The Evolution of Operations Management as a Research Area in Brazil

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Abstract

This paper aims to analyze the contribution of Brazilian researchers to the area of Operations Management (OM). A review of the following databases were carried out: websites of Brazilian Graduate Programs on Industrial Engineering, Mechanical Engineering and Business Schools, CV Lattes (a database of CVs of Brazilian researchers sponsored by the Brazilian Government, and scientific databases like Emerald, Science Direct and Taylor & Francis). The historical evolution of OM in Brazil is presented, encompassing keywords, methodologies and main outlets used by Brazilian researchers. In this research we considered authors who work in Brazilian Universities or Research Centers, regardless of whether or not they are Brazilians. We considered all publications from 1993 until 2009, when OM was consolidated as an independent area of knowledge. A particular set of international journals were considered, as they were used in similar studies carried out in the USA, Europe and Asia, in order to allow for a comparison of results. The study showed a significant expansion of OM in Brazil starting in the second half of the last decade, both in the number of publications as well as new authors. Quality and operations strategy are the most frequent keywords, and the majority of publications are in the Journals Produção and Gestão & Produção.

Keywords: operations management; Brazil; production and operations management.

1 Introduction

Operations management is a field of knowledge that deals with the 'management of operations' (Gouvea da Costa et Pinheiro, 2010). According to Cetnarski et al, the OM is an area of the knowledge that becomes from the Operational Research and Management Science. The development and acknowledgment as knowledge 'area independent' has started at 80's, with the release of the *Journal of Operations Management* (JOM), in United States, and the *International Journal of Operations and Production Management* (IJOPM), in England (BUFFA, 1980). Those roots also are assigned to the Industrial Engineering development (VOSS, 1995), this area in Brazil, had called 'Production Engineering' (FLEURY, 2008).

The idea of this project became from others studies that had made in USA (Barman *et al.*, 1991; Drejer *et al.*, 2000; Barman *et al.*, 2001), Europe (Soteriou *et al.*, 1999), and Asia (Jiang *et al.*, 2007). They talk about methodologies, key words, outlets and areas which the authors from OM used to do and publish their own articles. With this information, they could make a mapping about all the work at OM in their own countries or areas. This kind of research has never been done before in Brazil, so it's the first one, however it has been doing as the same way as the internationals, to be possible to compare.

This article presents the evolution, since 1993 until 2009, being a sample, the use of the keywords and methodologies on issues published in outlets contemplated on the project. It was used the conceptual-theoretical method with the use of sources of primary and secondary data, such as Web pages of research groups, the Lattes platform. There is a data base where the Brazilian's authors organized theirs own curriculums, that's include important journals, sites and prints journals (Emerald, Science Direct, Scielo etc.).

The division of this text is on three parts, first the methodology used to build this research, second the results obtained, and last the conclusion and future steps.

2 Methodology

The research is empirical, because it was used 'real data', primary and secondary. Flynn et al., 1990. The data collection used qualitative methods, like data from scientific journals and others secondary's sources.

According to the proposed classification by Gupta, Verna and Victorino (2006), could be classified the research as follows:

- As for the purpose: construction and testing of theory, since they are formulated hypotheses from the literature, and those hypotheses will be tested in empirical research;
- The approach to data collection: document analysis and interviews, depending on the phase of the research;
- The approach to data analysis: descriptive statistics, theoretical-conceptual and methods of comparison of means.

Figure 1 is the framework of the methodology created for this research.

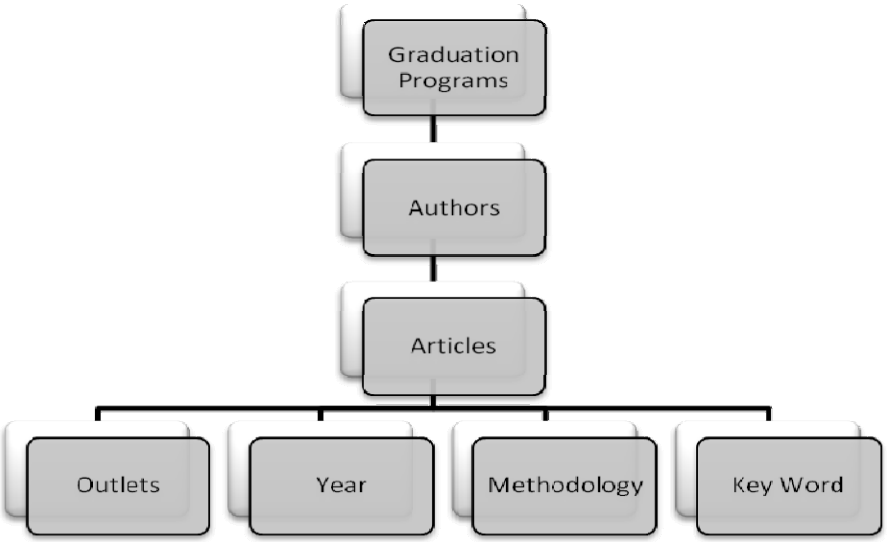

Figure 1 - Framework

2.1 Selecting Authors

First of all, was made a list with all Brazilians graduate programs of: Industrial Engineering, Mechanical Engineering, Transportation Engineering, Administration, Logistics, Operations Research; which content was complete based on operations management. With this list, was accessed the educations institutions web sites, where was obtained the researchers names. After that, was searched the CV Lattes of any author, from that was made a data base like at Figure 2.

Institution	Areas of Study	Researchers	CV Lattes
[redacted]	Operations, Technology and Logistics.	[redacted]	http://buscatextual.cnpq.br/buscatextual/visualizacv.jsp?id=K4791405Y6
		[redacted]	http://lattes.cnpq.br/1991123849240687
		[redacted]	http://buscatextual.cnpq.br/buscatextual/visualizacv.jsp?id=K4796378D9
		[redacted]	http://lattes.cnpq.br/2322569112425086
		[redacted]	http://buscatextual.cnpq.br/buscatextual/visualizacv.jsp?id=K4780057J4
		[redacted]	http://buscatextual.cnpq.br/buscatextual/visualizacv.jsp?id=K4790890P2
		[redacted]	http://buscatextual.cnpq.br/buscatextual/visualizacv.jsp?id=K4797261E4

Figure 2 - Institutions database

2.2 Outlets

With that was extracted the CV Lattes of authors published articles. Follow by was made another data base that intersects the authors with the outlets. This data base had around 250 authors and 450 outlets, represented by the Figure 3. In Highlight are the outlets with international recognition.

	P	GP	MM	RGI	PP	PO	RAE	PIGDP	RA	RAC	REA	GPOS	REPEP	RCT	FIEP	BJOPM	O&S	CD	UFF	INGEPRO	IO	IJPR	ORA	COR	IJAMT	EJOR	BTEU	IJQRM	JORS	UEPG	REU	JMPT	AE	RAM	IJPE	JCP	TRJ	ITOR	GVE	AM
	02	04	18	13	01	07	40	10	38	39	45	11	28	14	35	08	49	62	23	33	29	30	47	15	20	05	03	06	17	37	56	21	22	41	54	55	65	32	50	59
01	1				2																																			
02		1			1																						2													
03	3	4			3	2										2									1	2		4						1						
04	15	3			7			7				1																1												
05	8			1	7			10				2		9														6							2					
06	4	3										1																												
07		1				1		2	1			1																												
08		2		1	3							1				1																			1					
09		1				1						1												3		3			2									2		
10	4	2																								1												2		

Figure 3 - Outlets database

In this data base, had a lot of outlets with less than 10 publications, for this reason was cut out outlets with few publications and relevance, resulting in a little cut out researches, that numerically is not significant. The journals with great relevance were maintained in the research, therefore exist few outlets that have not publications, although some comparisons are necessary. At Table 1, there are the relevance outlets.

Table 1: Outlets

Number	Acronym Adopted	*Journal*	Number of Publications
1	P	Revista Produção	243
2	GP	Gestão & Produção	229
3	R A E	Revista de Administração de Empresas	91
4	PP	Revista Produto & Produção	89
5	RGI	Revista Gestão Industrial	88
6	PO	Pesquisa Operacional	69
7	RA	Revista de Administração da USP	62
8	RAC	Revista de Administração Contemporânea	62
9	PIGDP	Product (IGDP)	60
10	REA	Revista Eletrônica de Administração	53
11	GPOS	Gestão da Produção, Operações e Sistemas	41
12	BJOPM	Brazilian Journal of Operations and Productions Management	26
13	INGEPRO	Inovação Gestão Produção	23
14	IJPR	International Journal of Production Research	21
15	EJOR	European Journal of Operational Research	20
16	COR	Computers & Operations Research	19
17	JORS	Journal of Operational Research Society	19
18	RAM	Revista de Administração Mackenzie	18
19	IJPE	International Journal of Production Economics	18
20	IJAMT	International Journal Advanced Manufacturing Technology	15
21	IO	Investigação Operacional	14
22	JCP	Journal of Cleaner Production	14

23	CIRPA	CIRP Annals	14
24	IJQRM	International Journal of Quality and Releability Management	12
25	CI	Ciência da Informação	12
26	SG	Sistemas & gestão	10
27	ITOR	International Transactions in Operational Research	8
28	IJOPM	International Journal of Operations & Production Management	7
29	POD	Pesquisa Operacional para o Desenvolvimento	6
30	CIE	Computers & Industrial Engineering	4
31	JOM	Journal of Operations Management	3
32	IIET	IIE Transactions (Journal of Manufacturing and Operations Management)	3
33	I	Interfaces	2
34	POM	Production and Operations Management	1
35	TS	Transportation Science	1
36	OR	Operations Research	1
37	ORL	Operations Research Letters	1
38	PIMJ	Production and Inventory Management Journal	0
39	MSC	Management Science	0
40	DS	Decisions Science	0
41	NRL	Naval Research Logistics	0
42	O	Omega	0
43	JMOM	Journal of Manufacturing and Operations Management	0
44	JPMM	Journal of Purchasing and Materials Management	0
45	HBR	Harvard Business Review	0
46	AMJ	Academy of Management Journal	0
47	AMR	Academy of Management Review	0

Source: Cetnarski et al. 2011

2.3 Keywords

In this part was selected all the articles of the mentioned authors in the database before, with this information was classified just the author who had keywords on the table 2. This table of keywords was organized with the professor's group of PPGEPS (Graduate Program of Production Engineering and Systems). After this selection, the articles that were about 1500 passed to 754. In the same moment of the classification by keyword, also was collected the methodologies and the co-authors. According Garfield (1997) there is a gap of research that is possible the co-authors not have been accounted as authors of the research. The year of information published was collected latter, because the data base was modified for store more data. Therefore this article had a sample for that information can be used.

Table 2: Keywords

Key Words	
Aggregate planning	Performance management
Capacity analysis	Product design
Capacity planning	Productivity
Distribution	Project management
Environmental issues	Purchasing
Facility layout	Quality

Facility location	Reliability
Forecasting	Scheduling
Human factors	Service design
International operations	Service systems design
Inventory	Services
Logistics	Supply chain management
Maintenance	Sustainability
Manufacturing systems design	Technology management
Material handling	Work design
Multi-site operations management	Work improvement
Operations information management	Work measurement
Operations strategy	

2.4 Sample

The method that was used to define this sample was the stratified sample, because it's the most appropriated for this case, according to Ardilly et al. (2006) when there is a population that is divided into groups the sample has to include proportions into all the groups, at this population the outlets are the division adopted. Therefore was made one sample of 126 articles in total of 754. The data of the statistical experiment are on Table 3, and the formula to calculate it is on the Figure 4.

Table 3: Data of the statistical experiment

Confidence level	0,95
Sampling error	0,08
Population percentage	0,50
Finite Population	757
Sample Size	126

$$n = \frac{N \cdot \hat{p} \cdot \hat{q} \cdot \left(Z_{\alpha/2}\right)^2}{\hat{p} \cdot \hat{q} \cdot \left(Z_{\alpha/2}\right)^2 + (N-1) \cdot E^2}$$

Figure 4 - Formula

3 Results

In overview, without the division by year, the results can be seen at Figure 5 the methodologies, at Figure 6 the keywords and the outlets at Figure 7, these were used at the articles in the sample.

The methodology most used was the modeling with 35%, following for case study, 29% and literature review, 24%. The sum of this three parts pass the 85%, that's show how it's stay concentrated in a few methodologies, because 9 options of methods just 3 were used. The others didn't have significant percentages.

The keywords most used were the scheduling, operations strategy, and quality, their percentages are respectively: 14%, 12% and 12%, adding 37% in a list of 37 keywords.

The journals most used were 'Produção' and 'Gestão e Produção', both are Brazilians, their percentages are respectively: 17% and 16%. As a consequence of the decision to research with a sample, the data of the publication per year by each journal could not be made, because the size of each sample was too small to represent the reality.

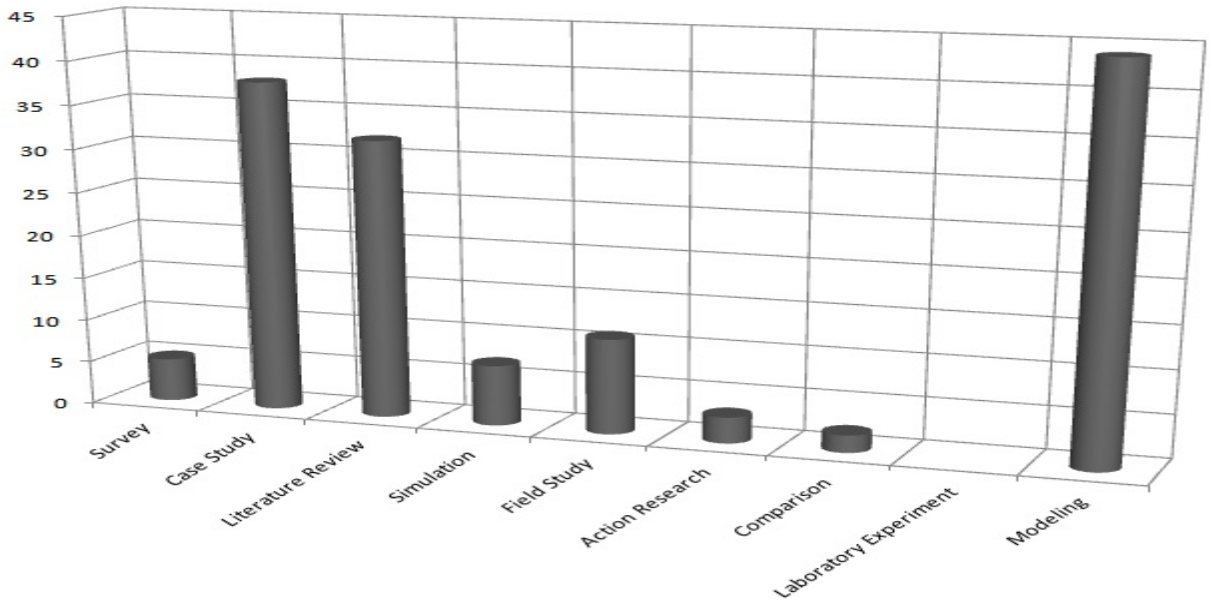

Figure 5- Methodologies

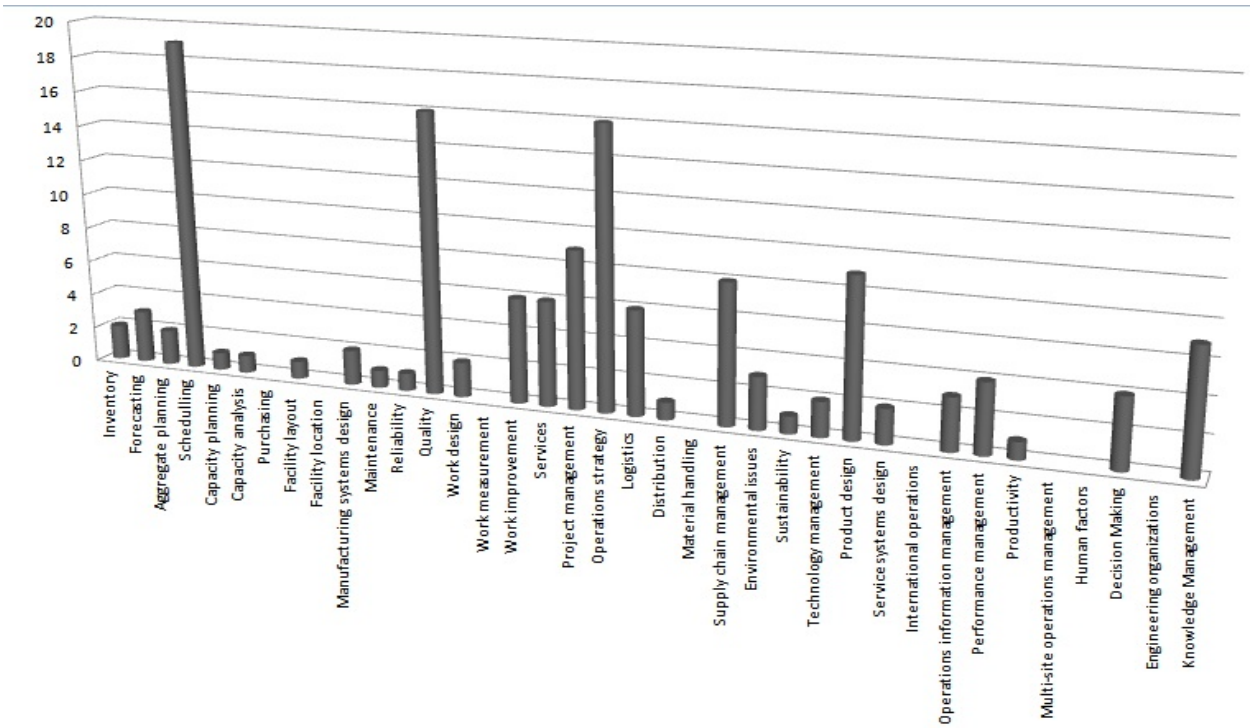

Figure 6 - Keywords

3.1 Results per Year

And about the methods, are almost the same, most common are modeling, case study, and literature review. The oldest is the literature review that has been used since 1993, and later in 1994 came the modeling follow by the case study in 1997. Others methods have emerged with the expansion of the OM, and the whole search, which brings a lot of knowledge to society. A clear example can be seen in Figure 9, is the survey methodology, which emerged from 2007 in the sample and has been used increasingly in the area.

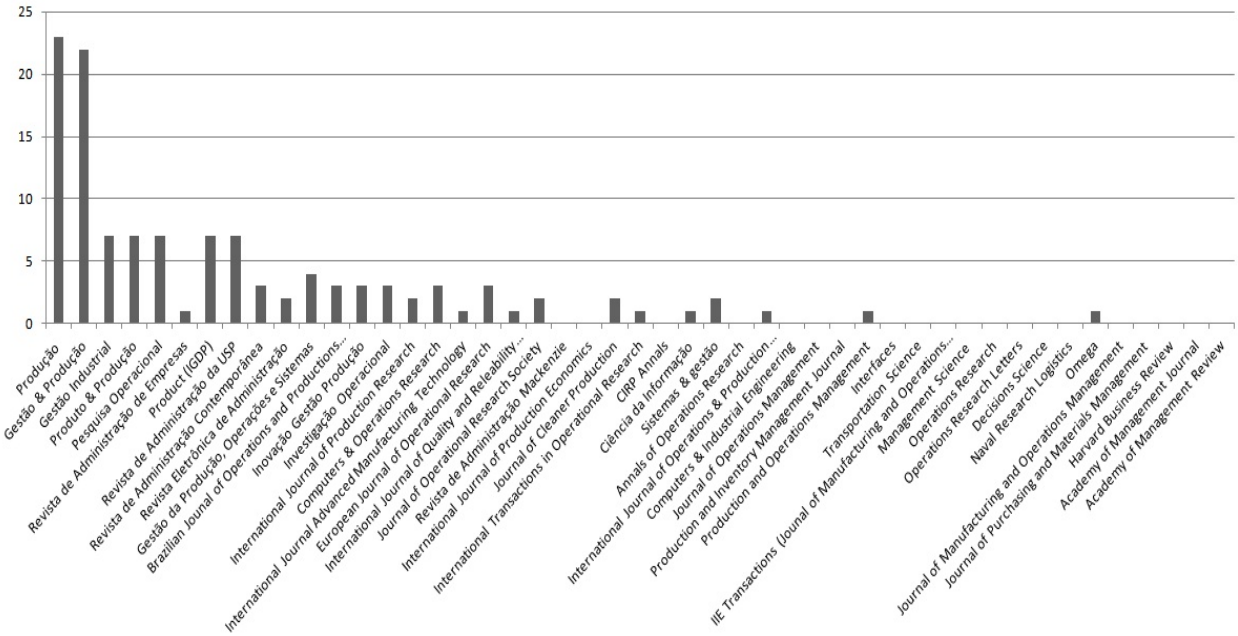

Figure 7 – Outlets

About the keywords are almost homogeneous during the years, most used of them are observed in the beginning, as scheduling that was started being used in 1993 and quality operations strategy one year later. But is possible to see that in recent years they had been used great variety of keywords, what shows the expansion of the OM.

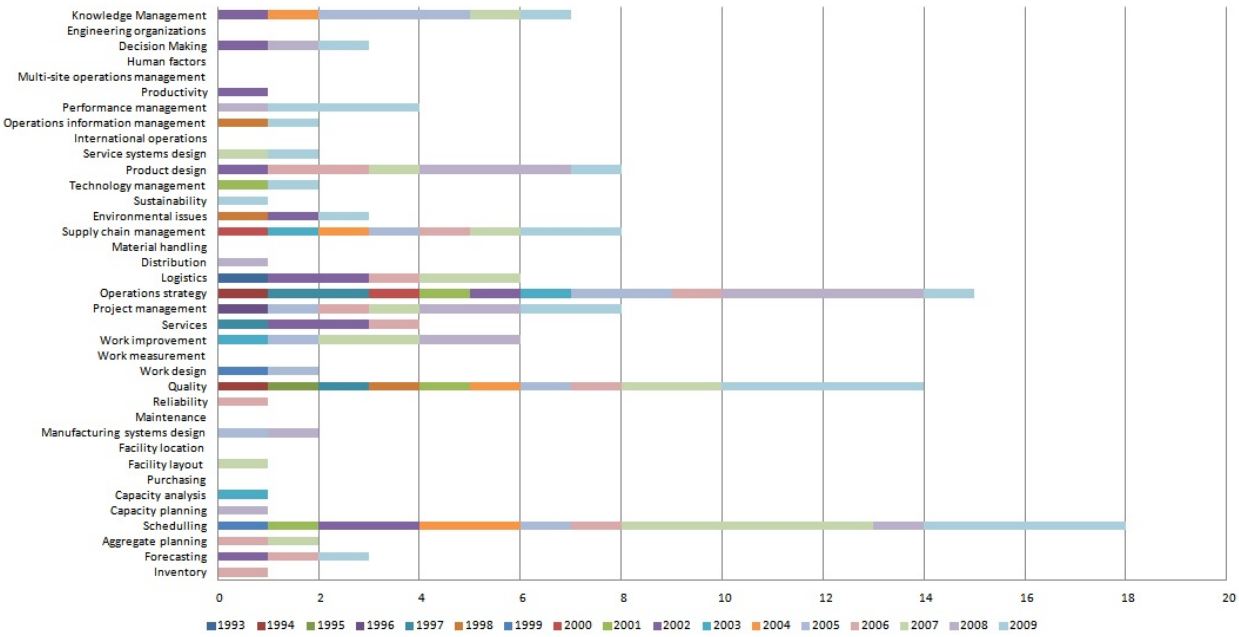

Figure 8 - Keywords by year

And about the methods, are almost the same thing, the most used as modelling, case study and literature review are used since the beginning, and others methods have emerged with the expansion of the OM, and the whole search, which brings a lot of knowledge to society. A clear example can be seen in Figure 9, is the survey methodology, which emerged from 2007 in the sample and has been used increasingly in the area.

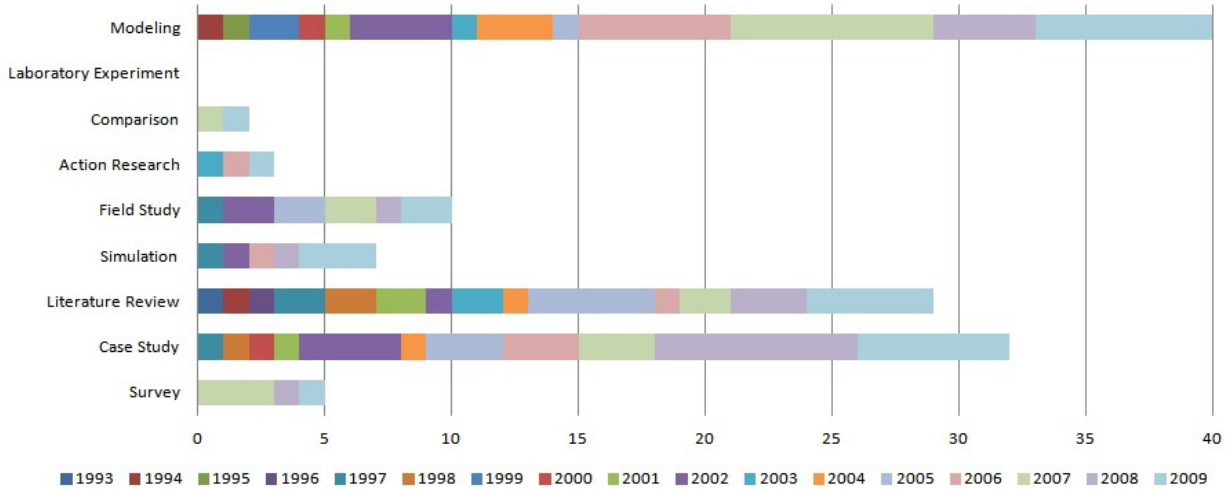

Figure 9 - Methodology By Year

4 Conclusion

As it was explained, the area of OM has been growing a lot since the recently years, however it can expand a lot, with more research and dedication of all interested, to improve the knowledge, and this knowledge can be disseminated widely and it is necessary that authors know the best sources of research, and where their researches will contribute the most, so it is essential that the journals are studied, classified and than it is possible to know exactly what each one offers the best , what is its importance and relevance to each theme.

It was noted that the use of methodologies is very concentrated, perhaps if more research was made with different methodologies, the result could be other. Brazilian's articles can be more accept in great scale in the international community, because was observed little participation of Brazilian's researches on international outlets. On those key-words, since of the principle was observed homogeneity with key-words and numbers of articles, which shows that areas of study are diversified too. This is excellent for the field of operations management, because opens new strands of knowledge. Therefore, which is notable this article is how the contributions of researches increase on the few years, helping the field of operation management to grow up. This is showed by the quantity of the key-words that emerged in a few time ago. And believes that the area can still grow more in the next years.

4.1 Future Steps

To know the perception of quality and relevance about the journals, for the Brazilians authors, will be done a survey. It will be like the international studies, which were already cited in the beginning of this article.

References

Ardilly, Pascal.; Tillé, Yves. (2006) *Sampling Methods: exercises and solutions*. New York: Springer.

Barman, S., Tersine, R. J., Buckley, M. R. (1991) *An empirical assessment of the perceived relevance and quality of POM-Related journals by Academicians*. Journal of Operations Management. vol. 10. no. 2, 194-212.

Barman, S.; Hanna, M.; Laforge, R. L. (2001) *Perceived relevance and quality of POM journals: a decade later*. Journal of Operations Management, vol.19, n. 3, p. 367-385.

Buffa, E. S. (1980) *Research in Operations Management*. . Journal of Operations Management. Vol. l. no. 1, l-8.

Cetnarski, E. M. ; Saldanha, G. C. ; Thies, M. M. ; Gouvea Da Costa, S. E. (2011) . *A pesquisa em gestão de operação no Brasil: primeiros resultados*. In: XXXI Encontro Nacional de Engenharia de Produção, 2011, Belo Horizonte. Inovação Tecnológica e Propriedade Intelectual: Desafios da Engenharia de Produção na Consolidação do Brasil no Cenário Econômico Mundial. Rio de Janeiro : ABEPRO, v. 1.

Drejer, A.; Blackmon, K.; Voss, C. (2000) *Worlds apart? A look at theoperations management área on the US, UK, and Scandinavia*. Scandinavian Journal of Management, v. 16, p. 45-66, 2000.

Fleury, A.C.C (Coord.) (2008) *Produzindo o Futuro: 50 Anos de Engenharia de Produção na Universidade de São Paulo*. São Paulo : EPUSP.

Flynn, B.; Sakaribara, S.; Schroeder, R.; Flynn, E. (1990) *Empirical Research Methods in Operations Management*. Journal of Operations Management, v. 9, n. 2, p. 250-284.

Garfield, E., (1997)*, "Citation indexing – Its theory and application in science*", Technology and Humanitied, Institute of Scientific Information, ISI Press Philadelphia.

Gouvea Da Costa, S. E. ; Pinheiro De Lima, E. (2010) *An Overview of Operations Management and its relations with Industrial Engineering*. IIE - Industrial Engineering Research Conference, 2010, Cancun. IE Annual Conference and Expo 2010. Norcross : IIE, p. 1-6.

Gupta, S.; Verma, R.; Victorino, L. (2006) *Empirical Research Published in Production and Operations Management (1992-2005): Trends and Future Research Directions*. Production and Operations Management, v. 15, n. 3, p. 432-448, 2006.

Jiang, B.; Fraizer, G.V.; Heiser, D. (2007) *China-related POM research: a literature review and suggestions for future research*. International Journal of Production and Oparations Management, v. 27, n. 7, p. 662-684.

Soteriou, A., Hadjinicola, G., and PATSIA, K. (1999) *Assessing Production and Operations Management related journals: the European perspective.* Journal of Operations Management, Vol. 17 no. 2, 225-238.

Voss, C. A.(1995) *Operations Management – From Taylor to Toyota – and Beyond?* British Journal of Management, v.6 (Special Issue), p. S17-S29.