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INTANGIBLE CAPITAL AND REORIENTATION OF MANUFACTURING DURING A PANDEMIC

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ABSTRACT

The Covid-19 pandemic has put enormous pressure on firms to respond to the economic downturn, while also providing opportunities to contribute to the health-care challenges. We investigate firms within the Sharing in Growth (SiG) programme, a government-funded transformation programme in the UK aerospace sector. We evaluate the firms that responded to the UK Ventilator Challenge, to provide equipment to the UK National Health Service (NHS) in order to tackle the pandemic, compared to the firms that did not respond. The study shows that intangible capital in terms of organizational capital is a key capability in responding to opportunities provided by the UK Ventilator Challenge. In particular, we show that the role of leadership in fostering a culture of engagement and empowerment via continuous experimentation and learning is a key capability for firms in responding to sudden and unexpected changes in the environment. Moreover, the study shows that the building and subsequent effectiveness of these forms of organizational capital among the SMEs would not have been possible without the benefits accruing from the SiG programme. We discuss the managerial and policy implications of our findings.

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1. Introduction

The Covid-19 pandemic has put enormous pressure on firms to respond to the economic downturn, while at the same time providing opportunities to contribute to the health-care challenges (Chesbrough, 2020; Financial Times, 2020). Some firms have responded better to these opportunities and challenges than others.

The Covid-19 pandemic is unique, resulting in significant and simultaneous changes in demand and supply conditions. In order for firms to increase tolerance to such uncertainty and secure their future, they need to have adaptive market orientation capabilities to sense and respond to emerging opportunities (see Day, 2011). Adaptive market orientation is a form of dynamic capability, as it includes organizational routines and capabilities to sense, seize and reconfigure resources based on identified opportunities (Wilden, Gudergan and Lings 2019). Teece (2007) emphasized that the ability of firms to enhance, combine and reconfigure their intangible and tangible assets is a core part of dynamic capability. We investigate how organizational capital influences firms' ability to respond to the opportunities provided by the pandemic (Kaplan and Norton, 2004). Organizational capital includes the firm's leadership and culture, including the degree of alignment of the employees with strategic goals and their ability to share knowledge.

We study 46 firms within the Sharing in Growth (SiG) programme. This government-funded transformation programme raises the productivity and capability of small and medium-sized enterprises (SME) in the UK aerospace sector. We evaluate the firms that responded to the UK Ventilator Challenge, to provide equipment to the UK National Health Service (NHS) in order to tackle the pandemic, compared to the firms that did not respond. Of the 46 SiG beneficiary firms, 11 participated in the UK Ventilator Challenge. We collected and analyzed sales per head and operating margins from publicly available annual financial reports of firms involved in the SiG programme as well as comparative firms in the aerospace sector not involved with the SiG programme. We find that firms involved in the SiG programme had better financial performance compared to a comparative set of firms not involved in the SiG programme. In addition, we find that SiG beneficiary firms that

were involved in the UK Ventilator Challenge had better financial performance compared to firms that did not participate in the UK Ventilator Challenge. In order to investigate these findings further, we conducted in-depth interviews with three firms that responded to the UK Ventilator Challenge.

The study shows that intangible capital in terms of organizational capital is a key capability in responding to opportunities provided by the UK Ventilator Challenge. In particular, we show that the role of leadership in fostering a culture of engagement and empowerment via continuous experimentation and learning is a key capability for firms in responding to sudden and unexpected changes in the environment. Moreover, the study shows, from a policy perspective, organizational capability-building programmes such as SiG are important to overcome the market failure arising from underinvestment in intangible capital which is required to strategically adapt in periods of extreme uncertainty such as the pandemic.

The next section reviews the literature. In Section 3, we conduct some empirical analysis of the SiG beneficiary firms. Section 4 describes the cases studies. Section 5 discusses the findings and Section 6 concludes.

2. Literature Review

Marketing scholars have emphasized that market-oriented firms tend to be more innovative and have superior performance (see Dong, Zhang, Hinsch and Zou, 2016; Kohli & Jaworski, 1990; Narver & Slater, 1990). Studies have emphasized the capabilities that help firms to identify changes in their environment and respond by providing new customer value propositions (see Day, 1994; 2011). Firms need to utilize knowledge on market insights to create effective new value propositions for customers in order to capture emerging opportunities (Day, 2011). In a fast-changing environment, firms need to develop capabilities to help them anticipate changes, shape the market and respond to opportunities that might arise. Day (1994) outlines that capabilities to sense and respond to the market can be usefully classified into three types: outside-in, inside-out and spanning processes. Outside-in capabilities enable firms to connect the processes to the external environment and to anticipate market and customer requirements ahead of competitors. Inside-out capabilities are activated by market requirements, competitive challenges and external opportunities that focus on processes for oversight

and control. Spanning capabilities help firms to integrate the inside–out and outside–in capabilities in order to generate value. Day (1994) called the combination of these adaptive marketing orientation capabilities.

Adaptive market orientation can be usefully depicted as a form of dynamic capability, as it includes organizational routines and capabilities in order to identify market intelligence, disseminate that intelligence and respond to the opportunities (Wilden, Gudergan and Lings 2019). Dynamic capabilities are conceptualized as consisting of identifiable and difficult-to-replicate specific bundles of routines that are required to adapt to changing customer and technological environments (Teece, 2007). Such dynamic capabilities are central to the recognition of, and response to, significant developments in the marketplace. These dynamic capabilities involve sensing and shaping opportunities and threats, seizing the opportunities and reconfiguring the resources appropriately. Teece (2007) identified that the ability of firms to enhance, combine and reconfigure their intangible and tangible assets is a core part of dynamic capability. There is increasing recognition of the importance of intangible capital in order to create competitive advantage. However, our understanding of why and how intangible capital affects competitiveness and the frameworks on this topic remains nascent (Teece, 2007).

Kaplan and Norton (2004) propose a useful framework to measure and manage intangible capital. The authors argue that managing intangible capital entails estimating how closely aligned the assets are to the firm’s strategy. They propose three types of intangible capital. First, there is human capital, which includes the skills and knowledge of the firm’s employees. Second, there is informational capital, which includes the firm’s databases, information systems, networks and technology infrastructure. Finally, third, there is organizational capital, which consists of the firm’s leadership and culture, including the degree of alignment of the employees with strategic goals and their ability to share knowledge. Better alignment of intangible capital has been shown to improve the performance of the existing business, as well as enabling innovation (Bachrach, Mullins, & Rapp, 2017; Baxter & Matear, 2004; Ittner, 2008).

Organizational crisis from health hazards like Covid-19 may threaten the future life of organizations and offer managers a sense of urgency as to how to react satisfactorily to these events (Cortez and Johnston, 2020). Although the crisis had a low chance of occurrence with high uncertainty, the pandemic has a significant effect across all levels of the organization (Gabrielli, Russo, and Ciceri, 2019). In fast-changing environments such as the pandemic, firms need to be able to translate new market insights into an innovative product or service offerings via suitable business models (Ritter and Pedersen 2020; Teece, 2010). Business models are a form of activity system that connects the internal aspects of the firm, such as resources and routines, with the external element, such as partners, markets and customers, and hence articulates how the firm goes to market to implement the strategy (Ehret, Kashyap, & Wirtz, 2013; Velu, 2016). Hence, innovative products and services would require appropriately designed business models to create and capture value.

The extant literature has shown the importance of dynamic capabilities to sense, seize and reconfigure resources to provide sustained value. Moreover, studies have argued that dynamic capabilities enable firms to create, deploy and protect the intangible capital that supports superior competitive advantage. However, the extant literature has not shown how different types of intangible capital influence firms' ability to respond to the unexpected change in the external environment, such as a pandemic or war. In particular, the literature is silent on how organizational capital influences the reorientation of business models during such an unexpected change in the environment.

3. Empirical Analysis

We have chosen to study the UK aerospace supply chain in order to investigate the research question, for three reasons. First, the aerospace sector has been severely impacted by the Covid-19 pandemic as a result of the grounding of air travel. Second, the UK is a global leader in the aerospace industry, with a turnover of more than £33 billion in 2019 (ADS 2019). Third, a number of aerospace suppliers have been involved in the UK Ventilator Challenge to supply ventilators or personal protective equipment (PPE).

We study small and medium-sized (SME) aerospace firms within the Sharing in Growth (SiG) programme. SiG is a transformation programme that raises the productivity and capability of UK

aerospace suppliers in order to share in the growth of aerospace and other global markets. The SiG programme is funded by the UK government regional growth fund and from the aerospace industry. It provides concentrated training and development programmes tailored to the assessed needs of each selected aerospace supplier firm, with a view to increasing productivity and performance. The training and development focuses on the organization’s people and processes, thereby improving the intangible capital to complement the more tangible capital such as the plant and equipment. The programme covers all relevant disciplines, including lean operations, manufacturing processes, purchasing, cost modelling, culture and leadership. It selects eligible firms in the UK aerospace supply chain and is run over a three- to five-year period, with input from specialist managers from SiG and external advisors.

We studied 46 firms involved in SiG. Of the 46 firms, 11 were involved in the UK Ventilator Challenge on Covid-19.¹ The core activities of these firms and their involvement with the UK Ventilator Challenge initiatives are listed in Table 1.

Table 1: Firm description and UK Ventilator Challenge Initiatives

No	Name of Firm	Annual Turnover (reported between Dec 2018 and March 2019)	Core Activities	UK Ventilator Challenge Initiative
1	Firm A	£32.9m	The manufacture of flexible joints and pressure duct systems primarily for the aerospace industry	Manufacturing visors and supplying them to local NHS hospitals
2	Firm B	£24.3m	The design and manufacture of printed circuit boards	Producing printed circuit boards to support the UK ventilator effort
3	Firm C	£12.7m	The design, development and manufacture of components, systems and technologies for the electronics and avionics industry	Repurposing PPE for use on the front line
4	Firm D	£33.7m	The manufacture of precision-machined components and the assembly of parts for the aerospace and defence industries	Producing ventilator components

¹ This was as of April 2020.

5	Firm E	£15.2m	The design, manufacture, assembly, marketing and testing of protective helmets, respiratory hoods, visors, communication systems, headsets and microphones	Accelerated manufacture of medical helmets
6	Firm F	£21.1m	The development, manufacture and marketing of components for aero engines and machine tools and accessories for machine tools	Producing ventilator parts
7	Firm G	£14.2m	The provision of surface engineering services	Response to supply for parts for medical equipment, patient handling equipment and ventilators
8	Firm H	£6.8m	Precision production engineers	Manufacturing parts that will be assembled on new ventilators
9	Firm I	£2.3m	Metal products	Producing ventilator components
10	Firm J	£7.8m	Metal finishing	Producing ventilator components
11	Firm K	£7.1m	Manufacture of precision aviation products	Producing ventilator components

We conducted a financial performance analysis between the 46 beneficiary firms in the SiG programme and 512 comparable non-SiG firms in the UK aerospace supply chain. We calculated the performance of the firms based on two indicators: sales per head, and operating margins.² Sales per head measures productivity, and operating margins measures profitability. We calculated the average for these two measures for each of the firms before and after the SiG programme, respectively.³ We then calculated the difference-in-difference (DiD) between the SiG beneficiary firms compared to the comparable non-SiG.⁴ Our findings show that SiG firms improved their performance more than non-SiG firms. In particular, SiG firms improved their average annual sales per head by £1.7K and their operating margins by 3.5% compared to non-SiG firms.

² We calculated the financial measures from the reported numbers in the annual reports between 2011 and 2018 by accessing the Company Watch database.

³ Since the SiG programme started at different times across these firms, we calculated the measures for the maximum number of years for which financial data is available following the start of the SiG programme.

⁴ The DiD is calculated by comparing the difference in the average financial performance (e.g., sales per head) of the firms involved in the SiG Programme with that of comparative firms not involved in the SiG Programme, after the SiG programme with the same calculation before the SiG programme. Positive differences indicate that the firms involved in the SiG Programme have benefited more than the firms that have not been involved in the SiG Programme, and vice versa.

In addition, the survey results show that firms involved in the UK Ventilator Challenge benefited more on average from the SIG programme than firms not involved in the UK Ventilator Challenge. In order to further investigate this benefit, we compared the financial performance of the 11 firms involved in the UK Ventilator Challenge initiative with the other firms not involved. As before, we then calculated the difference-in-difference (DiD) between the SiG firms involved in the UK Ventilator Challenge compared to the firms not involved in the UK Ventilator Challenge for sales and operating margins.⁵ Our findings show that firms involved in the UK Ventilator Challenge improved their performance more than firms not involved in the UK Ventilator Challenge following participation in the SiG Programme. In particular, firms involved in the UK Ventilator Challenge improved their average annual sales per head by £110.2K and their operating margins by 5.5% compared to firms that were not involved in the UK Ventilator Challenge.

4. Case Studies

In order to further explore the empirical findings, we conducted interviews with three firms that were involved in the UK Ventilator Challenge, namely, Firm A, Firm B and Firm C. We interviewed the chief executive officers of Firm A and Firm B, and the marketing manager of Firm C. We recorded and transcribed all the interviews. All quotes below are from the respective executives that we interviewed from the three firms. We also supplemented with publicly available information about these firms such as news articles, blogs and company websites. We explored two broad themes during the interviews, as follows:

- (1) How has organizational capital helped the firm with the UK Ventilator Challenge initiative?

⁵ The DiD is calculated by comparing the difference in the average financial performance (e.g., sales per head) of the firms involved in the UK Ventilator Challenge with that of firms not involved in the UK Ventilator Challenge after the SIG programme with the same calculation before the SiG programme. Positive differences indicate that the firms involved in the UK Ventilator Challenge have benefited more than the firms that have not been involved in the UK Ventilator Challenge, and vice versa.

(2) How has the Sharing in Growth (SiG) programme of activities helped you to get involved in the UK Ventilator Challenge initiative and navigate the pandemic more generally?

We next discuss our key findings from the three cases below.

Case of Firm A

Firm A is a leading supplier of precision sheet metal fabrications to the aerospace and other industries. The firm designs and manufactures metallic flexible joints and pressure duct systems, focusing primarily on the major aircraft manufacturers around the world. The firm's income was 90% from the aerospace industry and 10% from the non-aerospace sector. One of the major strategic decisions that the firm took in recent years was to diversify, with the aim of achieving an income stream of 70% aerospace and 30% non-aerospace. The firm's management team decided to respond to the UK Ventilator Challenge by manufacturing visors, which are manufactured using the firm's 3D-printing machines.

In the quest to diversify its income stream, there was initially some resistance to exploring new areas. After much searching, the firm decided to diversify into two major new sectors: oil and gas, and pharmaceuticals. These two industries are both heavily regulated, similar to the aerospace industry. The experience of developing new products for the pharmaceuticals industry provided the confidence to explore new areas:

We bend metal in very clever ways and we transmit fluids through systems, very hot gases at extreme temperatures in very regulated industries. So, we thought, well, why aren't we working more in oil and gas? Why aren't we working in medical and nuclear? What about pharmaceuticals? We just won a major order for the pharmaceutical sector. So, we were applying the technology to different markets effectively and that is something that we'd forgotten we could do easily if we just put our minds to it.

This ability to test and develop quickly by empowering the staff to be ambitious was one of the critical factors in helping Firm A to reorient its manufacturing to produce visors for the UK Ventilator Challenge.

...within a day we had a program and we were 3D printing these parts for the NHS. It's really made us think how we have to change and are changing, and we'd never say it's a good thing, it's a terrible thing, but if it's happening, we might as well the make the most of it, make the most of a bad deal.

The CEO of Firm A said that the most important intangible capital for the firm in responding to the UK Ventilator Challenge was its leadership and culture. These elements are encapsulated in the quote below:

I think we have to focus on the culture, the engagement and the teamwork. I think we've got some really good skills here, some good knowledge. I focus on that as a driver, to create that environment that the skills can thrive. The minds can be opened and people feel they have an environment in which to thrive, the operating framework in which to do amazing things.

I know what you say about knowledge and skills, that's important, but we have been lucky that we've got that in the organization, but we don't apply it as efficiently as we could. In terms of systems, we are fit for purpose.

The CEO goes on to articulate that leadership is key to creating the right conditions and motivation for the employees:

You can't always get it right, but the skills are a given. It is more about having that open mind, applying your skills to something that maybe is outside what you think is your remit or your expertise. How do we get that? How do we open those minds up? It's giving them an environment in which to do that, and I think that's a cultural thing and that's an engagement thing, the teamwork thing.

The SiG programme helped Firm A to strengthen its intangible capital in several ways. The first stage of the SiG programme provided the leadership team with the right strategic challenge to re-evaluate its purpose.

It was more about what is our purpose really... We started off going right back to basics about what do we do. These were communication sessions on leadership. That was very very important for me as a leader...we got clear in our mind what it is we wanted to do, in what

market, in what proportion of the business, and then, from a leadership point of view, we started looking at the culture and how do we change that.

Moreover, as with any change programme, there was initial resistance to the SiG programme, as noted below. However, the programme provided the bandwidth and focus on making the change, as mentioned by the CEO:

Everybody said to me there's no way we can do this SiG program because we've got our day job to do. And I said: 'This will become business as usual. This will be your day job.' The work we do now is business as usual and it's all around this stuff, so that's where SiG really helped me... But the fundamental thing that I really found the most value of, as the leader of this team, is the stuff around the leadership, the culture, the teamwork.

Moreover, the programme helped to establish the principles of the company values, recognizing that values and their behaviors are the external evidence of culture:

Everything we do is quality and we deliver quality throughout. How do we do that? Well, we work together, we respect each other, and we're honest. They were the published values that were adopted by the organization...and suddenly that was the most utilized publication.

These values were very helpful during the crisis in enabling the formation of teamwork to achieve the goal.

Case of Firm B

Firm B is a leading European player in the production of complex printed circuit boards (PCBs) for the aerospace and defence, space, automotive, communication and industrial instrumentation sectors. The firm manufactures bespoke and safety-critical products used in a multitude of applications within these sectors. Firm B responded to the UK government's call to make NHS ventilators; it was contacted by a firm that had won a contract to manufacture ventilators in order to supply PCBs. It turns out that the PCBs needed for ventilators are typically low-tech compared to the ones supplied by Firm B and are usually sourced from the Far East. Nevertheless, Firm B rose to the challenge of manufacturing the PCBs for the ventilators. One of the challenges was obtaining material supplies for the PCBs, as there was insufficient stock available across Europe. Firm B managed to

source the material from its networks in the Far East and began production; it has produced 180,000 PCBs for approximately 30,000 ventilators.

Initially, there was a level of apprehension from the workforce regarding whether Firm B should continue operating its factories. However, this changed dramatically when the firm decided to contribute to the UK Ventilator Challenge:

I think that like a lot of industry at that point we were getting the challenge from the workforce of, are we really essential?... First and foremost, we had to convince everybody that safety was the first priority. It helps that we've had some guidance, there's a whole initiative called Firm B Zero-Zero-Zero. Which is basically zero deaths, zero transmission in the workplace and zero risk, that's the whole approach for Covid-19... But for sure when we started to get involved in the ventilator projects it was almost a step-change in approach to the attitude from the workforce... So that's been a real boost for us. I say, the first few weeks were a bit tricky at times but now we're about 95% strength and it's all going well, with that emotional attachment from the workforce that we are doing something for the NHS, it's really helped a lot.

Firm B has made several changes to the way the workforce is empowered in recent years, which made a significant difference to its ability to respond to the unplanned nature of the UK Ventilator Challenge:

The key difference is if this would've happened three or four years ago, I think we might have struggled to get the engagement of the workforce in the first instance. Maybe the fact of the ventilators might have helped again, but I think we would've struggled with the engagement of the workforce more. I think the key difference is our ability to execute something which is very different to what we normally do. I think we've now got a workforce, particularly around team leaders, engineers, some of the junior managers, we've done some fantastic work on their growth through the (SiG) academy, and I think again now we much better understand our processes, we much better understand what we are capable of, we force the ownership and the responsibility down to the people at the processes. So, you know, we couldn't have done this three years ago, we would've said: 'How many panels? How many circuits? You've got no

chance, we're not going to do that, if we try it's going to be a disaster.' Whereas now it's just every day, every area, every team leader, is saying, 'Hang on, I can do more.'

The SiG programme helped Firm B to strengthen its team leaders, as noted below:

It's a very different approach when we are just giving the steer and the guidance, telling them what it's all about and what is required and they're actually making it happen, whereas in the past we were having to force-feed them from the top, and it would not have worked, not with this kind of constantly changing technology that we've just seen. We would have really fallen flat on our faces a few years back doing this, whereas now we just mopped it up, got on with it, done it. Every single person in every single function has just got on with it, taking responsibility, and I can't overstate the importance of that, the development of those individuals, and a lot of that has come about through particularly the team leader growth.

The SiG leadership training has given employees on the factory floor the ability to motivate themselves and solve problems independently:

I think particularly where this has been successful is around the operational side of it. One, we much better understand our processes because we've educated a whole group of people to better use data and science, to understand our processes and problem-solving techniques to address the problems they may get on a daily basis, and probably above all else is the communication and engagement skills. That large groups have now learnt and developed over the last couple of years, in particular, that they themselves are able to motivate and articulate the importance of what needs to be done at a local level in the factories.

Firm B acknowledged that it is difficult to measure progress on building such intangible leadership capital, and it takes a long time for the benefits to materialize:

I think what you don't know with the program, which is quite long, you know, we're in the fifth year of it. It's that gradual progression, you don't necessarily see it for yourself when you're looking at it. Then you see, then you get people from other organizations looking in on it and they can see the changes, the change in approach, to changing attitudes, and I think the key is

now that this is the first really big test that we've had because we had other tough times where we've had to go through changes, and that's been difficult.

Case of Firm C

Firm C is an electronic solutions provider, such as panel mount light-emitting diode (LED) indicators, electromagnetic interference (EMI) suppression filters and precision-machined connectors for the aerospace and military applications. Following an enquiry from the local general medical practice on the shortages of personal protective equipment (PPE) during the pandemic, Firm C decided to produce single-use face visors, and it has produced more than 2,000 of them. The manufacturing of these visors is based on a simple assembly line using cutting and riveting machines. Firm C is partly constrained by the shortage of supplies of Perspex plastics as a result of the supermarkets in the UK requiring plastic screens to be put between the shopper and the cashier during the pandemic.

The buy-in from the management and staff to be involved in the UK Ventilator Challenge was driven by a common purpose to serve the community:

As soon as we got the agreement, as soon as we got the design we launched it out to the whole business, and 'this is what we want to do and this is why we want to do it', and it's about protecting front-line workers, protecting the community. We've been in the community for 80 years, people care about their local community, and everybody wanted to help. And once we got the whole workforce on board people were offering to come in at evenings and weekends, people were saying that they would box them up, drive them to places they needed to be, people just got on board with the project.

The leadership and culture were seen as the principal driving force behind mobilizing quickly to meet the opportunity:

I'd say the organizational capital is the most important. The leadership, the culture, because it was all about...when we first got that call, on that Thursday, it was about pulling a team

together that would work well and who were prepared to work every evening, all day long at the weekend and do whatever it took to make it happen. And it was about having the right attitude. It was about being completely driven, overcoming every barrier that's put in the way to just keep moving forward and making it happen. And then it was very much about the culture of the organization that we said 'This is what we want to do, who's with us?' And the response from the workforce was huge.

Moreover, the management at Firm C took a deliberate decision to get everyone involved in the UK Ventilator Challenge initiative, since they saw it as a golden opportunity to build more of a sense of belonging and a common purpose:

Every single person that works in the company, including the chief executive, down to the shop floor making them, every single person has done a shift making the visors. So, it's been all about the culture and the engagement and the teamwork.

Moreover, the firm believed that the SiG programme made a significant difference in being able to build this capability, as illustrated by the quote below:

A lot of it has to do with our experience on the Sharing in Growth program. What we've done as part of that program is that we have looked at a whole piece of work around communication and engagement. So, we do regular team briefings, we have a good two-way feedback mechanism, we have a communications team like a staff council. So, we're much closer to our team and understanding what drives them and what motivates them, and I think that if we hadn't have done any of that work and we just tried to launch this we would have got much more of a 'so-what' kind of response rather than the all pulling together and making it happen response that we did get.

A significant part of the SiG programme was rooted in building engagement with the workforce and a continuous improvement philosophy:

So definitely communication and engagement with our workforce. It's changed people's attitude to how they feel about being part of Firm C, so they feel a lot more of a sense of pride and belonging. Also, two of the values really focused on last year are about being dynamic and

being agile, and so what we wanted to do is to really leverage the benefits of being a small organization that's privately owned by being able to respond to things quickly by being dynamic and agile. We put a lot of changes in place to enable that to happen, so we looked at our floor space utilization, the flow of products through the factory, we run SQDC (Safety, Quality, Delivery and Cost), so we've been able to say what our challenges are and adapt the business quickly to meet those challenges. And having some of those measures in place that allow us to be able to very quickly say we need to set up a new line, this is how it needs to work, this is what it needs to look like, and these are the people we need to make it happen. Where we wouldn't have really known where to start without having been through some of that process.

5. Discussion

The case studies show that intangible capital has provided the basis for key capabilities to respond to opportunities offered by the UK Ventilator Challenge. In particular, the cases show that organizational capital, in terms of the role of leadership in fostering a culture of engagement and empowerment via continuous experimentation and learning, is a key capability for firms to respond to sudden and unexpected changes in the environment.

Firm A created an environment whereby employees were able to go out and explore new market opportunities in the quest to diversify into the non-aero market. The leadership team enabled the organization to learn how to apply the underlying principles to different contexts, and that has probably helped in picking up new opportunities. This required management to empower the employees to explore and learn. Firm B developed team leaders and encouraged ownership and left the responsibility down to the people involved in the processes. Such process ownership enabled more initiative to be taken by the process owners to solve problems arising, as well as improving the operations without the necessity of being micro-managed from the top. Firm C focused on creating a set of values in being dynamic and agile through continuous process improvements. This aspect enabled the employees to take the initiative and be engaged with achieving the overall objectives. Firm C emphasized the engagement of the employees. A key observation and lesson of this value system can be observed by the firm enabling everyone to take turns at being involved in producing

the visors for the UK Ventilator Challenge, even though a small team could have done the actual work.

From a managerial perspective, this study shows that leadership and culture are important aspects of intangible capital in a period of abrupt changes to the environment. Leadership in such a context is important for two reasons. First, leadership sets the direction for the organization and encourages employees to have burning ambitions. Second, leadership is key to changing the culture of the organization by encouraging engagement through continuous learning and experimentation. Such a learning and experimentation culture would require the senior management leadership team to be able to ensure personal safety and offer compassion for trying and failing.

One of the key properties during a crisis period is the combination of a lack of understanding of cause and effect together with the preferences of the stakeholders being uncertain. In such situations, scholars have argued that charismatic leadership is vital (Thomson, 1967). This study shows that an important component of such charismatic leadership is the ability of management to provide a platform for employees to feel empowered while encouraging experimentation. In this context, scholars have argued that entrepreneurial action is essential in order to enable management and employees to revise their belief systems via learning from action and adapt to the opportunities provided by the market. As discussed, adaptive market orientation is a form of dynamic capability. Market orientation has been proposed as either a set of behaviours or the culture that contributes to such behaviour (Kohli & Jaworski, 1990; Narver & Slater, 1990). The study shows that one of the principal cultural artefacts that need to be harnessed in order for firms to sense and respond to opportunities effectively is employee engagement and empowerment. Therefore, we posit the following managerial implication:

Invest and develop a leadership culture of engagement and empowerment of employees to experiment and learn continuously during a period of extreme uncertainty such as the pandemic.

The second implication of the studies is relevant to policy-makers. Firms often spend less time and effort developing intangible capital than they do on tangible capital because the former is more difficult to measure, manage and finance. This practice is a form of market failure that requires policy

intervention. Our study shows that firms that were involved in the UK Ventilator Challenge reported that they had benefited more from the SiG programme and also reported better financial performance compared to firms that did not participate in the UK Ventilator Challenge. We can induce from such a finding that the SiG programme helps in overcoming the market failure of insufficient investment in intangible capital among SMEs. In particular, the study shows that the building and enabling of effective organizational capital among the SMEs would not have been possible without the benefits from the SiG programme. This is because leadership and cultural capital to enable engagement and empowerment are less easily measurable and take a long time to build. Therefore, there tends to be underinvestment by SMEs in these forms of intangible capital compared to more tangible forms of capital. Hence, from a policy perspective, capability-building programmes such as SiG are essential to fix the market failure caused by underinvestment. Therefore, we posit the following policy implication:

Government policy should enhance investment in transformation programmes that help to build intangible capital among SMEs during a period of extreme uncertainty such as the pandemic.

6. Conclusion

During a period of extreme uncertainty and economic downturns, such as the pandemic and its aftermath, firms have a natural tendency to curtail initiative among employees and governments are incentivized to cut expenditure on industrial transformation programmes. Our study shows that this is the exact opposite of what is required. Firms need to show leadership by engaging and empowering their employees, while governments should continue to invest in programmes to help strengthen the intangible capital of SME firms. Firms and governments recognize the need to invest in technology, tangible capital and skills. Still, the evidence suggests that focusing on intangible organizational capital will secure and augment benefits, both in weathering the short-term challenge and preparing for longer-term growth. Our study is exploratory, and the findings are indicative and could be further strengthened in several ways. Nevertheless, we hope that our findings will inspire more research in this area and also act as a set of guiding principles for firms and governments to tackle head-on the economic and business challenges facing us all.

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