THE PRODUCTIVITY, PERFORMANCE AND QUALITY PARADOX: AN ALTERNATIVE PERSPECTIVE

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Productivity, quality and flexibility are critical measures of performance for justifying the investment in manufacturing and production systems, including construction. Existing knowledge in Architecture Engineering and Construction (AEC) informs us that performance, productivity and quality are interconnected through conventional measures, focused on cost but which are implemented in practice through trade-offs affecting one or more in project outcomes. This paper offers a theoretical discussion which aims to create a dialog on how the AEC sector should evaluate the roles of both traditional cost-focused measurement and non-traditional measurement methods. Investing in people, both as a stock of knowledge and having expertise could be a way to increase productivity which, as extant research shows, will have on-going positive effects on both quality and performance.

Keywords: performance, efficiency, quality, paradox, value

INTRODUCTION

Extant research and theory posit that performance, quality and productivity constitute a paradox for the AEC sector. Construction business organisations aim for all three, yet they understand, from an economic perspective, that attainment simultaneously is often difficult at best. Trade-offs become an integral part of the process of decision-making in construction as limited resources and finite budgets force choices between performance, quality and productivity (the 3 Ps). Making decisions requires trading off one item against another. In economics, the term trade-off is often expressed as an opportunity cost, which is the most preferred possible alternative. A trade-off involves a sacrifice that must be made in order to get a specific outcome. This paper offers then a theoretical discussion which aims firstly, to review relevant arguments about performance, quality and productivity and how they related to trade-off, and secondly to create a dialog on how the AEC sector can look at non-traditional measuring methods. It is proposed that by investing in people (Human Capital) both being a stock of knowledge and having expertise, as a way to increase productivity which, as existing research shows, will have on-going positive effects on both quality and performance, and enable trade-offs to be reconsidered in ways that do not reflect costs and the bottom-line alone. Many authors have written on the 3 Ps independently, however when the three are considered as an entity there is a dearth of

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Scott, L and Kanjanabootra, S (2019) The Productivity, Performance and Quality Paradox: An Alternative Perspective *In:* Gorse, C and Neilson, C J (Eds) *Proceedings of the 35th Annual ARCOM Conference,* 2-4 September 2019, Leeds, UK, Association of Researchers in Construction Management, 134-142.

research that has been shared on this topic. The authors are of the view that much needs to be done to explore and develop this topic. We ask then:

how will construction organisations gain the best possible chance of achieving performance, productivity and quality goals, and subsequently minimise the need for trade-offs and maximise business value in a construction project, other than by cost?

The Paradox of Performance, Productivity and Quality

In trying to establish an argument about the interrelationships of performance, productivity and quality, it is essential to understand business intent or strategy. Porter (1980; 1985) argues that the fundamental purpose of strategy is the creation of business value concentrating on cost leadership, product or process differentiation, and/or focus. Porter argues that the creation of business value represents the essence of strategy, but that value needs to be measured. Performance Management is the most accepted means of measurement of business value created by strategy through a multitude of measurement systems such as 6-Sigma, TQM, BPM, PRR, etc. However, the focus here is not on these systems but on trying to tease out where the sources of value, the factors of production, can be used to enable some form of solution to what is seen as a paradox. In the literature some argue that productivity and quality are interconnected others argue that quality and performance, and productivity can performance are also interconnected. All are considered valid. Yet the interconnected nature of all three produces differing interpretation again all considered valid but unresolved.

Performance is argued by Rolstadas (1998) to be a complex relationship involving seven performance criteria: effectiveness, efficiency, quality, productivity, quality of work, innovation and profitability. Performance is essentially defined by a performance management system, a collection of specific metrics designed for multiple purposes: management accounting, strategy evaluation, or financial actions (Bossioni *et al.,* 2004; Franco-Santos *et al.,* 2007). In the AEC literature, performance is defined by how it is measured (Yang *et al.,* 2010; Love and Holt 2000; Cain 2008). Essentially construction projects and organisational performance are assessed by a set of ratios evaluating the relationships between the costs of inputs (labour, capital) and the benefits created as outputs (Kagioglou *et al.,* 2001; Ali *et al.,* 2010). Four sets of measurements are used and usually set as KPIs (Liu *et al.,* 2014; Beatham *et al.,* 2004). The first, financial performance, uses ratios of profitability, growth, financial stability and cash flow (Yu *et al.,* 2007). The second, customer relationship performance is measured by ratios that assess the quality of service and work (El-Mashaleh *et al.,* 2007), or that measure external customer satisfaction (Rankin *et al.,* 2008), or measure market share (Yu *et al.,* 2007). Thirdly, the literature identifies measures of internal business performance with ratios assessing safety (El-Mashaleh *et al.,* 2007; Rankin *et al.,* 2008), business efficiency and the effectiveness of planning (Yu *et al.,* 2007). Fourthly and more recently, measures of sustainability performance are being incorporated and assessed as part of the creation of value as integral to business strategy (Teh and Corbitt 2017).

However, this traditional approach does not capture other aspects that relate to performance (Neely *et al.,* 2001). Bassioni *et al.,* (2004) reviewed contemporary performance measurements in construction and argued for the inclusion of non-cost measures, quality, time, process, and flexibility, the earlier proposals of Cross and Lynch (1988) offered a performance pyramid that included a company's vision, market measures, finance measures, customer satisfaction, flexibility**,** productivity,

quality, delivery, process time, cost and operations. In contemporary business performance these outcomes are collated and most often measured as the Triple Bottom Line (Elkington 1998; 2013). One of the key elements we believe missing from this work, there could be others, is the value created by knowledge stocks, and the expertise of human capital as each contributes to performance, productivity and quality.

The Relationship Between Productivity and Performance and Quality

Productivity of any resource has been characterised by the OECD as a ratio of yield to inputs utilised for a specific activity of a process in the production of goods, services or any other product and construction (OECD, 2001). The existing research highlights some of the factors affecting construction productivity, namely rework, poor supervisor competency and incomplete drawings (Hughes *et al.,* 2014); unwell pre-construction planning, mismanagement of materials onsite and overcrowded tradesmen on site, change of scope of work and excessive variation order (Noaum 2016); and errors or inconsistencies in project documents, lack of requirement specifications in tender documents, and unforeseeable authority requirements or restrictions (Larsen *et al.,* 2015). Each in turn increases time-cost, resources cost and labour costs.

Performance is positively correlated to productivity (Arashpour and Arashpour 2015). However, that research sometimes, inadvertently, identifies the necessary role of trade-offs between elements of efficiency and the attainment of performance goals. In the traditional economics-driven business model, choices are made between the keys factors of production, the price of labour and the price of capital (investment in resources, machinery). The maximization of profit (performance) for a given level of expenditure (budget) is a ratio of these two. This ratio represents a way of perceiving, albeit simply, the relationship between productivity and performance. The determination of profit will vary between construction projects but inevitably there is a decision-making process where trade-off decisions are made to maximize the ratio of the two.

None the less, the modern economy is being disrupted by new inputs into the determination of productivity and therefore performance. Knowledge resources and the adoption of KM in construction has been shown to reduce the inefficiencies of operations (Al-Qubaisi *et al.,* 2018). These knowledge resources are sometimes translated into capital as either new technologies and/or new innovations. BIM for example has the potential to replace the paper-based tools of construction projects, with a digital environment improving levels of efficiency, exceeding those of traditional construction processes (Lee, 2008). Bryde *et al.,* (2013) showed that cost was the one most positively influenced by the implementation of BIM followed by time, communication, coordination improvement and quality. Each new technology input has a distinct cost (cost of software, cost of hardware, increased labour costs to purchase expertise for implementation and operations) and thus a price. However, there is an extended argument that the ‘new’ or ‘the innovation’ brings greater benefits by decreasing the price of ‘normal labour’ as there is less needed or less time is needed in the construction process. This is often wishful thinking as the research about technology and innovation adoption would suggest otherwise, increased time, increased cost and increased complexity. For example, Trkman (2010) refers to the return/evaluation of IT investments, which he indicates has been a challenge across all industries in the last four decades. On the other hand, Brynjolfsson and Hitt (1996)

argue that this is a phenomenon in the short run only and often resolves in the longer term, a dilemma when the expectancy of investment in innovations like IT is short run return. Carillo *et al.,* (2013) show that the implementation of KM systems, for example, is often ad hoc and adopted in an environment where expectations are that the system itself generates benefits. It is humans who generate benefits from technology adoption. This argument remains unresolved. However, knowledge, technologies and innovations are grounded in investment in human capital, the source of expertise. Again this suggests that alternative measures other than costs alone should be included in business models in construction, as a key element in the development of productivity, the attainment of quality and the achievement of business performance and value.

In the Construction literature quality is most commonly defined as conformance to requirements meeting customer expectations (Ali 2010). Often quality is assessed in construction against strict criteria in quality management systems such as ISO, TQM, JIT, BPR, Balanced Scorecard and 6 Sigma (Daniel 2016; Willar *et al.,* 2016). Such itemization of quality is mandated in construction in many countries (Ofori *et al.,* 2000; Turk 2009). The assumption of quality management systems is that adherence to quality processes will lead to measurable quality improvement. QM practices contribute to operational and financial performance, allowing a firm to achieve competitive advantage (Kim *et al.,* 2012). Construction productivity would be affected adversely if the materials required for use are not available in the quantity or quality required when they are needed (Pheng 2001; Pheng and Meng 2018). Mahmood *et al.,* (2014) highlighted this relationship between poor quality and productivity in projects. If quality is poor it negatively impacts on performance through increased costs and poor productivity.

Conventional wisdom offers that productivity, quality and flexibility are critical measures of performance for justifying the investment in manufacturing and production systems, including construction. Existing knowledge in construction informs us that performance, productivity and quality are interconnected through conventional measures. For example, if productivity increases, performance most probably also increases and vice versa. (Karunarate 2015). However, this conventional perspective is focused on cost and value production as profit. Essentially the existing research literature and theory proposes a business model based on the following general propositions, which can be represented as a simple model as shown in Figure 1 where decision making is reflected through the trade-offs made between each of performance, productivity and quality:

- Performance is measured through cost/benefit ratios;
- If productivity increases performance increases and vice versa;
- If resources increase, productivity increases;
- If quality is poor, productivity will decrease;
- If quality is poor, little business value is created;
- Quality is a good measure of performance;
- Expertise has positive effect on performance;
- If productivity improves, it will improve expertise?
- Implementation of Quality Management Systems will increase performance;
- Productivity, quality and flexibility are critical measures of performance.
- There is a positive correlation between performance and innovation.

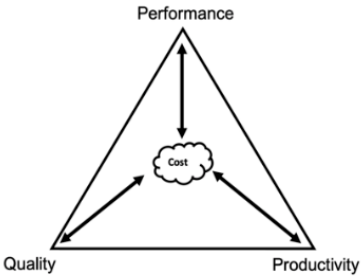

Fig: 1 The conventional construction business model

However, the very important point here is that the model makes no recognition of the effects of the disruptors or of the explicit value created by human capital. Human capital is a source of knowledge and expertise of the organization which subsequently will bring innovation to the organization. Human Capital are the elemental knowledge storehouses of organisations (Egbu, Botterill and Bates, 2001) which provide the intellectual capital that facilitates both efficient management and the possibilities of innovation adoption (Egbu and Robinson 2005).

An Alternative Business Model in Construction

In seeking to increase Performance, Productivity and Quality overall, it is important to look at the whole as well as the parts of a system and to understand how each part interacts with the others. History suggests there are deep-seated problems holding construction back as it struggles to improve performance and quality along with raising productivity (eg. Al-Qubaisiet al., 2018; Arashpour and Arashpour 2015). The argument here is that quality, productivity and performance are tangled in a traditional TQM like chicken and egg and centered by cost. For example, if an organization increase performance the productivity will also increase but quality also has impact on performance. For example, if a company finish construction project fast (this mean high performance) but the quality is not up to scratch and the building is full of defects. Therefore, you cannot say that that company has high performance.

Previous research outside construction identifies the role of human resources in business performance (Young and Berman 1997). More recently the research literature has focused on the role of expertise (Chan 2016; Mogendorff 2016) knowledge and the value they create in construction. That expertise can become an investment in human capital and therefore, we argue, can generate a focus on knowledge resources as a co-focus with cost within the business model (Fig 2)

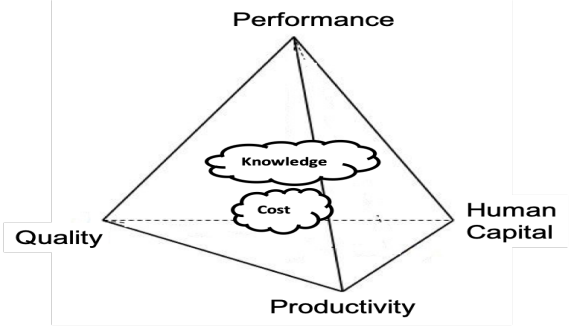

Fig: 2 Alternative business model in construction

What is not evident here, and certainly not in the conventional construction business model, (Fig 1) is an understanding of how these might enable moderation of the trade-

offs necessary in the conventional model. The existing research literature often shows the relationships between performance and various elements including finance, time, health and safety, functionality and the last two elements of our conundrum, quality and productivity (eg. Bossioniet al., 2004; Franco-Santoset al., 2007; Love and Holt 2000). It is argued here that there is no explicit established relationship between performance and knowledge and expertise. It appears that there is an implicit assumption that knowledge and expertise already exist in the business equation creating value. This begs a number of questions for research: how can a relationship between performance and knowledge and expertise be measured? What will the impact of that relationship be on quality and productivity?

As referred to earlier, the conventional wisdom is that productivity, quality and flexibility are critical measures of performance for justifying the investment in AEC sector. A 'compartmentalised' approach to knowledge management and expertise in this area is somewhat problematic, however, it is not entirely the fault of the sector as it has a plethora of disparate mandates ranging from security to education, legal interpretation, health, and service delivery and to harmonise knowledge expertise approaches across all would be a tall order. In order for the AEC sector to capitalise on the benefits of knowledge and expertise it is essential for it to overcome the cultural barriers that permeate its hierarchies by increasing teamwork, reducing bureaucratic decision making and increasing value management. With the advent of new public sector project structure in many regions, a less compartmentalised management regime for projects and the drive for cultural and efficiency changes, tomorrow's public sector projects could be less of a mystery and more of an open, transparent and practical service which will benefit public interest and so society. silo

CONCLUSION

As the diverse nature of the AEC sector, a 'one size fits all' solution is not applicable, for example, knowledge expertise delivery in house building sector, for example is subject to completely different parameters than knowledge and expertise applied through their application in infrastructure pharmaceutical projects. There have been few frameworks in the literature aimed at identifying the disparate nature of knowledge expertise and no single framework aimed at identifying individuals in the AEC sector and attempting to capture the knowledge/ expertise they hold.

A framework put forward that attempts to look at AEC sector knowledge expertise from an overarching perspective, which gives the reader an insight into high level AEC sector specific attributes. A way of developing this might be through communities of practice (COP). COP have been researched with the specific issues that are conducive to its proliferation in the public sector being discussed, such as its propensity to facilitate knowledge sharing, but in order to be successful, communities of practice must have management recognition, potential rewards, and requisite IT infrastructures.

The suggestion then is that collaborative performance in projects (joint specification, selected tendering, soft parameters in bid evaluation, joint subcontractor selection, incentive-based payment, collaborative tools, and contractor self-control) generally have a positive influence on project performance (cost, time, quality, environmental impact, work environment, and innovation). It is additionally proposed that these relationships are moderated or mediated by the collaborative climate (i.e. the trust and commitment among partners) in the project and moderated by the overall project characteristics (i.e. how challenging the project is in terms of complexity,

customisation, uncertainty, value/size, and time pressure). Based on this contribution, future research can, once developed, test any framework empirically to further increase the knowledge about how expertise and the impact on productivity and performance factors may influence project success.

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