

AI and Firm Competitiveness

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ABSTRACT

The inclusion of artificial intelligence (AI) can alter firm competitiveness through data analysis and strategic planning modelling. In this paper we demonstrate that firm AI inclusion is literature supported as a stage-wise, developmental, intelligences-driven, change process. Identified benefits that AI inclusion may bring to the firm: (1) a knowledge-driven competencies and capabilities collation, (2) engaging innovative digital deep-learning, along with (3) robust stage-wise interpretations. These AI actioning effects ultimately network, and coalesce, and can deliver beneficial changes towards altering the existing firm competitiveness positioning. An AI deliverance framework with AI feedback loops is presented which demonstrates that AI can provide a competitive advantage in the global workplace.

Keywords: Artificial Intelligence, Capabilities, Competencies, Creative Knowledge, Digital Technologies, Innovation, Intellectual Capital, Firm AI

INTRODUCTION

Artificial Intelligence (AI) and the Firm

AI captures the analysis of substantive firm captured data sets, identifies embedded patterns, and likely offers intelligent solutions. AI can assist a firm in: decision making, creating greater firm operational efficiencies, minimize risks, delivering firm personalized experiences to the marketplace, and in pursuing firm ongoing competitiveness. In firms, AI, and/or learning machines, and/or autonomous robots, can each mimic aspects of human intelligence. Yet each provides different task performance capabilities, and each can in some way complement the other's solution aspects (Varmavuo, 2020). AI considers complexities, and can assess and utilize these as it seeks to enhance net intelligences of firm products, firm services, or specific firm solutions (Shankar, 2018). In contrast, when compared to most intelligent machines and autonomous robots, humans in the workforce can provide creative, holistic and intuitive solutions. AI also offers intelligent, near error-free data derived solutions to complex organisational problems (Vishoi *et al.*, 2018). Hence, as AI rapidly analyses complex data and trends, it can also generate further accuracies and further insights across its solutions to maximize workplace productivity,

Currently AI, incorporated at the firm level, resides within a technology-firm-environment framework, and with diffusion of innovation theory (AlSheibani *et al.*, 2020). AI inclusion also links the firm and its business across a raft of theories including: theory of reasoned action, resource-based theory, competitive advantage theory, decision theory, motivated reasoning theory, theory of motivated reasoning, uncertainty reduction theory, value chain theory, and voice of the customer theory (Debnath & Mukhopadhyay, 2016). Further, firms can specifically pursue AI as further enablers towards their competitiveness position. For example, firms may include AI when aiming to move faster, sharpen predictions, boost efficiencies and optimize real-time product pricing and stock minimization, and blue-ocean position against rivals (Townson, 2021). Thus AI and its inclusion fits into an important firm modelling theoretical framework.

Krakowski *et al.* (2023) follow a resource-based perspective where AI and its effects across competitive capabilities and as a performance (competitiveness) outcome is mapped and explored. They show AI adoption triggers new resource dynamics, and typically make a traditional human workforce's competitive capabilities obsolete, whilst creating a new AI-based decision-making resource, along with generating new workforce-machine capabilities. Such heterogeneous interactions in-turn also create a dynamic shift in the firm's performance (competitiveness) position. Thus firms adopting AI likely find changes to prior sources of competitive advantage, and this likely requires new relevant AI-based capabilities to become performance engaged. Rowland *et al.* (2022) see AI and digital transformation as a natural operational choice tension. AI first determines successful competitive contributions. AI inclusion brings opportunities across emerging new technologies to further explore and exploit additional technologies-related approaches - that can in-turn: (1) embed values - such as improvements in connectivities, and knowledge (qualities), operational efficiencies (performance), productive engagement levels (economic worth), (2) deliver new significant pathway systems, and (3) execute beneficial digital transformations that offer enhanced overall firm competitiveness.

AI captures ‘narrow solutions’ like accuracy-of-prediction to augment human efforts, through to ‘broad solutions’ delivering integrated machine learning capabilities and recommendations (Davenport et al., 2021). The mapping a ‘situated AI’ pathway provides model perspectives of how AI helps drive a competitiveness position (Kemp, 2023). Kemp’s (2023) grounding, bounding, and recasting approach to AI firm activities (competencies) likely better enables the firm towards developing AI-supports capabilities that are: firm specific, cost effective, and appropriate for the opportunities arising in the strategic marketplace. Similarly, knowledge sharing (capacities and intellectual capital [IP]), plus market-orientated IT (creative technologies) competences support an innovative firm orientation (innovativeness) that blends with current firm innovativeness (values deliverance) (Singh et al., 2022). These then coalesce, and further enable an ongoing (sustainable) competitively advantageous (competitiveness) position - along with a specific consumer/marketplace orientation. Therefore, AI is an intelligent feedback system capable of rapidly advancing improvement solutions to the current data situation and the firm’s competitiveness (Davenport et al., 2021; Singh et al., 2022; Kemp, 2023). AI knowledge information capacities across available data systems as intelligent business systems (competencies) that can positively engage towards improving firm process performances (capabilities), and these in-turn can positively impact on the existing competitiveness position (Wang et al., 2023). The existence of an AI competencies to capabilities to competitiveness three stage developmental process, and like other _ third generation AI studies (Zhang et al., 2023), this process has structural feedback loops operating (Figure 1).

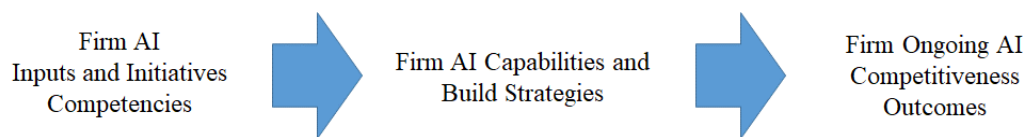


Figure 1: Three stage AI deliverance.

Research Agenda

This study’s research agenda assesses whether the AI deployed by firms can model Figure 1 to gauge the deliverance of overall competitiveness into the future. Hence, this study asks, at the firm- level: ‘can AI competencies and capabilities together model towards delivering a dynamic AI-enhancing competitiveness position?’ We answer this with the presentation of a AI deliverance framework and modelling approach first assesses firm AI inputs and initiatives including: IP capacities, technologies knowledge creation, and VRIO innovation as three key competencies readiness determinants. These inputs and initiatives covary and frame towards supporting firm operational AI values, risk, marketplace serving and communicative connectivities capabilities and their build strategies. Collectively these construct areas strategically build supportive relational systems that typically network-coalesce towards delivering ongoing firm AI-related outcomes - gauged as the firm’s ongoing (sustainable) AI-enhancing competitiveness positioning.

LITERATURE REVIEW

AI and Firm Input and Initiative Competencies

AI competencies provide computational agents that act intelligently whilst solving complex, time-consuming problems - sometimes akin to human cognitive intelligence processes (Makalef et al., 2023). This is achieved through the focus of AI technologies on pre-determined data and information requirements. AI systems learn, provide inferences, and leverage real-time data, that are aimed towards delivering operational and related firm-value benefits to the firms operations (Collins et al., 2021; Makarius et al., 2020). The conceptual view of competencies offered by Prahalad (1993) is supported by Mikalef et al., (2023) who argue competencies must address: (1) knowledge creative technologies offering technical abilities to differentiate; (2) IP capacities to support a raft of firm operations and processes; and (3) VRIO innovations to dynamically keep the firm proactively hard to imitate.

A firm is a ‘for-profit’ business entity. It is established to operate in-perpetuity, and over-time aims to grow its marketplace share. A new firm establishes so it can take unique input ideas and/or new initiative alternatives to the marketplace. When compared to its rivals, the firm strategizes its competencies to deliver such new initiative alternatives at greater efficiency, and/or lower cost. Thus, the new firm plans a fresh, differentiated entry into the marketplace. The new firm’s competencies draw upon its current intellectual property capacities, its existing technologies knowledge creation dimensions, and the existing resourcing innovations it can apply. The new firm’s differentiated competencies help it strategically support and build optimal capabilities sets of actioned, efficient, effective, and logical new product/service offerings with suitable sales appeal the firm’s chosen marketplace. The firm aims for its unique ideas and initiatives to provide an ongoing AI-enhancing competitiveness position against its rivals.

A firm collects its required and initiative alternatives as supply-side inputs. These frame the competencies required by the firm to support its ongoing business operations. Business operations that move into the digital domain, facilitate large data capture, and with this comes the opportunity to integrate AI. Firm supply-side inputs build around the firm’s capacities to collect and integrate inputs into a unique product, service or data-related intellectual property solution - typically of competitive use to the consumer and/or the marketplace. Similarly, the firm also captures technologies and innovations that offer it potential benefit and incorporates these as another input parameter. Further, the firm AI inclusion solutions also possess a unique mix of valuable, rare, inimitable, and firm organizational knowledge creation resources.

Firm AI IP Capacities

AI firm IP capacities represent the AI competence suite developed over time to support the continual-maintenance of a productive, valuable, operational business. IP offers patent protection and so provides a uniqueness or competitive-edge over rivals. It stops rivals copying, manufacturing, using, or selling the firm's product, service or artificial intelligences. The infusion of AI (and likely with machine learning [ML] support) add an IP capacities competency to quickly and accurately capture, process and analyse, the diverse, extensive, differentiated data sets available, and to provide real-time data-driven solutions and decisions against real-time, profitability-assessed insights.

Intellectual capital (IP), along with innovations in marketplace servicing capabilities, can enhance the current competitiveness position of a firm (Alkhatib & Valeri, 2022). Firms adopting AI that affected competitive capabilities, also found that these innovations also affected performance-related (competitiveness) outcomes (Krakowski et al., 2023). AI absorptive capacities moderate effects of engaged process and resource optimization of the servitization (service-centric business logistical models) (Abou-Foul et al., 2023). Therefore, inclusion of AI IP capacities contribute towards capacities to build further operational efficiencies, market offerings, consumer experiences, and socially engaging innovations. Thus the firm AI IP capacities are a set of competencies, that influence the AI capabilities being actioned, and collectively these likely affect the firm's AI-enhancing competitiveness positioning.

Firm AI Technologies Knowledge Creation

AI firm technologies knowledge creation is the AI competence suite required to initiate, support, and retain a competitive business edge. Technologies that AI-supported knowledge creation is useful in transforming, adapting and solving business communication processes from an accumulation, dissemination and effectively-used knowledge management perspective (Iaia et al., 2023). Thus AI technologies knowledge creation is a competency that likely supports efficient ongoing (and potential) transformational capabilities changes across the communicative-connectivities process domain. Specifically, AI-powered big data knowledge creation competencies can affect capabilities across the strategic marketplace (serving) decision-making domain (Bag et al., 2021). Further, an AI technologies knowledge creation change inclusion can then also affect this model's firm performance (competitiveness) outcomes. Hence, firm AI technologies knowledge creation is a likely required competence when delivering an ongoing AI-enhancing competitiveness positioning.

Firm AI VRIO Innovation

AI firm VRIO innovation captures AI predetermined valuable, rare, inimitable, and firm-specific input resourcing competence suite required to initiate the build of a competitive edge. (Barney et al., 2001; Lee, 2022). Such changeable AI focused VRIO input resourcing competences continually-refine, adapt over-time, and support sharper, better-aligned, more-efficient, digital operational capabilities systems, which in-turn can enhance an ongoing AI competitiveness position. From a resource-based view, strategic VRIO resources can enable AI-internal pathways towards a more sustainable competitiveness against relevant rivals, and in doing so, can leverage above-average profits, whilst also lessening competitive pressures (Agarwal et al., 2021).

Firm AI Inputs and Initiatives Competencies Covariance

Firm AI-driven VRIO innovation also engage firm AI IP capacities strategies, and firm AI knowledge-creating technologies techniques as competencies enlisted towards changing and/or transforming both internal processes and marketplace offerings. This also initiates dynamic AI technologies capabilities. Termed 'Edge AI' this initiates firm: competitive self-calibration, enhanced sensing, selective capture, and reputation (Agarwal et al., 2021), making machinery more-intelligent, smarter, and more self-aware. Edge AI links AI VRIO innovative ideas, internet of things (IoT) sensor devices, intelligent ML, and deep learning optimizations - delivering new capabilities performance levels to purposefully-enable, and dynamically-create, new firm and marketplace deliverables - like rapid prototyping, exploration of new device-combinations, and new feedback loop functionalities, that in-turn can simulate performance, assess functionalities, test personalization directions, increase conceptual precision, and interpret scalability (Agarwal et al., 2021). Thus the suite of AI inputs and initiatives competencies, supported by new Edge AI technologies and directions, bring an important, changeable dependency into firm competitiveness.

AI and Firm Capabilities

Firm AI deployment continues to accelerate in B2B and B2C marketplace environments - offering insights into consumer behaviors, marketplace insights, and streamlining of operational inefficiencies. AI competencies positively support fast AI capabilities actioning, and these can collectively contribute towards delivering rapid firm competitiveness (performance) outcomes (Mikalef et al., 2023). Furthermore, firm AI capabilities can offer higher informative AI-related effects, and can quicken firm AI-related quality decisions (Wamba-Taguimdje et al., 2020). Firm actioned operations collectively contribute towards the net capabilities available to the firm. Continuing across Figure 1, and considering a new firm from an AI incorporation perspective, firm AI capabilities are operationally actioned to strategically formulate, and deliver, new alternative products/services saleable suite solutions. Multiple dynamic consumptive construct areas help the new firm strategically build its Edge AI into its ongoing operational components.

AI as the key to technological intelligence advancements that achieve operational transformations capabilities (Dhamija & Bag, 2020). Their bibliometric analysis (2018-19) of English articles/documents finds six AI clusters emerge. AI first links to optimizations across a sector. Second AI links to firm research and advantageous automation against other sectors. Third AI supported operational performance and ML improve automated processes. Fourth AI brings an ongoing (sustainable)

interconnected supply chain - offering deep-thought development solutions. Fifth AI via technologies adoption, enhances ongoing (sustainable) developments, and sixth AI via IoT and reverse logistics feedback contributes towards economic, social and environmental sustainability outcomes. Broadly, AI exerts multiple network effects, across multiple firm operational capabilities areas including: values deliverance, risks mitigation, communicative connectivities and marketplace serving, and these targeted capabilities likely add towards building an ongoing AI-enhancing competitiveness positioning.

The AI values deliverance construct ensures as the operational area builds its quality, optimal performance product profitably. The AI risks mitigation construct involves the capture, assessment and solution across the competencies and capabilities network. The AI communicative connectivities ensures the consumer and the marketplace are transactionally-focused towards meeting or exceeding expectations. The AI marketplace serving construct ensures the logistics of best serving consumer and the marketplace are conducted in real-time to build consumer and marketplace confidence in the firm and its products. These firm actions collectively pursue the movement of unique ideas and initiatives towards providing a new, *ongoing AI-enhancing competitiveness* positioning against its rivals.

Firm AI Values Deliverance

Firm AI value deliverance is the AI capabilities suite required to strategically build the net operational system that is in-demand and that can generate profit. Firm value deliverance systems typically lower costs (less inventory), reduce waste, and optimize the supply chain, (Nollet & Beaulieu, 2003). They bring further value adds across manufacturing (Khorasani et al., 2020), digitize products/services (Pirola et al., 2020), gauge resourcing changes, lift qualities, optimize performance, and grow profitable investments (Lahti et al., 2018). These measures blend across three different value deliverance constructs – qualities, performance, and economic worth. This complex firm AI values deliverance system has multi, sequenced networked components across qualities, performance and productive calibrations, and net economic worth. For example, Hamilton & Tee (2018)) see GitHub's open source digital value deliverance as a stage-wise data mining system combining qualities, performance, and economic worth capabilities with marketplace servicing, and workforce satisfying behavioral considerations. Ramanujam, (2020) also shows the value linkage between qualities, performance and economic worth in delivering a sustainable competitive business positioning.

Firm AI Risks Mitigation

Firm AI risks mitigation is the AI capabilities suite required to strategically build risks minimized net operational components across all actioned operations. This complex system also has networked components capturing aspects of values, risks and communications. For example, Rana et al. (2022) adopt a resource-based and dynamic capability and contingency theory view and study the negative effects of AI business analytics components (including poor governance, poor data qualities, and poor workforce IP training) on delivering reduced operational efficiencies and negative economic worth plus delivering increased perceived risks, whilst also raising workforce dissatisfaction. These negatives network and likely result in a significant disadvantageous competitiveness positioning. The risk-competitiveness linkage further clarifies where AI risk mitigation capabilities decline, AI risks rise, and the AI-enhancing competitiveness positioning likely declines.

Firm AI Communication Connectivities

Firm AI communication connectivities is the AI capabilities suite required to dynamically and strategically connect with the end-users in the marketplace across the interactive transaction medium employed. This complex system also has networked components capturing aspects of values, risks and communications. AI knowledge management as a process of acquiring, using, transferring, developing and storing digital data in a transparent, accessible, communications form that builds connectivities across business processes (Iaia et al., 2023). AI as combining with values deliverance (qualities and operational performance components) to AI support firm-consumer engagements in B2B environments (Chatterjee et al., 2021). The resultant performance-related outcomes significantly support an AI-enhancing competitiveness positioning.

Firm AI Marketplace Serving

Firm AI marketplace serving represents the AI capabilities suite required to strategically build the net operational components that deliver service requirements into the marketplace. This complex system has networked components capturing aspects of values, risks and communications. Conceptually modeling AI and analytics capabilities as positively adding into marketplace sensing, seizing and reconfiguration capabilities components, and then towards improving an AI-enhancing competitiveness positioning (Hossain et al., 2022).

Firm AI-Enhancing Competitiveness

AI competencies and AI capabilities collectively deliver an ongoing dynamic firm AI competitiveness (performance) positioning outcome (Mikalef et al., 2023). AI-at-the-Edge, or Edge AI approach, adds competitive self-calibration, enhanced sensing, selective capture, and digital reputation capabilities into the firm's AI competitiveness positioning (Agarwal et al., 2021). AI-powered big data knowledge creation significantly develops strategic marketplace decision making, and likely enhances the firm performance outcomes enhancing competitiveness – measured as a coalesced delivery of: customer retention, sales increases, higher profits, greater ROI, new markets capture, faster product/service introductions, faster new products acceptances, and greater market share (Bag et al., 2021).

DISCUSSION

AI Deliverance Framework

To date, the AI deliverance framework as shown in figure 2 remains conceptual although some researchers claim a firm can also achieve the same result across the same general construct system. However by including AI additive components these can reside across the entire suite of constructs – sometimes as Edge AI inclusions. Alternatively, they can exclusively (or in part) enter the ongoing competitiveness system as external suite of AI moderators. This alternative moderator inclusion pathway option can also be tested as impacting across the pathways of figure 2's AI deliverance framework. In this inclusion option, the firm's competencies to capabilities to competitiveness system, accepts an external injection of likely useful AI additive components, and likely incorporates these in pursuit of further expanding its AI-enhancing competitiveness. Collectively, these measures spread over much of the competencies and capabilities of Figure 2 - giving father support to the competencies to capabilities to competitiveness AI deliverance framework proposed below.

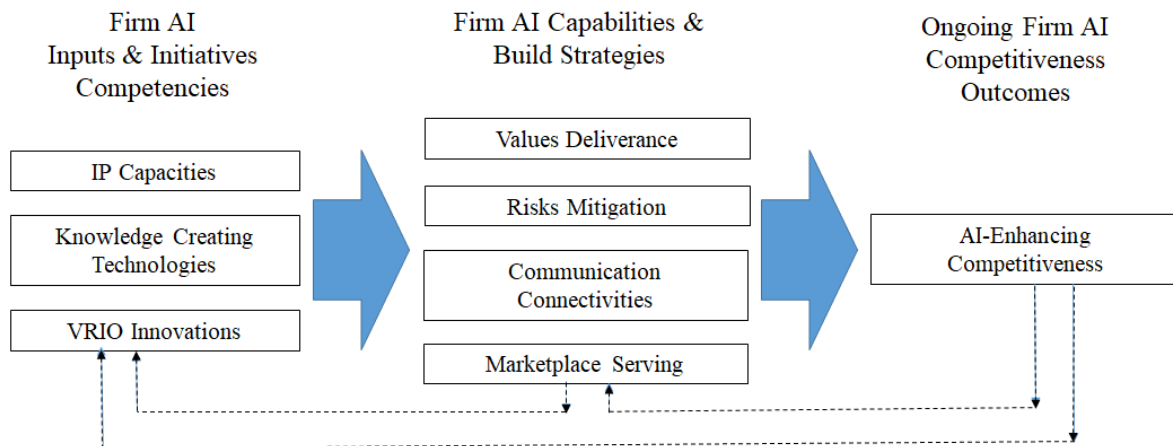


Figure 2: AI deliverance framework with AI feedback loops.

Implications of Research

Theoretical Implications

This study draws on data capture across many firm business measurement domains. Competencies-related theories include: resource based (Barney, 1991), competencies based (Prahalad & Hamel, 2009), dynamic capabilities (Teece et al., 1997), and dynamic competition (Petit & Teece, 2021). It adds expectations, motivation, consumption, and user-gratification theories, into its capabilities relationships. As the firm is consumer and marketplace end-user focused when investigating its AI inclusions, alignment to marketing theories is expected. The European Journal of Marketing 50 year collation of fifty widely-used key words is theory linked by Martínez-López et al., (2018). Relevant theories to this AI deliverance framework study include: consumer behavior, marketing, strategy, customer satisfaction, relational marketing, market orientation, trust, retailing, consumers, equity, loyalty, identity, brand image, stakeholder analysis, buyer-seller relationships, innovation, marketing theory, performance, marketing communications, brand image, research, market segmentation, pricing, competitive strategy, financial service, international marketing, consumption, services, empowerment, culture, and customer orientation (Martínez-López et al., 2018, Table X. Thus this study has a vast array of theoretical support.

Practical Implications

This study offers a new firm construct measurement approach towards building AI-enhancing competitiveness. To date this is a first literature study formally linking firm AI competencies to AI capabilities, and these then forming a precursor network suite focused towards delivering firm AI-enhancing competitiveness.

Future Research

Measurement Aspects

This study recognizes that when considering firm AI inputs and initiatives three major competencies construct areas are consistently required. First firm AI IP capacities retain a tangible (or physical) firm-possessed AI point-of-difference. Second, firm AI knowledge creating technologies bring a digital intangible dimension to the firm's AI. Third, Firm sourced and developed VRIO innovations bring newly discovered futures-focused tangible and intangible resourcing dimensions into the firm's competencies. These three competencies are interrelated and so likely covary as predicted above. Hence these independent competencies are proposed as a general prerequisite AI suite when updating and reframing the firm. It is likely that the interdependence between these three competencies suites varies depending on such things as: the country, the industry, the firm, the leadership and its' strategic approach, the firm's technical competence, the workforce, the firm's specific products/services, the risks involved, the firm-allocated AI investment level, the consumer and the marketplace. Research and measurement into the items making up each construct is now required.

The firm AI capabilities and build strategies constructs represent four interrelated systems (values deliverance, risks, connectivities and serving). Each is dependent on the available competencies mix. Research regarding measurement and understanding is required as to how these embedded systems operate and network towards delivering AI-enhancing competitiveness.

The inclusion of AI can be achieved by several pathways and each can exert differing AI-enhancing competitiveness outcomes. For example (1) AI can be selectively step-by-step added to a chosen construct (or related constructs), or (2) AI can be added across the full network of constructs, or (3) AI can be added as a moderator to select relational pathways, or (4) AI can be added at the edge (Edge AI) of the existing system. The optimal AI inclusion approach remains unclear and so is an area for further research.

Theoretical Aspects

Theory of AI Adoption

At firm/business level, or at the industry level, a certain level of input AI competencies need to be present before enacted firm AI capabilities can deliver significant operational enhancements. This firm AI approach encompasses 'Diffusion of Innovation theory,' along with a 'Resource Based View' approach. The 'Theory of Adoption' adds choice (accept/reject) of a chosen idea or innovation. An 'AI Intelligence theory' adds that developing technologies systems can execute tasks (visual, speech, decisions, language, translations, and the like) in real-time and in preference to a firm's workforce. Thus a 'Theory of AI Adoption' can be stage-wise proposed as:

'sourcing/examining, selecting/exploring, accepting/rejecting, and adopting/exploiting, a particular additive mix of latest AI innovative and useful components into the firm's (or the industry's) business solution.'

Theory of AI-Enhancing Competitiveness

This study proposes the inclusion of smart AI solutions into the firm (or into an industry) brings a new knowledge approach that likely changes firm competitiveness. A theory of 'AI-Enhancing Competitiveness' is defined as:

'a knowledge-driven competencies and capabilities collation, engaging innovative digital deep-learning, along with robust stage-wise interpretations that ultimately coalesce and deliver a beneficial change to the existing competitiveness position.'

Management Aspects

Management can investigate how Figure 2's feedback loops can best measure to facilitate useful real-time change solutions. The negatives to AI inclusions can also be located and eliminated. As changes are implemented by management the relative strengths of pathways within Figure 2's model may require further optimization or adjustments. The way AI is included need to be determined for the firm, the business and the industry under consideration.

CONCLUSION

This study concludes AI competencies and AI capabilities together model towards delivering a dynamic AI-enhancing competitiveness position. It proposes AI-enhancing competitiveness as a stage-wise, developmental, intelligent and changeable construct - arising from firm-relevant AI inclusions bringing positive, innovative changes to the existing complex systems of interrelated competencies and capabilities, and their network coalescence towards an AI-enhancing competitiveness positioning.

This study expands knowledge regarding AI and firm competitiveness. Its literature research frames the Figure 2 AI deliverance framework, and highlights different ways AI can be included in the firm's competitiveness strategies. The feedback loops of Figure 2 allow selective, preferential, maximum-impact, near real-time changes to be tested as rapid improvement mechanisms to the existing AI-deliverance system. The research agenda asks for executive firm-feedback regarding adoption of AI competencies to action AI related capabilities, and to help drive firm AI-enhances competitiveness..

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