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Perceptions of growth-impeding constraints acting upon SMEs' operations and the identification and use of transitional paths to elevate them

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Abstract

Purpose – The purpose of this paper is to know which growth-impeding constraints are perceived to act upon operations of small- to medium-sized (SME) companies by their owner-managers and to recommend transitional paths to elevate constraints and increase contribution levels made by SMEs' operations. To do so, this research has been primarily founded upon Hayes *et al.*'s (2005) operations contribution model for differentiating between different levels of operations' contribution, and secondarily on the theory of constraints philosophy to explain the perceptions of constraints found at each level – current and future.

Design/methodology/approach – An open-ended survey and a series of group workshops have gathered new empirical data about these perceptions, which were coded using the relational content analysis to identify a parsimonious set of perceptual growth-impeding constraint categories. The most popular transitions were identified and a correlation of frequency rank orders between “perceived current” and “perceived future” constraints categories was calculated, and likely transitional paths for growth are discussed. Three SME case studies were documented in related action research to contextualise survey findings.

Findings – The most popular transition was from “neutral” to “leading”. A lack of people capability was perceived to be the most commonly reported growth-impeding constraint category, followed by a combined lack of process competence and product and service innovation, further followed by a lack of skills in information technology automation. In addition, a new conceptual model has been generated inductively to address shortcomings found in the original operations contribution model (Hayes *et al.*, 2005) during its application to UK SMEs. The new model is referred to in this paper as the “Operations Growth Rocket”.

Research limitations/implications – This research only used data from UK SMEs.

Practical implications – This work should help SME owner-managers to overcome growth-impeding constraints that act upon their operations and assist them to develop more effective actions and paths to increase the contribution levels made by their operations. This in turn should support growth of their organisations. Findings will also inform teaching about more effective operations management in SMEs.

Social implications – This work should help UK SMEs to grow, which in turn will strengthen the UK economy.

Originality/value – A novel approach and new data from 208 SMEs modify a classical operations contribution model (Hayes *et al.*, 2005). This is achieved by considering transitional paths to be meta-categories continua abstracted from constraint categories combined with case data for moving towards higher levels of operations contribution, rather than using discrete growth-impeding and growth-constraining “levels”. This research has inductively generated a new version of the classical contribution model that should be more suitable for stimulating growth in (UK) SMEs.

Keywords Operations strategy, Conceptual framework, Contribution model, Operations growth, Small- to medium-sized enterprises (SMEs), Theory of constraints (ToC)

Paper type Research paper



Introduction

The importance of SMEs

This research set out to determine perceptions of growth-impeding constraints that act upon the operations of small- to medium-sized enterprises (SMEs). These growth-impeding constraints could have been directly related to operations (e.g. quality, flexibility, capacity, people, knowledge, and resources, etc.; Flynn *et al.*, 1999), to the underlying supporting infrastructure of operations (Jacobs and Bendoly, 2003), or to operations strategy (Kim *et al.*, 2014). Knowing when different growth-impeding constraints are prevalent and how they affect SMEs is important, not only to help individual SMEs to grow, but also to support the growth of national economies in which they reside. For instance, in the UK in 2015, there were 4.9 million SMEs (Chartered Management Institute, 2015) employing over 15.6 million people, who had a combined turnover of £1.8 trillion (GBP), accounting for over 99.3 per cent of all private companies registered. UK SMEs also provided 60 per cent of employment and 47 per cent of private sector turnover (BIS, 2015). These figures, which are similar to other reports from BIS in recent years, show just how significant SMEs are to the UK's economy. With these figures in mind, this research has surveyed how perceived growth-impeding constraints act upon UK SMEs' operations.

Initial theoretical framework

This research confines itself to constraints that primarily restrict growth through operations, operations management, and other very closely related activities. However, the research readily acknowledges that overall growth in SMEs can also be due to activities by other organisational functions such as: new product development (Hewitt-Dundas, 2006); effective marketing (Gilmore *et al.*, 2001); supplier partnering (Wynarczyk and Watson, 2005); adoption of relevant information communication technology (Higón, 2011); implementation of financing and accounting practices (Cowling *et al.*, 2015); internationalisation; and human resource planning (Hessel and Parker, 2013). All of these must be co-ordinated and controlled through effective infrastructure deployment and appropriate strategising along with effective operations management and operations-related activities (Hayes, 2002).

Exactly how operations contribute effectively to companies' growth *per se* is a much-debated topic and there are many classic works in this area. To name but a few, there are works that cover competitive priorities in manufacturing operations (Boyer and Lewis, 2002), good practice in service operations (Lillis and Sweeney, 2013), theory use in operations (Schmenner and Swink, 1998), and competitive trade-offs across operations (Ward *et al.*, 1998). One of the most revered group of authors to address operations contribution is Bob Hayes *et al.* (summarised latterly in Chapter 10 of Hayes *et al.*'s, 2005 monograph) who outline the competitive effectiveness of operations in a "contribution model" based on decades of leading research studies on operations strategy in manufacturing (e.g. Hayes and Wheelwright, 1984), general operations (Hayes and Upton, 1998), and service operations (Chase and Hayes, 1991) based predominantly on large USA manufacturing companies. Hayes *et al.*'s contribution model has since been cited widely and developed further in other scholarly research. For instance, Jain *et al.* (2013) developed 14 factors from related literature and applied this "contribution model" to find that the model fitted to responses from managers from 28 different manufacturing units. Newman and Hanna (1996) performed a similar study to explore the relationship between environmental management and manufacturing strategy using a priori factors in the model, and successfully developed two further models from open-ended questions to show how these factors were linked. The "contribution model" has also been widely adapted for teaching operations and is found in numerous operations management textbooks (e.g. Slack *et al.* (2010, pp. 63-64), Paton *et al.* (2011, pp. 52-54), and Bamford and Forrester (2010, pp. 137-139). Hayes' contribution model, alongside his other works, has

arguably become one of the modern classic models of operations management growth (Sower *et al.*, 1997).

However, caution must be exercised when using Hayes' contribution model, as the model has been criticised for being too conceptual. For instance, Hum and Leow (1996) attempted to apply the contribution model to 55 firms, and could only determine that most companies had achieved Levels 2 or 3 without any companies being able to make any further detailed distinctions. Hum (2000) then went further to apply the model to a single firm without generating any great insights. Similarly, Swink and Hegarty (1998) found that using the model gave outcomes that were too "conceptually aggregated" for specific decision making. In response to these studies, Barnes and Rowbotham (2004) and Rowbotham and Barnes (2004) developed detailed Likert scales for its "contribution" and "time" axes and gathered data from 460 survey responses, but still found that the contribution model lacked applicability and validity to UK-based managers' mindsets. Other more recent research applied this model to 21 services (Lillis and Sweeney, 2013) and found that categories and questions based on the model were too restrictive and should be opened-up to take into account external and unexpected operational issues experienced by managers. Bates *et al.* (1995) also used their own Likert scales to categorise 41 US manufacturing plants to explore links between manufacturing strategy and organisational culture, and could demonstrate a link between Levels 3 and 4 and organisational culture, but also found that questions developed from the work for Levels 1 and 2 were unreliable. Until now, the contribution model has not explicitly been applied to UK SMEs using open-ended data collection.

Research questions

In respect to Hayes *et al.*'s contribution model and its follow-on studies, this study asked the following specific research questions:

- RQ1.* Which growth-impeding constraints are perceived to act upon the operations of SMEs?
- RQ2.* How do perceived operational constraints (as identified by *RQ1*) relate to the perceived current level of contribution made by SMEs' operations?
- RQ3.* Will future perceived constraints be different from current perceived constraints – assuming that a higher level of operational contribution can be attained in the future?
- RQ4.* Can transition paths be suggested to help SMEs overcome current perceived constraints and move operations to a higher level of perceived contribution?

These research questions were designed to reveal current perceived and future perceived growth-impeding constraints on SMEs' operations and illuminate possible transition paths from low levels of contribution towards higher levels of contribution within five years. To summarise this section, the principle conceptual framework founding this research is Hayes *et al.*'s contribution model, which has been modified by applying the philosophical ideas found in Goldratt's (1990) theory of constraints (ToC) to perceived current and perceived future growth-impeding constraints at each level of contribution found in the contribution model. In this study, a constraint is considered to be "[...] anything that limits a system from achieving higher performance versus its goal" (Goldratt, 1988). The system here is SMEs' operations and the goal is to achieve higher levels of operational contribution as defined by the contribution model. This is appropriate because every contribution level must have at least one constraint, otherwise all SMEs would be at the highest level of contribution at all times. Novel organisational-wide application of ToC such as this has been called for by Kim *et al.* (2008).

This study is concerned with any changes to operations that could result in a partial or total elevation (a specific term in ToC meaning to reduce the effect of a constraint) of any perceived growth-impeding constraint on operations that could give SMEs growth. The philosophical application of ToC to the contribution model means that at each contribution level, the five philosophical steps to ToC can be applied. In this context, the steps are: Step 1: identify operations' constraint(s) that impede SME growth; Step 2: decide how to elevate constraints to allow growth through transitional paths; Step 3: adjust ("subordinate") unconstrained constraints so they are achieving change most efficiently given the prevailing constraint; Step 4: improve growth rate of any SME by setting more ambitious contribution levels whilst decreasing the timeframe; and Step 5: go back to Step 1 and find any other constraints, assuming that a higher level of operations contribution has been achieved. Applying ToC philosophy to the contribution model in this way means that the ToC thinking process (TP) could be used to design transitional paths from one level of contribution to another by deciding what to change, what to change to, and how to cause the change (Rahman, 1998). ToC philosophy has been used similarly in the fields of new venture development, improving success rates of small businesses, and general business improvement and growth strategies for owner-operated businesses (see Kim *et al.*, 2008); however, these studies did not link ToC to Hayes *et al.*'s contribution model as in the present study.

Methodology

With the strengths and criticisms of previous related research studies in mind, this study used a new approach to collect data and to make the contribution model more suited to a survey of UK SMEs. The initial modification was to use open-ended questions (given in Table A1) about "perceived current" growth-impeding constraints and "perceived future" growth-impeding constraints relevant to each level of contribution in the model (Goldratt and Cox, 1984), rather than using a set of a priori questions to test the model and its levels through regression, as previous studies tried this with limited success. The present study is the first known instance of the contribution model being used in this way. Therefore, to clarify, this research did not set out to test Hayes' contribution model *per se*, but instead used the concept of the contribution model, along with the ToC philosophy, to discover impediments to operations in UK SMEs at different levels of operational contribution. This removes the problems of endogeneity in regression models (as summarised by Guide and Ketokivi, 2015), which may have been the root cause of inconclusive findings from previous studies using the contribution model.

This study was openly advertised to SME owner-managers who could apply to participate in the study if they met the European Union's definition of an SME (< 250 employees, < 50 M euros turnover and < 43 M euros balance sheet; European Union, 2003). SMEs from all sectors applied to take part in the study; they ranged from manufacturing to service, from public to private, and from micro- to small- to medium-sized (in addition to a few who were classified as "larger" on some criteria but still operated in a similar fashion to SMEs in the majority of other criteria). The above range of SMEs provided a broad sample based on specific criteria (as per Forza, 2009, p. 116). All SMEs were based in the UK and were mainly from the Midlands region. Very new "start-up" companies were not eligible, as at least three years of trading accounts had to have been filed; a defined product, service, or product-service also had to have been established. SMEs also had to be running their operations as on-going concerns (i.e. no immediate plans to sell) and had to exhibit characteristics of high growth. It was not the intention of the study to focus on entrepreneurship or innovation *per se*, but instead to focus on growth through better operations management. In all, 640 SME owner-managers initially applied to take part in the study.

Each SME owner-manager was interviewed to ensure that they had genuine high-growth aspirations for their SME, by either seeking to maintain their competitive position in a changing and increasingly competitive marketplace, or better still, to grow their SME

substantially within the next five years. Each owner-manager had to agree to take part in a two-hour group workshop in which an individual survey was to be conducted and group discussions would be held on perceived current growth-impeding constraints on SMEs' operations, perceived future growth-impeding constraints on SMEs' operations, and whether or not they were likely to differ. The discussions were also designed to allow for suggestions of possible transitional paths to improve the level of contribution made by their operations. For instance, this could have been a discussion on moving from a "neutral" level of operations contribution towards a "leading" level of operations contribution through various operational, operational-related, and/or strategic changes.

The survey followed Forza's survey research process (Forza, 2009, p. 99) based upon Hayes *et al.*'s conceptual model. An initial (face-validity) design workshop was held in December 2011 with target respondents and academic and industry experts (30 in all) to translate the contribution model concept into practical and recognisable terms, which ensured content validity (Forza, 2009, p. 109). This gave the opportunity to identify and moderate ambiguous and difficult-to-interpret aspects of Hayes *et al.*'s conceptual model. After some iteration, eight subsequent data collection workshops (the first being a pilot), each consisting of approximately 30 people, were held between June 2012 and June 2015. These workshops were an essential part of this study's fieldwork and used good practices as defined by Voss *et al.* (2016, pp. 179-184).

Following Hayes' model, this study used four different levels: "Poor", "Neutral", "Good," and "Leading", which corresponded to Hayes' "Level 1 – Internally Neutral", "Level 2 – Externally Neutral", "Level 3 – Internally Supportive", and "Level 4 – Externally Supportive", respectively. The terms were changed as a direct outcome of the initial design workshop because UK SME owner-managers found these original terms confusing.

Each workshop (the first acting as a pilot) was conducted in the same way. First, an introductory discussion was held to clarify what was meant by operations, operations management, growth-impeding constraints on operations, transitional paths, and contribution levels, followed by individual time for participants to complete the survey form (see Table AI). The survey required each participant to name (in no particular order) up to five of their most significant perceived growth-impeding constraints that they currently experienced, and up to five of the most significant growth-impeding constraints that they expected to face in the future. As ToC philosophy states, it is possible to elevate some system constraints without entirely removing them, as a constraint could possibly be perceived to act in the present as well as in the future (as found by Hewitt-Dundas', 2006 study on innovation constraints). In the present study, this meant that SMEs could move up to higher levels of operational contribution while still experiencing some of the same growth-impeding constraints, although to a different degree (e.g. if skills levels are elevated they are perceived to be less of a constraint but may still constrain outright growth).

Once completed, the survey responses were collected, copied, and returned to the participants (anonymity was given if it was requested). Further group discussions then ensued (which were noted) about the most commonly experienced growth-impeding constraints and possible transitional paths able to move relatively lowly contributing operations towards more highly contributing operations.

Survey sample

In all, 235 owner-managers of UK-based SMEs filled in the survey. There were 208 (89 per cent) usable responses and 17 (11 per cent) discarded unusable responses. The response rate was probably high because respondents had already been pre-vetted and agreed to fill in the survey during a face-to-face workshop (as described above). SMEs in the sample were found to be predominantly small (70 per cent, 147/208), and most of them provided services (70 per cent, 146/208) or manufacturing with an allied service (15 per cent, 32/208); the minority of companies were solely manufacturing (14 per cent, 30/208).

The survey confirmed that 94 per cent (195/208) of owner-managers had ambitions to grow their businesses through better operations and only 6 per cent (14/208) of SMEs planned to maintain their current levels of operations contribution in the future (1 at “neutral”, 9 at “good”, and 4 at “leading”). There were no owner-managers who planned to drop their operation’s contribution level. This confirmed that the sample only contained owner-managers from aspiring and high-growth SMEs.

Overall, the perceived current contribution level of operations in the sample was “neutral” and owner-managers wanted to raise this to “leading” within one to three years: the sample profile is given in Table I.

This study refined the EU’s definition of SME by using the following sub-definitions for SME types: “micro” (< 5 people and < £1 m GBP turnover), “small” (between six and ten people and between £1-3 m GBP turnover), “medium” (11-50 people and between £3-10 m GBP turnover) or “larger” SMEs (more than 50 people and more than £10 m GBP turnover but still retaining many characteristics of SMEs both in number of employees, turnover, and operating characteristics), this profile is given in Table I.

Contribution levels are defined as “poor” (where operations were perceived to be performing below the standards of other organisational functions), “neutral” (where operations were perceived to be performing at similar standards to other organisational functions), “good” (where operations were perceived to be performing at above average when compared to other organisational functions), or “leading” (where operations were perceived to be above average for their industry); these definitions are adapted from those used by Hayes *et al.* (2005).

Planned timescales to change current contribution levels into future contribution levels were also collected and categorised as < 1 year (quick), one to three years (medium), and three to five years (slow). Any timescale greater than five years was considered too lengthy to be realistically considered by any SME owner-managers due to long-term investment funds being limited, risk aversion tendencies, lack of personal confidence, lack of wider market insights, and huge overall emphasis on “[...] just winning the next order and maintaining cash flow” (an SME owner-manager).

Content analysis

Open-ended qualitative survey data responses (from data collection form in Table AI), based on Hayes and Wheelwright’s contribution model, were analysed through the relational content analysis (Sekaran and Bougie, 2010, pp. 385-387). Open responses were sought so that respondents were neither led nor constrained in their answers (a restriction found by Lillis and Sweeney, 2013), so it was necessary to group similar responses from raw data responses into “constraints categories”. For instance, raw data responses from owner-managers such as “be better with our stock” and “hold less stock” became categorised into a single

Size of company	Type of company: service, manufacturing, or service and manufacturing	Companies’ current contribution level made by operations	Companies’ future planned contribution level to be made by operations	Timescales for changing contribution level made by operations
Micro = 54	Service = 146	Poor = 24	Poor = 0	< 1 year = 50
Small = 147	Manuf. = 30	Neutral = 113	Neutral = 6	1-3 years = 126
Medium = 2	Serv. + Manuf. = 32	Good = 67	Good = 86	3-5 years = 32
Larger = 5	–	Leading = 4	Leading = 116	–
Modal average = small	Modal average = service	Modal average = neutral	Modal average = leading	Modal average = 1-3 years

Note: *n* (number of usable responses) = 208

Table I.
Profile of SMEs used in this study

“improve stockholding practice” constraint category, as each respondent was effectively saying the same thing using different words. Similarly, if respondents included more than one constraint in each response, these were divided into different constraint categories. For instance, a response such as “staff recruitment and training” was split into two different constraint categories: “staff recruitment” and “staff training”, which made constraint categories more specific. Following the relational content analysis, 49 distinctively different constraint categories were identified, as given in Table II (Column C). The relational content analysis ensured that a parsimonious set of constraint categories was produced from participants’ open responses by eliminating all duplicated and compounded constraints.

The frequency of each constraint (by category) is also given in Table II (Column H); a priori this should have generated 2,080 frequencies (where 2,080 = 5 constraints per contribution level × 2 contribution levels × 208 usable responses). However, *post ante*, the net result was 2,243 constraint category frequencies, as not all respondents identified ten constraints, but some respondents’ compounded responses were divided.

Pareto analysis

Pareto analysis (Newbold *et al.*, 2003, pp. 26-28) was used to determine classes of constraint categories that had the highest frequencies known as the “vital few”, medium frequencies, and the lowest frequencies known as the “trivial many”, as discussed in the findings section (Table II, Columns B and J).

A #	B Class	C Constraint categories	D Poor		E Neutral		F Good		G Leading		H Σ Freq.	I Pareto of overall sample	
			Current n=24	Future n=0	Current n=113	Future n=6	Current n=67	Future n=86	Current n=4	Future n=116		Ranked n=208	Total % Frequency (1dp)
1	High priority (20%)	Developing and retaining people skills through training, development and mentoring	12	59	2	36	24	2	46	181	8.1	8.1	
2		Increasing use and effectiveness of IT process automation	4	53	3	31	22	2	36	151	6.7	14.8	
3		Defining and standardising processes and practices	11	64	26	24	22	147	6.6	21.4	6.6	21.4	
4		More effective recruitment of new good people (ft, pt, volunteers and freelance consultants)	6	42	4	23	26	2	40	143	6.4	27.7	
5		More effective sales and marketing (including communications, CRM use and branding)	10	39	1	26	15	2	32	125	5.6	33.3	
6		Developing better customer focus (including delivery and relationships)	9	31	2	10	13	1	34	100	4.5	37.8	
7		Improve development, testing and innovation of products and services	3	18	18	15	2	35	89	40.0	40.0	40.0	
8		Developing company performance measurement and quality management system	6	30	14	9	1	23	83	3.7	45.4	45.4	
9		Improving quality and reliability of facilities, layout and equipment	6	22	17	12	18	75	3.3	48.8	3.3	48.8	
10		Changing location of facilities for a better location	1	15	2	7	20	1	23	69	3.1	51.9	
11		Improving effective capacity of facilities and resources	2	19	1	10	12	22	66	2.9	54.8	54.8	
12		Bettering operational cashflow and working capital	7	20	12	9	1	16	65	2.9	57.7	57.7	
13		Improving the management structure	3	12	1	14	8	20	58	2.6	60.3	60.3	
14		Aligning roles to responsibilities more effectively for monitoring people's performance	3	21	5	7	19	55	2.5	62.7	2.5	62.7	
15		Improving processing speed	5	19	10	8	2	11	53	2.4	65.1	65.1	
16		Developing better links with suppliers/subcontractors for outsourcing (and purchasing) practice	5	16	6	10	16	53	2.4	67.5	2.4	67.5	
17		Increasing online/mobile presence (for employees and external users)	5	13	9	11	2	13	53	2.4	69.8	69.8	
18		Transferring in new knowledge to the organisation (from external experts)	2	15	1	8	6	12	44	2.0	71.8	71.8	
19		Win new contracts	4	9	11	3	1	14	42	1.9	73.7	73.7	
20		Making product and service provision more scalable and flexible (by increasing volume and variety mix)	1	13	6	7	1	12	40	1.8	75.4	75.4	
21		Reducing wasteful practices (and unnecessary costs) through lean practices	3	15	4	6	10	38	1.7	77.1	1.7	77.1	
22		Improve stockholding practice	4	13	1	7	10	35	1.6	78.7	1.6	78.7	
23		Improve strategy (with focus and ambition)	5	10	3	8	1	8	35	1.6	80.2	80.2	
24		More effective storage and analysis of company data/knowledge	5	9	1	5	3	11	34	1.5	81.8	81.8	
25		Improve work scheduling system	3	10	5	6	1	9	34	1.5	83.3	83.3	
26		Changing the culture to become more professional	4	8	4	3	12	31	1.4	84.7	1.4	84.7	
27		Developing and effectively managing a multi-site operation (inc. franchising)	9	8	2	12	31	1.4	86.0	1.4	86.0		
28		Growing internationally (multi-national, importing and exporting)	4	2	9	1	14	30	1.3	87.4	1.3	87.4	
29		Developing new markets and customers	3	8	3	3	1	15	30	1.3	88.7	88.7	
30		Better project management	2	12	1	4	7	26	1.2	89.9	1.2	89.9	
31		Partnering and collaborating with other companies which have complementary competences	5	2	5	1	12	25	1.1	91.0	1.1	91.0	
32		More effective leadership	1	6	3	7	7	24	1.1	92.1	1.1	92.1	
33		More accurate job costing (estimating and control)	3	8	3	2	6	22	1.0	93.0	1.0	93.0	
34		Be better at dealing with external accreditors, inspectors and legislators	3	1	3	6	11	21	0.9	94.0	0.9	94.0	
35		Increasing effective team working	3	3	4	3	1	5	19	0.8	94.8	94.8	
36		Developing and improve middle management for operations management	2	6	3	2	5	18	0.8	95.6	0.8	95.6	
37		Increase profit margins	4	1	7	1	4	17	0.8	96.4	0.8	96.4	
38		Encourage new investors to the company	1	5	1	4	4	1	16	0.7	97.1	97.1	
39		Develop and protect intellectual property	1	2	1	3	7	14	0.6	97.7	0.6	97.7	
40		Develop a human resource function	1	2	2	5	4	12	0.5	98.3	0.5	98.3	
41		Move from Government grant dependency to being commercially sustainable	2	2	2	2	3	7	0.3	98.6	0.3	98.6	
42		Become better at implementing organisational change	3	1	3	1	3	7	0.3	98.9	0.3	98.9	
43		Improve health and safety practice (including handling waste materials)	1	3	2	6	2	6	0.3	99.2	0.3	99.2	
44		Communicating better with external shareholders	2	1	1	1	1	4	0.2	99.3	0.2	99.3	
45		Address threats from specific competitors directly	1	2	1	1	2	4	0.2	99.5	0.2	99.5	
46		Review ownership of the company	1	1	1	1	1	3	0.1	99.6	0.1	99.6	
47		Become more socially responsible	1	1	1	1	1	3	0.1	99.8	0.1	99.8	
48		Develop another new business through diversification	1	1	1	1	1	3	0.1	99.9	0.1	99.9	
49		Become more environmentally responsible	1	1	1	1	1	2	0.1	100.0	0.1	100.0	
Total			147	0	680	20	353	365	29	649	2,243		

Notes: In column J the red shading highlights the high priority (“vital few”) constraint categories, the orange shading highlights the medium priority constraint categories and the yellow shading highlights the low priority constraint categories (“trivial many”)

Correlation

The most popularly reported transitions (e.g. “neutral” to “leading”, as shown in Table I, bottom row) had R^2 correlation coefficient analyses performed on their “frequency rank orders” to see if they differed to other popularly reported transitions; these are discussed in subsequent analyses.

Case examples

To triangulate the findings, three action research case studies were also produced based on Voss' (2009, pp. 162-195) case study principles. The process of action research enabled these cases to be recorded in journal form as they unfolded and later took “the form of a traditional case study written in retrospect” (Coughlan and Coghlan, 2002, p. 226). Three SMEs whose owner-managers had participated in the first four workshops were selected on a single common control criterion, that the owner-managers all perceived their operations to have “good” current contribution levels and wished to achieve “leading” levels within three years. Using another contrasting control criterion (as per Eisenhardt, 1989; Yin, 1994) the cases were selected because they were also different and from different sectors: construction (product based), manpower provision (service based), and information technology (product-service-systems based), to see if this would illustrate different aspects of operations contribution development. Each owner-manager agreed to have a dedicated action-researcher work in their company full-time for between 12 and 24 months to help transfer-in knowledge, implement it, observe, and report on operations constraint categories identified using Hayes *et al.*'s model. Three cases were considered, a parsimonious and “theoretically useful” (Voss, 2009, p. 180) number based on these criteria, boundaries, and timeframes (Miles and Huberman, 1994), as they may “potentially produce contrary results for predictable reasons (e.g. a theoretical replication)” (Voss, 2009, p. 172). Within this project, each case had cycles of action research (Coughlan and Coghlan, 2002, p. 230) within them to help elevate (or lessen the effect of) impeding constraint categories (as described in the case studies later) and each case study itself formed a parallel meta-learning action research cycle to feed into the new inductively generated theoretical model (Coughlan and Coghlan, 2016, pp. 254-256). These action cycles within action cycles accelerated learning and increased this study's depth and breadth.

Each action-researcher had open access to company sources (personal observation, informal conversations, attendance at meetings and events, semi-structured interviews, objective data, and archival sources) and activities (e.g. meetings, events, activities) facilitated by the owner-manager (a.k.a. the “principal-informant”; Voss, 2009, p. 175). Each action-researcher acted independently on a day-to-day basis and was co-ordinated by the lead-researcher (author) to ensure that they followed the same course of action whilst: making journal entries of observations on contribution levels; suggesting transitionalary paths for improvement; action-taking to make actual real changes along transitionalary paths by working with the owner-manager; and reassessing the contribution levels made by operations. Co-ordination meetings between the lead-researcher and action-researchers were held every three months to ensure inter-rater consistency and reliability across cases (meta-cycles) and within case action research cycles.

Three cases are used towards the end of this paper to illustrate how the most popularly reported constraint categories and transitions manifested themselves in these control-criteria-specific successful SMEs. Because the application of the contribution model is somewhat subjective, this study has used general survey data to allow open and exploratory enquiry combined with case data to be able to contextualise nuances in the survey data. Other transitions and features of these cases could also have been highlighted but were not directly related to this study. This study's particular mix of research methods was designed to triangulate findings and generate rich new insights based primarily on the contribution model of Hayes *et al.* in relation to UK SMEs.

Findings in respect to perceived constraints

Workshops confirmed that each SME was being run as a going concern delivering an adequately established product, service or product-service. This meant that innovation, entrepreneurialism, and start-up *per se* were not the prime emphasis of this study, but instead the focus was on growth of an established SME, particularly growth achieved through better operations and better operations management.

Table II gives a consolidated view of the survey's findings in respect to perceived constraint categories. Column C defines constraint categories, which are the outcome of the relational content analysis of the survey's open responses. In brief, Column C gives the answer to *RQ1* by listing the perceived constraint categories – done by popularity (i.e. overall highest “frequency rank order” given in Column H) and as a percentage for the total sample (in Column I). Table II also shows the perceived constraint categories by Pareto analysis classes, by using cumulative total per cent frequency (in Column J) for “high”, “medium”, and “low” priority classes (seen in Column B). These initial analyses prioritise the most important overall perceived constraint categories.

Table II is extensively and explicitly referred to throughout the analyses sections of this paper to explain more detailed relationships between frequency rank orders for each contribution level, future and current (see Columns D, E, F, and G), to be able to answer research *RQ2-RQ4*.

Analyses in respect to perceived constraints

The findings summarised in Table II are now analysed in detail.

Constraint categories for the whole sample

The Pareto analysis (see Table II, Columns B and J) ranked the 49 constraint categories in order of frequency (per cent and cumulative per cent). Class boundaries were fixed at 20 per cent of constraint categories (ten) for the “high priority” class, 20 per cent (ten) for the “medium priority” class, and 60 per cent (29) for the “low priority” class. These class boundaries were adopted, as just over half (51.9 per cent) of the constraint category frequencies were included in the high priority class of ten constraint categories (a.k.a. the “vital few”). The next quartile of constraint category frequencies accounted for the medium priority class of ten constraint categories, and the remaining 20 constraint categories together accounted for the remaining quartile of constraint category frequencies (24.6 per cent), which formed the low priority class of constraint categories (a.k.a. the “trivial many”). The high priority class (20 per cent of constraints) was most important, as this accounted for just over half (51.9 per cent) of all constraint category frequencies.

Constraint categories for the high priority class

The constraint category of “developing people and retaining people skills through training, developing and mentoring” came top in this high priority class (see top of Columns B, C, I, and J), such was the perceived importance of productive human resources by these SME owner-managers. One can conjecture that this may be because people have to be useful and productive at all times in an SME, or as one SME owner-manager stated, “[...] there is nowhere to hide for freeloaders ... everybody must add value to the organisation”. Allied to this constraint category is the “more effective recruitment of new good people (full-time, part-time, volunteers, and freelance consultants)” category. Both are clearly related to developing productive human resources and together account for 15.5 per cent of all constraint category frequencies – highlighting people-related issues as the most highly reported impediment to growth after a fledgling company is established and has developed viable products, services or product-services.

The next two highest-ranking constraint categories are “increasing use and effectiveness of information technology (IT) process automation” and “defining and standardising processes and practices”, which are both related to the efficacious use of underlying infrastructure and logical operational thinking; together these constraints accounted for 13.3 per cent of all constraint category frequencies. This constraint category accords with Matthews *et al.* (2017).

Next came two marketing-orientated constraint categories: “more effective sales and marketing (including communications, CRM use, and branding)” and “developing better customer focus (including delivery and relationships)”, which accounted for 10.1 per cent of the total sample’s constraint category frequencies. This finding reinforces the need for marketing and operations functions to be tightly coupled in an SME.

Then came the “improve development, testing, and innovation of products and services” constraint category, which is a fairly standalone category in this class and specifically emphasises the importance of the end deliverables to the end customer, rather than focusing on operations *per se*. However, as effective operations managers know, and as classic concurrent or simultaneous engineering states, the product, service or product-service should be designed together with the operations that deliver them (Berndes and Stanke, 1996, pp. 15-57); this constraint alone accounted for 4.0 per cent of the total constraint category frequencies.

Finally, in this high priority category, there seem to be three linked constraint categories: “developing company performance measurement and quality management *systems*”, “improving quality and reliability of facilities, layout, and equipment” and “changing location of facilities to a better *location*”. Collectively these accounted for 10.1 per cent of all constraint category frequencies and seem to be aimed at bettering SME operating environments for those who work in them, and for those who interact with them, whether they be customers, partners or suppliers. In effect by elevating these three constraints SMEs are able to “[...] install greater confidence and certainty in the eyes of their customers” (an SME owner).

Constraint categories for the medium priority class

Ten constraint categories (20 per cent of constraint categories) were identified in the medium priority class (see middle of Columns B, C, I, and J); however, the medium priority class only accounts for 23.5 per cent of constraint category frequencies (compared to 51 per cent for the high priority constraint category class). Overall, and in contrast to the high priority class, with perhaps the exception of “win new contracts” (1.9 per cent of constraint frequencies), these constraint categories focused on operations strategy rather than on general company strategy (which explicitly involved other functions, such as human resource management and sales and marketing management). Also, in contrast to the high priority class, there was a smaller range in constraint category frequencies (high priority class range = 5, while medium priority class range = 1.1), meaning it is less useful to discuss individual constraint categories in this medium priority class, and perhaps more useful to discuss constraint categories as sub-classes. For instance there are five constraints, a sub-class, on classic internal operations trade-offs (Boyer and Lewis, 2002) such as “improving the effective capacity of facilities and resources”, “bettering operational cash-flow and working capital”, “improving processing speed” and “making product and service provision more scalable and flexible (by increasing volume and variety mix)”; together these accounted for 10 per cent of all constraint category frequencies. Two other constraint categories, “improving the management structure” and “aligning roles to responsibilities more effectively for monitoring people’s performance” were about the management of operations (accounting for 5.1 per cent of constraint category frequencies). Three further constraint categories: “developing better links with suppliers / sub-contractors for outsourcing (and purchasing) practice”, “increasing online / mobile presence (for employees and external users)”, and “transferring in new knowledge to the organisation (from external experts)” seem to form a sub-class about opening up SME operations to external influences (accounting for 6.8 per cent of constraint category frequencies), and can be linked closely to

“win new contracts”. The awareness and balance of internal and external constraints in this medium priority sub-class suggests that owner-managers of SMEs perceive that their operations managers should become more sensitive to external factors and act as moderators to fine-tune decisions about operational trade-offs.

Constraint categories for the low priority class

The low priority class (see bottom of Columns B, C, I, and J) had less than 25 per cent of all constraint category frequencies, even though this class had 60 per cent of the constraint categories (29 in number) and the smallest range of frequencies of all three of the priority classes (range = 1.6). As such it becomes very difficult to meaningfully differentiate between constraint categories in this class, even as sub-classes. Collectively, these low priority constraint categories are an eclectic mix of strategic, tactical and operational activities, which are, as one SME owner-manager stated, “[...] things I would dearly love to do if only I had more time, money, and everything!” Themes from this class are briefly explained further using a contemporary pedagogic approach to operations (Paton, *et al.*, 2011, p. vi), as these low priority constraint categories fall into either “directing”, “designing”, “managing” or “improving” operations management.

First, there are constraint categories relating to directing operations, which include “improving strategy”, “developing and effectively managing a multi-site operation (including franchising)”, “growing internationally”, “developing new markets and customers”, and being able to “move from government grant dependency to being commercially sustainable”.

Second, there are constraint categories relating to designing operations, which include “improving work scheduling systems”, “partnering and collaborating with other companies that have complementary competencies”, “developing and improving middle management for operations”, and “developing and protecting intellectual property”.

Third, there are constraint categories directly relating to managing operations, which include “reducing wasteful practices (and unnecessary costs) through lean practices”, “improving stock-holding practice”, “more effective storage and analysis of company data/knowledge”, “better project management”, “more accurate job costing”, and “increasing effective team working”.

Fourth, there are constraint categories that relate to improving operations, which include “changing the culture to become more professional”, “being better at organisational change”, “more effective leadership”, and “being better at dealing with external accreditors, inspectors, and legislators”.

Finally, there are other more general constraint categories, which are only partly attributable to operations, concerning “increasing profit margins” and “encouraging new investors to the company”.

It was surprising to find that contemporary issues such as “becoming more socially responsible”, “becoming more environmentally responsible”, and “improving health and safety” were not ranked more highly. One owner-manager summed up the attitude, whether right or wrong, towards these issues by SME owner managers, when she said, “[...] CSR [corporate social responsibility] is nice to have for accreditations and badges, but will not necessarily help my organisation grow unless a particularly large and important customer wants it; then we’ll get it! Or we’ll get CSR stuff implemented when we have to have it, by law, like the health and safety stuff [...]”.

Analyses in respect to contribution levels and transitions

Knowing which constraint categories impede SMEs’ operations and inhibit SME growth is useful but perhaps it is even more useful to know how these constraints could be elevated to

enhance SME growth. For this purpose, this survey collected constraints, current and future, as perceived by SME owner-managers at each level of operations contribution (found in Columns D, E, F, and G of Table II).

Contribution levels

Results show that the majority of owner-managers, at 54.3 per cent (113/208), considered their operations to be currently “neutral” in terms of the contribution operations made to their organisation (see top of Column E). In all, 11.5 per cent (24/208) rated their operations as currently “poor” (top of Column D). In total, 32.2 per cent (67/208) currently rated their operations as “good” (top of Column F) and only 1.9 per cent (4/208) of owner-managers currently rated their operations as “leading” (top of Column G). The results also showed that the majority of owner-managers, at 55.7 per cent (116/208), wanted their operations to make a “leading” contribution in the future (top of Column G). In comparison, no owner-manager (0/208) perceived that their operations were going to make a “poor” contribution in the future (top of Column D), only 2.8 per cent wanted their operations to be perceived as “neutral” in the future (top of Column E) and 41.3 per cent (86/208) wanted their operations to be perceived as making a “good” contribution in the future (top of Column F). Therefore it can be deduced that most SME owner-managers had the transition from “currently neutral” ($n = 113$) to “future leading” ($n = 116$) at the forefront of their minds, and so this most popular transition was explored in further analyses. The second most popular transition was from a “currently neutral” ($n = 113$) to a “future good” ($n = 86$) level of contribution, and the third most popular transition was from a “currently good” ($n = 67$) to a “future leading” ($n = 116$) level of contribution (see top of Table II, columns D, E, F, and G). While these second and third most popular transitions are less aspirational than the most popular one, they are both logical stepwise transitions, which nearly half of all the SME owner-managers taking part in this survey saw themselves making in the next one to three years, and so these two transitions were also analysed further. The fourth most popular transition was found to be from “currently good” ($n = 67$) to “future good” ($n = 86$), but as this transition was only considered by a minority of respondents, along with other even less popular transitions (e.g. “poor” to “leading”), it was not analysed any further.

Transitions

Table III shows the full breakdown of transitions between current and future perceived levels of operations contribution, including the intended timescales to achieve these changes. For the three most popular aggregated transitions (first, from “currently neutral” $n = 113$ to “future leading” $n = 116$ (sum $n = 229$); second, from “currently neutral” $n = 113$ to “future good” $n = 86$ (sum $n = 199$); and third, “currently good” $n = 67$ to “future leading” $n = 116$ (sum $n = 183$)), the R^2 covariance correlation coefficients for each transitions’ frequency rank order of constraint categories are given (see highlighted cells in Table III).

Two transitions were logical incremental single stepwise transitions (“neutral-to-good” at $R^2 = 0.7419$; and “good-to-leading” at $R^2 = 0.737$). Another, the most popular, was a double incremental transition (“neutral-to-leading” at $R^2 = 0.6817$). These transitions are described in the following sections. Other transitions, the next highest being from “currently poor” $n = 24$ to “future leading” $n = 116$ (sum 140), were not so popular and therefore not analysed any further.

Stepwise transitions. Stepwise transitions are those that may be thought of as logical and incremental.

“Neutral”-to-“good” transition. Overall, 113 SME owner-managers currently perceived their operations as making a “neutral” contribution and 86 perceived their operations as likely to make a “good” contribution in the future. If the covariance correlation coefficient between constraint categories’ frequency rank orders at these two levels is calculated we see

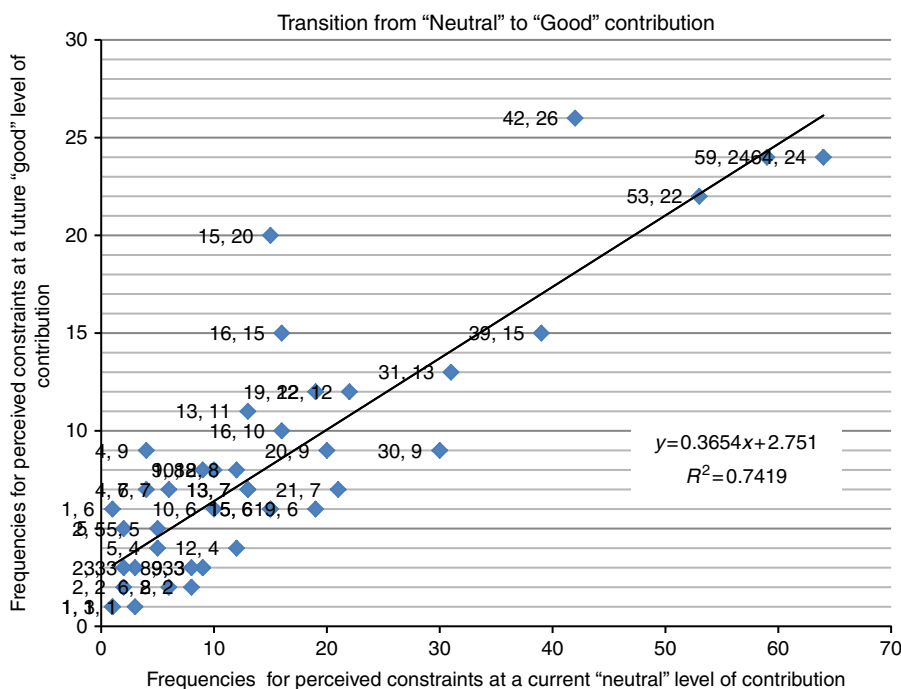
that there is medium to high correlation ($R^2 = 0.7419$), demonstrating that the constraint categories' frequency rank orders do not dramatically change during this transition (see Figure 1). The most impeding constraint categories of this transition (those clustered in the top right-hand corner of Figure 1) were, in order: first, "developing and retaining people skills through training, development, and mentoring"; second, "defining and standardising processes and practices"; and third, "Increasing use and effectiveness of IT process automation". Outlying constraint categories that owner-managers perceived must be elevated to achieve a "good" level were identified as "more effective recruitment of new good people (full-time, part-time, volunteers, and freelance consultants)" and "changing location of facilities for a better location". The full spread of constraint category frequencies is given in Figure 1. The majority of SME owner-managers wanted to make this transition (from "neutral" to "good") within one to three years ($n = 36$) with a strong skew towards the shorter end of this timescale of less than one year (as shown in Table III).

"Good"-to-"leading" transition. Overall, 67 SME owner-managers currently perceived their operations as making a "good" contribution and 116 owner-managers wished to reach a "leading" level of contribution in the future. If the covariance correlation coefficient between constraint categories' frequency rank orders at these levels is calculated there is medium to high correlation ($R^2 = 0.737$), which demonstrates that the constraints do not change dramatically during this transition either (see Figure 2). The most impeding constraint categories (those clustered in the top right-hand corner of Figure 2) of this transition were, in order: first, "developing and retaining people skills through training, development, and mentoring"; second, "increasing use and effectiveness of IT process automation"; third, "more effective recruitment of new good people (full-time, part-time, volunteers, and freelance consultants)"; fourth, "more effective use of sales and marketing (including communications, CRM use, and branding)"; and fifth, "improve development, testing, and innovation of products and services". Towards the end of this transition the analysis showed that "developing better customer focus (including delivery and relationships)" became more important. The majority of owner-managers wanted to make this transition within between one and three years ($n = 40$) with a slight skew towards the longer duration of three to five years (as in Table III).

Table III. Breakdown of transitions between current and future perceived levels of operations contribution – with R^2 covariance correlation coefficients between the three most popular transitions' frequency rank orders of their constraint categories

			Future perceived level of operations contribution								Sub totals	Totals
			Poor		Neutral		Good		Leading			
			<i>n</i>	R^2	<i>n</i>	R^2	<i>n</i>	R^2	<i>n</i>	R^2		
Current perceived level of operations contribution	Poor	<1 year			4		7		1		12	24
		1-3 years			1		6		4		11	
		3-5 years							1		1	
	Neutral	<1 year			1		20	0.7419*	6	0.6817*	27	113
		1-3 years					36		32		68	
		3-5 years					9		9		18	
	Good	<1 year					2		8	0.737*	10	67
		1-3 years					5		40		45	
		3-5 years					1		11		12	
	Leading	<1 year							1		1	4
		1-3 years							2		2	
		3-5 years							1		1	
			0		6		86		116		208	

Note: *Most popular aggregated transitions



Note: Data key: horizontal = "current neutral" – column E, vertical = "future good" – column F in Table II

Figure 1.
Frequencies of
perceived constraint
categories acting on
the "neutral-to-good"
transition

In contrast to the transition from "neutral"-to-"good", the "good"-to-"leading" transition had wider inclusion and elevation of product and service innovation, target markets and customer interaction constraint categories, as well as directly elevating operational constraint categories created by people, process, and information technology competences.

Most popular transition: from "neutral"-to-"leading" transition. Overall, 113 SME owner-managers currently perceived their operations as making a "neutral" contribution and 116 SME owner-managers wanted to have a "leading" level in the future. If the covariance correlation coefficient between frequency rank orders of constraint categories at these two levels is calculated we see that there is medium to high correlation ($R^2 = 0.6817$) between the constraint categories, demonstrating that constraints do not change dramatically even during this double transition, although the R^2 correlation coefficient is less than either R^2 coefficient found in the two single stepwise transactions. This is perhaps not unexpected, as increasing two contribution levels is a more radical change (as seen in Figure 3). The most impeding constraint category in this transition (those clustered in the top right-hand corner of Figure 3) was similar to the two stepwise transitions. In order these were: first, "developing and retaining people skills through training, development, and mentoring"; second, "increasing use and effectiveness of IT process automation"; third, "more effective recruitment of new good people (full-time, part-time, volunteers, and freelance consultants)"; fourth, "more effective use of sales and marketing (including communications, CRM use, and branding)"; and fifth, "developing better customer focus (including delivery and relationships)". A noticeable outlier at the beginning of this transition, when the contribution level is nearer to "neutral", is "defining and standardising processes and practices", and another towards the end of this transition, when levels are perceived to be approaching "leading", is "improve development, testing, and

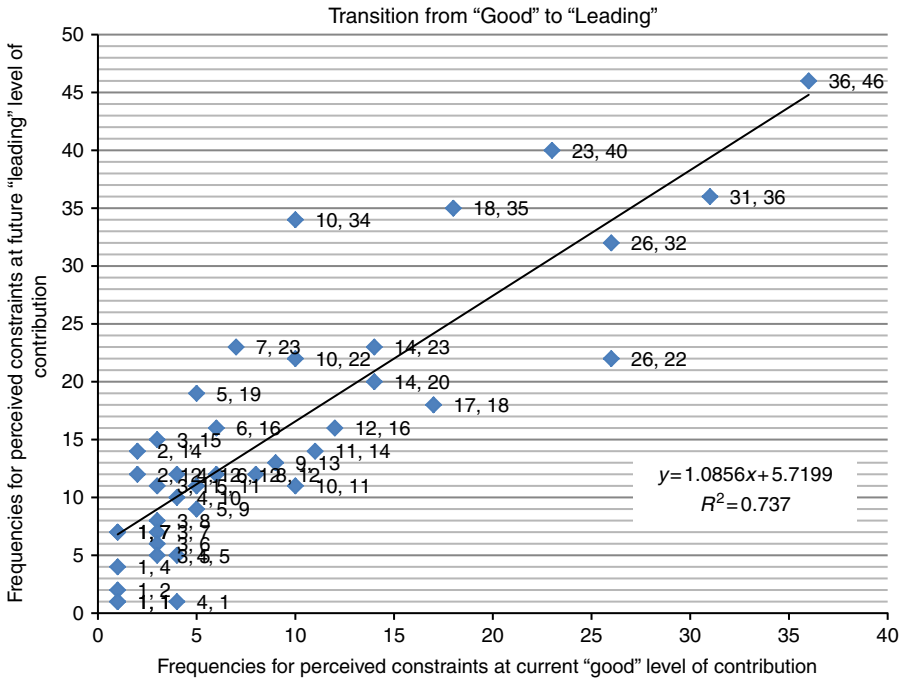


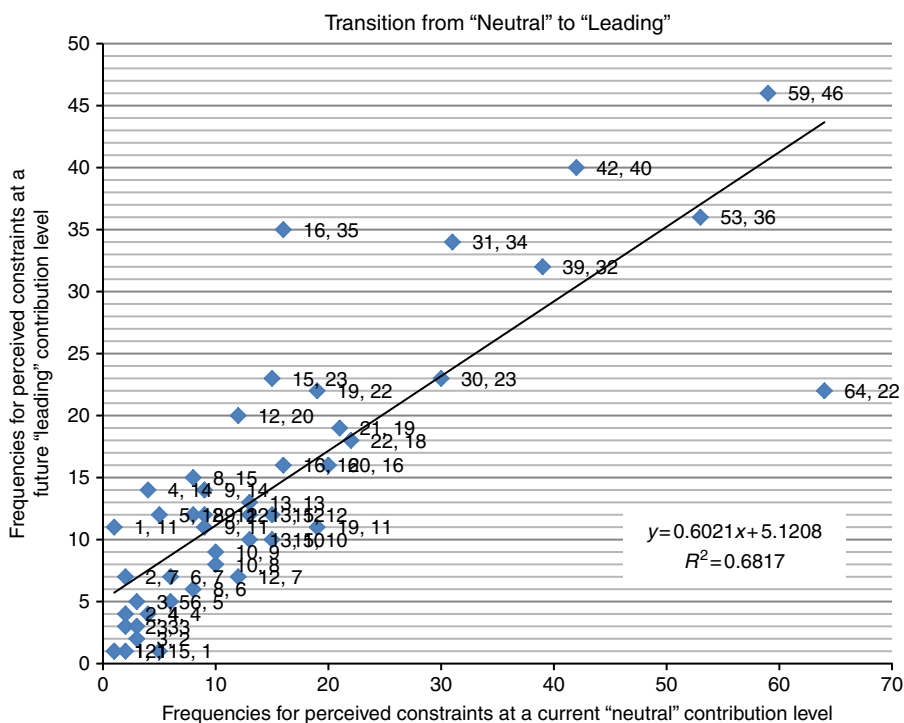
Figure 2. Frequencies of perceived constraint categories acting on the "good-to-leading" transition

Note: Data key: horizontal="current good" – column F, vertical="future leading" – column G in Table II

innovation of products and services". So, as one might also anticipate, this more radical double transition has similar constraint categories, as seen previously in the two single stepwise transitions, and although this is a somewhat repetitive finding, it is also perhaps the most important one, as this double transition summarises the most popular impediments experienced by the majority of SME owner-managers during the most popular transition, and furthermore this double transition is perhaps the most popular because it achieves the biggest perceived increase in contribution level in the shortest time. The majority of owner-managers wanted to make this double-transition within one to three years ($n = 32$) with a slight skew towards just over three years (see Table III). In contrast the two individual stepwise transitions from "neutral"-to-"good" and "good"-to-"leading" performed sequentially would take between two and six years. So by attempting the most popular double transition, even though SME owners may experience more risk, since the frequency rank order of constraints is slightly less correlated (proven by a lower R^2), owner-managers stand to gain more competitive advantage, as they could achieve the new "leading" contribution level up to three years sooner.

In summary this particular double transition (correlation analysis seen in Figure 3) requires SME owner-managers to have innovative products and/or services that have a clear focus on customers' requirements and target markets' needs delivered by a skilful, motivated, and trained workforce, using defined and effective processes supported by suitable information technology.

It would be interesting to further investigate whether managers' perceptions of different transitions differed in terms of various moderating factors, such as creativity and cost (a.k.a. knowledge and financial "buffers" in ToC terminology), velocity (a.k.a. "drum" and "rope" in ToC terminology), and magnitude (a.k.a. "size of buffers" in ToC terminology)



Note: Data key: horizontal="current neutral" – column E, vertical="future good" – column G in Table II

Figure 3. Frequencies of perceived constraint categories acting on the most popular double transition – "neutral-to-leading"

(Watson *et al.*, 2007). The author suspects that more creativity, cost, velocity, and a greater magnitude of effort would be needed to go from "good"-to-"leading" in comparison to going from "neutral"-to-"good"; and even more to go from "neutral"-to-"leading". Data from this study is currently not able to directly answer these additional questions, but conjectures that the moderating factors to elevate constraints for different single or multiple transitions may not be linear; and suggests that J-shaped or S-shaped curvilinear relationships may exist; and if so, this could explain why covariance correlation coefficients (R^2) of constraint categories' frequency rank orders were so similar at different contribution levels. Practically, this means that owner-managers are somewhat bounded by their own rational knowledge and resource availability, and radical strategic external interventions (e.g. mergers, acquisitions, sales, issue of new share capital or re-financing) may be the only way to "evaporate clouds" of competing and/or conflicting constraint categories (a.k.a. the "dilemmas" of ToC) (Kim *et al.*, 2008); this would be done by surfacing hidden assumptions, which can prevent the identification of effective solutions to specific core underlying organisational problems (Scheinkopf, 1999).

Cases of transition

This section describes how three SME owner-managers who took part in this survey achieved aspects of the most popular double transition ("neutral"-to-"leading") in practice over the last two years as part of action research projects, by elevating constraint categories identified by the survey; and the plans they have for the immediate futures of their own SMEs.

The narrative is linked to the constraint categories in Table II (cf. con. cat. 42, Table II Column B) to explain how each company took action through action research, based partly on the action-researchers' practical interventions, to elevate (remove the restrictive effects of) the constraint categories identified.

Coen Limited – a construction company

A fifth of all UK SMEs operate in the construction sector (BIS, 2015), making it the second largest SME presence in the UK after the automotive sector. Coen Ltd is a medium-sized construction company and typifies some leading practices for SMEs in that sector. In 2012, the company had 33 employees and an approximate turnover of £1.8 m; most of the revenue was produced through plastering and dry lining of private housing, and contracts were won on the basis of being the lowest-priced bidder in a competitive tendering process. The owner-manager, new to the company in 2010 (cf. constraint category 46, Table II, Column B) perceived the contribution from his company's operation as "good", but wished this to increase to "leading" within one to three years. A major perceived constraint on the company at that time was low employees' skills, attitudes (cf. con. cat. 1, Table II, Column B), aspirations, and low propensities towards change, especially amongst the incumbent management team (cf. con. cat. 42, Table II, Column B). Another major constraint category was the lack of operational process definition, documentation, and adherence to practice by employees (cf. con. cat. 3), particularly by tradesmen working on-site (as auditable by ISO9001, ISO14001 and ISO18001) (cf. con. cat. 34). The last major constraint category was the lack of information process automation, as much of the administration was paper based (cf. con. cat. 2).

Since 2012 much has changed at Coen, as all the workforce, including senior managers, has been removed and replaced with new employees (cf. con. cat. 36), who all share the same vision as the new owner-manager (cf. con. cat. 23), which was to modernise the company. A dedicated quality manager was also hired to define, document, and train the workforce in operational processes (cf. con. cat. 9), and information to support this was placed on a company intranet (cf. con. cat. 24). The on-site workforce of builders, plasterers, and craftsmen also now has the use of a software application, accessible through a mobile electronic device (e.g. a smart phone, or a tablet or laptop computer) (cf. con. cat. 9) to manage their work progress in real-time (e.g. time sheets, invoices, job progress, quality problems, on-site deliveries), which links to back-office systems at the head office (cf. con. cat. 15). Development of this proprietary piece of software (cf. con. cat. 39) was initially outsourced to a software company but further developed in-house (cf. con. cat. 18); this was with a view to selling it on, under licence, to other SMEs with similar mobile workforce requirements (cf. con. cat. 48). These changes were partly instigated and implemented by the action-researchers.

By 2015, Coen had become a very different company from what it was in 2012. Not only had it elevated its top three constraints to growth, but it had also moved to larger premises (cf. con. cat. 11) in a better location near a science park and universities (cf. con. cat. 10). A new company had also been acquired to prefabricate insulation panels to be fitted by Coen (cf. con. cat. 48), which enables the company to have more control over its suppliers and value stream (cf. con. cat. 16) and to move towards new markets with new products, generating new and diversified revenue streams (cf. con. cats. 7 and 29). On-going continual professional development and training of staff through stronger links to universities and trade bodies also began to be the norm (cf. con. cat. 1 and 18). Coen also now works with huge international construction companies and in partnership (cf. con. cat. 31) with universities to discuss multi-organisational enterprise (MOE) management concepts, which has given the company a "thought leader" status in the industry by being seen as "[...] a cut above the average Joe Blogs construction SME" (strategic purchasing manager of a multi-national construction company). In 2015, Coen had 27 employees and a £3.9 m turnover, demonstrating a near threefold increase in productivity per person.

Future constraint categories for Coen to address are perceived as continuing its cultural change training (cf. con. cat. 26), imbibing forward-thinking ideas amongst its workforce (cf. con. cat. 23), bettering project management (cf. con. cat. 30), reducing materials waste (cf. con. cat. 21), and having better materials handling on-sites and in the newly acquired fabrication plant (cf. con. cats. 25 and 43). These changes should be provable through a maturing quality management system (cf. con. cat. 8) and a set of suitable key performance metrics for individuals, processes, and the overall company (cf. con. cat. 14). Coen's operations contribution level is now considered to be approaching "leading".

Vanti – an audio-visual and IT systems integrator

Just over 5 per cent of all UK SMEs operate in the information and communication sector, making it joint ninth out of 16 UK business sectors (BIS, 2015). Vanti is a small company that designs, installs, and maintains audio-visual and IT systems in buildings (e.g. civic libraries and commercial office premises), which can integrate different kinds of data feeds and display them seamlessly. Vanti may be thought of as a technology-based product-service provider, as it does not manufacture its own hardware nor write new software (other than control systems and middleware); it does, however, provide a full systems integration service for its clients. In 2012, Vanti employed eight people and had a turnover of approximately £1 m (GBP). The owner-managers of Vanti perceived their operations to be making a "good" level of contribution, but wished this to become "leading" within one to three years. The main constraints to Vanti's operational growth in 2012 were a lack of experienced and trained people (technical engineers and non-technical managers) (cf. con. cats. 1 and 4, Table II, Column B), a lack of clearly defined processes (cf. con. cat. 3), a need for better project management practice (cf. con. cat. 30), and a need to further innovate its delivery of products and services (cf. con. cat. 7). The owner-manager of Vanti was keen to overcome these constraints so that Vanti would be able to on-board larger projects and win more clients (cf. con. cat. 19), whilst simultaneously improving its professionalism (cf. con. cat. 26) and its ability to deliver projects on time, to cost, and to specification (cf. con. cat. 30). This in turn would help the company to grow.

Since 2012, Vanti has undergone a significant transformation, which has included taking on and training new back-office and project delivery staff (cf. con. cats. 4 and 1), who have defined and developed new projects, processes, and procedures (cf. con. cat. 3), which have been posted on the company's shared work space (cf. con. cat. 24). Process mapping activities first focused on defining processes (cf. con. cat. 3), then establishing whether they were already automated or not (cf. con. cat. 2), and if not, whether it was feasible to do so. For instance some processes, such as ordering, were already automated, but many other key processes, such as project delivery, systems design, product configuration, maintenance, and customer relationship management (CRM) (cf. con. cat. 5), were not. To grow the company, take on more clients, and win larger projects it was perceived by its owner-managers that more purposeful IT had to be put in place (cf. con. cat. 2). An analytic hierarchy process (Ossadnik and Lange, 1999) was used to shortlist and select IT systems to fit Vanti's remaining feasibly automatable processes. For instance project delivery, systems design, and product configuration and maintenance processes had a number of new IT systems piloted, and a leading CRM system was implemented (cf. con. cat. 5). Other innovative changes at Vanti included a more intimate product-service delivery for the customer (cf. con. cat. 5), which has won the company loyalty from large new clients (cf. con. cat. 6). These changes, in part, were instigated and implemented by the action-researchers.

By 2015, Vanti had become more successful, employing 23 people and with a turnover of £2.5 m. This is largely due to the company having won more large contracts and being able to deliver them to plan with confidence: "[...] without these changes it is unlikely this would have happened, as these transformations have helped the admin office and our technical lab

to operate smarter [...] so our project teams can deliver “stuff” at a distance more effectively” (an owner-manager of Vanti).

Vanti’s operations contribution level is now considered to be approaching “leading”. But future challenges for Vanti remain: to continually improve its internal training programme (cf. con. cat. 1), further develop its middleware integration platform (cf. con. cat. 7), support solution delivery and on-going maintenance (cf. con. cat. 24), use increasingly mature processes (cf. con. cat. 15), and efficaciously implement more information technology (cf. con. cat. 2), which should lead to a multi-site set-up that is better at on-boarding bigger projects for international clients (cf. con. cat. 28).

Auctus Management Group Ltd – a resource provider to the rail industry

In total, 5 per cent of all UK SMEs operate in the transport and storage sector, also making it joint ninth out of 16 UK business sectors (BIS, 2015). Auctus Management Group Ltd, formed in 2012, is a medium-sized service-based company that trains, certifies, and supplies specialised workers, safety fencing, and specialist track warning systems to Network Rail (UK) and other principal contractors that build and maintain the UK’s rail infrastructure. Auctus may be thought of as a specialised resource provider for the rail industry. The owner-manager of Auctus perceived the company’s operations to be making a “good” contribution to the overall company growth, but wished this to become “leading” within one to three years. In 2012, Auctus employed 18 people and had a turnover of £564 k (GBP). The main perceived constraints on growth at that time were ill-defined processes (cf. con. cat. 3, Table II, Column B), which could not be adhered to, information technology that was not fully utilised (cf. con. cat. 2), staff who needed more training, and poor communication among teams (cf. con. cat. 1). In addition, the process of managing fleet vehicles and equipment suppliers was error-prone and inefficient (cf. con. cat. 9).

Since 2012, Auctus has elevated these constraints by moving to a better and larger location (cf. con. cats. 10 and 11) more suited to its variety of training and planning requirements. Also, by recruiting new staff, and training (“up-skilling”) existing ones (cf. con. cat. 4) in operations, supplier relationship management, scheduling, and resource planning, Auctus’ workforce has become more productive (cf. con. cats. 11, 14, 15, and 21). Both these changes were part of the newly re-focused strategic plan to grow and professionalise the company (cf. con. Cat. 26). New office automation (e.g. order processing and job rostering) software has also been implemented (cf. con. cat. 2) and large TV-style screens have replaced the old error-prone and time-consuming white-board/paper rostering of jobs and resources in the office (cf. con. cats. 9 and 25). All processes have been defined and documented (cf. con. cat. 3) and an online training handbook with training videos has been produced to help staff do their jobs more consistently (cf. con. cat. 24). This has helped to define who was responsible for which process roles and how individuals’ performances would be assessed (cf. con. cat. 14). Clarification of these points has increased employee motivation (as shown by successive surveys of employees into equality, diversity, and inclusion) (cf. con. cat. 23). A major breakthrough for Auctus was to open another new office in another city some 93 miles away, which serves a new catchment area (cf. con. cat. 27). The new site duplicated all improved operating procedures and practices once successfully established at the original site (cf. con. cats. 3 and 10). Altogether these changes made the culture (cf. con. cat. 26) more focused on customers’ requirements (cf. con. cat. 6), more embracing of lean thinking (cf. con. cat. 21), increasingly ambitious, and more conducive to Auctus’ workforce satisfaction rates (cf. con. cat. 23). In part these changes were instigated and implemented by the action-researchers.

By 2015, Auctus was a very different operation. Not only had the above changes been made through this action research, but also an extensive improvement to the interaction with suppliers had taken place. Substantial portions of fleet and equipment provision were

outsourced to subcontractors (cf. con. cat. 16), improvements were made to the sales ordering process (cf. con. cat. 12), automation of the process occurred (cf. con. cat. 2), performance measurements for suppliers were established (cf. con. cat. 16), and reduction of errors and waste were achieved (cf. con. cat. 8), especially to the fleet's management processes. The Auctus Group of companies also purchased another company (cf. con. cat. 48) (Rail Safety Solutions Ltd), which had complementary core competences to the existing operations (by providing track warning systems); and so the Auctus Group has developed collectively from a one-product-only company to a more diverse and robust product-service-system provider (cf. con. cat. 7) delivering recruitment, resource management, safety fencing, training assessments, and apprenticeships. The Auctus Group has developed from an initial 18 staff to a full-time team of 44 staff, and coordinates over 400 contractors across the country. New national framework contracts with major contractors have since been won by the Auctus Group, based on improved quality (cf. con. cat. 19), service, and commerciality. Turnover stood at £10.3m at the end of 2015. Auctus' operations contribution level is now considered to be approaching "leading".

Future challenges for Auctus are to: continually improve the training levels of its own staff and the human resources it provides for the rail industry (cf. con. cat. 1), explore opportunities to open other new sites in rail-intensive regions of the UK (cf. con. cat. 27), further automate (and replicate) administrative processes (cf. con. cats. 2 and 27), and adopt MOE thinking to improve cross-company processes with its partners and customers (cf. con. cats. 16, 6, and 5), as it has already done with its main suppliers. Auctus also has further plans to adopt more information technology (cf. con. cat. 17), which may in turn lead to gaining new operating compliances in other similar sectors (e.g. highways) (cf. con. cats. 34 and 29).

Conclusions and implications

This paper concludes by first explicitly and succinctly answering the research questions set, and then discusses their general implications via a newly induced conceptual model derivative to suggest how SMEs (in the UK) could grow by increasing their perceptible levels of operations contribution, as constraints impeding their growth become elevated (i.e. their effects are reduced).

Answers to the research questions

RQ1. Which growth-impeding constraints are perceived to act upon the operations of SMEs?

The survey and the subsequent relational content analysis identified a parsimonious set of 49 constraint categories that impede SMEs' operations, as detailed in Table II by frequency rank order within a Pareto analysis. Each constraint category has been discussed in the Findings and Analyses sections and illustrations given for how they may be elevated, where found, using three action research case studies. These constraint categories were previously undefined and are a new contribution to operations management growth literature for SMEs made by this study:

RQ2. How do perceived operational constraints (as identified by question 1) relate to the perceived current level of contribution made by SMEs' operations?

This study found that constraints did not change dramatically between different levels of operations contribution, and so Goldratt's ToC (Goldratt and Cox, 1984) was not directly useful in the context of the Hayes *et al.* contribution model, based on these findings. It was previously believed that ToC-type constraints could be applied at each of these levels and were apparent in all types and sizes of operations, but this study has shown that they are not apparent in UK high-growth SMEs. This is another new finding made by this study,

which could fundamentally change theoretical, pedagogical, and practical applications of the Hayes *et al.* contribution model to high-growth SMEs:

RQ3. Will future perceived constraints be different from current perceived constraints – assuming that a higher level of operational contribution can be attained in the future?

This study found that owner-managers easily related to the general concept of different levels of operations contribution but did not find that constraints differed dramatically across different levels, as similar constraint categories prevailed throughout SMEs' growth, but were experienced to different degrees at different operational contribution levels, as discussed in analyses of transition paths and illustrated via these three action research case studies. This means that a modified model of growth should be developed from the Hayes *et al.* contribution model; one that is more applicable to UK SMEs and unconstrained by discrete levels of operations contribution, which is another new recommendation based on these findings:

RQ4. Can transition paths be suggested to help SMEs overcome current perceived constraints and move operations to a higher level of perceived contribution?

Based on this study it is possible to propose generic transitional paths – theoretical, pedagogical, and practical. Implications of these paths have already been partly explained in the Analyses Sections and illustrated using these three action research case studies. Furthermore a newly induced generic conceptual model is proposed below, based on these empirical survey and case findings, which may over time make a generalisable contribution to the related theory, teaching, and practice of SME growth through better operations primarily based on the Hayes *et al.* contribution model, and secondarily, to the use of ToC application within it.

Implications – growth through better operations theory and practice for SMEs

Although this research has not been able to directly apply Goldratt and Cox's (1984) ToC to clearly differentiate constraint categories between contribution levels in the Hayes *et al.* (2005) contribution model, some useful findings have still been made. Overall, although it seems that growth is not overwhelmingly impeded due to discrete contribution levels, it can be catalysed through meta-constraint continua (categories of constraint categories mixed with lessons on transitional growth paths from cases), which are demonstrably difficult to disentangle or stratify. The possibly lack of levels and continuing complexity is eluded to in part by Chase and Hayes when they stated that: "the stage [level] attained by a firm at any given time is a composite [...] A company may fall at a different point along the continuum [...] where in a sense, the firm's centre of gravity lies" (Chase and Hayes, 1991, pp. 16-17). In ToC terminology this is similar to identifying, analysing, elevating, and/or evaporating clouds of dilemmas (Kim *et al.*, 2008) using various ToC tools, such as decision trees (Blackstone, 2001) to continuously elevate (i.e. reduce the effect of), rather than totally eliminate constraints. This subtlety is often not picked up by those who use the contribution model, neither has it even been empirically demonstrated in a specific given context until now, in this study, using data from potentially high-growth (UK) SMEs. Therefore, this study makes another important contribution by partly confirming the validity of Hayes and Wheelwright's contribution model, but noting it should be used with caution because the levels within it, although conceptually useful, may not exist in practice in any measurable, significant or tangible ToC form unless the application context is focused and clearly defined. In this particular instance of (UK) high-growth SMEs it has been shown that it is more useful to talk in terms of transitional paths (a.k.a "logic paths" in ToC terminology (Kim *et al.*, 2008)), referred to in this paper as meta-constraint continua to higher operations

contribution levels rather than refer to constraints (or constraint categories) as limiting factors at different discrete contribution levels. These meta-constraint continua are similar in purpose to Garney's (1998) "growth paths" for early development in firms.

This departure from levels of constraint is deemed necessary here because it has not been possible to find empirical evidence that these different levels actually exist in practice in high-growth (UK) SMEs – other than in a purely academic or conceptual form. This is a new and important empirical finding made by this study, which has implications for future developments of operations contribution models in specific contexts where similar behaviours are found. It also gives scope for further deeper reflection on the ToC TP to help explain complex interactions, trade-offs between constraint categories, and transitional paths from one contribution level to another. For instance, further application of other ToC tools (Kim *et al.*, 2008) within the context of meta-constraint continua rather than discrete contribution levels (Gupta and Boyd, 2008) might reveal some interesting ways to catalyse ongoing SME transitions.

In conclusion this research proposes that overall perceptible growth occurs, and can be represented, by abstracting from a particular mix of constraint categories and empirical case data, to form meta-constraint continua, which can be used as generic transitional path descriptors. First and most essentially, perceptible growth occurs by developing a meta-constraint continuum for an organisation's people resources – as they are perceived to be the root to all innovation, commercialisation, and operationalisation – needing active recruitment, continuous training, and up-skilling to become more productive. Second, three concomitant meta-constraint continua need developing: purposive high velocity processes need to be defined and aimed at the organisation's vision, product and service innovations need to happen through new product-service development activities, and information technology needs to be used to automate administrative systems wherever and whenever possible. Customer interactions and market-focused meta-constraint continua activities then need to be persistently and re-generatively nurtured to ensure that operations are efficacious. These are practical operations management-based actions for SME owner-managers to make, as established from data generated by this study, which can have direct positive impact on growth in SMEs. These theoretically founded and empirically derived meta-constraint continua are depicted in Figure 4 – shown for artistic effect as a rocket shape – and thus referred to as the Operations Growth Rocket. The Operations Growth Rocket is an abstraction from lessons learned from these given cases and from the relational content analysis in this paper, and is more than just an aggregation of individual constraint categories.

Summary

The Operations Growth Rocket is a new inductively generated derivation of the Hayes *et al.* contribution model, whose provenance comes from new empirical data collected from 208 UK SME owner-managers. It is an incremental development of the original Hayes *et al.* model (Hayes *et al.*, 2005) and does not purport to be another new theory; the Operations Growth Rocket addresses some of the shortcomings of the original model, which have been highlighted by previous research studies. Hence, the Operations Growth Rocket has no levels and no causal axes, as found in the original model. Each part of the Operations Growth Rocket conceptual model in Figure 4 is a meta-constraint continuum abstracted from constraint categories, having the highest frequency rank orders (shown in Table II, Column I) found in the most popular transitions in this study (shown in Table III's shaded cells and regression correlation in Figures 1-3) and transition path lessons learned from three empirical case studies.

But, so what? The theory-based answer to this is that there are many studies on innovation *per se*, which look at organisation-based factors (e.g. Adams *et al.*, 2006) and external organisational factors (Dunphy *et al.*, 1996). These studies tend to end up with a proof of

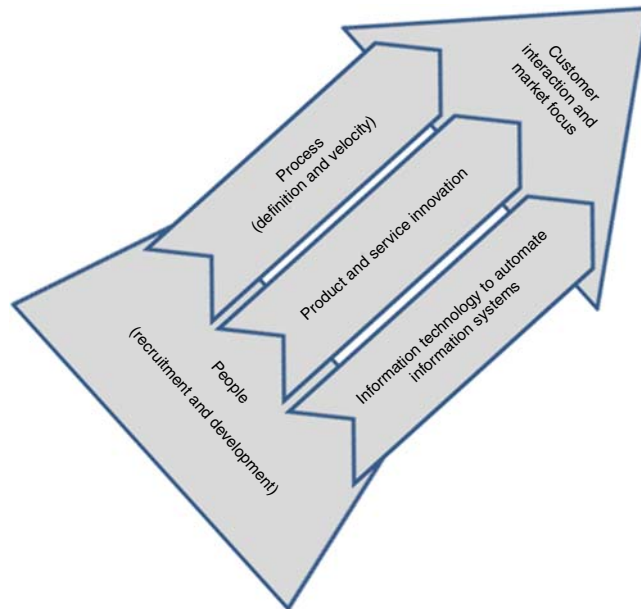


Figure 4.
The “Operations Growth Rocket” showing the meta-constraint continua as transitional paths towards higher operations contribution

concept of a new product or service. There are also many useful operations growth models such as Ferdow’s Sandcone model (Ferdows and Thurnheer, 2011; Schroeder *et al.*, 2011), which usefully depict how cumulative competences are built-up in *larger* companies that have already established their operations, but these tend to begin by assuming a strongly established product or service in a mature and stable operations environment. In contrast there is a relative paucity of research on theoretically based and empirically derived models that focus directly on transitional growth paths for bettering the level of operations contribution made during the growth of SMEs. This study has begun to fill this gap by inductively generating the newly derived Operations Growth Rocket.

The Operations Growth Rocket proposes an overall generic path for growth in SMEs. It does this first by developing human resources to drive innovation (the base meta-constraint continuum). Second, it focuses on simultaneously delivering better products and services, designing better delivery processes, and encouraging increased process automation (three concomitant meta-categories continua shown in Figure 4). The aim is to achieve better “customer interaction and market focus” (the nose-cone meta-constraint continuum), which should give “better quality”. Better quality is salient because it is synonymous with the first stage of the Sandcone cumulative capability development model (Ferdows and De Meyer, 1990). As Ferdows and De Meyer (1990) stated “[...] to obtain a sandcone one has to first create a stable foundation of quality improvements”. The Operations Growth Rocket therefore fills some paucity of knowledge on growth aspirations for SMEs between innovative activities *per se* and growth through better operations in larger-scale organisations covered by other innovation and growth models (e.g. the Sandcone model), which use resource and competence based theories.

Limitations and further work

This study is limited by the size of the survey and by the fact that it has only been developed from data from high-growth SMEs in the UK. The new inductively generated

Operations Growth Rocket proposes a generic transitional growth path to catalyse debate about contribution levels made by operations in growing SMEs; it should now be tested in transfer studies using new sets of data. There is no claim that the Operations Growth Rocket is generalisable to all SMEs, but this study claims that it is representative of the general behaviour of this sample of high-growth SMEs in the UK and as such it has some insightful theoretical, pedagogical, and practical implications.

Further work could include fitting these raw data to other models (e.g. the Sandcone model) or to other theories based on resource and competence development in a similar way to how it has been fitted to Hayes and Wheelwright' growth model in this study. A retrospective study could also be performed in a few years' time to attempt to measure the actual velocity, cost, creativity, and magnitude of efforts taken by these SMEs to achieve perceptible changes to their constraint categories, which may enable best-fit curvilinear regression curves to be found. Further theoretical work could also be done to apply other ToC tools within the meta-constraint continua to help catalyse growth transitions in SMEs even more effectively.

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Appendix

Organisation/name?				
Current organisation size?	Micro	Small	Larger	
Organisation type?	Service	Manufacturing	Social	Other
Current contributions made by operations?	Poor	Neutral	Good	Leading
Top five growth-impeding constraints perceived to act on current operations?	<ul style="list-style-type: none"> • • • • • 			
Planned contributions of operations in the future?	Poor	Neutral	Good	Leading
Timescale?	Less than 1 Year	1-3 Years	3-5 Years	5+ Years
Top five growth-impeding constraints perceived to act on operations in the future?	<ul style="list-style-type: none"> • • • • • 			

Table AI.
Open ended
questionnaire template

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