Digital transformation and strategic agility during the COVID-19 crisis: the role of the intangible capital conversion

Ahmed Bounfour
Ritm, European Chair on Intangibles, Université Paris-Saclay, Sceaux, France
Thomas Housel
Department of Information Sciences, Naval Postgraduate School, Monterey, California, USA
Trent Silkey
Stonefish, Honolulu, Hawaai, USA, and
Alberto Nonnis
Ritm, European Chair on Intangibles, Université Paris-Saclay, Sceaux, France

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Abstract

Purpose – The purpose of the current study is to illustrate the importance of strategic agility (SA), the capacity to respond agilely to a rapidly changing environment, for digitally transforming firms during the COVID-19 crisis. A secondary purpose of the study is to conceptually frame SA as a function of the creative to realized intangible capital (IC) ratio.

Design/methodology/approach – To inferentially corroborate the hypothesis, this study exploits the results of a recent firm-level survey, conducted under the H2020 project GlobalInto (2021). Via OLS and ordered logistic regressions, the relationship among SA, economic performance and IC was tested.

Findings – The exploratory findings implied that the more strategically agile companies were those that responded more effectively to the pandemic crisis, but only if they were ahead in terms of digital transformation. Moreover, the results implied that firms that were able to efficiently convert their creative IC into realized IC were the most strategically agile.

Originality/value – This study developed a new conceptual framework for digitally transforming firms that included the role of SA and the IC conversion ratio in the context of extreme threats to the survival of firms. Some preliminary practical recommendations were offered to management about how to measure the IC conversion ratio as well as how to stimulate and reward greater creativity among employees, filling a notable gap in the SA literature that provides less than precise guidance about how this concept can be measured.

Keywords Strategic agility, Digital transformation, Strategy, Intangible capital, COVID-19, Conversion ratio

Paper type Research paper

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1. Introduction

Firms following a digital transformation (DT) process, defined as the shift in the way firms use digital technologies in order to develop new business models that create more value for a firm and its shareholders (Kane, Palmer, Phillips, & Kiron, 2015; Verhoef *et al.*, 2021), should include in their strategic plan the capacity to respond agilely to a rapidly changing environment. The leadership of firms moving forward with a DT process must assume the inevitability of unforeseen threats. COVID-19 is an example of an unforeseeable systemic threat that ruined many businesses that were not strategically agile despite their move toward DT. This capability of responding quickly to radical changes in market conditions is often referred to as strategic agility (SA) (Doz & Kosonen, 2010).

A growing literature has pointed out the importance of SA for companies under different contexts but did not address the context of a digitally transforming company. The current study attempts to address this gap in the prior research by exploiting the particular context offered by the COVID-19 crisis. This opportunity to exploit an extreme natural experimental context allowed us to test the argument that SA is particularly important for digitally transforming firms. Second, the unique characteristics of the survey employed in this study allowed us to examine the characteristics of SA, with particular attention given to the role of intangible capital (IC) in defining SA in this application of the DT process.

To address the identified literature gap, we argue that the capacity for SA must be "built-into" the DT approach from the outset. Moves by firms to digitally transform that attempt to foster SA during a crisis will miss a critical opportunity to exploit the creative IC of their employees. This is precisely the case for firms in the Internet services sector that were slow to digitally transform and incorporate SA in their models in the most hyper-volatile market sector in the history of commerce. An additional benefit of DT approaches that foster SA is that such approaches will provide leaders with more efficacious options to respond to any form of market volatility including new market competitors (Vial, 2021; Plekhanov, Franke, & Netland, 2022). This is an important gap in the literature, which primarily considers SA alone, without examining its role in a DT context.

Prior research on SA did not address the role of IC in fostering agility. The current study addressed this gap in the SA literature by positing the conceptualization of how IC might provide a means for improved SA, especially in firms that are digitally transforming. We believe that it is essential for firms to foster ways to build-in SA, including exploiting employees' IC capacities. Even though SA implies forward planning, company leadership cannot anticipate all future threats (Berends, Jelinek, Reymen, & Stultiëns, 2014; Weber & Tarba, 2014). To address this seeming conundrum, company leadership may be able to find ways to foster agility using a strategy to exploit the inherent creative capabilities of employee IC to help adjust company strategy in the face of unknowable threatening events such as the COVID-19 pandemic.

Given the assertion that creative IC is an important determinant of successful SA, the problem is that directly observing this employee's creative IC is problematic. It is only when they convert the creative IC to realized IC (i.e. observable, measurable) that it becomes possible to track the use of the realized IC in fostering SA in digitally transforming companies. The reasoning is that strategic response to existential threats heavily relies on employees' ability to think creatively in ways that lead to realized actions, e.g. changes to core processes, and the invention of new core processes, which can support strategic responses. While this hypothesis is problematic, without the direct observation of employee creative thinking, the actual agile adjustments to corporate strategy provide promising indirect evidence of the creative IC to realized IC conversion process.

For these reasons, we will argue that DT must include the capacity for SA and that employees' ability to convert their creative IC into realized IC is central to our understanding of SA. This translates into the two hypotheses we tested, namely, (H1) that firms that had included SA as a function of their DT strategy were more successful at adapting to the COVID-19 crisis (H2); that the SA of a company strongly depends on how well it has built-in

SA in its DT model and, in particular, on how successful its management is in facilitating the conversion of employee creative IC into realized IC.

To corroborate our hypothesis, we developed a conceptual model that we tested with data from a recent survey, conducted under the H2020 project GlobalInto, which focused on evaluating the effects of IC investment of European firms located in seven countries [1]. By means of analysing the responses to questions, using Likert-type interval scales, the survey allowed us to obtain proxies for the variables of interest in the current study. For example, parameters of primary interest, such as SA, DT and economic performance, were presumed to be related to H1, allowing a first attempt at assessing the critical relationship between SA and DT. This analysis also allowed us to infer that the SA in companies that successfully responded to the crisis were also those who were able to more effectively convert creative IC to realized IC allowing a conceptual test of this conversion ratio reflected in our second hypothesis.

The structure of the remainder of the paper reflects the procedures to test the two aforementioned hypotheses. Section 2 was an attempt to contextualize the relationship between SA and DT, based on the literature, the adaptations from the survey results as well as how DT should "build-in" SA in practice. Section 3 focused on our second hypothesis, concentrating on the potential role of the IC conversion process in fostering SA. Section 4 was dedicated to the empirical analysis derived from the survey results, where we tested the basic relationships in our guiding framework. Section 5 discusses the results the hypotheses tested and Section 6 offered summary conclusions from our analysis of the results with potential future research opportunities to further refine the IC conversion ratio and its role in fostering SA in digitally transforming companies. We also offered several practical suggestions from the results of the current study that would help digitally transforming firms build-in SA capabilities by fostering a more productive conversion of creative employee IC to realized IC.

2. Digital transformation and strategic agility

The DT of society has fomented a shift from the old mechanistic model to the new fluid digital model. New digitality-based theories are seeking a foothold among managers brought up with a seemingly mechanistic worldview (Bounfour, 2016), making the DT of business inevitable in most companies. This digital conversion process is already widespread throughout the world. The benefits of the shift to new, more agile, strategies are evident in the firms successfully competing in today's hyper volatile (Prange, 2021) and uncertain markets, especially during periods of crisis. It is possible to infer from their success that they have been productively converting creative employee IC to realized IC. An indirect support for this assertion is that the capital markets do not look kindly on knowledge-intensive companies announcing significant layoffs which would likely have an impact on their innovative productivity resulting in lowering their revenue streams and stock prices [2].

In spite of this compelling evidence for DT, all those new digital resources have not guaranteed success for many companies that have invested heavily in DT efforts. Recent research attempted to conceptualize the challenges DT posed for organizations (Kallinikos, Aaltonen, & Marton, 2013; Guo-Fitoussi, Bounfour, & Rekik, 2019; Breslin & Gatrell, 2020; Satwekar, Volpentesta, Spagnoletti, & Rossi, 2022; Bounfour, Etienne, Cheng, & Nonnis, 2022), in light of the relevant role played by dynamic organizational capabilities (Benitez, Castillo, Llorens, & Braojos, 2018), such as SA. As a matter of recent record, DT has been found to improve the ability of firms to respond quickly to normal market perturbations (Vial, 2021). This DT and agility linkage has been indirectly studied both conceptually and practically (Kohli & Johnson, 2011; Fitzgerald, 2016; Huang, Henfridsson, Liu, & Newell, 2017). Both SA and DT are considered to be important drivers of economic performance in modern highly volatile economies (Elali, 2021). However, not much has been said about the conditions through which the two concepts boost economic performance when they are built-

in to a corporate business strategy. It can be argued that one of the problems in the way companies have approached DT is that the DT definitions they use do not include how SA would be built-in to their plans or implementations. We believe that a new focus on building-in SA to DT definitional concepts, with an emphasis on nurturing employee creativity, will provide a more fertile ground for evolving DT models to meet the unknowable, unknowns such as the COVID-19 crisis.

There is a growing consensus for the necessity to adjust firms' DT business models to be able to respond to major digital technological discontinuities (Lucas & Goh, 2009). Other research has shown that SA capabilities can reach beyond corporate boundaries and would require digital systems that allow rapid and efficient communication between partners (Jagtap & Duong, 2019). In the current study, however, we limit our focus to understanding SA capabilities from within an enterprise. SA capabilities should be a central consideration by management reviewing investments in new digital innovative capabilities in a DT effort that focuses on reducing organizational rigidity (Chan, Teoh, Yeow, & Pan, 2019), which ultimately should lead to a more successful SA capability.

The review of the various approaches and conceptual definitions of SA has provided input to our formulation of this concept. Strategic agility has a number of common definitions, some of which are more grounded and pragmatic than others. A representative list of types of agility, that are comparable to SA in various ways, is included in the definition we use in the current study. The conceptual components of SA, include enterprise agility, strategic flexibility, dynamic capabilities, improvisational capabilities, operational agility and portfolio agility (Table 1 - Past Definitions of Agility).

Roth (1996) described strategic agility as "the capability to produce the right products at the right place at the right time at the right price." Sull (2010, p. 2) suggested that the goal of an agile company is to become efficient in "spotting and seizing game-changing opportunities." Other definitions provide a view of agility as continual adjustment of a company's business model to stimulate innovative value creation and retain the flexibility to face emerging challenges. For a linguistic relativist, the breadth and number of terms describing agility alone are enough to elucidate the prominence the concept enjoys in contemporary business scholarship. The prior research on SA has concentrated primarily on refining its conceptualization and identification as well as on its general impact on firm performance (Schilke, 2014), while little effort has been

Enterprise agility	Ability of a firm to sense environmental change and react accordingly based on components of sensing and reacting to change
Dynamic Capabilities	"A firm's building, integration, and reconfiguration of internal and external competencies to address rapidly changing environments" (Teece, Pisano, & Shuen, 1997) Extenuation of the Resource Based View into high-velocity markets
Strategic Flexibility	Defined as the organizational ability to manage economic and political risks by promptly responding in a proactive or reactive manner to market threats and opportunities (Battistella, De Toni, De Zan, & Pessot, 2017; Grewal & Tansuhaj, 2001)
Business Agility	Exemplified by organizations that are resourceful, quick to respond to changes, and highly adaptable (Mathiassen & Pries-Heje, 2006)
Operational Agility	"A company's capacity, within a focused business model, to find and seize opportunities to improve operations and processes" (Sull, 2010)
Portfolio Agility	"The ability to quickly and effectively shift resources, including cash, talent, and managerial attention, out of less-promising units and into more-attractive ones" (Sull, 2010)
Organizational agility	Capacity of an organization to efficiently and effectively redeploy/redirect its resources to value-creating and value protecting (and capturing) higher-yield activities as internal and external circumstances warrant (Teece *et al.*, 1997)

Source(s): Own elaboration

Table 1.
Past definitions of agility

made to understand the mechanisms and the activities that lead to successful strategic agility (Pereira, Budhwar, Temouri, Malik, & Tarba, 2021).

SA has been studied in numerous contexts, such as Multinational Enterprises (MNEs, Fourné, Jansen, & Mom, 2014), Small and Medium Enterprises (SMEs, Hock, Clauss, & Schulz, 2016) or startups (Weiblen & Chesbrough, 2015) and its importance in guiding aspects of mergers and acquisitions (Brueller, Carmeli, & Drori, 2014) as well as, in stimulating innovation (Wilson & Doz, 2011; Cai, Liu, Huang, & Liang, 2019). In particular, for the premises of our primary research purposes, the most recent literature evolutions have pointed out the strong bond between DT and SA. Organizations that recognize the need to build-in agility when acquiring digital technologies are also quicker when they need to respond to market shocks (Li, Wu, Cao, & Wang, 2021).

In spite of the promise of DT that incorporates the flexibility of SA capabilities, many in corporate leadership positions continue to be rooted in outdated business models that implicitly presume a more stable, predictable, controllable environment where the overriding goal is to maintain an incremental positive performance momentum. This may be a by-product of the influence of traditional economic theory that portrays corporate systems as closed, static systems that operate primarily via partial analogies to mechanical laws rooted in Newtonian Physics (Mirowski, 1992) and industrial era accounting practices (Elliott, 1992; Housel & Shives, 2022). Corporate strategy has been heavily influenced by the implicit assumptions that reflect these mechanistic laws (Housel & Bell, 2001; Baer, Bounfour, & Housel, 2018). As a result, management treats strategy as a fixed plan, while the requirements of DT that incorporate SA are seemingly ignored. DT approaches may unwittingly embrace the more rigid boundaries of these dated business models making agile responses to potential crises problematic. For example, consider the difference between a company that uses a traditional strategic planning model, where the company sets goals for 3–5 years, and focuses the corporate energy on achieving the predicted outcomes, while an agile company's management would create a DT model that focuses on rapidly responding to new opportunities and challenges that occur in hyper-competitive emerging markets.

It follows that given the growing importance of digitally transforming companies in this highly volatile market environment, it is crucial to understand the factors that determine SA. Notably absent in the current definitions of agility is the concept of creative IC as a critical enabler of agility. IC has been defined as an intangible "source of value [. . .] generated by innovation (discovery), unique organizational designs, or human resource practices" (Lev, 2000, p. 7). The technological growth and importance of innovation have spawned a realization that IC is the critical driver for innovation in our emerging digital economy (Lin & Chen, 2005; Pike, Roos, & Marr, 2005; Kamukama, Ahiauzu, & Ntayi, 2010). Heavy investment in IC may increase a company's level of portfolio agility but may also be wasted if the IC produces less than satisfying value yields.

As a result, creative IC provides an organization with numerous possibilities for accelerating its evolutionary adaptation by generating new capabilities to take advantage of emerging opportunities or by shifting strategic direction to avoid emerging problems. Creative employee IC can be defined as the innovative potential capability, be it problem-solving or opportunity-seizing, resident in the minds of its employees. This has important consequences in a world where DT is at the center of corporate strategies, which necessarily should include the ability to adapt to opportunities and challenges that this emerging environment fosters. Moreover, as we argue in this study, what is important for SA is not IC *per se*, but the ability of firms to convert creative IC into realized IC. This "conversion ability" of an organization represents a "firm's ability to translate a given idea [i.e. patented idea] into a launched product" (Chandy, Hopstaken, Narasimhan, & Prabhu, 2006, p. 494). Given that employee talent is the source of new ideas, it is essential to identify, quantify and monitor this critical aspect for enabling SA. In what follows, we explore these concepts in more detail.

3. Strategic agility and intangible capital

In spite of the critical value creation resident in employees' IC, prior DT and SA research has not provided a means to determine how many creative ideas are converted into patented ideas, new products or other forms of internal innovation making it difficult to determine a company's value yield from their employees' creative IC. To remedy this gap in the research, we propose a conceptual framework that addresses this issue directly by suggesting a means to assess employees' creative IC and the conversion of that creative IC in the forms of product innovations, process innovations and other forms of realized IC necessary for a company to be strategically agile. Once this framework is implemented, the data it spawns will allow managers to gauge which employees are more capable of converting their innovative ideas into outputs that create novel methods of value generation, and who thereby are contributing most to the company's SA. The caveat is that not all employees need to have a high creative to realized IC ratio to keep a business running. But, armed with the knowledge of which employees are providing the optimal conversion, managers can call on these employees in times of crisis to help a company contour its strategy to major system shocks. In addition, this information will help management find new ways to increase the overall creative potential IC of their workforce which should in turn lead to greater organizational agility. To corroborate our conceptual framework, in Section 4, we will attempt to infer that the IC conversion has occurred and then, we will infer its potential effects on the SA of European firms in the survey.

In order to realistically achieve SA, managers need an efficient way of converting creative potential IC into realized IC that generates a positive yield (Housel & Bell, 2001; Cohen & Kaimenakis, 2007). It follows that it is necessary for management to quantify the conversion ratio of the creative potential IC to the realized IC resulting value yield. In modern economies, this value creation process is implicitly connected to the DT plans of firms which would allow them to be faster and more efficient in their IC conversion rates. Moreover, creative IC can only enable SA if it is actively managed, necessitating a method to monitor its productivity.

The corporate aggregate IC conversion ratio represents the total realized innovation occurring within an organization, which is indicative of its potential to field new products and adapt to rapidly fluctuating market environments. Each individual employee's conversion ratio provides a way for managers to track the productivity of an individual employee's creative IC. A high amount of potential creative IC does not necessarily imply a benefit in the form of increased SA. It is only when the creative IC is converted into realized IC that the potential for increased value yield is possible. An ideal conversion ratio would be 1:1, it would be akin to a perfect system where potential energy is completely converted into kinetic energy. This perfect conversion ratio is, practically speaking, not possible, but this conversion to value yield should be the stretch goal for employees and, a company's management leadership, in general. A manager can use the proposed conceptual framework to evaluate an employee's performance over time, and gauge which investments (via education/experience), in producing creative potential IC, are most productive in increasing SA.

Expanding on our conceptual framework, we can view tangible assets as artifacts and intangible assets, IC in particular, as organic in nature. Artifacts have all their capabilities to be agile built-in *a-priori* by the designer; as such, the level of flexibility or fluidity of these artifacts is inherently limited in scope and application. Creative organic IC, on the other hand, has potentially unlimited innovative capabilities to be agile in response to various threats and opportunities.

Tangible assets are easily quantified, but also imitable because they serve a specific purpose. Tangible assets, like artifacts, have appeal because the value they represent is easily quantified and tracked (e.g. in terms of book value or potential discounted cash flows from future sales). Business models often imply that a well-designed information technology architecture is a surrogate for embedding SA within organizations (Railing & Housel, 1990; Weill, Subramani, & Broadbent, 2002; Morris, Schindehutte, & Allen, 2005; Huarng, 2013).

Precisely quantifying the IC conversion ratio requires that a common unit of measurement be assigned to IC outputs. Creative potential IC is difficult to measure, as it is not directly observable being resident in the minds of employees. In spite of this challenge, there have been attempts to indirectly measure the inventory of this intangible asset, for example, standardized intelligence testing, linguistic analysis of analytic essays, amount of education and experience in a given industry as well as performance in job interviews. Armed with a well-refined measure, comparing the conversion ratio of multiple companies over time would provide a measure of which organizations were more likely to survive in periods of crisis. Plotting the conversion ratios in a matrix over time would reveal the momentum, as well as the market position, of each individual company's value-generating ideas. Doing so also resolves some of the "difficulty in answering questions about conversion [from lack of] data availability for both inputs (i.e. promising ideas) and outputs (i.e. launched products)" (Chandy *et al.*, 2006, p. 495).

We identified two possible methods for the quantification of the conversion ratio. The first relies on specific interviews and reports provided by the employees at different stages over time. This method would require the use of a substantial amount of resources, as it would require the observations from many different companies at a granular level, and, even if we were not able to use it in this study, it is still useful to describe it to understand the mechanism through which employees creative abilities translate into SA.

A hypothetical example of how creative IC might be calibrated can provide a more practical understanding of this first method. In this conceptual example, the initial step would be to develop case scenarios used to assess the amount of an employee's creative potential IC that can be applied to a given company's problems and opportunities.

The employees would be required to write analytical essays addressing the problems presented to them. Analysis of these essays based on their linguistic complexity (e.g. richness of descriptive analysis) would provide a common method with which to rate the employee's general creative potential IC based on a common reference point linguistic complexity scale. Employee experience and education would be included as weightings to the final creative IC potential quantification. These measures would form the basis for the initial quantification of an employee's creative potential IC score [3].

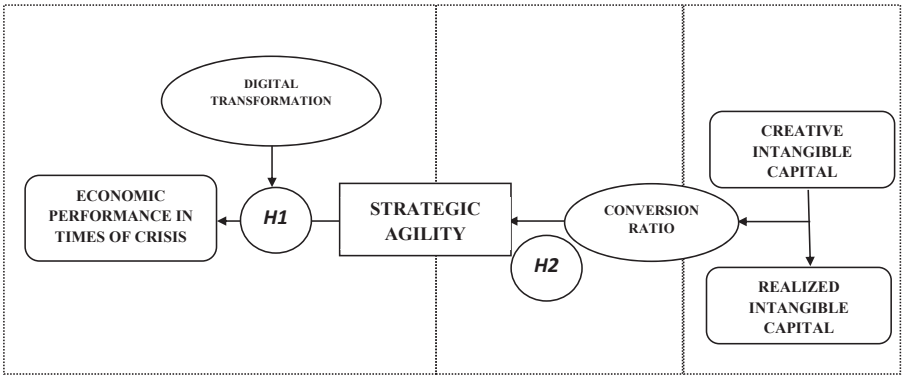
As a second step in the quantification process, employees would be asked to record their creative ideas, in a daily or weekly log, for example, in the case context of creative ideas they used to improve the online customer interface syntax. These logbooks could provide a measure of the employee's IC conversion ratio.

In the third step, the yield from their IC conversion ratio would be measured in terms of the number and quality of the implementation of their creative ideas. Increased customer traffic or repeat usage on the company's web platform would provide one measure of successfully yielded IC implementations and represent the value of the outputs of employees (Housel & Bounfour, 2011). This conversion ratio data could be used to help predict a firm's capacity for SA in times of significant market disruptions.

4. Survey data: exploratory analysis

4.1 Conceptual model

We summarize the hypotheses of the conceptual model we described so far in Figure 1 (Conceptual Model DT to SA to IC Ratio). The first block on the left of the figure shows the role SA plays in digitally transforming companies, in terms of how this capability helps improve economic performance in times of economic stress, such as the COVID-19 crisis (Hypothesis 1). The second block and third block on the right-hand side of the figure concern the inferred process of converting creative IC into realized IC, which in turn is presumed to affect the SA of firms (Hypothesis 2). Because we are not able to directly observe creative and realized IC (block 3), we inferred that the conversion ratio in Block 2 could be reasonably represented by a proxy metric.



Source(s): Own elaboration

Figure 1.
Conceptual model DT to SA to IC ratio

Our conceptual model assumes that creating and sustaining SA in digitally transforming companies is a byproduct of generating a superior yield from converting employees' potential creative IC to realized IC. Using the aforementioned methods for monitoring the conversion ratio, we assume this action would represent a potential first step in quantifying a company's SA capacity. The next much more difficult step for corporate leaders would be to increase SA by increasing the IC conversion ratio yield.

Doing this natural experimental research with firms that have responded to the COVID-19 crisis provides an extreme context to robustly test our conceptualizations of SA and the IC conversion ratio. The assumption was that firms that reaped more benefits from IC would be those that were more able to convert their creative IC into realized IC. The logic was that these high IC investment firms would be the most successful because their investment would have enabled a higher IC conversion ratio. As a consequence, by implication, these firms would also be making higher investments in SA resulting in better SA than other less successful firms. For now, at a minimum, we believe that it is reasonable to assume that successful firms most likely made better use of their employees' creative IC than those firms weighed down by industrial era-driven mechanistic response models.

We fully acknowledge that these operationalizations likely require further refinement in controlled experimental contexts with more robust internal validity controls. However, in a more controlled setting, we would give up the more appealing external validity-based generalizations but would gain more precision in our operationalizations of creative and realized IC. For the current study, we believe that this trade-off in precision for greater generalizability was justification enough for this study.

4.2 Methodology

As a first attempt to empirically explore the potential effect of the IC conversion ratio, we exploited a recent natural experiment using a firm-level survey carried out under the H2020 project GlobalInto focused on the initial (i.e. 2019) and a later period (i.e. 2020) of the COVID-19 crisis. The implied relationship between SA, IC and performance was tested using OLS and ordered logistic regressions, a statistical design which is particularly appropriate when dealing with survey data and with Likert-type interval scale dependent variables.

The analysis consists of two parts:

(1) First, we tested the relationship between SA, DT and performance during the COVID-19 crisis. Here, SA was measured by several organizational level questions,

aggregated together to produce an overall SA score, while firm performance was measured as turnover [4] change from 2019 and 2020. We summarize the first hypothesis as follows:

H1. Strategic agility helped firms that invested more in digital technologies, than firms that did not, in order to tackle the negative effects of the crisis.

In order to test this hypothesis, the estimate used the following equation with OLS:

$$\Delta Y_i = \alpha + \beta_1 SA_i + \beta_2 X_i + \varepsilon_i \quad (1)$$

where ΔY_i denotes turnover change between 2019 and 2020 for firm i, SA_i the aforementioned SA indicator, while X is a vector of the control variable [5]. We refer the reader to the data section for the details on how the variables were computed. Equation (1) is estimated both for the whole sample and for two subsamples in which firms are divided depending on their degree of DT, evaluated on the basis of Q49 in the survey, which divides firms into four categories: innovators, early adopters, late adopters and laggards.

(2) Second, we tested the role of the conversion ratio as a determinant of SA. To do so, we attempted a first quantification of the conversion ratio by measuring the extent to which firms benefitted from intangible investment in terms of turnover. This evaluation is obtained from Q43_1 in the survey (cf. Table 2 – conversion ratio independent variable used), in which firms self-evaluate the impact of their IC investment on turnover. Here, the basic assumption is that firms with a high conversion ratio were able to convert much of their IC investment into revenues, unlike firms with a low conversion ratio, who converted only a small fraction of their IC investment into revenues. In other words, the question allowed us to evaluate how productive a firms' investment in IC was, and we identified those firms that were presumed to benefit from creative IC, turning it into realized IC, resulting in higher revenues. Here, it is important to note that it is not IC *per se* or firms' performance *per se* that is important for SA, but actually the process of converting investment in the first into performance in the second. To further check this hypothesis, we also tested IC and firm turnover as potential explanatory variables. In this sense, IC was proxied using the aggregation of six types of investment in intangibles, measured as a percentage of turnover. These items were included in the survey (R&D, organization capital, design, training, brand and software). We summarize our second hypothesis as follows:

H2. The conversion ratio of creative IC to realized IC is associated with higher SA.

In formulas, H2 was tested via the following equation estimates:

$$\mathrm{SA}_i = \alpha + \beta_1 int_i + + \beta_2 Y_i + \beta_3 CR_i + \beta_4 X_i + e \quad (2)$$

where int_i represents an intangible investment for firm i, Y firm turnover in 2019, CR the conversion rate proxy and X is a vector of controls. Given the nature of the dependent variable, which is the aggregation of several Likert-type interval scale variables, the equation is estimated with the ordered logistic regression model.

4.3 Data

The GlobalInto (2021) questionnaire was conducted between the end of 2020 and the beginning of 2021 on a sample of 1796 firms from seven countries (Denmark, Finland, France,

Table 2.
Variables used

Indicator	Variables	Question #	Question text	Type
Strategic Agility				
	SA vs competitors	Q36.b	*Our enterprise responds rapidly to moves by competitors*	Likert - scale
	SA vs market	Q36.e	*Our enterprise is quick to recognize changes in its market - e.g. competition, regulation, demography*	Likert - scale
	SA vs customers	Q36.f	*We quickly identify new opportunities to better serve our customers*	Likert - scale
Intangible Capital				
	R&D investment	Q8	*In 2019, which percentage of the enterprise's turnover was spent on in-house R&D/R&D carried out by external providers (including enterprises in your own group)/the acquisition of external knowledge?*	% of turnover
	Employer funded training	Q12	*In 2019, which percentage of the enterprise's turnover was spent on staff training organized by external providers on-site or elsewhere or using internal resources?*	% of turnover
	Organizational or business process improvement	Q16	*In 2019, which percentage of the enterprise's turnover was spent on organisation or business process improvement?*	% of turnover
	Software and databases	Q20	*In 2019, which percentage of the enterprise's turnover was spent on software and databases purchased from external providers or developed or customized in-house?*	% of turnover
	Design	Q24	*In 2019, which percentage of the enterprise's turnover was spent on design activities carried out by external providers or using internal resources?*	% of turnover
	Reputation and Branding	Q27	*In 2019, which percentage of the enterprise's turnover was spent on activities to improve reputation or brand values undertaken by external providers or using internal resources?*	% of turnover
Performance				
	COVID-19 turnover change	Q47a	*Because of the COVID-19 crisis, will turnover in 2020 as compared to the turnover of 2019 decrease/increase/no impact by approximately what percentage?*	% of turnover
	Turnover in 2019	Q5	*In 2019, what was the enterprise's total turnover (market sales of goods and services including all taxes except VAT)? [Euros]*	Euros
Conversion ratio				
	Conversion ratio proxy	Q43_1	*Please indicate to what extent the enterprise benefited from investments in intangible assets made in 2017-2019, in terms of: Turnover*	Likert-scale
Firm characteristics				
	Digital transformation	Q49	*How would you characterize your enterprise in terms of digital transformation performance before the outbreak of COVID-19?*	Innovator/early adopter/ late adopter/laggard
	Firm size	Q4	*At the end of 2019, what was the total headcount number of full-time employees in the enterprise?*	Number

Source(s): GlobalInto (2021)

Germany, Greece, Slovenia and the UK). The survey focused on the role of intangibles in the COVID-19 economic crisis. The survey included 51 questions that covered general aspects of firms' activities, their investment in several categories of IC, their performance and their response to the COVID-19 crisis. Because the study focused on intangible assets, very small companies, i.e. with less than 20 employees, were not selected for the questionnaire, as they do not typically make substantial investments in IC compared to their investments in tangible assets. Most of the firms in the sample (about 75%) were classified as small and medium enterprises (SMEs), with less than 250 employees and were selected from the ORBIS database. were. About 60% of the firms are from the manufacturing sector, while the remaining 40% are from the services sector. The survey was evaluated either via telephone, web or face-to-face interviews.

The independent variables used are summarized in Table 2 (Table 2 – SA independent variables used). In particular, the SA indicator was the aggregation of three organizational capabilities questions: Q36.b *("Our enterprise responds rapidly to moves by competitors")*, Q36.e ("*Our enterprise is quick to recognise changes in its market - e.g. competition, regulation, demography*") and Q36.f ("*We quickly identify new opportunities to better serve our customers*"), all responses were measured on a five-point Likert-type interval scale. These three questions captured three aspects of SA – with respect to competitors, with respect to the market and with respect to customers – and were aggregated into a single indicator in our analysis.

As mentioned in the previous subsection, the IC conversion ratio is proxied by Q43_1. As for intangible investment, we used questions related to the six categories of investment in the intangibles included in the survey: R&D, organization capital, design, training, brand and software. For each type of intangible asset, firms were asked to provide an estimate of how much they invested in it in 2019, as % of the enterprise turnover. In order to obtain an overall measure of how much each firm invested in IC in 2019, we summed up the investment in each category of intangibles to obtain a single indicator.

To evaluate the degree of DT for each firm, we exploited Q49 (*How would you characterize your enterprise in terms of digital transformation performance before the outbreak of COVID-19?*), which allowed us to divide the sample into four categories: innovators, early adopters, late adopters and laggards.

Moreover, we used both firm turnover in 2019 in Euros (*Q5. In, 2019, what was the enterprise's total turnover -market sales of goods and services including all taxes except VAT*), and the turnover change in 2020, so after the COVID-19 outbreak, (*Q47a_1. Because of the COVID-19 crisis, will turnover in 2020 as compared to the turnover of 2019 (Decrease/ Increase/No change) by approximately what percentage?)*. Finally, we are able to control for the size of the enterprises, using the total headcount number of full-time employees in the enterprise (Q4).

In Table 3 (Table 3 - Descriptive statistics), we reported the descriptive statistics for the variables used.

4.4 Results

The outcome of the estimation of equation (1) is reported in Table 4 (Table 4 – Regression results: Strategic agility and firm performance). In particular, Part (a) used turnover change in 2020 (as a percentage) as a dependent variable, while Part (b) used turnover in 2019 (in euros). In each of the two sub-panels, the first column reports the estimates for the full sample, while the second and the third for the subsamples of firms that define themselves, respectively, either as "laggards" or "late adopters", or either as "innovators" or "early adopters" [6] in terms of DT performance (cf. Q49 in Table 2 – variables used).

The key finding from Table 4 was that SA significantly helped firms tackle the negative effects of the crisis, as the coefficient of the SA in the first column of panel (a) was significantly positive. However, this effect is valid only for companies that invest heavily in digital

Variable	Obs	Mean	Std. Dev	Min	Max
Intangibles					
R&D	1,341	3.67	8.35	0	96
Organ. Capital	1,341	1.18	2.85	0	30
Training	1,341	1.57	3.60	0	53
Software	1,341	1.47	3.90	0	55
Brand	1,341	0.94	2.60	0	30
Design	1,341	1.10	4.77	0	90
SA					
Q36_2	1,334	3.64	1.05	1	5
Q36_5	1,340	3.76	0.95	1	5
Q36_6	1,340	3.74	0.86	1	5
Other variables					
Conversion Ratio	1,308	2.61	1.21	1	5
Turnover in 2019	1,338	50300	235000	8.06	7400000
Δ Turnover in 2020	1,327	−7.71	23.94	−100	300
Firm size	1,341	195.84	567.22	20	11696

Note(s): Intangible variables are expressed as % of turnover. Firms that declared a total investment in intangibles (sum of the first six variables) greater than 100 have been cut from the sample (a total of ~300 observations). Questions Q36_2-5-6 are expressed on a five-point Likert scale. We refer to Table 2 for their full text. Turnover in 2019 is expressed in thousand euros, while 2020 turnover changes as % change with respect to 2019. The firm size variable measures the total number of employees of the company

Source(s): Own elaboration

Table 3.
- Descriptive statistics

technologies, as the coefficient remained positive and significant only in the innovators and early DT adopters sample (third column), and not in the late DT adopters sample (second column). Moreover, no SA effect was detected in panel (b), where the dependent variable was a pre-crisis turnover. Therefore, we find evidence in favour of SA as a determinant of economic performance, but generalize only to periods of high shocks to the environment and also was a determinant in companies that were ahead in DT.

In Table 4 (Table 4 – Regression results: Strategic agility and firm performance), our second hypothesis was tested, which is the linkage between SA and the IC conversion rate (equation 2). Again, we tested the equation both on the full sample (Column 1) and on two subsamples (Columns 2 and 3) depending on DT intensity, defined the same way as in the foregoing. The model was estimated via ordered logistic regressions, as the dependent variable, SA, is the aggregation of three Likert-scale variables, also as explained in the previous subsection. In Table 5 (Table 5 – Ordered logistic regression results: SA and conversion ratio), the coefficient of interest was represented as the conversion ratio, which was significantly positive in all three specifications, at all confidence levels. Moreover, it was interesting to note that none of the control variables were significant. In particular, the non-significance of the coefficients of the variables "Turnover" and "Intangibles" corroborated our initial hypothesis that they are not individually important as drivers of SA, but they were in their interaction that we defined as the IC conversion ratio because this was intended to capture how much IC each firm was able to convert creative IC into realized IC.

5. Discussion

There are two main imperatives that can be taken from our analysis: the first is that digitally transforming firms should be prepared to behave in an agile way in case of adverse events, and second that in order to maximize their agility, firms should improve their ability to convert creative IC into realized IC.

Table 4. Regression results: Strategic agility and firm performance

	(a) (Full sample)	(Late DT adopters)	(Early DT adopters)	(b) (Full sample)	(Late DT adopters)	(Early DT adopters)
SA	0.0316*** (0.0102)	0.0132 (0.0141)	0.0427** (0.0177)	−0.0126 (0.0492)	0.0837 (0.0734)	−0.0393 (0.0745)
Size	0.0001 (0.0001)	0.0001** (0.0001)	0.0000 (0.0001)	0.0011*** (0.0003)	0.0015*** (0.0005)	0.0009*** (0.0002)
Constant	4.373*** (0.0377)	4.419*** (0.0492)	4.358*** (0.0692)	16.20*** (0.195)	15.91*** (0.246)	16.20*** (0.312)
Observations	1326	735	567	1338	742	570
R^2	0.008	0.003	0.013	0.166	0.174	0.193

Note(s): ***, ** and * indicate significance at 1%, 5% and 10%, respectively. Standard errors are reported in parentheses. The dependent variable is firm turnover change in 2020 in panel (a) and firm turnover in 2019 in panel (b). Late adopters subsample includes laggards, while early adopters subsample includes innovators. The dependent variables are considered in logarithms

Source(s): Own elaboration

Table 5.
Ordered logistic regression results: SA and conversion ratio

	(1) (Full sample)	(2) (Late DT adopters)	(3) (Early DT adopters)
Turnover	−0.0039 (0.0355)	0.0721 (0.0473)	−0.0621 (0.0564)
Intangibles	0.499 (0.4320)	0.984 (0.6520)	−0.0067 (0.0046)
Conversion ratio	0.364*** (0.0429)	0.338*** (0.0592)	0.336*** (0.0648)
Size	0.0001 (0.0001)	−0.0001 (0.0001)	0.0001 (0.0001)
Observations	1306	726	560
Pseudo-R^2	0.0143	0.0124	0.0121

Note(s): ***, ** and * indicate significance at 1%, 5% and 10%, respectively. Standard errors are reported in parentheses. The dependent variable is strategic agility. The variables turnover, intangibles and size are considered in logarithms
Source(s): Own elaboration

In particular, what emerges from our analysis is a high complementarity between DT and SA in periods of extreme market stress. The inclusion of both in business strategies considerably helps companies emerge stronger from periods of stress when compared to those companies that do not build-in these elements in their plans. Being able to rapidly adapt to changes and circumstances is important in general terms, but when facing the extreme negative events, such as the COVID-19 crisis, it becomes pivotal that firms are ahead in the DT process because they will be those that reap more benefits from this approach. This happens because being agile means being able to quickly adapt operations and processes to the market conditions, and firms that are digitally ahead of the curve have more instruments for implementing these changes because they are more capable to anticipate extreme events and will be better able to predict and adjust their strategies accordingly. New digital technologies are those that allow companies to improve their products and services according to their market requirements, which becomes pivotal in times of high volatility, when products and services can become outdated very quickly and require continuous innovation to survive. SA is also important for managing firm performance in times of uncertainty, as it allows firms to identify the right responses to make to sustain high performance. Moreover, the combination of DT and SA helps firms maintain positive relationships with customers because agility is what allows them to quickly identify the changes in their customers' needs.

In this context, we argue that a critical role is played by IC and that managers should foster their organization's SA by increasing their employees' creative IC and by tracking its conversion to realized outputs. Once a manager has a better grasp of the creative potential IC at his/her disposal, the benefits of monitoring this information would be self-evident.

Those firms that are ahead in the DT process are those that suffer less of the negative performance consequences of low IC conversion ratios, and, consequently, low SA. For digitally transforming companies, it also is important to track the gaps in organizations' aggregate IC, which company leadership can then remedy, leading to potentially increased profitability from increased SA capacity.

By incentivizing creativity, a manager achieves two benefits. One aspect is that the employees will provide more creative solutions, especially in the digital sector, as they are encouraged to think about them. Inter-employee cooperation to produce the best ideas will generate more thought on how best to take advantage of collective SA to address troubling issues that a company is facing. This cooperation is particularly important for digitally transforming companies, given the nature of the intangibility of employee creative ideas. If many employees believe in the same solution to a problem or improvement in, for example, interface syntax, it is likely to have some triangulation validity as a way to increase value. Lastly, the manager will be able to keep track of the exact date innovations are proposed,

solving the issue of identifying "the date of the original flash of insight on the part of the scientist or R&D team involved." (Chandy *et al.*, 2006, p. 499).

Essentially, there are three pragmatic courses a manager can take to allow his/her organization to increase SA capacity, that are valid for any company, not just for digitally transforming firms. The first is to buy IC and SA by purchasing small to medium-sized enterprises (SMEs). SMEs are more likely to exhibit inherent agile attributes because their management structures are not overburdened by bureaucracy, the managers/owners are free to make decisions quickly, and they are able to allocate resources where they see a market opening.

If a company has the resources to acquire these companies, there are also drawbacks and potential risks that must be taken into account. First of all, an SME's agility is contained in its management structure, employees and digital infrastructure so when management purchases one of these agile companies, they cannot make too drastic of changes lest they negatively impact the conversion of potential to realized IC which is the root source of their SA. The competent business leader will allow the company to operate much as it did before the merger, while monitoring its employee's IC conversion ratio to ensure it is increasing its subsequent value yield.

To conclude, company leadership must recognize the need to foster and stimulate the IC conversion ratio among its employees to enable their organizations to achieve sustainable SA as they digitally transform. They must ultimately recognize that creative human talents will lead them to the promise of greater profitability and long-term success. Ultimately, this process acquires a particularly relevant role in the DT context, as our research showed that digitally transforming companies are those that benefit more from high SA skills.

6. Conclusion

The goal of this study was to increase the understanding of SA, in relationship to DT as an organizational practice, with particular attention to its impact in periods of economic stress such as the COVID-19 crisis and to the role of IC as the primary determinant of SA. We believe this is essential for modern businesses because the study results demonstrated that strategically agile firms were those that suffered less of the negative impact of the crisis as long as they also had a robust DT process. In addition, we showed that in order to increase their SA, firms should generate a superior yield from converting employees' potential creative IC to realized IC. We did so both conceptually, emphasizing the importance for DT firms to be agile and to stimulate their SA through effective investment in IC, and empirically, exploiting data from a recent firm-level survey conducted on European firms. In this sense, it was relatively straightforward to evaluate indicators for economic performance, DT and SA of firms. The more complicated task was to translate the concept of the IC conversion ability to value increases which we assumed was essential for nurturing the SA of a firm. Our results indicated that our approximation of this ratio yield (which depended on the capability of a firm's leadership to accurately to-evaluate the benefits of IC capital investment) was found to be an effective way to predict improvements in the SA capability of companies. This result provided compelling evidence that our hypothesis that SA strongly depends on the ability of firms to convert innovative ideas into real outputs, that lead to higher value yields in digitally transforming firms, should stimulate further investigations into this line of research.

Limitations. SA is obviously not the only explanation for the different success of companies in tackling the crisis. For example, it might be argued that some firms would more naturally succeed in any given crisis, such as COVID-19. However, there is always differential success among firms in the same market segment which begs the question of why some succeed and others fail. It also might be an overreach to argue that the firms had different levels of DT as questions about this subject might lead to defensive subjective claims by the participating respondents.

That said, it stands to reason that successful firms, regardless of the market segment they were part of, most likely exploited employee creative IC better than others in the extremely threatening market crisis that was the context in this study. Also, the survey sample size was large enough (i.e. 1,796 firms) to account for many other potential factors affecting firm success in this extreme crisis context. The survey results most strongly correlated with survey responses about the relative level of SA capability in digitally transforming firms.

Future research. There are a number of gaps in our understanding of the value of SA in digitally transforming firms that must be addressed by future research. First, it is critical to determine the role of IC in social collectives that span company boundaries to address new market opportunities and the development of new concepts and digital structures to facilitate new business models. How do these collectives form? What impact do they have on the individual companies that have active members in the collectives in terms of new products, services, core processes and motivations for the employees?

Second, further direct empirical tests of the IC to realized IC conversion ratio must be accomplished to determine the efficacy of this conversion ratio in predicting the future value of a company's SA. How can the data feeding the conversion ratio be operationalized in a relatively unobtrusive way? Are there forms of archival company data that can provide a means for estimating the values of the conversion ratio? Moreover, complementarities between different types of intangible assets are important and should be accounted for.

Third, it is necessary to identify and secure the cooperation of a set of potential companies to enable original data collection to more directly test the general concepts proposed in this research paper. What market niches would be the most fruitful for attracting sample companies? How would venture capitalists and market analysts use the kinds of analysis from the results of this research? How would they compare the relative usefulness of this kind of analysis to their routine forms of analysis of start-up companies and other companies in the targeted market niches? Addressing these research questions is necessary to propel this kind of research in useful directions. This research is critical for improving the success of existing companies and start-ups in the increasingly highly volatile marketplace.

Notes

1. Denmark, Finland, France, Germany, Greece, Slovenia and the UK.
2. One of the authors worked with a major knowledge-intensive company to develop a strategy to stem the loss of their highly productive knowledge workers in 2008. When the company finally acknowledged this problem to the business press in 2010, their revenue took a significant dip.
3. This approach was used in the Nun studies of sequestered nuns who had to write an essay about why they wanted to join the order. The linguistic complexity and linguistic richness of their essays were predictive of the likelihood of getting dementia and Alzheimer's disease later in life (Sweatt, 2010).
4. Turnover is defined as "market sales of goods and services including all taxes except VAT," as specified in the survey.
5. Given the nature of our data, we were able to control only the size of the enterprises. We assume therefore that the effect of possible other controls was captured by the constant term and that our analysis remains valid in terms of average relationships.
6. We aggregated these four categories in two for the sake of simplicity. However, different aggregations of the four categories do not significantly change our findings.

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Corresponding author
Ahmed Bounfour can be contacted at: ahmed.bounfour@universite-paris-saclay.fr