Inventory optimisation adoption amongst SMEs

DRAKELEY, Peter and PERERA, Terrence

Available from Sheffield Hallam University Research Archive (SHURA) at:

https://shura.shu.ac.uk/31340/

Inventory Optimisation Adoption Amongst SMEs

Peter DRAKELEY[a] and Professor Terrence PERERA[a]
[a]Industry & Innovation Research Institute, Sheffield Hallam University, S1 1WB

Abstract. It is acknowledged that UK SMEs make a significant contribution to its economy. However, SMEs are generally slow to adopt new technologies due to intrinsic constraints such as lack of in-house expertise and investment limitations. Inventory is a key asset in any organisation. Most SMEs use of some form of IT platforms to manage inventory but it appears that inventory optimisation is not a prime goal. If deployed correctly, inventory optimisation can significantly reduce costs and improve operational effectiveness. This paper presents the underlying causes behind the lack of commitment to inventory optimisation in UK SMEs based on the evidence gathered from industry and literature. It also outlines potential actions that may be taken to motivate adoption of inventory optimisation in SMEs.

Keywords. SMEs, inventory management, optimisation, systems adoption.

1. Introduction

SMEs represent over 99% of all UK businesses, 61% of all UK employment and 48% of UK turnover [1]. The success of SMEs is vital to the UK economy, and yet SMEs are stuck amid a well document productivity problem [2]. Despite their significant contribution to the UK economy SMEs trail behind the EU average for the adoption of most technologies [3]. Increasing this adoption rate to improve productivity is a key part of UK government strategy with several initiatives under way, led by the Business Basics Programme.

Low rate of technology and management practise (TAMP) adoption has been identified as a key cause of low productivity amongst UK SMEs [4]. The documented factors inhibiting TAMP adoption are broad, but consistent across different TAMPs. They range from an SME having the self-awareness to acknowledge the shortfall of existing approaches, to continued top-level management support throughout the implementation process. SMEs are generally restricted by intrinsic organisational constraints rather than challenges related specifically to the TAMP being adopted.

For SMEs that carry inventory to manufacture, distribute or retail, Inventory Optimisation (IO) is a TAMP that has well established benefits. IO is 'one of the significant tasks in supply chain management' [5], it is concerned with balancing the risk of investment in inventory against the ability to supply customers. Empirical studies show the ineffective ways SMEs approach IO, as well as the benefits that can be achieved from deploying IO correctly. The primary benefits of IO include improved customer service levels, a reduction in administration time and a reduced investment in inventory, all profoundly important for SMEs who are generally limited by organisational and

financial constraints. With cloud-based software solutions making IO accessible to SMEs, these benefits have never been more attainable.

2. Literature Review

There is broad consensus in the literature that SMEs face intrinsic challenges affecting growth and productivity. Roland [2] highlights financial and management practises. Argyropoulou et al. [6] similarly notes that SMEs have severe resource limitations, and goes on to add personalised management, and an absence of proper and formal IS practises and skills as challenges. Beijsterveld & Groenendaal [7] state that compared to large enterprises 'SMEs have fewer resources, SMEs have limited information technology (IT) expertise.' Other works highlight various other challenges including higher capital and transaction costs, a reactive nature, weak organisational structure and over reliance on the CEO / founder, supply chain inefficiencies and technological obsolescence [8-10].

The link between SME low productivity and the failure to adopt new TAMPs is well established [11]. Much research has been conducted into the factors that motivate SMEs to adopt and successfully implement new TAMPs [4, 12-13]. The documented factors range from an SME having the self-awareness to acknowledge the shortfall of existing approaches, to continued top-level management support throughout the implementation process.

SMEs are in an operational Catch-22. Whilst the intrinsic challenges they face are exacerbated by the low rate of TAMP adoption, those same challenges have a clear causal impact on the low rate of TAMP adoption. In his work on ICT Adoption and SMEs Garg [9] based on prior work [14], summarised ICT Adoption challenges faced by SMEs as shown in Table 1. Most of the highlighted ICT adoption challenges can be linked either to clearly understanding the TAMP possibilities and opportunities available (lack of awareness & information, resistance to technology, lack of confidence, cultural factors), or having an efficient, and simple route to successful adoption (lack of money, lack of time, skills shortage, lack of knowledge, lack of operational procedures).

For stock holding SMEs to achieve their full growth potential the management of inventory is a TAMP of the highest importance [15]. However, the introduction of IM to SMEs 'is very limited due to lack of initiation, expertise and financial constraints' [16]. Based on our earlier consolidation of adoption challenges faced by SMEs clearly to drive adoption of an important TAMP like IM we need to start with a clear definition of that TAMP.

Literature review also revealed that no attempt has been made to embed inventory optimisation as an integral part of reported frameworks. Ganeha and Athal [17] present the development of an integrated inventory management control framework for a retailer. Whilst the authors consider different operational aspects of inventory management in their framework, no consideration has been given to optimizing inventory levels. Matsebatlela and Mpofu [18] also report on the development of an inventory management framework to minimize supply and demand mismatch in a manufacturing organization. Their work too has not addressed the ways to optimize inventory levels. A survey by Krishnadevarajan et al [19] laments that the lack of frameworks hinders the development of systematic approaches to inventory management.

3. Defining Inventory Control, Management and Optimisation

Stock holding businesses perform three primary inventory related operations; Inventory Control (IC), Inventory Management (IM) and Inventory Optimisation (IO). Each of these operations builds on the preceding one and involves distinct technologies, and typically departments within an organisation. These operations are often labelled interchangeably with the inventory synonym stock e.g., Stock Control, Stock Management, Stock Optimisation.

Table 1. ICT Adoption Challenges Faced by SMEs [9]

Capabilities	Resources	Access	Attitude	Context	Operations
Inadequate IT user skills. Poor trouble shooting skills. Inadequate IT development capabilities. Limited IT planning capabilities. Lack of IT knowledge.	Lack of money. Lack of time Lack of motivation.	Inadequate hardware and software. Poor IT infrastructure.	Resistance to technology. Lack of engagement of management. Lack of value and personal incentives. Lack of confidence. Lack of awareness. Lack of trust.	Cultural factors. Mismatch between technology and social / business systems.	Lack of operational support and administration. Inappropriate operational procedures.

Inventory Control (IC) is the tracking and counting of inventory already in a company's warehouses, factories or stores. IC systems extend from the most basic 'Memory System', which involves a human putting stock somewhere and remembering where it is, to RFID systems which automatically tag and track individual stock units as they move in and out of storage facility [20]. IC encompasses tracking product details, locations and histories, completing inventory counts, keeping track of physical inventory with sales and purchase orders and tracking of goods in and out [21]. The specific number of units of a particular item in stock is generally stored in a company's ERP system, however for larger warehouse facilities, split into many storage bays it may be necessary to employ a dedicated Warehouse Management System, 'an informational system dedicated to manage entire high-volume warehouse operations in real time mode' [22]. Inventory control aims at maximizing inventory accuracy, and 'is a vital part—perhaps the most crucial part—of your inventory management strategy' [18].

Inventory Management (IM) 'includes the business processes of product replenishment and forecasting. Management encompasses when to reorder products and how much product to order, to avoid either stockouts or holding too much inventory. It ensures that the right inventory is in the right place, at the right time, and in the correct quantity.' [23]. A multitude of well-established IM best practises exist in the literature. As noted by Khader et al. [24] 'inventory management models assume implicitly that the physical stock available in a warehouse is equal to the quantity shown in the informational system'. IM, therefore, builds implicitly on effective Inventory Control.

Whilst IM generally operates at the single item / stock keeping unit level, Inventory Optimisation (IO) works 'over a large assortment of stock keeping units', applying statistical techniques to 'capital investments and constraints, or service level goals' [25]. Inventory optimisation is a long established, proven process for helping businesses achieve an optimal balance of inventory investment and product availability. 'The role

of inventory as a buffer against uncertainty has been established for a long time' [26] and achieving optimal inventory is 'one of the significant tasks in supply chain management' [5]. IO is the application of a range of mathematical and algorithmic techniques that enable stock holding businesses to prepare for demand and supply variability [5, 27]. The mathematical techniques, and large volumes of data processing required generally necessitate a dedicated best-of-breed IO software solution, of which many modern examples exist e.g Netstock, EazyStock, Slimstock.

Whilst IC, IM and IO are becoming better defined in Industry [23, 28], in literature the terms are used interchangeably, and often overlap as in the explanation of IM given by [29]: "The element of 'management' or 'control' is thought to be pivotal in this context because any 'control' is deemed a process by which events are made to conform to a set plan." As the words control and management can be considered synonyms this overlap is to be expected and is present in many works [30-32]. IM is the prevalent term used in literature and generally covers IC and IM as described here, sometimes with elements of IO.

Whilst IC, IM and IO are closely related they rely upon distinct technologies, skillsets, and people within an organisation. A noted barrier to SMEs adopting new or enhancing existing TAMPs is a lack of understanding and awareness. Having no distinct definitions of these processes and associated technologies is therefore likely a barrier to wider adoption.

4. The Impact of Inventory Management / Optimisation at SMEs

As described in the preceding section IC, IM and IO definitions often overlap in the literature. The literature referenced below may refer either to IM or IO. In all cases the practical application of the referenced literature is aligned with the goal of achieving a more optimal inventory portfolio.

For stock holding SMEs optimal inventory is critical to remaining competitive [30]. A multitude of well-established IM / IO best practises exist in the literature however empirical evidence suggests there is limited application of these practises amongst SMEs [33-36]. Noted methods of IM followed by SMEs are rule of thumb, EOQ (economic order quantity), Always Better Control (ABC), Computerised IM, Just in Time (JIT) and Vendor Managed Inventory (VMI) [33]. Based on the authors' industry experience SMEs will typically resort to home-made-spreadsheets to facilitate Inventory Management. Others will use modules in their ERP system however these modules typically lack important capabilities to achieve optimal results including effective demand forecasting, inventory classification and automated replenishment [37].

Many studies highlight the positive correlation between optimal inventory and economic performance of SMEs [16, 35, 38]. This correlation is facilitated by an increase in inventory turnover, a reduction in inventory levels, a reduction in holding costs, and a decrease in order processing time. Optimised inventory also leads to improved customer satisfaction which drives additional revenues [39, 40]. Case studies from industry verify the significant, reliable range of improvements in business KPIs that result from embedding IO at SMEs [41-43].

Cloud technology makes the benefits of IO more accessible than ever, but the decision adopt the technology is no guarantee of success, the benefits come from effective adoption. Petroni [13] referring to MRP, an antecedent of IO, remarks that 'the success rate is low, especially among small and medium sized Enterprises' having earlier

noted that an important aspect of MRP systems is often overlooked – implementation. The need for systematic frameworks to drive successful TPAM adoption at SMEs is well established both generically [44] and focused on specific TAMPs [13, 45-46]. Invariably the justification for the framework is the risk of implementation failure, generally linked to the intrinsically   limiting characteristics of SMEs.

Frameworks typically focus on a successful implementation ending at 'go-live phase, the point at which the TAMP is in everyday use by the business. Other frameworks however go beyond this, justifying an on-going post implementation review related of key KPIs for the TAMP performance, driven by a motivation to continuously improve. In their case study of JIT at an SME manufacturer Gunasekaran & Lyu [47] highlight the need for a systematic methodology to evaluate the performance of the JIT implementation. Similarly motivated by the need to help manufacturing SMEs remain competitive Bhise & Sunnapwar [48] created a framework to help SMEs implement advanced manufacturing technology. Following a comprehensive literature review they deem the post implementation phase necessary to ensure results are delivered. The value of IO is in the results, and therefore similarly a process to continually evaluate the results and performance of any IO system is necessary.

5. Conclusion and further work

IO is a TAMP that yields significant benefits when adopted correctly, but correct adoption is not trivial, particularly for SMEs who face intrinsic TAMP adoption challenges. Many cloud software solutions exist that make IO accessible to SMEs and include tracking of key IO KPIs such as stock turn, stock value and service level, however even these software solutions require correct implementation, necessitating implementation frameworks. Whilst implementation frameworks are common in the literature a search shows that IO is neglected.

Given the prevalence of SMEs in all economies the development of a usable framework, specifically designed to help SMEs better adopt IO will have a significant positive impact for the businesses who employ the framework, their respective economies, and the global supply chains in which many of them operate. The development of this framework should therefore be a high priority.

References

[1] Department for Business Energy and Industrial Strategy. Business population estimates for the UK and regions 2021: statistical release (HTML) [Internet]. GOV.UK. 2021 [cited 2022 Mar 27]. Available from: https://www.gov.uk/government/statistics/business-population-estimates-2021/business-population-estimates-for-the-uk-and-regions-2021-statistical-release-html
[2] Roland I. Unlocking SME productivity. 2020 Jan;23.
[3] Organisation for Economic Co-operation and Development. OECD Science, Technology and Industry Scoreboard 2015: Innovation for growth and society [Internet]. OECD; 2015 [cited 2021 May 14]. (OECD Science, Technology and Industry Scoreboard). Available from: https://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-scoreboard-2015_sti_scoreboard-2015-en
[4] Department for Business Energy and Industrial Strategy. Attitudes to adoption: understanding the barriers and enablers to the adoption of best practice technologies and management practices by small and medium sized enterprises (SMEs). 2019;80.
[5] Singh SR, Kumar T. Inventory Optimization in Efficient Supply Chain Management. International Journal of Computer Applications in Engineering Sciences. 2011 Dec;1(4):428–34

[6]   Argyropoulou M, Ioannou G, Koufopoulos DN, Motwani J. Measuring the Impact of an ERP Project at SMEs: A Framework and Empirical Investigation. International Journal of Enterprise Information Systems (IJEIS). 2009;5(3):1–13.

[7]   Beijsterveld JAA, Groenendaal WJH. Solving misfits in ERP implementations by SMEs. Information Systems Journal. 2016 Jul;26(4):369–93.

[8]   Arend RJ, Wisner JD. Small business and supply chain management: is there a fit? Journal of Business Venturing. 2005 May;20(3):403–36.

[9]   Garg A. ICT Adoption and SMEs: A Contextual Framework. International Journal of Engineering Technologies and Management Research. 2016 Dec 31;3(12):1–11.

[10] Pham H, Nguyen K. IT and Business Value-a Missing gap: A SME Case Study. In: International Conference on Information Management and Evaluation [Internet]. Reading, United Kingdom: Academic Conferences International Limited; 2013 [cited 2021 Nov 6]. p. 189–IX. Available from: http://www.proquest.com/docview/1380630382/abstract/835A3971A5084E76PQ/1

[11] Department for Business Energy and Industrial Strategy. Made Smarter Review [Internet]. GOV.UK. 2017 [cited 2021 May 14]. Available from: https://www.gov.uk/government/publications/made-smarter-review.

[12] Moradlou H, Perera PT. Identification of the Barriers in Implementation of Lean Principles in Iranian SMEs: Case Study Approach. Global Journal of Management And Business Research [Internet]. 2017 May 31 [cited 2021 Mar 31]; Available from: https://journalofbusiness.org/index.php/GJMBR/article/view/2252

[13] Petroni A. Critical factors of MRP implementation in small and medium-sized firms. International Journal of Operations & Production Management. 2002 Jan 1;22(3):329–48.

[14] Wolcott P, Kamal M, Qureshi S. Meeting the challenges of ICT adoption by micro-enterprises. J Enterprise Inf Management. 2008 Oct 17;21:616–32.

[15] Monisola O. An Assessment of Inventory Management in Small and Medium Scale Industrial Enterprises in Nigeria. 2013.

[16] Rajeev N. Do inventory management practices affect economic performance? An empirical evaluation of the machine tool SMEs in Bangalore. International Journal of Management Science and Engineering Management. 2008 Jan 1;3(4):312–20.

[17] Ganesha H.R., Aithal, P.S., 2020. Integrated Inventory Management Control Framework. International Journal of Management, Technology, and Social Sciences (IJMTS), 5(1), pp.147-157.

[18] Matsebatlela, M.G., Mpofu, K., 2015. Inventory Management Framework to minimize supply and demand mismatch on a manufacturing organization. IFAC-PapersOnLine, 48(3), pp.260-265.

[19] Krishnadevarajan, P.K., Balasubramanian, S., Kannan, N. and Ravichandran, V., 2016. A Multi-Criteria Decision Framework for Inventory Management. International Journal of Management (IJM), 7(1).

[20] Muller M. Essentials of Inventory Management [Internet]. Saranac Lake, UNITED STATES: AMACOM; 2011 [cited 2021 Jul 18]. Available from: http://ebookcentral.proquest.com/lib/shu/detail.action?docID=678727

[21] Linnworks. What is inventory control? Definition, importance and methods. [Internet]. [cited 2022 Mar 26]. Available from: https://www.linnworks.com/blog/inventory-control

[22] Woźniakowski T, Jałowiecki P, Nowakowska M, Zmarzłowski K. ERP SYSTEMS AND WAREHOUSE MANAGEMENT BY WMS. Information System in Management. 2018 Jun 30;7(2):141–52.

[23] Brightpearl. What is Inventory Control? Definition, Challenges, Best Practices [Internet]. Brightpearl. [cited 2022 Mar 26]. Available from: https://www.brightpearl.com/inventory-management-system/inventory-control

[24] Khader S, Rekik Y, Botta-Genoulaz V, Campagne J-P. Inventory management subject to multiplicative inaccuracies. International Journal of Production Research. 2014 Sep 2;52(17):5055–69.

[25] Wikipedia. Inventory optimization. In: Wikipedia [Internet]. 2020 [cited 2022 Mar 26]. Available from: https://en.wikipedia.org/w/index.php?title=Inventory_optimization&oldid=996421639

[26] Baker P. An exploratory framework of the role of inventory and warehousing in international supply chains. The International Journal of Logistics Management. 2007 Jan 1;18(1):64–80.

[27] Caggiano KE, Jackson PL, Muckstadt JA, Rappold JA. Efficient computation of time-based customer service levels in a multi-item, multi-echelon supply chain: A practical approach for inventory optimization. European Journal of Operational Research. 2009 Dec 16;199(3):744–9.

[28] NetSuite.com. Inventory Control vs. Inventory Management: Which Does What? [Internet]. Oracle NetSuite. [cited 2022 Mar 26]. Available from: https://www.netsuite.com/portal/resource/articles/inventory-management/inventory-management-inventory-control.shtml

[29] Aro-Gordon S, Gupte J. Contemporary Inventory Management Techniques: A Conceptual Investigation. 2016;21.

[30] Ngubane N, Mayekiso S, Sikota S, Fitshane S, Matsoso M, Bruwer J-P. Inventory Management Systems used by Manufacturing Small Medium and Micro Enterprises in Cape Town | Mediterranean Journal of Social Sciences. 2020 Aug 5 [cited 2021 Aug 8]; Available from: https://www.richtmann.org/journal/index.php/mjss/article/view/5477

[31] Singh D, Verma A. Inventory Management in Supply Chain. Materials Today: Proceedings. 2018;5(2):3867–72.

[32] Waller MA, Esper TL. The Definitive Guide to Inventory Management: Principles and Strategies for the Efficient Flow of Inventory across the Supply Chain [Internet]. Council of Supply Chain Management Professionals; 2014 [cited 2021 Oct 27]. Available from: https://learning.oreilly.com/library/view/the-definitive-guide/9780133448856/

[33] Pillai RN. Inventory management performance in machine tool SMEs: What factors do influence them? Journal of Industrial Engineering and Management. 2010 Dec 27;3(3):542–60.

[34] John NE, Etim JJ, Ime TU. Inventory management practices and operational performance of flour milling firms in Lagos, Nigeria. International Journal of Supply and Operations Management. 2015 Winter;1(4):392–406.

[35] Kareem TS. Impact of Inventory Management Practices on Small and Medium Enterprises Manufacturing Subsector In Oyo State, Nigeria. South Asian Journal of Social Studies and Economics. 2018 Jul 18;1–8.

[36] Pillai RN. Factors discriminating inventory management performance: An exploratory study of Indian machine tool SMEs. Journal of Industrial Engineering and Management. 2014;7(3):605–21.

[37] Baker T. ERP Inventory Management - How Advanced Is Your ERP? [Internet]. 2020 [cited 2022 Mar 26]. Available from: https://www.eazystock.com/uk/blog-uk/how-enhance-erp-inventory-management-capabilities/

[38] Gołaś Z. The effect of inventory management on profitability: evidence from the Polish food industry: Case study. Agricultural Economics. 2020;66(5):234–42.

[39] Patil H, Divekar BrigR. Inventory Management Challenges for B2C E-commerce Retailers. Procedia Economics and Finance. 2014 Jan 1;11:561–71.

[40] Rukiya A, Kibet Y. Effect of Inventory Management on customer satisfaction in public institutions of higher learning in Kenya [Internet]. 2019 [cited 2022 Mar 31]. Available from: http://www.iajournals.org/index.php/8-articles/669-iajpscm-v3-i1-198-216

[41] EazyStock. Araco Sees 12% Reduction In Inventory Levels [Internet]. EazyStock. 2018 [cited 2021 May 14]. Available from: https://www.eazystock.com/uk/resources/araco-reports-great-roi-on-eazystock/

[42] EazyStock. Blinkfyrar on route to hitting new highs with the help of EazyStock [Internet]. EazyStock. 2020 [cited 2021 May 14]. Available from: https://www.eazystock.com/uk/resources/blinkfyrar-on-route-to-hitting-new-highs-with-the-help-of-eazystock/

[43] Netstock. Our fill rate has improved by over 30% since we implemented [Internet]. Available from: https://2qhx7nxywxj15qlup3d8hlus-wpengine.netdna-ssl.com/wp-content/uploads/2021/09/Prospectors-NETSTOCK-Case-Study.pdf

[44] Reascos I, Carvalho JA. A Conceptual Framework for the Implantation of Enterprise Applications in Small and Medium Enterprises (SMEs). In: Rocha Á, Guarda T, editors. Proceedings of the International Conference on Information Technology & Systems (ICITS 2018). Cham: Springer International Publishing; 2018. p. 50–61. (Advances in Intelligent Systems and Computing).

[45] Alaskari O, Pinedo-Cuenca R, Ahmad MM. Framework for implementation of Enterprise Resource Planning (ERP) Systems in Small and Medium Enterprises (SMEs): A Case Study. Procedia Manufacturing. 2021 Jan 1;55:424–30.

[46] Sahran S, Goni F, Mukhtar M. ERP Implementation Challenges in Small and Medium Enterprise: A Framework and Case Study. Advanced Materials Research. 2010 Oct 1;139–141:1636–9.

[47] Gunasekaran A, Lyu J. Implementation of just-in-time in a small company: A case study. Production Planning & Control. 1997 Jan;8(4):406–12.

[48] Bhise D, Sunnapwar V. Developing Framework for the Implementation of Advanced Manufacturing Technologies in Small and Medium-Sized Enterprises. International Journal of Applied Management and Technology [Internet]. 2019 Jan 1;18(1).