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Where next for manufacturing productivity research?

Propositions based on exploratory empirical investigation

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STRUCTURED ABSTRACT

The purpose of this research is to develop empirically grounded propositions for further research into UK manufacturing productivity.

Interviews were conducted with managers from strategic, tactical and operational levels from four manufacturing sectors to produce case studies. A modified strategic alignment theory framework was used to code, compare and contrast narratives on perceived productivity antecedents, definitions, compatibility with the definition from the UK Office for National Statistics, and vertical alignment issues within and across cases.

In addition it was found that different key antecedents can facilitate and/or prevent strategic vertical alignment. Discussion reveals complex nuances in perceptions of manufacturing productivity and using the modified strategic alignment theory / productivity antecedent framework.

In revealing the alignment or otherwise of productivity definitions at different levels within the firm, the paper reveals nine propositions for future research including definitions, skills, metrics, performance measurement systems, people and system centric perspectives, value-added perspective of productivity and the role of innovation.

KEYWORDS: productivity, efficiency, strategic alignment, manufacturing, case study

1. INTRODUCTION

Th*is research was motivated by a perceived* disconnect between the UK Government's use of the term *'*productivity*'* (ONS Productivity Handbook, 2016) and its use by UK manufacturing companies against a backdrop of concerns about productivity improvement (EEF, 2018; IoD, 2018; WEF, 2020) and the latest ongoing reports of productivity decline (UK Productivity Commission, 2022). Founded on the premise that many UK manufacturing companies use the term 'productivity' inconsistently, and may differ with the UK Government's Office for National Statistics' (ONS) definition it is a valuable starting point to understand how companies use the term 'productivity' and if there is a perceptible difference to the Government's Office for National Statistics (ONS) definition. The ONS definition of is *Productivity = (Turnover – Intermediate Consumption) / Number of Workers* (ONS, 2022).

If people mean different things when they use the word productivity, there is a danger of confusion, and also the chance that actions are not aligned – even within the same organisation. To better understand the language of productivity (e.g. Hutton and Eldridge, 2019; Melnyk et al., 2004; Melnyk et al., 2005) and how companies use it at different levels, this research is based on '*strategic alignment*' theory (Venkatraman and Camillus, 1984). Strategic alignment theory offers a means of conceptualising different hierarchical levels and ability to uncover use of definitions and antecedents of productivity in companies at strategic, tactical and operations levels. Alignment of vertical performance is not new (McAdam & Bailie, 2002); however, when specifically applied to productivity, there is a dearth of published works.

Productivity and performance literature (e.g. Neely et al., 1995; Bititci et al. 1997; McAdam et al., 2014; Micheli & Mura 2017) tells us the importance of creating vertical alignment between strategy, tactical and operational objectives. Therefore, if governments wish to increase economic productivity (e.g. Harari, 2017), top-down and bottom-up, a deeper understanding of manufacturing productivity is required. Only in this way will manufacturers, economists and policy makers be able to align

thinking, effect positive change, and provide useful insight to the UK's productivity puzzle (Barnett et al., 2014). The challenge of how and why companies vary in their measurement of productivity and how this relates to national productivity is challenging given the lack of recent academic research in this area. The productivity literature that does exist is typically specific to a manufacturing function or market. This is despite widespread acknowledgement that productivity improvement is important for the economy, as well as individual companies. Therefore, the objective of this research is to develop propositions for further research into UK manufacturing productivity.

This research makes the following contribution: (i) by capturing practice-based perceived definitions of manufacturing productivity, with perceived barriers and enablers to productivity (ii) defining how manufacturing companies and managers perceive the antecedents of productivity; (iii) gives original empirical cases on alignment and/or misalignment of productivity perceptions in manufacturing companies; and, (iv) gives theoretical *reflections* and practical *propositions* to further research into the UK's manufacturing.

The next section provides a literature precis on (a) vertical strategic alignment in companies, and, (b) antecedents of productivity. The literature precis is not intended to be an exhaustive systematic literature review; instead, it is intended to give a brief academic grounding to this empirically driven research. The research methodology then follows, which uses semi-structured interviews and case studies to reveal manufacturing managers' perceptions. The findings section gives case study narratives of companies using the theoretical framework modified from vertical strategic alignment theory / productivity antecedents. The penultimate discussion gives a cross-case analysis and inducts propositions for future research into UK manufacturing productivity. The paper finishes by revisiting the purpose of the research and its limitations.

2. LITERATURE REVIEW

Building on two bodies of knowledge, strategic alignment and productivity, this research gives an overview of each and puts forward a theoretical framework combining both, which allows for empirical data interpretation and discussion.

2.1 Vertical strategic alignment in companies

The concept of *strategic* alignment is central to the field of strategic management (Venkatraman and Camillus, 1984; Venkatraman, 1989; Tan and Tan, 2005, Nassani and Aldakhil, 2023). Porter (1996) argues that alignment of management practice in a management hierarchy is essential to create and sustain competitive advantage. Traditional literature distinguishes between two types of organizational alignment: horizontal and vertical. Horizontal alignment refers to coordination of efforts between operations across processes (Ghoshal and Bartlett, 1995) and normally defined in terms of cross-functional integration of marketing, operations, manufacturing, and human resource management (HRM) activities. Vertical alignment refers to the configuration of strategies, objectives, action plans, and decisions top-down and bottom-up throughout organizational hierarchical levels; for instance, the conceptualization of management at three levels - corporate/strategic, business/tactical, and functional/operations – is widely acceptance in the literature. See Gunasekaran, Patel, and Tirtiroglu (2001) for a review of the related discussions. This research focuses on vertical strategic alignment of productivity perceptions and links to wider productivity conversations (e.g. at an economic and political level).

Strategy literature portrays vertical strategic alignment from different perspectives. Peters and Waterman (1982) analyse alignment via strategy, structure, and systems, skills, staff, style, and super-ordinate goals. Similarly, Miller (1986) focused on vertical alignment between a company's strategy,

structure and the business environment. Similarly, Leong, Snyder, and Ward (1990) proposed a vertical alignment model to include competitive strategy, business level strategy, functional strategies, and functional capabilities. More recently, Frohlich and Westbrook (2001) studied vertical alignment between operations and competitive strategy, while Gattorna (2017, 2016) proposed a four-stage strategic alignment framework where supply chain level strategy is included to respond to customer segmentation requirements. Larsen et al. (2018) further explore vertical alignment between the reverse supply chain and competitive company strategy. Vertical stratification offers an opportunity to target decision makers in an organisation and assess perceptions of alignment in respect to productivity. Vertical alignment, sometimes known as 'strategic fit' can also help position a company in a wider economic context (Maes, 2007).

Most research posits that suitable correct vertical alignment has a positive effect on organizational performance. For instance, Porter (1996) argues that a company's ability to seek and maintain competitive advantage rests on its ability to acquire and deploy resources commensurate with external needs. However, some strategy researchers argue that vertical over-alignment may lead to paralysis and inability to adapt to dynamic external economic environments. For instance, Hagel and Singer (1999) argue that vertical over-alignment and rigid fit be moderated by external transaction costs of a company. Similarly, Pascale (1999) argues that restrictive strategic fit leads to counterproductive equilibrium. Pascal (1999) contends that companies should strive for adaptive dynamic equilibrium with external change rather than inflexible strategic alignment acting to entrench equilibrium. Similarly, Hamel and Prahalad (1994) warn that vertical strategic alignment and/or strategic fit achieved by paring down ambition will inhibit company adaptability.

Other important research considers the *enablers* and *inhibitors* of strategic alignment. For instance, Wong *et als.'* (2012) systematic literature review on supply chain alignment identifies organisational structure, internal relational behaviour, customer relational behaviour, top management support, information sharing, and business performance measurement systems. Skipworth *et al.* (2015) tested

the strengths of these relationships with previously identified enablers of supply chain alignment and business performance and only found alignment to customer relational behaviour to have a direct positive impact on company performance. While such studies clarify practices and the contextual conditions to enable vertical strategic alignment none explicitly addresses the effects on productivity. Moreover, an empirical study by Skipworth et al. (2015) suggests that different vertical alignment practices have different degrees of effectiveness based on their context; therefore, the interplay between practices, contextual conditions, and alignment levels, in respect to productivity, is still currently unclear and in needs further research.

2.2 Definitions of productivity

In academic circles there is a vast literature on productivity, but often from different perspectives and academic disciplines. This was clearly articulated in a number of publications that highlight the different standpoints (eg. McCann 2018, McCann & Vorley 2020). In a technical sense, productivity can be defined as single factor productivity or multifactor (total) productivity measures (Thomas and Mathews, 1986; Organisation of Economic Cooperation and Development (OECD), 2001; and Crawford and Vogl, 2006). Single factor productivity takes into consideration one input (e.g. raw materials), while multifactor productivity considers two or more inputs (e.g. materials and labour, equipment, energy, and capital). Furthermore, productivity can be calculated at task level (e.g. manufacturing), project level (i.e. combination of two or more tasks) and company level (i.e. combination of two or more projects) (Chapman and Butry, 2007). Definitions of productivity also vary with context (Ghoabadian and Husband, 1990). In addition, Mankins (2017) warns that 'productivity' and 'efficiency' are not the same but often conflated and even used to define one another. For instance, the European Association of National Productivity Centres (EANPC, 2005) defines productivity as, "*how efficiently and effectively products and services are being produced"*, and *efficiency* describes the best way of using resources (Grünberg, 2004); and, *effectiveness* indicates the extent that company efforts are aligned to customer requirements (Neely et al., 1994). In this study

we focus on *productivity* according to Bernolak (1997) where 'productivity' means "*how much and how much good we produce from [all] the resources used*". Whilst older publications provide definitions to build research on, the debate of how to measure productivity continues (e.g. BLS, 2023; Beugelsdijk et al 2017) leading to further uncertainty in standard metrics.

As productivity is a relationship between outputs produced by a system, and the input resources utilized by a system to produce outputs, improvements rely on either the production of more output with the same input factors or the reduction of input resources. Productivity is therefore required to *add-value* to final goods and services (Tangen, 2005). Understanding productivity levels and productivity growth rates matters due to the vast differences in performance and improvement rates globally (APO, 2023), indications of productivity stagnation in Europe (TPI, 2023) and how the determinants of productivity vary significantly by country (Dua and Garg, 2019) and by continent (ILO, 2022).

2.3 Antecedents of productivity

The UK Government's measure of company productivity is single factor and output per worker (ONS, 2022) despite total factor productivity being the sustainable source of growth (van Ark et al., 2023). Companies, in contrast, use multi-various metrics appropriate to particular sectors, business nuances, strategies and tactics (Ghoabadian and Husband, 1990). For companies, productivity measurements usually focus on various levels:

- economic /sector – for external competitiveness (Bloom and Van Reenen, 2005)
- strategic – for supply chain of particular sites/plants using financial metrics such as profitability or market share (Pagell et al., 2013)
- tactical – for value-add metrics such as cost of production, quality, flexibility and delivery
- operational – for machines or individual people, such as operational equipment effectiveness (OEE) (Neely and Lewis, 2005).

These metrics do not all neatly vertically align, as higher-level metrics are not directly reducible into lower-level metrics and vice versa. The absence of vertically aligned productivity antecedents with national metrics indicates that improving national productivity will be difficult without better understanding of productivity perceptions within manufacturing companies on endogenous and exogenous antecedents. Endogenous antecedents include organisational structures (e.g. Hortaçsu and Syverson, 2011; Garicano and Heaton, 2007), human capital (Bandiera, Barankay and Rasul, 2009; Fox and Smeets, 2011), incentives and rewards (Lazear, 2000), human resources practices (Ichniowski and Shaw, 2003) and managerial talent and practices (Bloom and Van Reenen, 2005). Exogenous antecedents are affected by: productivity spillovers, competition (intra-market and trade), deregulation or proper regulation, and flexible input markets (Syverson (2011). Syverson's (2011) exogenous antecedents fall out of the scope of this research as this research focuses on company and supply chain antecedents. Despite this long-standing knowledge, practice adoption is still lacking leading to calls to increase diffusion of productivity enhancing practices (TPI, 2023).

More influential for this research are Larsen et al's. (2018) taxonomy of supply chain oriented productivity antecedents / enablers (e.g. general capabilities, information sharing, organisational structure, top management support (policy), product design, service design, customer relational behaviour) and Syverson's (2011) classification of endogenous productivity antecedents; namely, (i) Managerial Practice/Talent, (ii) Higher-Quality General Labour and Capital Inputs, (iii) Information Technology and R&D, (iv) Learning-by-Doing, (v) Product Innovation, and (vi) Firm/Company Structure Decisions. For this research, these productivity antecedents form an explicit parsimonious summary of productivity antecedents and are presented in a modified framework for vertical strategic alignment theory – as seen in Figure 1 – with emphasis on Syverson's (2011) endogenous antecedents.

2.4 Productivity antecedents and strategic vertical alignment

While previous studies on vertical strategic alignment have focused on company strategy *per se* and implementation at different levels, they have not explicitly simultaneously considered effects on productivity antecedents, and *vice versa*. This study addresses this knowledge gap by uniting strategic, tactical and operational levels of productivity perception with Larsen *et al* (2018) and Syverson's (2011) productivity antecedents.

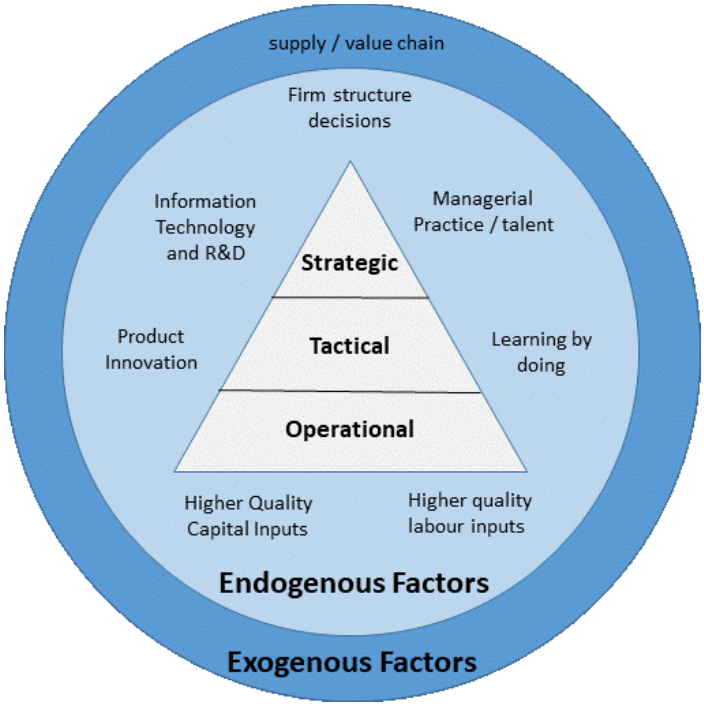

Figure 1: New theoretical framework for this manufacturing productivity research

Figure 1 captures relevant endogenous and exogenous antecedents, incorporates the strategic, tactical and operational levels of strategic vertical alignment, and embodies Larsen et al., (2018) and Syverson's (2011) productivity antecedents. Figure 1 forms the theoretical framework for this research methodology, case study findings and discussion. These endogenous factors may not capture all the relevant factors and relationships that influence manufacturing productivity. These factors provide

structure for methodological tool to investigate the area. The methodological choice introduced in the next section enables new factors to be captured and presented in the research outputs.

3. RESEARCH METHODOLOGY

This research uses an empirical case study approach. Data collected from multiple UK manufacturing companies reveal perceptions of productivity by managers employed in vertical company hierarchies. Ten case study companies represent four significant manufacturing sectors, namely: food and drink, automotive, aerospace and pharmaceutical. These significant sectors were chosen because they either have relatively high value (e.g. pharmaceuticals and aerospace) or high volume (e.g. food and drink, and automotive) and indicative of UK manufacturing at its best. Purposeful selection of interviewees represent each hierarchical level (in line with the productivity framework, Figure 1): strategic (e.g. Operations Director), tactical (e.g. Technical Operations Director) and operational (e.g. Operational Excellence Scientist). Three interviews conducted in nine companies and four interviewees in one other; 31 interviewees in total. Each interview lasted between 1-2 hours and interviewees identified with a level of management; verified by checking job title and responsibilities. Four researchers conducted 29 face-to-face interviews on company premises and two by telephone over a five-month period from January 2019 to May 2019. All Interviews were recorded (with permission); recordings were professionally transcribed and checked by interviewer and interviewee before coding. Table 1 shows a summary of companies and interviewees. Methodology followed the University of Strathclyde's ethical procedures.

Case ref.	Sector	Size**	Site number /location	Number of respondents	Level in company hierarchy	Respondent job titles
Aero1	Aerospace	L		3	Strategic	Manufacturing Executive*

			Multiple sites globally		Tactical	Manufacturing Manager
					Operational	Manufacturing Process Engineer*
Aero2	Aerospace	L	Multiple sites globally	3	Strategic	Procurement Director*
					Tactical	VP Manufacturing
					Operational	Manufacturing Manager*
Aero3	Aerospace	L	Multiple sites globally	3	Strategic	Head of Programmes*
					Tactical	Programme Manager*
					Operational	Programme Controller
Aero4	Aerospace	L	Multiple sites globally	3	Strategic	Head of Transformation
					Tactical	Operations Group Leader
					Operational	Manager*
Pharma1	Pharmaceutical	L	Multiple sites globally	3	Strategic	Site Director
					Tactical	Site Operations Manager*
					Operational	Shift Supervisor
Pharma2	Pharmaceutical	L	Multiple sites globally	3	Strategic	Operations Director
					Tactical	Technical Operations Manager
					Operational	Operational Excellence Scientist
Pharma3	Pharmaceutical	L	Multiple sites globally	4	Strategic	Operations Director
					Strategic	Chief Technology Officer*
					Tactical	Senior Production Manager
					Operational	New Product Integration Manager
Auto1	Automotive	L	Multiple sites globally	3	Strategic	Plant Director
					Tactical	Assembly Operations Manager
					Operational	Assembly Team Leader
Auto2	Automotive	M		3	Strategic	Chief Executive

			Multiple sites UK		Tactical	Group HR and Development Manager
					Operational	Group Engineering Manager
Food1	Food and drink	M	Single site	3	Strategic	Operations Director
					Tactical	Production Manager
					Operational	Supervisor
Number of respondents				**31**		

Key: *Edited to remove identifiable job title; ** Size: M (51-250 employees); L (>250 employees)

Table 1: Control data: profile of companies and interviewees

An interview protocol (Eisenhardt, 1989) gathered consistent qualitative data on productivity perceptions through semi-structured interviews. Interview was selected over survey given the research was motivated by the perception that productivity was inconsistently interpreted by industry, therefore an exploratory approach was needed. Interviews were based on an interview protocol (see Appendix A that is aligned with Figure 1). The interview protocol was formulated from the literature, first seeking their definition of productivity (given the literature offered multiple interpretations in literature Section 2.2), second examining the antecedents influencing productivity (enablers and constraints in literature Section 2.3) and third seeking any other factors including exogeneous factors. The data collection sections and sections of the interview protocol aligns with the productivity framework in Figure 1. Whilst the protocol was developed from the literature, it was iterated in a researcher workshop and applied to companies (one food, one engineering) for which only one level of seniority was available. Sampling drew on existing contacts across the researchers seeking multiple companies in the significant manufacturing sectors, namely: food and drink, automotive, aerospace and pharmaceutical. Only where the senior initial contact could provide access to interviewees at multiple levels did the work with each company progress to interview. Given the

choice of case study method the response rate was not calculated. Each interview was conducted as a single event, interviewees were given the opportunity to review and correct the transcripts.

Approved and validated data were analysed by a team of six researchers (that included interviewers) in the following standardised way. For each company a pair of researchers (not including the original interviewer):

1. identified definitions of perceive productivity in practice
2. identified perceptions of productivity antecedents
3. agreed on steps 1 and 2 above
4. produced a case study for each company abducting to the modified strategic vertical alignment theory / productivity antecedents shown in Figure 1.

These steps ensured that interviewer bias and single-rater coding bias was reduced. Steps 1 and 2 mirror the literature review, the productivity research framework (Figure 1) and the interview protocol (Appendix A). Analysis produced large thematic coding tables of productivity definition perceptions and antecedent perceptions using the principles of open and thematic coding (Glaser, 1994; Glaser & Strauss, 1999). Occasional spot checks from the analysis tables back to the source data were made in cases of ambiguity or anomaly, however, no corrections to the coding resulted. Through further axial comparisons and confrontation with the aforementioned literature, full narrations of company case studies were produced (Eisenhardt, 1989); the next section gives an abstract summary of salient points from each.

Following the analysis of all case studies, the research team ran a three hour in-person workshop to bring the cases together for cross-case analysis. The activity to draw collective findings implicitly ensured consistency of the highlights across the cases resulting in some updates to each case write up to ensure consistent reporting.

4. FINDINGS: CASE STUDIES NARRATIVES OF PRODUCTIVITY PERCEPTIONS, VERTICAL STRATEGIC ALIGNMENT AND ANTECEDENTS

The following company case study narratives illustrate productivity perceptions at strategic, tactical and operational levels. For each company, we provide productivity definitions, enablers and inhibitors; the perceived alignment of productivity definitions between levels; and an abductive reflection on productivity antecedents (Syverson, 2011) – all given in the context of Figure 1. Following the examination of each case, Table 2 summarises the 10 case studies.

4.1 Aero1

Productivity understanding was not aligned in Aero1. Even though the term 'productivity' was widely used, it was perceived as 'performance-against-plan', 'efficiency' or 'effectiveness'. At the strategic level, the Manufacturing Executive* stated, "*If somebody uses the word 'productivity' … it will be a direct measure of how efficient the direct workforce is being*". Meanwhile the Manufacturing Manager talked more about motivating the workforce, "*I am trying to get as much as I can out of the same amount of people ..., maximising the resource that I've got, getting the most out of them within certain timeframes*." Finally, at an operational level, the Manufacturing Process Engineer* referred to, *"… numbers, targets, customer demand and customer requirement; which all add up to a viable business*."

In terms of the enablers and barriers to productivity, there was general perception that employee engagement (including reduced absenteeism), customers (e.g. changing orders), and suppliers had a significant negative impact on productivity. Similarly, product complexity and awkward suppliers were perceived as productivity constraints due to confusion and delay in supplying raw materials, while employee engagement and automation (in terms of robotics with automated processes) were perceived as positive productivity enablers.

In summary, Aero1 did not have vertically aligned definitions of productivity. At strategic and tactical levels, definitions of productivity were synonyms for efficiency and effectiveness, whereas at an operations level, productivity activities addressed specific components and objective metrics within the company. Key antecedents contributing to Aero1's *misalignment*, as perceived in Syverson's terms were: (i) managerial practice/talent being different at different levels, with higher levels focussing on business objectives, and lower levels focusing on customer requirements; and, (ii) company structure decisions cultivating different productivity philosophies.

4.2 Aero2

There was no alignment in Aero2 about the understanding of productivity. The Procurement Director* stated, "'*productivity' is an old-fashioned term … and can often be constrained to manufacturing. So, we tend to follow more business-oriented KPIs that give a measure of growth … I think we talk more about growth and improving our competitiveness*". Meanwhile the VP Manufacturing defined productivity as, *"... having greater output with a similar size headcount over time*" and the Manufacturing Manager* stated, "*If you look at productivity in the classical sense, it's the output you get for the input you put in … attuned to a shop floor environment in a manufacturing sense. I think these days, however, we tend to look at it more holistically. It's about the overall business*". There was however, a general agreement that performance objectives were important, should focus on customer value and company growth; and productivity measures should go beyond the manufacturing environment.

Perceived productivity enablers were digitalisation (particularly for running tests and predictive analytics for digitally integrated operational support) and staff upskilling in emerging technologies. Perceived productivity constraints were technology (in relation to IT system installation delays), geopolitical sector characteristics and product complexities, including instability in the supply chain;

the non-repetitive nature of projects; and a focus on constant innovation - which prevented deployment of structured practices for better economies of scales.

In summary, there was no vertical alignment of productivity perceptions. According to Syverson's (2011) antecedents this was caused by: (i) managerial practice/talent; because strategic level productivity was defined by personnel hours per project; and contrastingly, at the tactical level productivity was seen as a synonym to efficiency; and at the operations level focus was on delivery with specific measures related to on-time delivery and utilisation; (ii) IT and R&D creating tensions between standardization of production and need for product innovation; and, (iii) company structure decisions relating to counter-productive plant level decisions failing to reconcile strategic goals and operational measures.

4.3 Aero3

Within Aero3 there was an agreed perception of productivity. Respondents spoke of, "*the level of work that an individual can do in a day*" (Head of Programmes*), "*to make or produce more in the same time, or have the same output in a reduced time, in a reduced timeframe, with the same quality standards.*" (Programme Manager*) and, "*… it's really efficiency and readiness … it's very about safety and quality, efficiency, delivery and tracking*" (Programme Controller). Themes of meeting output and quality expectations was common and Aero3 interviewees placed productivity in the context of improvement and competitiveness.

Perceived enablers of productivity were quality of labour with significant emphasis on employee skills, training and engagement. Mixed reactions were in respect to managerial practice and talent as an enabler. Although the term 'productivity' did not feature significantly, insights suggested there was a strong management culture that proactively engaged with workers. For capital inputs, there was a significant emphasis on deployment of technology, both tooling and digital, and wider product

innovation. There was clearly a drive to be competitive but maintaining and improving productivity was hampered by constantly changing customer demands.

In summary, Aero3 had commonly grounded productivity perceptions and there was an alignment up and down through strategic, tactical and operational levels in the company. Key antecedents contributing to this, according to Syverson's (2011) antecedents, were: (i) managerial practice/talent engaging staff in strong process oriented mind-sets by having the right people in the right jobs; (ii) higher quality labour and capital inputs emphasising metricised training and skills, as well as common views on the need to innovative through new technologies; and, (iii) firm structure decisions with focus on driving improvement and change.

4.4 Aero4

In Aero4, there was no aligned understanding of productivity. 'Productivity' terms were used - but all respondents acknowledged there was confusion about its meaning, and cited differences in respect to vertical strategic alignment based on individuals' functional biases. There were perceptions that the term 'productivity' had limited value due to this variation, "*whatever area you're in it is going to get looked at differently.*" (Manager*). For instance, the Head of Transformation described productivity as, "*reductions and efficiency, rather than anything else*", while the Operations Group Leader stated, "*It means producing an object or a service that you can sell to a customer. Something that's value-added*", and the Manager*, being focused on making things, defined it as "*bringing raw materials in, doing something with it, making money out of it and sending it to the customer*".

Perceived productivity constraints related to: decisions on company structure (i.e. productivity measurement, strategic focus, internal competition, and business complexity), managerial practice/talent (i.e. cultural aspects, workforce engagement, lack of encouragement, leadership and management capabilities); and the need for higher quality capital and labour inputs (i.e. knowledge and skills, working hours and pay, suppliers, machinery, aging workforce). There was some alignment

across senior and middle management about information technology and R&D being a constraint (e.g. machinery, suppliers). Productivity enablers were perceived as high quality capital and labour inputs (e.g. capital investment, working conditions, machinery, knowledge and skills development), and there was perceptible agreement between the Operations Group Leader and the Manager* about good managerial practices/talent being enablers.

In summary; however, there was no tight alignment of productivity perceptions across all levels. Definitions varied focusing on cost-based efficiency, the generation of product/service for customers to create value, and conversion of inputs to value-added outputs.

Key antecedents contributing to misalignment, according to Syverson's (2011) antecedents, related to: (i) managerial practice/talent - with key factors being the company's culture, the variation in the type of language used, a focus on measurement, and some disengagement with the workforce; (ii) company structure decisions - where the strategic focus supported a narrative of efficiency, cost cutting and measurement – while operational accounts were more aligned to productivity.

4.5 Pharma1

There was no alignment in productivity perceptions in Pharma1. The Site Director described productivity as, "*how we drive our cost-of-goods down in order to remain competitive*", while the Site Operations Manager* referred to cost reduction, efficiency and improvement stating, "*we've always talked about things like efficiency and cost but I don't think the word 'productivity' is the one we hang on"*. The Shift Supervisor provided a narrower perspective focusing on production and the completion of work, "*to me it's about getting as much out of what you put in and a very general term.*"

Key perceived productivity constraints, according to Syverson (2011), were managerial practice/talent (e.g. knowledge and skills, decision making), high quality capital inputs (including machinery, capital investment and ROI, component stockpiling/uncertainty), and knowledge and skills. A number of

additional constraints were mentioned including "*access to support*" (Site Director), "*machinery and cost cutting*" (Site Operations Manager*), and the "*sector's innately high-cost characteristics and the uncertainty over inputs*" (Shift Supervisor). All respondents identified managerial practice/talent as a perceived productivity enabler, while the Site Director and Shift Supervisor aligned over capital investment. Additional perceived enablers included machinery and working conditions (Site Director); and from the Shift Supervisor's perspective, suppliers' behaviours and product development practices.

In summary, there was no overall alignment in productivity understanding in Pharma1. Definitions varied around cost-based efficiency, leveraging value from inputs, and driving costs down. Perceived antecedents contributing to misalignment, according to Syverson (2011), were (i) managerial practice/talent with key factors being leadership capabilities, knowledge and skills, and some disengagement with the workforce; (ii) company structure decisions where the strategic focus, operational activities and success indicators gave a negative account of cost-cutting and overly lean thinking.

4.6 Pharma2

In Pharma2 there was vertical alignment across all three management levels. Respondents talked about increasing volume, and more specifically about the company's measurement system. The Operations Director clearly defined productivity as, "*being able to produce what you can produce in the best most efficient way possible. You can look at particular measures of whether it's tests [units of output], or units per head ...; or you can look at it from a cost perspective. How much labour you spend versus how much you produce*", and similarly the Technical Operations Manager saw it as, "*an expression or description of how much, or how many units of something you get out of how much effort you put in. So, not to be confused with efficiency.*" The Operational Excellence Scientist perceived it as being, "*… all about innovation of your throughput, how you increase your capacity without*

decreasing or increasing your head count … trying to make the most of what we've got and making sure productivity of your people is good."

Perceived productivity enablers include managers' skills and decision-making as the prevailing driver, along with new technology and machinery with reference to information technology, R&D, and communications more broadly. Perceived productivity constraints were attributable to unnecessary organisational complexity, aspects of leadership and management, unnecessary organisational change, and poor company culture.

In summary, there was vertical alignment of productivity perceptions in Pharma2. The prevailing perceived positive antecedents, according to Syverson (2011), were (i) managerial practice/talent, with a key factor being the company's culture; (ii) learning by doing, where people talked about the use of visual performance management boards; and, (iii) company structure decisions, relating mainly to a recent successful takeover by a foreign company.

4.7 Pharma3

Productivity perceptions were aligned in Pharma3, as were productivity metrics. The Operations Director defined productivity as a combination of, "*Efficiency, cost reduction, takt time and process time*", in line with the Chief Technology Officer* who defined productivity as efficiency, stating that, "*They [efficiency and productivity] are kind of the same thing*". Similarly, the New Product Integration Manager argued that, "*We don't often mention productivity as a word … you know the guys talk a lot about efficiencies*".

Perceived productivity enablers were the shared understanding of productivity and the pivotal role played by IT systems that force the introduction and adoption of highly structured metrics. Although the Senior Production Manager stated that, "*we do need to look more at the automation side of things; we need to get smarter in the way we're doing stuff*." The New Product Integration Manager

highlighted how investments in IT were having a positive effect, "… w*ith our new ERP [Enterprise Resource Planning] system giving standard times for production planning; picking products, sub-assembly build, final production, and testing … getting all those right is critical to maintaining our efficiency and productivity*".

In summary, for Pharma3, there was alignment of productivity definitions, according to Syverson's (2011) antecedents the positive causes were: (i) managerial practice/talent, as all those interviewed bought into a similar philosophical production definition; (ii) information technology and R&D, as ERP systems and their metrics were fundamental for everyone; (iii) product innovation linking this with new products and their manufacture; and, (iv) company structure decisions - connecting strategic plans to operational decision making.

4.8 Auto1

In Auto1, there was a common understanding of productivity perception although 'productivity' was not an improvement metric. The Plant Director perceived productivity as, " *… making people work smarter … driving productivity has always been about making the existing product with as little resource as possible and maximising resources*". Meanwhile the Assembly Operations Manager viewed productivity as, "*inputs into making something, or producing a product, and comparing it to the outputs*" and the Assembly Team Leader said, "*I think people talk more about efficiency as opposed to productivity these days*." There was a view that '*efficiency'* could imply production volumes only, whereas '*productivity'* included wider dimensions of cost, quality and on-time deliveries.

'People' were emphasised as perceived enablers for productivity. Interviewees spoke of knowledge and skills both for 'hard', (e.g. using machinery), and 'soft' skills (for management and engagement). With relatively high labour costs (a constraint), the focus was on getting the most out of people, "*by making people understand why we're doing what we're doing*". Notably, there was emphasis on ensuring consistency of working practices.

In summary, for Auto1, there was vertical strategic alignment in perceived productivity understanding up and down the strategic, operational and tactical levels of the company. Antecedents contributing to alignment, according to Syverson (2011), related to: (i) managerial practice/talent promotion of common purpose and performance monitoring; (ii) higher-quality labour and capital inputs with significant emphasis on knowledge and skills; and, (iii) company structure decisions where managers drove change to remove waste.

4.9 Auto2

There was no common understanding, or clear definition, of productivity in Auto2 although the respondents could articulate performance using their own metrics. The Chief Executive defined productivity as, "*there's all sorts of types of productivity; there's labour productivity, capital activity, … , it just depends what word you put in front of the word 'productivity' … but most people here will look at labour and percentage-of-sales as an indicator of productivity*". In contrast, the Group HR and Development Manager referred to it as, "*filling customers' orders, on time, in full. Also, making sure that we're not wasting anything … So, doing things as efficiently as possible*". Likewise the Group Engineering Manager described productivity as, "*how many components we make in a given time period … so it's hitting production targets we know we could make, or theoretically should make, against our plan.*"

In terms of perceived productivity constraints, all respondents spoke of collection and interpretation of data (through IT) as significant. Investment and maintenance of production capital were a challenge for the company, and labour costs were reducible. Reliability was also a significant concern. The quality of the managers' skills needed improving and everyone spoke of the need for continuous improvement and the effective management of people. The aging workforce was a significant concern, as was absenteeism and finding new people with appropriate skills and attitude.

In summary, there was no alignment about how productivity perceptions in Auto2. Definitions varied from sales contribution, to on time delivery and output volumes. Antecedents contributing to misalignment, according to Syverson (2011), pertained to: (i) managerial practice/talent with emphasis varying between standards, skills development and internal/external focus; (ii) higher-quality labour and capital inputs with differences in the focus on improvement; and, (iii) company structure decisions - where there were no common metrics.

4.10 Food1

In Food1 there was alignment around how productivity perceptions, although respondents recognised multiple productivity definitions, "*obviously, there's a wide range of meanings to the word 'productivity'*" (Operations Director). Interviewees tended to use efficiency and productivity interchangeably, "*a phrase that we use more often would be 'more efficient'*" (Operations Director) as, "'*Efficiency' is the language we use, 'efficiency' and 'labour recovery'*" (Production Manager) and, "'*productivity'… which I call 'efficiency'*" (Supervisor). The two most common metrics were, "*volume per hour*" and, "*labour recovery*" and interviewees understood targets associated with these measures. There was a common perception of productivity in the production function but 'productivity' was not so frequently discussed in other areas of the company.

All respondents mentioned the importance of information sharing and communication clarity as an enabler, with the Director talking about "*empowerment*" and the Manager and Supervisor talking about, "*the need for clarity from the top-level down*". Respondents also recognised that employing good staff was important, as poor quality work had previously affected productivity. Perceived productivity constraints included unnecessary process complexity and product variety, complex introduction of new products and long changeover times.

In summary, there was alignment of productivity perceptions even though 'productivity' was almost synonymous with 'efficiency'. Perceived antecedents contributing to vertical strategic alignment,

according to Syverson (2011), were: (i) managerial practice/talent particularly leadership capabilities, to communicate common purpose and empower teams through information sharing; (ii) higher-quality labour and capital inputs, with acceptance of appropriate automation and a "*can-do*" attitude; and, (iii) company structure decisions where a new management structure used key metrics to drive "*top-down*" Improvements.

4.11 Summary of cases

Table 2 summaries the results for each case to demonstrate the similarities and differences between the cases. Table 2 shows the breadth of interpretations of productivity interpretation by strategic, tactical and operational levels; the productivity factors as enablers or constraints; the alignment or otherwise of the key antecedents to productivity.

Case	**Productivity by level** **S** Strategic, **T** Tactical and **O** Operational	**Productivity factors** **+** Enablers and **-** Constraints	**Key productivity antecedents** **+** alignment and **–** misalignment
Aero1	**T, S**: efficiency, effectiveness **O**: performance-against-plan	**+** employee engagement, automation **-** employee engagement, customers, suppliers, product complexity	**-** managerial practice/talent **-** company structure decisions
Aero2	**S**: hours per project **T**: efficiency **O**: on-time delivery, utilisation	**+** digitalisation, upskilling **-** technology, geopolitics, product complexity, non-repetitive projects; innovation	**-** managerial practice/talent **-** company structure decisions **-** standardization versus innovation
Aero3	**S, T, O aligned**: output rate, quality, competitiveness	**+** labour quality, skills, training and engagement. **-** managerial practice/talent (both also as enablers), demand variation	**+** managerial practice/talent **+** company structure decisions **+** higher quality labour and capital inputs
Aero4	Varied across **S, T, O**: cost-based efficiency, value creation, inputs to outputs	**+** managerial practice/talent, high quality capital and labour inputs **-** company structure, managerial practice/talent, high quality capital and labour inputs, IT, R&D	**-** managerial practice/talent **-** company structure decisions
Pharma1	**S**: driving costs down **T**: cost-based efficiency **O**: value from inputs	**+** managerial practice/talent, capital investment, machinery and working conditions, supplier behaviour, product development practices **-** managerial practice/talent, high quality capital inputs, knowledge and skills, access to support, machinery and cost cutting, cost, uncertainty	**-** managerial practice/talent **-** company structure decisions

Pharma2	**S, T, O aligned**: Efficiency, output rate, inputs to outputs, innovation	**+** managers' skills and decision-making, new technology and machinery, R&D, communications **-** organisational complexity, leadership and management, organisational change, company culture	**+** managerial practice/talent **+** company structure decisions **+** learning by doing
Pharma3	**S, T, O aligned**: Efficiency, cost reduction	**+** shared understanding of productivity, IT systems, structured metrics **-** lack of automation, data standards	**+** managerial practice/talent **+** company structure decisions **+** information technology and R&D, **+** product innovation
Auto1	**S, T, O aligned**: Efficiency, inputs to outputs, maximising resources	**+** people, knowledge and skills **-** high labour costs, consistency of working practices	**+** managerial practice/talent **+** company structure decisions **+** higher-quality labour and capital inputs
Auto2	**S**: *labour and percentage-of-sales* ***T****: orders on time in full, no waste, output rate*	**+** continuous improvement, people management **-** collection and interpretation of data, capital investment and maintenance, labour costs, reliability, manager skills, aging workforce, absenteeism, recruitment	**-** managerial practice/talent **-** company structure decisions **-** higher-quality labour and capital inputs
Food1	**S, T, O aligned**: Efficiency, labour recovery, output rate	**+** information sharing and communication, empowerment, management clarity, staff quality staff **-** process complexity, product variety, complex new product introduction, changeover times	**+** managerial practice/talent **+** company structure decisions **+** higher-quality labour and capital inputs

Table 2: Summary of results by case company for productivity interpretation, productivity factors, antecedent alignment

Highlights to draw out in Table 2 include: variation between companies on the use of definitions, variations within companies on the definitions used (some aligned, some not), repeated citations of similar factors impacting on productivity, variations across companies in whether these factors were constraints or enablers and, finally, a variety of antecedents to productivity metric alignment but consistency in citation of management practice/talent, company structure decisions and higher-quality labour and capital inputs. These highlights will be explored further in the discussion section to draw out research propositions driven by the framework (Figure 1).

5. DISCUSSION

The following discussion draws on above case narratives and literature precis. Firstly, it considers the perceived definitions of productivity, barriers and enablers. Secondly, it considers the perceived vertical alignment of productivity definitions through strategic, tactical and operational levels of companies *(c.f.* centre of Figure 1). Thirdly, it abducts to strategic alignment theory to narrate how perceived antecedents of productivity enable or bar productivity endogenously or exogenously (*c.f.* Figure 1, centre and outside circles respectively).

The objective of this research was to develop propositions for further research into UK manufacturing productivity. Accordingly, the following discussion inducts develop empirically grounded propositions in the context of prevailing literature. The following three sub-sections on definitions, alignment and antecedents are drawn from the major themes of the case analysis and in particular the inconsistencies apparent in Table 2. The propositions drawn within each sub-section combines the challenges uncovered in the cases with the gaps in the literature.

5.1 Definitions of productivity

Findings shows that most companies do not explicitly define ‘productivity’, and ‘productivity’ was often synonymous to ‘efficiency’. Often productivity was an ethos rather than an explicitly named,

well-understood metric where references to quality, safety metrics and improvement activities were numerous.

Explicit definitions referred to productivity as an outcome, output against a plan or target, in line with Bernolak's (1997) definition. Most interestingly, no company agreed on a tight set of productivity metrics that directly aligned to the ONS' definition (ONS, 2022). The definitions varied within some companies, within sectors and across companies as shown in Table 2.

> **Research Proposition 1:** Investigate why there is a mismatch between the ONS definition of productivity and common perceptions of productivity in manufacturing companies.

On one hand, definitions provided at the strategic level were more representative of the long-term view and had a better understanding of multi-factor dimensions of productivity. This reflects Ghoabadian and Husband's (1990) findings about the wide range of usable metrics. On the other hand, at the tactical and operational levels, definitions tended to focus on shorter-term nature of the operations where interviewees often used single-factor productivity measures. It is interesting to note that the single-factor productivity measures, used by junior (operational) managers, are most similar to that used by the ONS - rather than more accurate and sophisticated multi-factor measures preferred by executives and senior managers. This aligns with van Ark et al.'s (2023) challenge to promote sustainable growth.

> **Research Proposition 2:** To design a useable universal multifactor measure of productivity usable by manufacturers *and* governments (e.g. the ONS).

Given the variation in definitions, influenced by context, it may not be possible to attempt a single common definition of productivity; but instead, one should use nuances from the above cases and quotes. These cases demonstrate a wide-range of productivity perceptions that match closely to

EANPC's (2005) definition. For instance, as a simple efficiency metric, common definitions were; input of labour hours to planned units of output (single factor), or input of all resources to output (multi-factor).

> **Research Proposition 3**: If single factor measures of productivity are used then users must be aware of their oversimplification and limitations, especially those that relate to growth and sustainability.

Some cases revealed a focus on productivity improvement; including greater output over a period for given resources, cost reduction and volume increase. Other cases focused on meeting demand, where productivity was not a customer aligned value adding set of activities (Neely et al., 1995; Tangen, 2005).

> **Research Proposition 4:** To establish typologies, or international standards, of productivity/efficiency measures for each industry sector to be used as competitive and/or longitudinal benchmarks.

Interestingly, as interviewees revealed deeper productivity perceptions, productivity increasingly related to people, but not akin to the Government's belief that it is a simple employee headcount. In contrast, productivity perceptions related to mind-sets, a collective belief of peoples' perceptions, context, purpose, skills-sets, and educational levels. Indeed, some saw innovation as counter to productivity. This realisation is largely absent from the literature on productivity definitions.

> **Research Proposition 5**: Productivity measures need to take into account skill levels, investment in automation, culture and attitude of the workforce rather than just a workforce head count.

Cases demonstrate that productivity is a multi-factor practice requiring sophisticated measurement systems. This research shows that most measures of performance are hugely oversimplified and

therefore, at best, crude proxy measures and at worse unhelpful misrepresentations. *Manufacturers need a usable multifactor definition of productivity taking into account Research Propositions 1-6 above.*

5.2 Alignment of productivity definitions

Case study narratives demonstrate an equal split between aligned and misaligned perceptions of productivity (illustrated by Table 2). When alignment was present, similar metrics and incidents from the recent past illustrated perceptions, this demonstrates the importance of a common company mind-set. Typically, aligned perceptions, supported by focus on similar metrics, gave clearer understanding of political drivers, and their effects on strategic alignment at different levels. Perceived greater alignment went hand-in-hand with higher employee education, aspiration levels and more mature IT competence.

> **Research Proposition 6**: Investigate whether 'soft' people-centred stories of productivity definitions or 'hard' systems of metrication are more successful at achieving vertical strategic alignment.

Moreover, in some companies classified as misaligned, there was alignment at the strategic and tactical level, but not at the operational level (e.g. Aero1 and Aero4). This is an unexpected result, according to Frohlich and Westbrook (2001). A possible explanation is that this study focused on 'perceived' definitions and not actual operational-level production metrics (e.g. lead-times, scrap-rates, etc.) and detailed behaviours of customers (e.g. forecasting accuracy) (Wong et al., 2012). These cases suggest most companies express alignment in operational (transactional) language rather than strategic (value-add) language. This is maybe because this study used only manufacturing companies who are more familiar with operational metrics. We suggest that aligning productivity perceptions and 'soft' perceptions is a necessary precursor to aligning actual productivity practices and metrics.

> **Research Proposition 7**: Investigate how to reduce the gap between metric/measurement systems, predominantly used by the operational workforces (and the ONS), and 'value-add' language of productivity, used by tactical-senior level managers.

Strategic vertical alignment varied across case companies. Perceptions showed that, irrespective of alignment, it was possible to detect different strategic, tactical and operational foci (Larsen et al., 2018). For example, in non-aligned business Aero1, the Director talked about workforce efficiency at the company level, the manager talked about maximising the efficiency of the workforce, whilst the supervisor was specific about metrics such as customer demand.

Vertical alignment across all three management levels was not typical. Whilst some respondents in senior positions made the strategic role of productivity explicit, few also engaged in detailed definitions of the metrics. Thus, there are implied metrics of productivity through vertical levels, but their degree of alignment or misalignment found by this research highlights a gap in practice. Namely, how to produce a system of metrics for collective productive mind-sets that includes 'harder' metrics (for operational-tactical levels) and 'softer' value metrics (for tactical-strategic levels) that can also be used by external interested parties.

> **Research Proposition 8**; produce a holistic performance management system, designed around productivity that includes both hard and soft measures for operational, tactical, strategic and economic levels of analysis?

5.3 Antecedents influencing vertical alignment

Syverson's (2011) productivity antecedents shown in Figure 1 extend to the immediate business environment; and thus, influence exogenous economic environmental factors, especially those in supply chains, and vice versa. Five of the productivity antecedents were evident in these company

cases. The most influential productivity antecedents were Managerial Practice/Talent, and Company Structure. This fits with recent research (e.g. Bender *et al*., 2018) and evidence presented in the UK Government Business Productivity Review (HM Government, 2019).

In respect to 'managerial practice/talent', most commonly cited and influential was employee engagement. The alignment importance highlighted in scientific literature (e.g. Skipworth et al., 2015) makes it is easy to understand why leadership (Gattorna, 2017), and higher involvement of employees, enhances and aligns a company's understanding of productivity.

The 'structure of the firm/company' was the second most mentioned perceived productivity antecedent. Company structure played a key role in terms of process improvement and performance measurement. This is because performance measurement enhances alignment, and process improvement acts as an enabler for alignment and can imbibe consistency and objectivity in measurement systems. In general, these cases suggest strong underlying strategic foci on process improvement and product innovation as enablers of alignment. It is therefore possible to posit a strong management team and distinct company identity facilitates better understanding of shared values, and thus alignment between the different vertical levels within a company.

Another perceived productivity antecedent of vertical strategic alignment is the level of maturity in terms of 'communication and IT' infrastructure. Indeed, on the one hand, IT automation forces the definition of a set of objective performance indicators, thus enabling alignment. Communication, on the other hand, also facilitates information sharing and thus alignment.

In addition to Syverson's (2011) and Larson's (2018) antecedents an important meta-antecedent was revealed by this study. This was the *enabling* antecedent *to find, acquire and imbibe*: 'high quality general labour and capital input' (in two companies), 'information Technology and R&D', 'product innovation', and 'learning-by-doing' (all mentioned by at least one person in each company).

Conversely revealed was the *barrier* antecedent *inability to find, acquire and imbibe:* 'high quality general labour and capital input' and 'information technology and R&D' (evident in every company).

> **Research Proposition 9**: Find further contemporary antecedents of productivity applicable to manufacturing innovation.

Surprisingly the antecedent of 'innovation' did not come out strongly. Perhaps this was because questions were asked to productivity orientated employees rather than more innovative roles. Whilst process improvement came through it was not expressed in the context of innovation.

6. RESEARCH IMPLICATIONS

The above discussion posits nine research propositions related to productivity definitions, productivity definition alignment and antecedents to alignment. These propositions call for greater fundamental research for the field of productivity. The major weakness of the current body of knowledge on productivity is the lack of common understanding of the meaning of productivity and the objective of productivity measurement. This weakness exists between national government and individual companies and within each company. Surprisingly many companies in this research did not have an aligned understanding of productivity from operational through to strategic levels.

First, the research is needed to establish either a single common definition of productivity or definitions that can be translated between different users. None of the (UK) companies in the research sample had a definition that aligned with the recognised (UK) national definition. Whether definitions are single or multi-factor, it was clear from the research that government assessment of productivity was different from how companies conceive productivity. This could mean that policy interventions at a national scale may not trigger the desired response at company scale. Additionally, at company level the perception of what productivity was seeking to measure and in turn be used for action varied between softer, people focused to harder process focused. This difference was observed between the

strategic through to operational areas of a business and the seniority of the managers. Such differences call for more research into how to design a definition of productivity that acknowledges the breadth of potential productivity improvement behaviours.

Second, the alignment of the definitions of productivity matters because driving productivity at a strategic level may not result in the desired response at operational level or result in inefficiencies in achieving the desired response. For research, the perceived definition of productivity as distinct from the actual metrics could be a potential cause of underperformance in manufacturing companies. The language of productivity is common in manufacturing so it is unclear why a company would allow multiple perceptions of it to exist across operational, tactical and strategic levels and not ensure alignment. It would be valuable to understand why misalignment can occur and what needs to be done to bring about alignment. This research suggests higher employee education, aspiration levels and more mature IT competence were highly influential. That is of course assuming that alignment of definitions would bring about a more effective company operation.

Third, more research is required to understand factors or antecedents influencing alignment. Many were discussed in this research with managerial practice/talent, engagement, company structure, communication and innovation being frequently cited. These can be barriers or enablers - with different companies suggesting both. A greater understanding of the antecedents to productivity could enable suitable conditions to be set for greater organisational productivity definition alignment across levels. How these antecedents can bring about alignment and to what extent these are beneficial is untested.

Fourth, a particular focus on innovation is also needed in productivity research. Innovation might be thought of as an enabler for productivity through the introduction of new technologies or product designs; but for some innovation is seen as a barrier to productivity. Therefore more research is

needed on the conditions for innovation and how it impacts on productivity across the levels of a manufacturing business over time.

7. SUMMARY

This exploratory research sought to develop propositions for further research into UK manufacturing productivity. Using empirical evidence this paper has: (i) defined manufacturers' perceptions of 'productivity' with perceived barriers and enablers; (ii) enquired into perceived antecedents of productivity; (iii) discovered differences in perceptions of productivity between different vertical levels of management (i.e. alignment/misalignment between strategic, tactical and operational levels); and, (iv) compared and contrasted managers' perceived definitions of productivity to theory, especially to the Office for National Statistics' (ONS, UK) definition, and given practical propositions to further research into the UK's manufacturing. This has used a modified form of the strategic alignment model to include productivity antecedents of Syverson (2011) and Larson (2018) (c.f. Figure 1).

Findings demonstrated an equal split between perceived alignment and misalignment. Among perceived antecedents affecting the level of alignment the most mentioned one was employee engagement, followed by the structure of a company, and then the level of maturity in terms of communication and IT infrastructure. It is important to highlight that the study focused on perceptions of productivity rather than data extracted from productivity measurement systems.

Contributions from this research are fourfold, benefitting academic and practice alike, it has: (i) captured practice-based perceived definitions of manufacturing productivity, with perceived barriers and enablers to productivity (ii) defined how manufacturing companies and manufacturing managers perceive the antecedents of productivity (iii) delivered original empirical cases on alignment and/or misalignment of productivity perceptions in manufacturing companies; and, (iv) given theoretical *reflections* on strategic vertical alignment theory / productivity antecedents (using Figure 1) and practical *propositions* for further research into the UK's manufacturing productivity puzzle.

This study is limited by using a small number of case companies (ten) in four manufacturing sectors, but every effort has been taken to give generalizable propositions and abductive discussion relating to either productivity theory or vertical strategic alignment theory as given in Figure 1. Findings should therefore be transferable to other sectors and studies on productivity. Further research could include (a) deductive testing of the propositions in a large-scale questionnaire using statistical methods and, (b) correlation of vertical alignment with actual productivity metrics.

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Appendix A: Interview Protocol

1. Introduction to project

- Project overview – aim, funder and universities involved.
- Confirm permission to record interview.
- Sign consent form

2. Control data (participant and organisation)

- Participant title, role, and management level in the organisation.
- Length of time in this role and brief history in this organisation.
- Parent company? (Where and what level of independence exists)? Other sites?

3. Your perception of productivity

- What does the term 'productivity' mean to you?
- Do you think productivity is important for an organisation like yours? Why?
- Is there consensus about what productivity means in your organisation?
- How do you discuss productivity? (E.g. definition, key messages, context)
- Do you see productivity and efficiency as being different?

4. Productivity enablers / inhibitors

- Is anyone actively encouraging productivity in your organisation? If so, who is doing this and how is this undertaken? Examples of messages, activities etc.

5. Productivity performance and measurement

- How does your organisation measure productivity performance?
- How is the organisation performing against these measures?

OR

- How do you measure productivity in your area of the business?
- How are you performing against these measures?
- How could productivity be improved in your organisation (OR your area of the business)?

6. Antecedents influencing productivity (enablers and constraints)

- What key factors (internal and external) constrain productivity in your company?
- What key factors (internal and external) support productivity in your organisation?

7. Ask about the following further aspects as and when relevant

Holistic / Systemic prompts
Suppliers
The quality or nature of **inputs** (e.g. poor quality materials can slow production and increase rejection rates).
Internal controls
External regulations
Specification of outputs by customers (e.g. are there unnecessary requirements that could be removed such as packing that could speed things up?)
Customers
Machinery (including technology)
Knowledge and skills
Sector characteristics
Capital investment
Working hours and pay
Level of leadership and management capabilities
Complexity of business operations

Size
External operating context e.g. education, transport, export and innovation levels

8. Future challenges

- What are your main future challenges in terms of productivity?
- What type of support would help you address these challenges?
- Do you think there is a productivity problem in (i) your sector (ii) the UK?

8. Closing

- Anything further to add?
- Opportunities to discuss further with other employees / company tour?