The evolution of operations management contents: an analysis of the most relevant textbooks

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Abstract
Studies the evolution of the operations management (OM) contents in the last decades. For this purpose, a sample of 84 OM textbooks has been analysed. First, we identify the main approaches and frameworks used to organise the OM contents in the different textbooks. Thereafter, we proceed to analyse the trends in the orientation of the textbooks' contents according to the qualitative/quantitative and long-/short-term dimensions of every topic. From this survey, we conclude that in this period (1960-1998) a shift in the OM approach has emerged, modifying the consideration rendered by the textbooks to the different topics, not affecting the orientation of the contents.

Introduction: the evolution of operations management

Operations management (OM) is an academic discipline formed by a heterogeneous body of knowledge, experiences, and techniques. All of them have as a common objective the study of goods and services production management in any kind of organisation. The current OM did not arise until the end of the 1950s (Meredith and Amoako-Gyampah, 1990, p. 147) and since then, different areas such as engineering, operation research, psychology, economics, and organisation theory have contributed to the discipline's development. Hence, OM, as a knowledge area, has assimilated advances in a faster way than strategic management. It has also undergone major changes and transformations in the nature of its contents (Buzacott, 1994, p. 118).

This transformation reflects a high degree of internal dynamism inherent in disciplines which pass through the first stages of development, and which have not yet shaped a body of knowledge. Successive "crises of identity" have taken place in OM. These crises have modified substantially the study approach and the focus of the subject's content (Westbrook 1995, p. 6). These changes, which sometimes take place over a short period (even less than one decade) have maintained academics' interest in the study of the research methods' evolution and OM contents.

Several studies have focused on the study of the evolution of the discipline in the last decades. The most relevant topics have changed dramatically over time (Amoako-Gyampah and Meredith, 1989; Chase, 1980; Filippini, 1997; Neely, 1993), as well as OM research methodology (Filippini, 1997; Flynn *et al.*, 1990; Meredith, 1993; McCutcheon and Meredith, 1993). Furthermore, OM evolution has been scarcely studied (Johnston, 1994; Meredith and Amoako-Gyampah, 1990). However, the discipline's basic core body of knowledge has been identified by the most relevant OM literature (Chand, 1996) and some "OM classics" authors are broadly considered (Sower *et al.*, 1997). Also different aspects regarding educational methodology and didactics have been analysed in different OM studies (Bahl, 1989; Bowen, 1996; Goffin, 1998).

This study shares the same motivation as previous research, since it pursues the study of OM evolution. Nevertheless, the main approach emerges from the analysis of textbooks considering the textbook as the unit of analysis. Textbooks reflect, with a certain degree of delay, the evolution and current state of a discipline, since they gather the most relevant results of OM research.

OM textbooks constitute a fundamental frame for the integration and diffusion of knowledge. They contain the main techniques and theories, of which this discipline is made up. Therefore, a common nexus of contents involves all textbooks. Furthermore, discipline evolution is reflected in the textbooks' contents, so different editions are adapted progressively in their structure as well as their contents to new techniques, theories and advances generated in OM.

Ebadi and Paul (1985) conducted an early study of ten bestseller textbooks published between 1980-1984. These authors detected some overlapping between OM and other disciplines' contents. They emphasised that textbooks were delayed in incorporating the most recent development of the discipline. Further analysis has highlighted the main features of OM evolution through the last decades as follows:
- At the end of the 1950s and during the 1960s, the first OM textbooks were published. At this time OM became a new discipline different from industrial engineering and operations research (Chase and Aquilano, 1992).

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- According to Filippini (1997), within the evolution followed by OM research, some textbooks in the 1970s adopted a broader perspective with a management-oriented approach.
- In the 1980s, the importance of certain subjects such as strategic management development stood out. Especially, topics such as process design and technology or operations strategy attracted more attention than in previous periods. In the 1980s, a trend towards macroeconomic aspects, which were also individual-oriented was noticed. Microeconomics and equipment-oriented aspects lost importance in this decade (Neely, 1993).
- In the 1990s, the tendency towards the study of organisational and human resources aspects in OM seems to continue. According to Westbrook (1995), the main OM discussion has actually been focused on the analysis of those unstructured issues regarding the firms. In particular, this kind of integration creates value for managers in order to obtain a more global view of management issues. As a consequence, new areas such as organisational behaviour are being included in OM core knowledge in order to use "qualitative" versus "quantitative" research methods. Throughout the last few years a greater interest in the importance of services in the economy has been taking place. This means that there is greater focus on a client-oriented approach (Johnston, 1994).

In any case, it does not seem that there is a consensus about assuming that this evolution exists. Thus, some investigators such as Walton and Handfield (1996) think that there have not been special or important changes in OM research: the main research area continues to be inventory control and mathematical programming which are closer to operational research. Following Johnston (1994), a major problem is that many academicians are not yet ready to open their minds beyond the application of quantitative techniques, which limits OM development.

In this paper, the results of an analysis based on a sample of 84 OM textbooks (listed in Appendix 1), published between 1960 and 1998, are presented. From this sample, OM evolution is initially analysed in order to group them on the basis of qualitative/quantitative and long-/short-term dimensions. Finally, some conclusions are suggested.

Research method and data analysis

Sample and data collection
A database was developed in order to collect detailed information about relevant and available textbooks. Finally, a representative sample of 84 textbooks, whose edition dates cover almost four decades (1960-1998) was obtained. Such a sample was obtained by considering all OM syllabuses of Spanish universities and institutions where OM courses were taught. Hence, all OM textbooks used by OM professors are included in the sample. Furthermore, some other textbooks were also included because of their academic relevance, that is to say, textbooks considered or recommended in foreign and prestigious universities mainly from the USA and the UK. In certain cases, successive editions of the same textbooks were included in the sample. Textbook contents were classified in four pre-established groups which include all the possible contents of an OM textbook:
1 strategic decisions;
2 operational decisions;
3 quantitative techniques; and
4 new OM tendencies.

All of them were measured by considering the number of chapters contained in every textbook relating to such subject areas. Appendices were weighed according to their relative extension, measured individually and added to the number of pages to the relevant topic. Owing to the low number of textbooks published in the 1960s and because of the requirements of analysis (one-way ANOVA), the four decades were finally grouped into three periods:
1 1960-1979;
2 1980-1989; and
3 1990-1998.

Measures operationalization
This analysis identifies whether there have been significant changes in the evolution of the OM textbook contents throughout four decades (1960-1998), in two aspects:
1 weight given to quantitative vs qualitative techniques and models; and
2 weight given to the study of the long- vs short-term decisions.

The first aspect gathers the qualitative versus quantitative dimensions in which the different contents of the textbooks are grouped. This allows us to define two categories of textbooks:
1 qualitative-oriented textbooks; and
2 quantitative-oriented textbooks.

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This dimension has been measured by means of an indicator reflecting the proportion of chapters that all textbooks give to quantitative models versus qualitative techniques. A high value of this indicator shows the qualitative trend of the textbook. In order to analyse the second aspect, two categories of textbooks have been defined:

1 long-term oriented textbooks (system design and/or strategic decisions); and
2 short-term-oriented textbooks (system maintenance and control, and/or operational decisions).

This dimension is measured by an indicator of the proportion of chapters that each textbook gives to long-term decisions (strategic and/or system design) versus short-term decisions (operation and/or system control). A high value of this indicator shows a long-term orientation of the textbook.

Statistical analysis

Considering the published textbooks in the three time periods as samples of their respective sub-populations, the one-way ANOVA tests the following null hypothesis:

> The samples are extracted from sub-populations, all having the same average of the previously defined indicators.

It is possible according to this analysis to verify the null hypothesis about average equivalence for each of the three considered periods. The F-test in the ANOVA verifies whether there are any significant differences among the means, and as a consequence a greater F-value reflects a higher differentiation among groups. ANOVA assumes the items to be normally distributed, independents, with the same variance in each population. However, should the population not be normally distributed, this fact does not have relevant influence in the F-test (Hand and Taylor, 1987). An alternative tool is the student t-test for two independent samples. This test should be applied to all possible periods pairs. Nevertheless, it ignores the dependent variable distribution over the rest of the groups, so it tends to detect statistically significant differences that might not exist. Therefore, ANOVA seems to be the most convenient technique to detect the trends in the evolution of the OM contents through the three decades.

Results and discussion

Table I shows the seven topics with their relative weights – higher than 5 per cent of the total contents – in each analysed period. The whole sample dedicates special attention to the development of these topics. Only four of them – introduction to OM, process and tasks design, and inventory control – remain among the seven most important topics throughout the three periods. Each one of them belongs to a different pre-defined group and, although its weight diminishes progressively, they constitute the central nucleus of OM. However, scheduling, programming, control and linear programming, lose importance when considering long-term decisions (i.e. operations strategy, product development, and quality management).

Finally, in the textbooks published before 1980, the seven topics with a greater weight include around 54 per cent of the total of contents. This number decreases to 44 per cent from 1980 to the 1990s and 43 per cent between 1990-1998. This indicates a quantitative shift in the number of topics in the textbooks published in the 1980s. It may be a result of the development of this discipline.

Table II exhibits the values of the indicator of the qualitative vs quantitative contents over the three analysed periods. The average value in each of the two first periods is close to 25 per cent and in the last one increases slightly to approximately 29 per cent. The average weight of qualitative aspects for all the period is approximately 28 per cent. The dispersion of these percentages is not significantly high, as stipulated by standard deviation values. Likewise, a high degree of overlapping in the intervals of confidence for the average indicator of the three periods is observed. From these data, it can be hypothesised that the average value of the indicator of the contents relating to weight remains quite constant throughout the three periods. This hypothesis is resisted through one-way ANOVA, summarised in Table III. At the standard significance level (5 per cent) – significant differences in the average values of the indicator for the three considered periods do not exist (p-value = 0.393).

Table IV shows the values of the short-term versus the indicator of long-term decisions. These values of the indicator are similar for the three periods, in spite of there being a slight increasing tendency. Unlike the previous case, the values spread is higher. There is no such evident overlapping in the intervals of confidence for the average, which implies that a hypothesis of constant average values of the indicator throughout time is not expected to be confirmed. The analysis of Variance, summarised in Table V, does not detect, at the standard level (5 per cent), significant differences in the average values of each period. However, this is not so clear at significance levels of 10 per cent (p-value = 0.113). These results could confirm the existence of one slight tendency

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Table I
OM central issues

1960-1979		1980-1989		1990-1998	
Issue	Weight (per cent)	Issue	Weight (per cent)	Issue	Weight (per cent)
Job design	11.9	Job design	9.8	Operations strategy	8.7
Process design	9.7	Inventory control	7.7	Job design	6.6
Inventory control	7.8	Product development	5.4	Inventory control	6.4
Introduction to OM	6.8	Introduction to OM	5.4	Product development	5.5
Linear programming	6.4	Scheduling programming	5.3	Process design	5.4
Scheduling programming	6.3	Process design	5.1	Introduction to OM	5.4
Aggregate planning	5.0	Operations strategy	5.1	Quality management	5.0

Source: Own processing

Table II
Evolution of the direction of the contents towards qualitative aspects

Decade of publication	No. of textbooks	Average (per cent)	Standard deviation (per cent)	95 per cent confidence interval for average (per cent)
1960-1979	17	25.66	12.29	19.55-31.77
1980-1989	17	25.61	0.94	20.75-30.48
1990-1998	50	29.45	13.73	25.67-33.24
Total	84	27.94	12.74	25.24-30.63

Source: Own processing

(statistically non-significant) towards the increase in the average values of the indicator (relating to the weight of strategic contents), particularly in the decade of the 1990s.

These two analyses indicate that significant differences in each dimension of the analysed periods are not detected. So, there are no relevant changes in the orientations of the textbooks' contents. All textbooks give a similar weight to quantitative vs qualitative contents regardless of the decade of publication. In recently published textbooks the attention dedicated to the study of quantitative techniques does not diminish. On the other hand, the increase experienced by the study of long-term decisions – fundamentally strategic – is not relevant.

Figure 1 shows the position of each textbook according to the quantitative-qualitative dimensions. In some of them the dates of publication are provided. This Figure is interpreted as follows: a textbook located close to the co-ordinates' origin is supposed to adopt a quantitative and short-term approach. The textbook concentration at the lower values of both indicators is observed: approximately 80 per cent of the textbooks dedicate more than half of their contents to qualitative/operative contents. Besides, a positive linear relation between both dimensions appears. This indicates that long-term approaches are associated with qualitative contents while short-term approaches are associated with quantitative contents.

In effect, as Appendix 2 shows, both dimensions have a statistically significant degree of positive association (Pearson's correlation coefficient = 0.842, sig. < 0.001). This is confirmed in the regression analysis of the qualitative/quantitative dimension vs the short-term/long-term dimension (coefficient B = 0.721, sig. < 0.001, fit R^2 = 0.706).

These results indicate that it cannot be affirmed that a defined evolution in the textbooks' contents of the manuals clearly exists. However, a tendency towards the association of long-term oriented with qualitative approaches is appreciated.

Table III
ANOVA

Quality vs quantity	Sum of squares	Degrees of freedom	Quadratic mean	F	Sig.
Between groups	3.066E-02	2	1.533E-02	0.944	0.393
Within groups	1.381	81	1.625E-02		
Total	1.412	83			

Notes: Levene statistic: 0.969; *p*-value = 0.384
Source: Own processing

Conclusions

These results question the fact that a radical change might have emerged in a significant way, especially considering the evolution of OM textbooks over the last three decades. In

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Table IV

Evolution of the direction of the contents towards the long-term decisions

Decade of publication	No. of textbooks	Average (per cent)	Standard deviation (per cent)	95 per cent confidence interval for average (per cent)
1960-1979	17	31.32	13.18	24.77-37.88
1980-1989	17	32.92	10.06	27.74-38.09
1990-1998	50	38.78	16.26	34.29-43.26
Total	84	36.12	14.89	32.97-39.28

Source: Own processing

fact, all textbooks give a similar weight to qualitative vs. quantitative contents regardless of the dates of publication. Otherwise, even though long-term decisions, especially strategic decisions, have undergone a slight increase, such increase is not significant. Strategic contents tend to be associated with qualitative contents, while operative contents are associated with quantitative contents. However, it does not seem that the authors' interest in qualitative topics is translated into textbook contents, at least with the same intensity. Operational

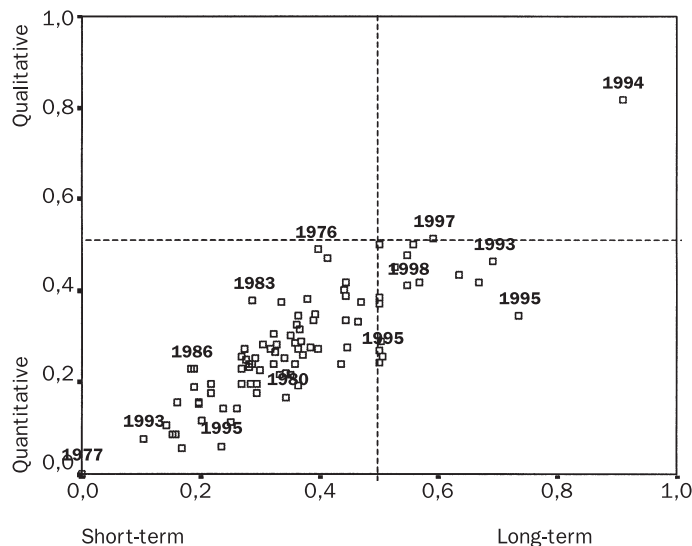research still has a strong presence in OM. A possible explanation of this fact is the usual delay existing in most disciplines between research advances and OM teaching. Anyway, recent textbooks tend to include quantitative contents as appendices. This may become an indicator of a shift from operational research contents to strategic-oriented contents.

As a consequence, new questions such as the change of the OM paradigm that exceeds the objectives of this study emerge. Such change should be occurring gradually. In order to analyse all the consequences it would be necessary to study the different approaches to which authors adhere when developing an OM textbook. Furthermore, owing to the importance that the services sector is acquiring in most economies, the new and existing manufacturing techniques are being adapted.

Table V

ANOVA

Short vs long	Sum of squares	Degrees of freedom	Quadratic mean	F	Sig.
Between groups	9.630E-02	2	4.815E-02	2.233	0.113
Within groups	1.833	81	2.156E-02		
Total	1.929	83			

Notes: Levene statistic: 2.351; *p*-value = 0.101
Source: Own processing

Figure 1

Relationship between qualitative/quantitative and short-term/long-term dimensions

Source: Own processing

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Appendix 1. Textbooks included in the sample

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Appendix 2. Qualitative/quantitative dimension vs short-term/long-term dimension regression

Table AI
Summary model

R	R^2	Adjusted R^2	Standard error of the estimation	Durbin-Watson
0.842[a]	0.710	0.706	6.905E-02	1.386

Notes:
Dependent variable: qualitative vs quantitative
[a] Predictable variable: (constant), short vs long

Table AII
Coefficients

Var.	Non-standardised coefficients		T statistic	Sig.	95% confidence interval for B	
	B	Standard error			Lower limit	Upper limit
(Constant)	1.908E-02	0.019	0.983	0.328	–0.019	0.058
Short vs long	0.721	0.050	14.494	0.000	0.622	0.819

Note:
Dependent variable: qualitative vs quantitative
Source: Own processing