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A Proposed Keyword Taxonomy for Operations Management Research

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Abstract:

Purpose: To develop a controlled vocabulary of less than 30 terms that represents level 1 of a taxonomy for the field of operations management, integrating previous available work to improve efficiency in searching and retrieving scientific information in the area.

Design/methodology/approach: A systematic review of encyclopedias and glossaries in the field was conducted, mainly based on Hill (2012, 2019). The three authors employed an iterative process to define and validate the first-level terms, contrasting them with sources such as Gass and Fu (2013), Helms (2006), and the APICS thesaurus. Affinity diagrams were used to structure and relate the identified terms.

Findings: 20 top-level terms covering the main areas of operations management were identified and defined. The resulting taxonomy is available online (https://taxom.blogs.upv.es/). It provides a hierarchical structure that integrates the main concepts of the field, differentiating itself from previous work by focusing on relevance to research, education, and professional practice contexts.

Research limitations/implications: The thematic coverage of the proposed taxonomy requires further verification to ensure its comprehensiveness. Future research should focus on validating the taxonomy by applying it to a representative sample of articles within the field of operations management. This validation process will help confirm whether the first-level terms are robust and precise for effective categorisation and usability in academic and professional contexts.

Practical implications: The taxonomy facilitates scientific editorial management by providing a standardised list for selecting keywords in manuscripts and identifying reviewers' fields of expertise. It also improves the efficiency of mapping science studies and systematic reviews and enhances the visibility and accessibility of published research in operations management.

Keywords: *I*nformation retrieval, information searching, classification schemes, semantics, controlled languages, operations management, knowledge organisation, Search efficiency.

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1. Introduction

The current scientific system allows us to produce and store many articles summarising the results of various investigations. These items, in theory, are accessible or locatable. However, the abundance of information poses a problem in retrieving what is relevant and distinguishing it from what is not (Sandieson et al., 2010). When we conduct a literature search in the area of operations management, either to clarify state of the art, to establish the framework for new research activities, to identify trends, to identify areas or sub-areas not addressed, or to identify barriers or facilitators in the implementation of an approach or method, it is not easy to find all the related works that have been published. One of the reasons is the richness of the language itself, which allows the use of a large number of synonyms and equivalent words in the main search fields (title, keywords, and abstract). In other words, there is a lack of standardisation of the terms researchers use. This can be solved by establishing elaborate search strategies with complex nesting loops, including the most known word variants. However, it can be a complex and laborious task that often does not yield the expected results. For operations management practitioners, the problem is even more pronounced, as they often lack expertise in navigating scientific databases, leading to incomplete or inefficient searches that fail to provide the desired information.

One of the options to overcome this lack of efficiency that affects the search for information is to create and maintain a taxonomy of terms in the scientific area. This could limit terms and avoid many problems due to faulty or inadequate labelling of current and future scientific production (Kremer et al., 2005).

In this regard, it should be clarified that a "controlled vocabulary" is a list of terms assigned a specific meaning expressed in their definition and covering a specific domain of knowledge. A "taxonomy" is a controlled vocabulary where terms are organised hierarchically. A tree structure is often used for this: more general terms are broken down into more specific terms representing parts of the general term. A "thesaurus" is an extension of taxonomy, complemented by a list of terms with equivalent meanings (synonyms), indicating the preferred term to use. It also includes the differentiation of possible polysemy and links to other related terms with different meanings that are not hierarchically related (Centelles, 2005).

An example of a thesaurus in a scientific area other than operations management is maintained by the *Institute of Education Science* (https://www.eric.ed.gov/?ti=all). The *ERIC Thesaurus* comprises a list of keywords that attempt to represent the research topics in Educational Sciences (although it also includes terms related to the psychology of organisations and human resource management). Its 2019 edition comprises 4,539 keywords that group another 7,089 terms (for a total of 11,761 terms). It also identifies 139 terms considered obsolete and not recommended to be used to tag current jobs. Figures 1, 2, and 3 show an example of localised terms based on "teamwork," which leads us to a more general term that is "group behaviour," and from this to "groups," to end up locating a specific teamwork model such as "quality circles."

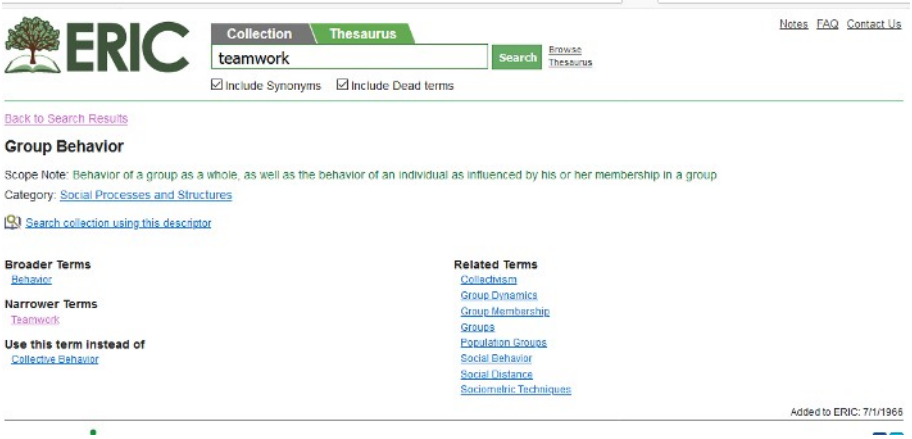

Figure 1. Example 1 ERIC. Localised Group behaviour through teamwork

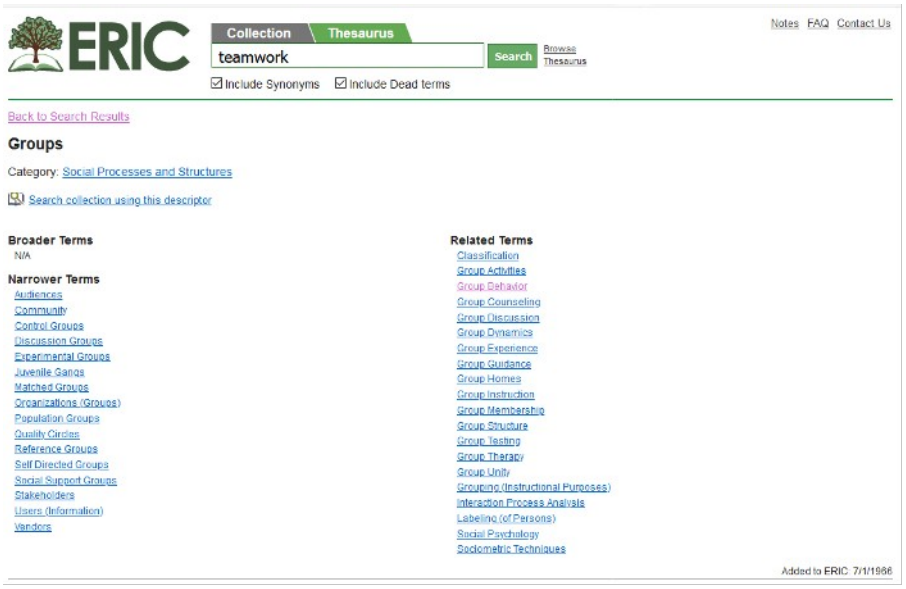

Figure 2. Example 2 ERIC. Groups as a more general concept than group behaviour

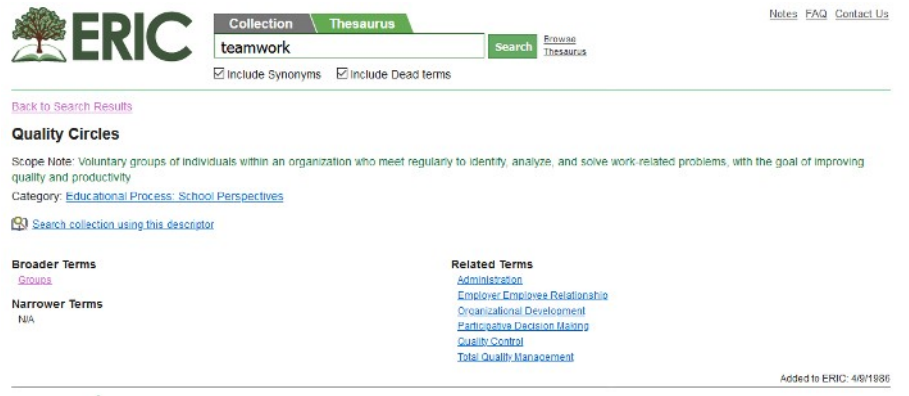

Figure 3. Example 3 ERIC. Quality Circles as a specific concept of teamwork located in Groups

Another example, but much more limited, is the IEEE taxonomy (Institute of Electrical and Electronics Engineers (IEEE), 2017).

Without reaching that level of detail, we aim to create a controlled vocabulary of fewer than 30 terms, representing level 1 of the taxonomy and integrating the previously available work. In the future, expanding to a thesaurus with the 200 most relevant terms in operations management is proposed. It is not planned to make a general thesaurus of all the terms in the area since Hill has published a controlled vocabulary with 2,000 terms (Hill, 2019). On the other hand, (Blackstone) 2013 has a controlled vocabulary of about 5,000 terms. Our approach is focused on the development of a hierarchical structure. Unlike previous works, which focus on the quantity and definitions of a controlled vocabulary, we will prioritise relevance in taxonomy in research, educational, and professional contexts. Another aspect is that they do not contemplate synonyms in the previous work (Blackstone, 2013; Hill, 2019). This is a critical need in the operations management field today.

This paper aims to offer a taxonomy of keywords and their synonyms for the field of operations management. This can serve as a first step so that, in the future, the gap between topics researched by academia and topics relevant to business professionals can be analysed.

2. Operations management glossaries

Fenske's work (1971) reflects on the need for a taxonomy of the field of "operations research or management science." According to the author, taxonomy is necessary to classify research results, identify new areas, organise operations research textbook provide a framework for national meetings, and index the number of publications that exist and will exist. This would be useful both for students as it would facilitate the understanding of the broad field of *operations research*, for researchers as they would be able to see both their actual and future work with the whole perspective and for professionals as it would allow them to find more quickly what applies to their company. In addition, the author points out the speed of knowledge generation in the area and the penetration of operations research methods in different areas of society and the economy. Thus, his work presents a taxonomy with five aspects/classifications: (1) general, (2) common processes and problems, (3) practical classification areas, (4) theoretical and practical problem-solving techniques, and (5) contextual code. Each of these aspects is developed with its corresponding terms ordered hierarchically.

However, to our knowledge, this taxonomy has not been used in *operations research*. Looking for the citations of this work in the WOS and Scopus, only two citations appear, one very old (Holmes, 1976) and the other more recent (Plà et al., 2014). Plà et al. (2014) work does not frame this taxonomy in its contribution; it only cites the Fenske (1971) to describe the structure of his taxonomy incompletely since it only cites three parts when the author describes five parts in his work.

In one of the sub-areas of operations management (optimisation methods), there are taxonomies in the literature focused on classifying different models (Meignan et al., 2015). They are very specific taxonomies that do not fit the classification approach sought in this work.

Given the limited use of taxonomies in the field, we have sought other types of works whose approach is to 'structure' a scientific area, among which we can highlight glossaries and encyclopedias. In an initial phase, we searched Google Scholar for encyclopedias or glossaries of 'Operations Research' or 'Management'. Regarding glossaries, informal documents uploaded by professors for their specific subjects with brief extensions were found. Concerning encyclopedias, we were able to locate several references (Cochran & Cox, 2011a; Gass & Fu, 2013; Helms, 2005; Hesse, 2011; Heyel, 1963; Hill, 2012; Slack & Lewis, 2005). Subsequently, we conducted a search using the keywords 'encyclopedia' and 'management' in WOS and SCOPUS. The results found were reviews of the aforementioned encyclopedias, with Gass and Fu (2013) being the most reviewed. Additionally, a specific encyclopedia of human resources emerged. The identified encyclopedias were reviewed by the authors of this work, and among all of them, only the one presented by Hill (2012) provides a grouping of terms into global disciplines. The encyclopedia by Helms (2005) and that of Gass and Fu (2013) describe different terms in glossary form. Similarly, Cochran and Cox (2011b) is a compendium of 600 articles grouped by topics.

On the other hand, we have investigated whether the national and international organisations of operations management had some type of classification accessible from their website. Of the search, only the one carried out by INFORMS (Institute for Operations Research and the Management Sciences) was noteworthy. On its website (https://www.informs.org/Explore/History-of-O.R.-Excellence/O.R.-Methodologies), the history section of operation research includes a section that lists the 31 historical methodologies used by INFORMS communities, specialised journals, entries in the "Encyclopedia of Operations Research and Management Sciences," and other taxonomies. INFORMS does not explicitly state which encyclopedia it is referring to. However, since we have not found anything different with that name, we assume it is Gass & Fu (2013). Regarding taxonomies, he does not cite any.

3. Methodology

To create the aggregate level (level 1) of general terms of operations management, we will start with localised encyclopedias (Gass & Fu, 2013; Helms, 2006; Hill, 2012, 2019). We will use Hill as a first reference (2012, 2019), which, at the most general level, contains a manageable number of terms (37 terms in its 2012 edition and 43 terms in the 2019 edition) and provides a selection of what it considers to be the essential terms that any student or professional in the area of operations and supply chain management should know, and, by extension, we

understand that any research in the area should be linked to one of these keywords. The 2012 edition features around 100 core keywords, doubled in the 2019 edition. We will use this list of essential terms as a starting point for developing the extended classification in the future (level 2). To narrow down the level 1 terms, we will relate them to a set of level 2 terms and some keywords.

Later each of the first-level terms was defined, identifying synonyms or terms included under that term, indicating the references used for the definition or synonyms. This task was iterative, with the three authors of this work participating in the process. Starting from the terminology proposed by Hill (2012, 2019), we checked the coverage of that term in the other two encyclopedias (Gass & Fu, 2013; Helms, 2006) and also in the APICS thesaurus (Blackstone, 2013) to decide on the coined term we propose for level 1 so that it can represent as precisely as possible (with less chance of generating false positives in a literature search) the concept it wants to represent. Since Helms (2006) is a general encyclopedia of management and not specific to operations management, we will focus on the entries that appear linked to the following categories: *Production and Operations Management, Supply Chain Management, Innovation and Technology, Management Information Systems, Management Science and Operations Research, Performance Measures and Assessment, or Quality Management and Total Quality Management.*

4. Results, discussion and, conclusions

This paper presents the initial development of a taxonomy for the field of operations management, identifying and defining 20 first-level terms that cover the main areas of the discipline. The taxonomy, available online (https://taxom.blogs.upv.es/):

1. Capacity management
2. Demand management and forecasting
3. Information systems/e-business/industry 4.0
4. Innovation/ knowledge management
5. Inventory management
6. Lean management
7. Learning operations management
8. Logistics/ transportation/distribution
9. Maintenance/reliability engineering
10. Operations research
11. Operations strategy
12. Product/ service development
13. Production planning, scheduling and control
14. Project management
15. Quality management
16. Sourcing/purchasing
17. Supply chain management
18. Sustainability (social, economic or environmental)
19. Warehousing
20. Work systems (method, measurement, management)

The figures in the annexe show the affinity diagrams resulting from the iterative work with the terms of the sources consulted.

Our work has practical applications in the scientific publishing field. On the one hand, it provides authors with a standardised list to select keywords in the metadata of their manuscripts, allowing it to be supplemented with additional terms according to their specific needs. On the other hand, it facilitates the identification of reviewers' fields of expertise, thus optimising the assignment process in editorial management. Additionally, this structure can

be used in the purification phase of the corpus or for coding categories in mapping science studies and systematic reviews.

Among the study's limitations is the need to verify the exhaustiveness of the proposed thematic coverage. As a future line of research, it is proposed to validate the taxonomy by applying it to a representative sample of articles in the area to confirm that the first-level terms are sufficient for an effective categorisation.

The main contribution of this work lies in establishing a standardised vocabulary that enhances editorial management and the visibility and accessibility of published research.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest concerning this article's research, authorship, and/or publication. All three authors are current or former editors of the Journal Of Industrial Engineering and Management.

All three authors have contributed equally to all phases of this research.

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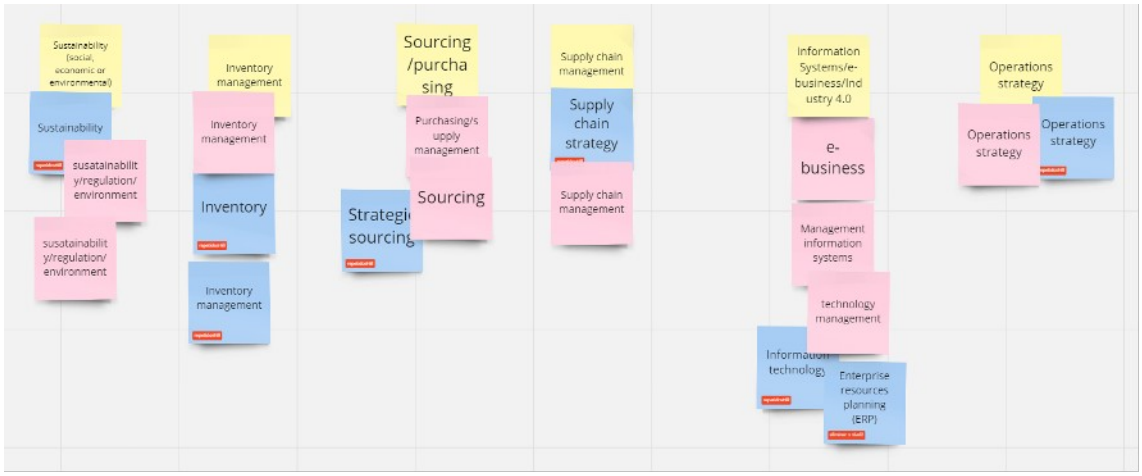
Annex

Affinity diagram of the terms contemplated. Legend: Yellow level 1 selected name; Pink Hills (2019); Green Added by the team; Blue (Blackstone, 2013).




Lean management
Lean thinking
Lean thinking
Lean sigma (six sigma)
Lean management
Quality management
Quality management
Quality management
Service quality
Customer service
Voice of the customer
Quality
Product/ service development
New product development
New product development
Product and service


Time base competitic
internationa operations
programs
Manufacturing management
Service management
Healthcare management
Level 2 or 3 (pending to link level 1 in the future)
Rapid prototyping
Customer relationship management (CRM)
humanitarian disaster relief
Systems engineering
Simulation
job desing
Theory of Constraints
Theory of straints
Automated manufacturing
Supply chain visibility, synchronization,a nd bullwhip minimization
Vendor-managed inventory (VMI)
Service processes
Theory of constraints (TOC)
Inventory models
Advanced service systems
Material requirements planning (MRP)
Responsiveness, agility, and efficiency
Standard time
Web collaboration/e-business
Manufacturing process environments
Collaborative planning, forecasting,
Risk management
Risk management
Manufacturing execution systems management
Production activity control (PAC)
Dispatching
Queuing and simulation
Master production schedule (MPS)and final assembly schedule (FAS)
Distribution requirements planning (DRP)
KPIs/OKR /Hoshin planning
Mass customization
Locating facilities