REVENUE MANAGEMENT IN MANUFACTURING: CHARACTERISTICS OF EXISTING RESEARCH VIA CONTENT ANALYSIS

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Abstract

Revenue management is selling the right product, with the right price, at the right time, to the right customer as defined in literature. In its infancy revenue management was rather a tactical inventory management approach, nowadays it is more strategic approach for managing revenues. While this technique is traditionally considered a tool of service operations, it shows considerable potential for application in manufacturing. However, revenue management in service systems has been studied more than in production systems. To provide a comprehensive understanding of research in this field, this study adopted a systematic process of reviewing the literature using content analysis as the main technique. The process involved searching for existing articles that are relevant to this study with no restriction on the date of the issue, evaluating and selecting the suitable ones, analysing and synthesizing their findings and organizing the findings to determine what is known and what is yet to be known. The classification of the literature into core activities of revenue management in manufacturing serves as a useful guide for practitioners and academics to trace various aspects of this concept and to visibly notice the gaps in the existing literature as well as directions for future research.

Key words: revenue management, content analysis, manufacturing, production

JEL Code: L11, L60

Introduction

Revenue management focuses on observing customer buying behavior and then adjusts price and product availability to increase revenues (Cross, 1998). It is a combination of information technology, theory of probability, statistics and business experience, which allows companies to process huge amounts of data very quickly, giving them the ability to predict purchasing behavior and manage revenues under much more complex conditions than previously possible. Revenue management uses a variety of forecasts and models based on historical

price elasticity of products, sales data, competitors' responses, and other variables to create analyses that support business strategy decisions.

A company can increase its revenues by selling the right product in the right packaging to the right customer at the right price. However, nowadays, when the product portfolio of companies is mostly very complex, the business environment is turbulent and the needs of consumers are often fragmented, it is difficult to achieve this optimal combination without using the adequate techniques and analyses offered by revenue management.

The revenue management era begins several years after the deregulation of the US airline industry in 1978 (Vinod, 2016). Deregulation has impacted airlines' profitability, increased competition and created an environment in which only the strongest players on the market could survive. This has led competing airlines to offering discounted tickets, making air travel accessible to a wider range of people who have never used it before.

The method was developed soon after the deregulation by American Airlines, which had to deal with the problem of how many seats should be sold in advance at a lower price, while leaving enough tickets for customers who buy them shortly before departure at full rate (Defregger and Kuhn, 2005). Revenue management thus became a technique to help sell as many unsold seats as possible and to maximize revenues through analyses optimizing service availability and its price. The method has allowed airlines to provide the same service at a different price, depending on how much the customer is willing to pay for it.

When speaking about revenue management, in most cases it is meant its implementation in air transportation, but one of the other sectors that implemented this method in its early years was the hotel industry (Kimes, 2016). The hotel industry began to apply revenue management in the 1980s, inspired by its success in airlines. This was due to sectoral similarities including high fixed costs, perishable inventory, ability to forecast demand and market segmentation based on customers' price sensitivity.

Revenue management techniques then quickly moved to other service sectors with characteristics like airlines and the hotel industry. They were used by other tourism companies, such as car rentals, restaurants, railways and theatres.

1 Literature review

Although these methods are predominantly used in the service sector, recently revenue management research has expanded to its application in manufacturing. This has been done especially in the field of operational research through various mathematical models and

algorithms. However, research on the general use of this discipline in manufacturing is still limited.

One of these studies is the analysis of Defregger and Kuhn (2005), who, on a sample of paper, steel and aluminium companies, surveyed whether these companies met the prerequisites for introducing revenue management and whether they were using these techniques. The results show that about 60 % of the analysed companies meet the prerequisites for the application of revenue management, but its use is still not widespread.

The research of Voigt et al. (2008) aimed to analyse the potential of revenue management in the German car industry. The results show that German car buyers could be segmented into different groups according to the criteria "delivery time" and "configuration changes" which enables manufacturers to introduce revenue management. Its implementation could help to reduce complexity and offer each customer the appropriate degree of change flexibility and the optimal delivery time combined with adequate pricing.

Kolisch and Zatta (2009) further investigated the use of this concept in the German process industry. The results show that the overall importance of this approach is considered high within the industry and that this importance positively correlates with the turnover, the time of use of these techniques and the extent of IT integration. Obstacles to the deployment of these systems lie mainly in the absence of a clearly defined pricing strategy and a lack of experience with this discipline.

The authors then extended their research to Europe and North America (Kolisch and Zatta, 2011). Their study shows that revenue management techniques are already widely used in process industry of these countries. 86 % of the companies in the sample use the revenue management concept. However, unlike the service industry, revenue management experience in manufacturing is much more limited. As the main obstacles to the implementation of this discipline, respondents stated unawareness of its existence or suitable systems, unclear pricing strategy and lack of attention of the company management. If organizations decide not to implement revenue management, they usually do so because other projects and activities have a higher priority or managers do not perceive the potential of these activities as significant.

Coker and Helo (2016) analysed practices of largest manufacturing companies in Finland regarding balancing their demand and supply. The survey shows that the companies either cannot or do not know how to influence demand through revenue management. Though companies reported being quite adept in understanding market behaviour and analysing customers and competitors, they failed to operationally act upon this intelligence.

This approach should increase financial performance but so far, research has not paid enough attention to the impact of revenue management implementation on the revenues or profit of manufacturing companies.

A survey by Zatta and Kolisch (2014) among revenue managers of companies from process industry in Europe and North America is a study examining the impact of revenue management on profitability. Respondents were asked to determine the increase in profit they expected from this discipline before it was introduced and to estimate the subsequent impact on profit. It turned out that revenue management was perceived as a technique that allows profit to be increased. Estimates of the impact of revenue management on profit were positive both before and after its introduction.

Shields (2005) conducted a survey on revenue management of small businesses in various industries. The author prepared a regression analysis to examine the impact of this technique on revenues, with revenue management elements representing independent variables and average monthly revenues dependent variable. The influence proved to be significant and positive.

2 Methodology

The research question of this paper is: What are the characteristics of existing research of revenue management in manufacturing? To provide a comprehensive answer, this study adopted a systematic process of reviewing the literature using content analysis as the main technique, based on the approach of Guillet and Mohammed (2015). The process involved searching for existing articles that are relevant to this study with no restriction on the date of the issue, evaluating and selecting the suitable ones, analysing and synthesizing their findings and organizing the findings to determine what is known and what is yet to be known. To locate the relevant articles for this study, keywords search was conducted in online database ProQuest Central. The list of keywords was generated based on the revenue management framework provided in the literature. Main keyword “revenue management” was combined with manufactur*, product*, “make to order”, “build to order”, “assemble to order”, “make to stock”, “build to stock”, “assemble to stock” and “process industry” and the abstracts and titles of the documents were searched.

Then more precise criteria were applied to select the final list of papers for analysis. The criteria for the inclusion of studies were based on three conditions. First, the article needed to be a full-length paper. Second, only document types such as articles, features, case

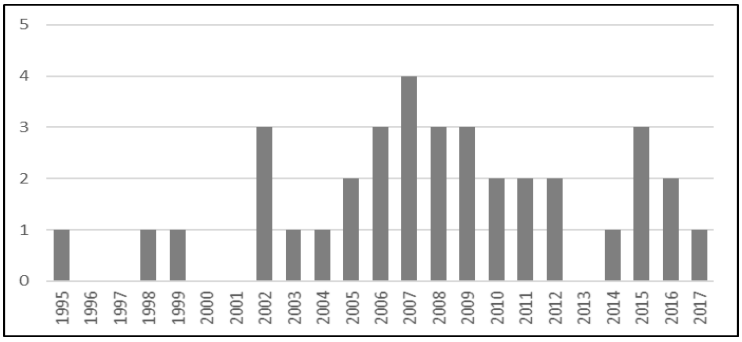
studies and working papers were included, suggested they are the most suitable source for determining the state of knowledge in this field (based on the previous literature review). In all, 241 articles were identified. These articles included a broad range of topics, some of which were outside the purview of this study. So, the third criterion for the selection of the papers was that the article had to be related to manufacturing and the focus of the paper had to be revenue management. To determine whether the paper's focus was on revenue management, the revenue management practice described in the literature served as the reference point. The abstracts or the whole articles were read to select the final sample. It included 36 papers.

The content analysis of the selected studies began with reading of all the articles. In this process, each paper was analysed in greater detail according to the following thematic areas: year of publication, journal of publication, regional focus, study design (quantitative, qualitative, mixed, theory), subject area (inventory control or capacity allocation, pricing, both, other) and topic focus (MTO, MTS, both, ATO, all, not specified).

3 Results

Figure 1 shows that revenue management in manufacturing has been evolving in the surveyed literature for last 25 years. Compared to revenue management in the service sector which was developed at the beginning of 1980s several years after the deregulation of the US airline industry (Vinod, 2016), revenue management in manufacturing is relatively new topic with first studies appearing in the middle of 1990s.

Fig. 1: Articles according to year of publication



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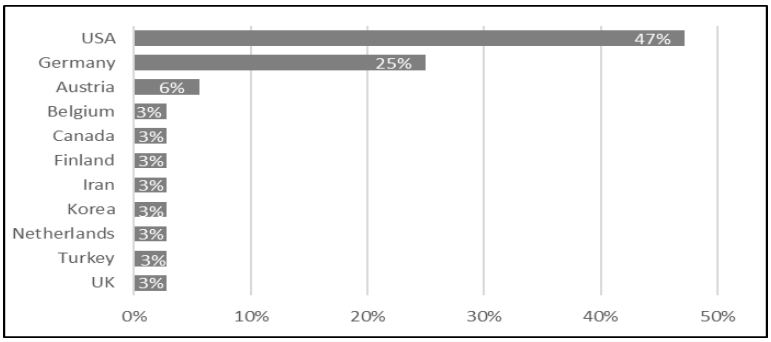
Regarding the journals in which the relevant articles have been published, according to the results Journal of Revenue and Pricing Management is fundamental on this topic (22 % of all relevant articles have been published in this journal), following by IDEAS Working Paper Series from RePEc, Manufacturing & Service Operations Management and OR Spectrum (8 % of articles). Among other journals which have published articles about revenue management in manufacturing belong Annals of Operations Research, Asia Pacific Management Review, Asian Business, Benchmarking, Beverage World, Business Credit, Business Research, Decision Sciences, European Journal of Operational Research, Industry Week, Journal of Business & Economics Research, Journal of Enterprise Information Management, Journal of Management Control, Journal of Manufacturing Technology Management, Journal of Small Business Strategy, Operations Research, The International Journal of Advanced Manufacturing Technology, Journal of Operations Management and The Journal of the Operational Research Society (3 % of articles).

The authorship analysis shows that most of the articles have been written by researchers from the United States, illustrating the concentration of experience and practical expertise in this country. 47 % of all articles come from authors affiliated in the USA, followed by Germany (25 %). This means that revenue management in manufacturing is specifically an American domain.

Fig. 2: Articles according to regional focus



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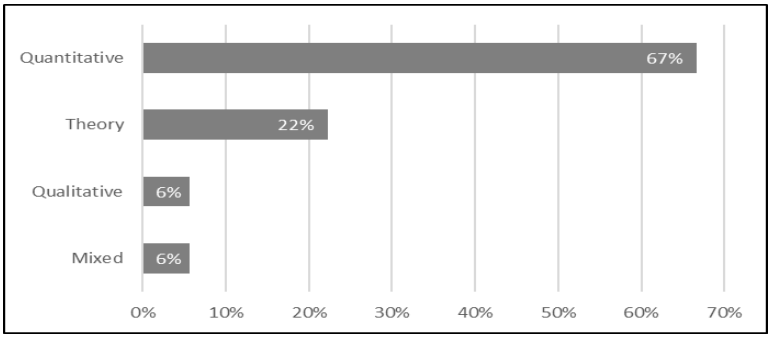
From the results presented in Figure 4, it can be noted that significantly higher proportion of the studies (67 %) use quantitative research design. 22 % of articles have theoretical background and only 6 % use qualitative or mixed methods. This is caused by the fact that the relevant articles mostly deal with revenue management as topic from operational research concerned with algorithms and mathematical computations.

Fig. 3: Articles according to study design



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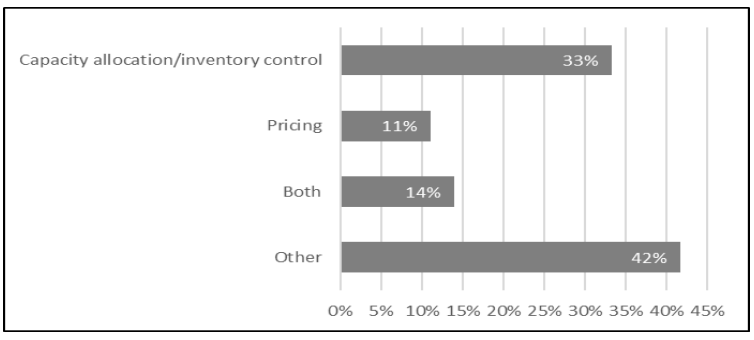
The concept of revenue management originated from the interconnection of classical pricing and capacity allocation problems. Thus, the subject area was defined as capacity allocation/inventory control (33 %), pricing (11 %) and their combination (14 %). 42 % of relevant articles were not assigned to any of these categories because they dealt with other/general issues. The proportion of subject areas regarding revenue management in manufacturing does not correspond with results of the study performed by Guillet and Mohammed (2015) regarding revenue management in hospitality services, where these techniques were developed. According to this study, during the last decade hospitality revenue management researchers have been increasingly interested in topics related to pricing and customers' reaction to these practices. From this evidence of a higher number of studies focusing on pricing relative to capacity/inventory optimization it can be noted that hospitality revenue management research is expanding from the hardcore tactic, which dwells more on capacity/inventory optimization, to strategy, which dwells more on price optimization (Guillet and Mohammed, 2015). In manufacturing the results do not reveal this trend.

Fig. 4: Articles according to subject area



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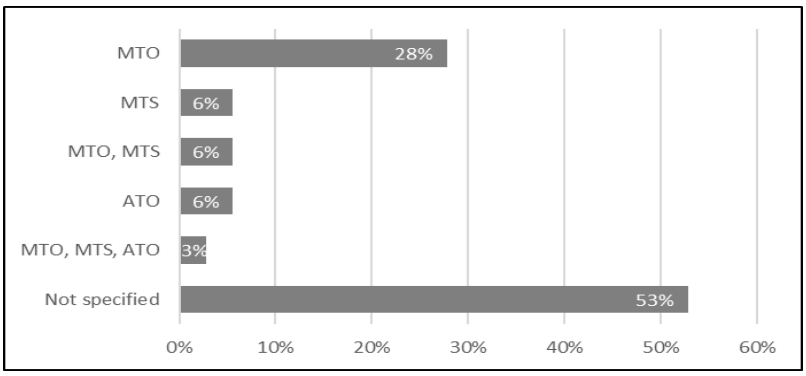
The literature on the use of revenue management in manufacturing settings is split between make-to-order (MTO), make-to-stock (MTS) and assemble-to-order (ATO) environments. MTO companies are confronted with the problem to decide which orders to accept and which orders to reject in order to maximize overall profit (Ferguson et al., 2008). For MTS environments, most of the research focuses on inventory rationing, where a portion of the inventory is reserved for higher margin customers who may arrive in the future. The focus of ATO revenue management lies on selling the available resources to the different customer segments in the most profitable way (Quante et al., 2009).

Many common characteristics between order-driven manufacturing and traditional revenue management industries make MTO promising environment for the application of revenue management (Hintsches et al., 2010). Figure 6 shows that if the manufacturing environment was specified, it was mostly MTO (59 %). The low number of studies on the MTS and ATO environments shows that it would be useful to conduct more revenue management research in these areas.

Fig. 5: Articles according to manufacturing environment



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Discussion

Contrary to hospitality revenue management, where pricing has become the major area of research during the last decade (Guillet and Mohammed, 2015), in manufacturing this trend was not confirmed. It can be stated that current studies in hospitality journals pay more attention to revenue management as a strategy-oriented tool than studies in manufacturing. According to Guillet and Mohammed (2015), customer-related articles have become also prominent in hospitality revenue management research which could indicate that this field is

becoming more strategic-focus and customer-oriented. Surveyed papers do not deal with customer perspective except one article developing an approach for capacity control considering long-term effects on the value of a customer. This throws up new challenges and opportunities for further research regarding revenue management in manufacturing, which could address the issue of influencing customers' price sensitivity and willingness to pay.

This study has its limitations regarding the process of identifying the relevant articles and their classification.

Conclusion

This study documents the areas of revenue management research in manufacturing using content analysis. The findings that can be noted from this study are that revenue management in manufacturing is relatively new topic and especially an American domain with MTO as prevailing environment. From the evidence of a higher number of studies focusing on capacity/inventory optimization, it can be concluded that revenue management in manufacturing dwells rather on operational discipline and hardcore tactic contrary to more strategic hospitality revenue management.

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References

Coker, J., & Helo, P. (2016). Demand-supply balancing in manufacturing operations. *Benchmarking: An International Journal, 23*(3), 564-583. doi:10.1108/bij-04-2014-0028

Cross, R. G. (1998). *Revenue management: Hard-core tactics for market domination*. New York, USA: Broadway Books.

Defregger, F., & Kuhn, H. (2005). *Revenue Management in der Sachleistungswirtschaft: Eine empirische Untersuchung am Beispiel der Papier-, Stahl-und Aluminiumindustrie. Ingolstadt, DE: Katholische Universität Eichstätt-Ingolstadt* (No. 171). Research Report.

Ferguson, M., Fleischmann, M., & Souza, G. (2008). Applying revenue management to the reverse supply chain.

Guillet, B. D., & Mohammed, I. (2015). Revenue management research in hospitality and tourism. *International Journal of Contemporary Hospitality Management, 27*(4), 526-560. doi:10.1108/ijchm-06-2014-0295

Hintsches, A., Spengler, T. S., Volling, T., Wittek, K., & Priegnitz, G. (2010). Revenue Management in Make-To-Order Manufacturing: Case Study of Capacity Control at ThyssenKrupp VDM. *Business Research, 3*(2), 173-190. doi:10.1007/bf03342721

Kimes, S. E. (2016). The evolution of hotel revenue management. *Journal of Revenue and Pricing Management, 15*(3-4), 247-251. doi:10.1057/rpm.2016.27

Kolisch, R., & Zatta, D. (2009). Stand und Perspektiven des Einsatzes von Revenue Management in der Prozessindustrie. *Zeitschrift Für Planung & Unternehmenssteuerung, 20*(2), 197-214. doi:10.1007/s00187-009-0075-6

Kolisch, R., & Zatta, D. (2011). Implementation of revenue management in the process industry of North America and Europe. *Journal of Revenue and Pricing Management, 11*(2), 191-209. doi:10.1057/rpm.2011.9

Quante, R., Meyr, H., & Fleischmann, M. (2009). Revenue management and demand fulfillment: Matching applications, models, and software. *OR Spectrum, 31*(1), 31-62. doi:10.1007/s00291-008-0125-8

Shields, J. (2005). Revenue management: A strategy for increasing sales revenue in small businesses. *Journal of Small Business Strategy*, *16*(2), 43-54.

Vinod, B. (2016). Evolution of yield management in travel. *Journal of Revenue and Pricing Management, 15*(3-4), 203-211. doi:10.1057/rpm.2016.15

Voigt, K., Saatmann, M., & Schorr, S. (2008). Flexibility and revenue management in the automotive industry. *Journal of Enterprise Information Management, 21*(4), 424-439. doi:10.1108/17410390810888697

Zatta, D., & Kolisch, R. (2014). Profit impact of revenue management in the process industry. *Journal of Revenue and Pricing Management, 13*(6), 483-507. doi:10.1057/rpm.2014.14

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