education [8], among the "Main Subject Headings", one is "Operational Research". From Table 3 we conclude that only Operational Research, Management Sciences and Econometrics are taught at a significant number of the existing 46 British universities, under the headings of our ten keywords.

The situation in America is different again. Peterson's guides [e.g., 10, 11] provide information on postbaccalaureate degree programs in 241 academic fields offered by more than 1300 accredited institutions in the U.S. and Canada. "Operations Research" and "Industrial and Management Engineering" figure as academic fields, but the other keywords are not encountered in the list of fields.

To cope with sheer numbers, we turn to the Gourman Report [4]. This gives ratings of graduate programs in 60 distinct academic fields, among whom "Industrial Engineering" and "Operations Research" are distinguished. Table 4 gives the numbers of institutions with scores in the 4.0-5.0 range (strong to very strong) for some of the fields. We conclude that from among our list of keywords, Operations Research and Industrial Engineering are well established in the American academic world.

4. Conclusions

Ten concepts adjacent to, or overlapping with, Operational Research were reviewed. Their expansion was assessed, both in the professional world and in academia, both within Britain and the United States, and internationally.

Professional organizations are strong nationally. Within the U.S., there are large associations of engineers, general managers, and more specialized management functionaries like information managers, production and inventory planners, material, maintenance, and project managers.

Scientific organizations are strong internationally. This holds for the five cooperating federations: IFAC, IFIP, IFORS, IMACS and IMEKO, and also for organizations using the words "cybernetics" or "systems" in their names.

University programs in Britain especially recognize Operational Research, Management Sciences and Econometrics. In the U.S., Industrial Engineering and Operations Research are at a level with Statistics and Applied Mathematics.

The spread of these concepts in the world of publishing has not been considered. One may suppose that there is a strong positive correlation between the number of books and journals published in a field and its expansion in academic and scientific institutions, and that there is a weaker correlation between publications and professional organizations because to the latter, publishing is less essential.

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Table 1. American* organizations by membership sizes

Code number**	Organization	Membership
4458	Institute of Electrical and Electronics Engineers (IEEE)	180,000
4793	American Society of Mechanical Engineers (ASME)	80,000
1898	American Management Associations (AMA)	70,000
1921	National Management Association (NMA)	60,000
4772	Society of Manufacturing Engineers (SME)	50,000
4728	Association for Computing Machinery (ACM)	40,000
4499	American Institute of Industrial Engineers (AIIE)	31,000
1899	American Production and Inventory Control Society (APICS)	28,000
4785	American Mathematical Society (AMS)	18,681
4791	Mathematical Association of America (MAA)	18,500
5078	American Statistical Association (ASA)	13,000
1903	Association for Systems Management (ASM)	10,000
4883	Operations Research Society of America (ORSA)	7,000
1912	The Institute of Management Sciences (TIMS)	6,500
5082	Econometric Society (ES)	6,000
4765	Society of Logistics Engineers (SOLE)	5,800
5281	American Institute for Decision Sciences (AIDS)	4,500
4792	Society for Industrial and Applied Mathematics (SIAM)	4,400
4723	American Society for Information Science (ASIS)	4,000
1923	Planning Executives Institute (PEI)	3,700
4782	International Material Management Society (IMMS)	3,500
4286	Numerical Control Society (NCS)	3,300
1885	American Institute of Maintenance (AIM)	2,244
1925	Project Management Institute (PMI)	2,000
5098	Society for General Systems Research (SGSR)	1,000
4439	American Society for Cybernetics (ASC)	200
4790	Industrial Mathematics Society (IMS)	120

Source: [15]

* Designated as such in [15].

** Refers to [15].

Table 2. International* organizations

Code number**	Organization	Membership
A3893y	Five International Associations Coordinating Committee (FIACC)	5 Sister Federations***
B1174	International Association for Mathematics and Computers in Simulation (IMACS)	individuals and scientific and industrial institutions in 33 countries
C1187	International Association for Cybernetics (AIC)	individuals and industrial firms in 42 countries
C1778	World Organization of General Systems and Cybernetics (WOGSC)	societies in 44 countries
C1862	International Federation of Automatic Control (IFAC)	scientific or professional engineering organizations in 40 countries
C1828y	International Federation for Information Processing (IFIP)	societies in 42 countries
C1966	International Federation of Operational Research Societies (IFORS)	societies in 33 countries
C2250	International Measurement Confederation (IMEKO)	scientific and technical societies in 27 countries
C4167	Society for General Systems Research (SGSR)	individuals and institutions in 39 countries
C4518	International Institute for Applied Systems Analysis (IIASA)	organizations in 17 countries

Source: [14]

* Designated as such in [14].

** Refers to [14].

*** These are, in the order as they occur in this table: IMACS, IFAC, IFIP, IFORS, and IMEKO.

Table 3. Numbers of British universities teaching key subjects of this article

Subject	Number of universities	
	First degrees	Post-graduate courses
Operational research	15	15
Management science(s)/Studies	20	12
Industrial engineering	1	2
Systems analysis	-	1
Decision science	4	4
Cybernetics	1	4
Automatic control	4	1
Information processing	-	4
Econometrics	11	5
Scientific management	4	4

Source: [8]

Table 4. Number of American universities with strong to very strong graduate programs in some academic fields (wider in scope than the key subjects of this article)

Academic field	Number of universities with strong to very strong graduate programs
Computer science	51
Mathematics	48
Business (MBA)	47
Economics	46
Industrial engineering	28
Statistics	25
Operations research	14
Applied mathematics	11

Source: [4]

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