Amending Dynamic Capability Theory for Information Systems Research on the Reskilling of Coal Miners in an AI-Driven Era

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Abstract. Due to digitalization and disruptive technologies, the business landscape has changed. The change will influence the nature of work across all industries. The South African mining sector is going through a modernization process to stay relevant. The paper explores Dynamic Capability Theory (DCT) as a suitable theory for the reskilling of coal miners. The paper will define the theory and related concepts to get a better understanding and explore the link with information systems. It amends existing dynamic capability frameworks and proposes a modified model that can be used to guide the reskilling of mineworkers for the new era. The amended framework can be used to mitigate the foreseen consequences of the use of robotics and automation in the mining industry in South Africa. The inclusion of human aspects in DCT is especially important to facilitate the Africanization of information systems within the mining sector on the continent. As a result, this will increase the understanding and learning of transitioning skills within the context of using a variety of emerging innovative technologies fueled by the new era.

Keywords: Dynamic capability · Dynamic Capability Theory (DCT) · Digitalization · Human resource development (HRD) · Coal mining · Information Systems (IS) · Information technology (IT)

1 Introduction

Disruptive technologies and digitalization are driving change and innovation in the business landscape [1, 2]. Digitalization is changing the nature of work, the skills needed and the way the work is done [3]. A major impact of this change is a reduction in the workforces of companies due to robotics, automation, artificial intelligence (AI) and autonomous vehicles which have replaced numerous manual jobs such as mine workers', truck drivers' and receptionists' jobs. The most affected industries will be those with routine and repetitive jobs [4]. To address this problem, Stubbings and Williams [1] suggest taking deliberate action in driving technological development whilst exploring

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innovative solutions to unemployment. According to Valsamis et al. [5], the net impact of the changes on the nature of work is still unknown and more studies need to be done to determine it. As much as technology threatens the current workforce, it has also created new jobs that require the adaptation of manual skills into new digital skills. This means that the reduction in the workforce is not as drastic as might have been expected, because technological advancement has proven to be viable due to job relocation [5]. This creates a fertile learning environment for identifying new skills and reskilling opportunities.

To determine the impact of digitalization, the paper focuses on coal miners in South Africa. This is largely because the South African mining sector is a key contributor to the South African economy and it is also responsible for the employment of many low-skilled South African workers [6]. Hence, the impact of digitalization in this sector will be massive for the South African labor market. Manual laborers, including mineworkers, should be taught new skills that are directly or indirectly related to the digital work environment, e.g., how to operate or program mining robots. The use of Africanized information systems, that are intuitive to use in local environments, could facilitate and ease such a reskilling process. Such a deserving endeavor should be founded on a suitable and rigorous Information Systems (IS) theory. Vartiainen and Hansen [7] point out that most change drivers today are IS-enabled. Therefore, the research question of this paper is: *What is a suitable theory to guide the reskilling of coal miners in the digital era?*

The authors explore Dynamic Capability Theory (DCT) as a foundation for research on how to keep coal mines competitive in the ever-changing mining business. DCT has been gaining popularity over the years across multiple disciplines, including the information systems and information technology space [8]. DCT was initially published by Teece, Pisano and Shuen [9] in the strategic management space where it was built to enhance the Resource-based View theory (RBV). Unlike its predecessor, DCT takes into consideration market dynamics, such as technology developments, changes in laws, innovation, and so on.

To begin with, the paper discusses the background of DCT, with specific reference to its origins and its relation to information systems, followed by the definition of the different concepts related to dynamic capabilities. The paper then explores the drivers of dynamic capabilities as well as the key constructs of dynamic capabilities and how they relate to human resource development (HRD). Finally, an amended dynamic capability model is proposed to be used to guide the reskilling of coal miners for the new digital era.

2 Background

According to Gumede [10], there is a need for basic mechanization or modernization geared towards the mining process to leverage it through digitalization in South Africa. Mechanization refers to the process of replacing physical tasks done by people or animals with machinery [10]. "Automation is the next phase of mechanisation, where the interaction between humans and tasks are further reduced through modern information and control systems" [10]. With this as a backdrop, the firm has two main groups of business capabilities. Firstly, operational capabilities address the day-to-day running of the business; secondly, dynamic capabilities drives the development of new operational

capabilities and thereby effectively change the way the business functions [11]. However, the classification differs from one firm to another, depending on the firm's strategic outlook and the use of the capability or capabilities concerned. If the capability is strategic, it is classified as a dynamic capability, and if it has an operational nature, it is identified as an operational capability [11, 12]. Dynamic capabilities are made up of the following: dynamic managerial capabilities, dynamic integration, dynamic organization capabilities, dynamic reconfiguration, and dynamic learning. It's important for these dynamic capabilities to be cognizant of the information system landscape. IS capabilities are the abilities to acquire, deploy and leverage information system or information technology resources to strengthen business strategy and they form part of other capabilities (operational or dynamic) depending on usage [7].

Teece, Pisano and Shuen [9] introduced the DCT in their seminal 1997 paper which defined dynamic capabilities as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" [9]. Since then, the theory has evolved and gained popularity [13, 14], with some authors dismissing it as "fuzzy" and "tautological" and others recommending it as a good base [15]. DCT expands on the resource-based view of the firm which states that the firm's ability to be competitive depends on the bundling of resources and capabilities that it has [8]. The resources of the firm are typically tangible or intangible assets that are used to develop or control input to the production of value in a specific market [16]. The challenge with RBV is that it is static and ignores the influence of the market dynamism. Besides, it fails to explain how resources are converted to be competitive instruments [11, 16].

Furthermore, DCT provides an ideal lens for studying how a firm can adjust its resource-base to take advantage of opportunities in the long-term [17]. Dynamic capabilities facilitate valuable, rare, inimitable and non-substitutable (VRIN) resources to ensure competitiveness and performance [11].

Since the introduction of dynamic capabilities in 1997, literature has shown a continuous increase in usage of this theory [11, 15]. This has been particularly evident in the information systems and information technology space due to the increased impact of digitalization and the fourth industrial revolution in the business landscape. The main influence of dynamic capabilities is on the resource-base, and generally resources are viewed from a technical aspect and overlook human resource (HR) as one of the critical resources in an organization. Information systems is defined as the use of information technologies by humans in conducting the affairs of the organization [18]. Human resources are a key component of this definition and it has a direct positive impact on the performance of the firm [19, 20]. A correlation exists between firm performance and human resources [12, 19], as confirmed by Breznik [13] who insists that the deployment of human resources as a dynamic capability will result in sustained competitiveness. Thus, organizational performance can be achieved by setting up human resource development (HRD) practices that enable HR as a dynamic capability. The relationship between human-resource development practice and dynamic capabilities is, however, not discussed sufficiently in existing literature [7, 21]. Neither does it break down the concept of the resource base into lower levels or show the multi-level construct nature of DC on job responsibilities as highlighted by Vartiainen and Hansen [22]. These knowledge gaps are addressed in the paper (see Sects. 5 and 6 below).

3 Definition of Dynamic Capabilities

There are several definitions of dynamic capabilities. These definitions have evolved, but the essence remains. The original definition provided by Teece, Pisano and Shuen [9] refers to "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" [9]. Eisenhardt and Martin [23] further expand this definition as follows: "The firm's processes that use resources — specifically the processes to integrate, reconfigure, gain and release resources — to match, and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die." Therefore, the key highlight of this definition is that dynamic capabilities influence a firm's strategic routines and processes.

Similarly, in an attempt to simplify dynamic capability definitions, Helfat et al. [15] redefined dynamic capabilities as follows: "A dynamic capability is the capacity of an organization to purposefully create, extend, or modify its resource base". Furthermore, recent papers have simplified the definition of dynamic capabilities to three main constructs: sense; seize (orchestrate the design of the business); and transform (implement a business model) [16, 24–26].

Additionally, DCT states that capabilities represent resources within the organization. To this end, the dynamic capability conceptualization of company resources and the evolving business environment is generative for grasping how resources are utilised to remain competitive. As a result, this supports the reason why any company adopts information systems, which is the use of information technology, people and organizational processes to be competitive.

According to Teece [25], dynamic capabilities are divided into 'microfoundation' and 'macro-level capabilities'. The former deals with new product development, expansion into new regions, and obtaining new resources through acquisitions and alliances [27]. Microfoundation refers to the analysis of dynamic capabilities in its lowest form. Carnahan et al. [28] provide a more comprehensive definition of the microfoundation as follows: "The microfoundations of dynamic capabilities — distinct skills, processes, procedures, organizational structures, decision rules, and disciplines — which undergird enterprise-level sensing, seizing, and reconfiguring capacities are difficult to develop and deploy" [28]. Contrary to this, the macro-level capabilities are higher-level processes that help the organization achieve its daily operational abilities to attain its goals [15, 21, 28]. These higher-order capabilities deal with changing and rebuilding the ordinary capabilities of the organization.

Fallon-Byrne and Harney [21] oppose the popular view by highlighting the need to further expand on the concept of microfoundation of dynamic capabilities at a lower level. They believe that sensing, seizing and reconfiguration are at a macro level and not a micro level, as demonstrated in their model [25, p. 26]. This is in direct contradiction with Teece's [28] perspective which is based on the dynamic capability framework which will be discussed later on. Fallon-Byrne and Harney's [21] model uses an innovation perspective and it argues that an innovation strategy represents human resources [21].

There are four main themes within the dynamic capabilities for innovation model as discussed by Fallon-Byrne and Harney [21]: organizational innovation strategies, climate (i.e., innovation and affective behaviors), dynamic capabilities and outcomes. The first two themes represent microfoundations of the organization while the last two themes are represented by dynamic capabilities and innovation outcomes respectively, and it can be deduced that they are macrofoundations. The bottom part of the dynamic capabilities for innovation model [25, p. 26] illustrates the link between the following human resource views: intended managerial strategy, employee perspective, employee behavior, dynamic capability, and organizational outcomes. This view is instrumental in the contextualization of the relationships between macro and micro-processes. This demonstrates that microfoundations are multi-layered [21] and Teece [25] supports this argument. According to Teece [25], sensing, seizing and transforming can be seen as the top layer of the microfoundation.

3.1 Definition of Capability

Capability is defined as the ability to perform a particular task or activity [15]. Firms use capabilities to achieve their goals, as highlighted by Helfat et al. [15] and Teece [28]. Also, there are different types of capabilities as listed below:

Substantive capabilities [8] are the abilities to solve business problems.

Higher-order capabilities [25, 26] are "the abilities to change the way the firm solves its problems" [29].

Innovative capability is "the ability to develop new products or markets" [30]. In the context of this paper, this refers to using new technologies to create new products, processes and markets.

Absorptive capabilities refer to "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" [11]. In the context of this paper, this means the ability to identify emerging disruptive technologies and how they will affect the business landscape.

Adaptive capability [11, 30] is the firm's ability to identify and take advantage of emerging market opportunities such as technology.

Dynamic managerial capabilities are the abilities of the firm's management to motivate their skills and experience for the management of a changing landscape.

Dynamic organizational capabilities [8, 25, 31] refer to the ability of the organization to deal with changing business landscapes.

It is, therefore, apparent that the above-mentioned capabilities are especially relevant in this digital age as they can be categorized into one of either operational type of capabilities or dynamic type of capabilities (see Table 1). The former enables the organization to earn a living by running the day-to-day routines. In contrast, the latter is concerned with the future adaptability of the organization [15]. Therefore, it supports the original argument by Teece, Pisano and Shuen (1997) that operational capabilities ensure that the company delivers on its value proposition on a daily basis.

Table 1. Operational vs. dynamic capabilities.

Operational capabilities	Dynamic capabilities
Substantive capabilities	Innovative capability
Higher-order capabilities	Absorptive capability
Human resource capabilities	Adaptive capability
First-order capabilities	Dynamic managerial capabilities
Human resource development (HRD)	Dynamic organizational capabilities
IS capabilities	IS capabilities
	Strategic human resource development (SHRD)

4 Constructs of Dynamic Capabilities

The key constructs and elements of dynamic capabilities shown in Teece's [21] dynamic capability framework illustrate the ability to sense changes in the business environment and to seize the change advantageously by designing a refined business model and committing the necessary resources to finally transform the organization by realigning and influencing its culture. These abilities are crucial, particularly in the digital era where information technologies are affecting the business model. Taking into consideration the current strategy of the Minerals Council South Africa to modernize mining operations [10], mines' management needs to go through a process of sensing new technologies relevant for the mining industry, such as robotics, artificial intelligence (AI), autonomous driving and the like [32]. They should then seize any opportunities for modifying their business models to ensure adoption of the digital technologies. Once that is done, they need to realign the mining culture with the new technologies.

According to DCT, the three main processes for dynamic capabilities are:

Sense, which is defined as the continuous scanning of the environment internally and externally for opportunities brought by market dynamism [13, 15, 24].

Seize, which refers to the firm's ability to take advantage of the opportunities by designing and refining the business model and ensuring that resources are committed to take advantage. (Breznik [13] highlights that seizing is about making a good decision in uncertain times.)

Transform, which refers to the firm's ability to realign and re-configure its routines, processes, structures and culture [13, 15, 24].

According to Teece's [21] framework, the above three processes are also referred to as "microfoundations" as they enable internal knowledge and skills development to gain a competitive advantage. Furthermore, it has become apparent that the success of dynamic capabilities is dependent on the role, skills and competences of the manager [13, 25]. Management has developed into a sub-field of dynamic managerial capabilities [25] which, in turn, has led to the dynamic managerial capabilities (DMC). DMC refers to senior management's abilities to effectively alter company routines, processes and resources configuration [29]. Therefore, a manager's perspective concerning dynamic

capabilities is crucial for orchestrating and enabling change to take advantage of opportunities [29]. To be effective in the transformation journey, the manager needs to be adaptive, absorptive and to possess innovative capabilities [11].

A firm-specific process, such as integration, reconfiguration, renewal and recreation, together with the above capabilities, will regulate the firmness of the dynamic capabilities within the firm. It can therefore be concluded that higher performance and appropriate change in the organization is reliant on the viability of the dynamic capabilities.

Wang and Ahmed's [13, p. 39] research model of dynamic capabilities shows that market dynamism triggers dynamic capabilities. Dynamic capabilities are made up of two main parts: the common features depicting component factors, and firm-specific processes depicting underlying processes. The higher the dynamic capabilities the firm shows, the more likely it will be to build new capabilities over time. As a result, the development of these new capabilities will be directed by the firms. It is also important to note that capability development differs from business to business as it is simultaneously directed by the strategy and the dynamic capabilities of the firm concerned.

Capability development has a direct influence on the performance of the firm, as per the research model [13, p. 39].

Notably, the influence of dynamic capabilities on performance generally takes place over the long-term rather than the short-term [11].

As a result, capability development deals with the development of strategic dynamic capabilities – such as strategic human resource development (SHRD), dynamic management, dynamic learning and others – that will move the firm into the future.

5 Discussion

It is therefore apparent that similarities exist between Teece's [25] dynamic capabilities framework and Wang and Ahmed's [11] research model of dynamic capabilities. Wang and Ahmed's [11] model takes a wider view on their modelling to include market dynamism and capability development. In contrast, Teece's [25] model focuses on the dynamic capabilities, business model and strategy. It can also be seen that the firm-specific process that forms part of Wang and Ahmed's research model reflects the dynamic capability process, which itself resembles Teece's dynamic capability framework. Both models show the influence of strategy on the dynamic capabilities, but Teece [25] expands on the strategy discussion by explaining the relationship between the strategy and the business model.

Teece [25] and Wang and Ahmed [11] discuss the importance of human resource development and dynamic managerial capabilities, however, their models do not reflect this. Consequently, this creates a misconception of human resources and dynamic managerial capabilities as equivalent to other dynamic capabilities. Furthermore, as mentioned earlier, the manager's perspective is crucial, and it needs to be technology conscious. Hence, Wang and Ahmed's [11] model discusses common features which are constituent factors for management, adaptive capability, absorptive capability and innovative capability. These constituent factors are therefore crucial in establishing SHRD practice which will develop the human resources in the firm or establish if additional ones are needed. This means that features common to both can be expanded to effectively

reflect the dynamic managerial capabilities and SHRD. Therefore, this paper expands the dynamic capability framework to incorporate the proposed additions, as indicated in the proposed model in Fig. 1. Also, the literature review exposes a gap between the relationship of human resource development practice and dynamic capability [19, 33]. This indicates a need for further studies to be conducted in this area. Furthermore, dynamic capability literature describes the resource base as a significant element of DCT, but it does not break down the concept of the resource base into lower levels [15]. It does, however, describe resource-base elements, such as assets, equipment, relationships and human resources.

This paper aims to break down the aspect of the resource base and focuses, in particular, on the human-resource aspect. According to the findings of Kareem and Mijbas [33], the relationship between HRD and organizational effectiveness is not direct in changing the business environment but indirect through the facilitation of dynamic capabilities.

HRD has been defined as "a process of developing and unleashing expertise to improve individual and teamwork processes, and organizational systems" [12]. Kareem and Mijbas [33] expand on the definition to includ deliberate plan for developing an employee's knowledge, skills and abilities to increase organizational effectiveness concerning the adoption of information systems. This is, however, rejected by Garavan and Carbery [12] who distinguish between HRD and SHRD. Garavan and Carbery [12] insist that the former looks at HRD from an operational perspective while the latter has a strategic perspective of the HRD.

6 Proposed Model

Figure 1 proposes a model that takes into account dynamic management capabilities and strategic human resource development. The proposed model shows dynamic management capabilities as an extension of dynamic capabilities because the manager's perspective is essential for sensing changes and for developing relevant SHRD. This is important so as to ensure that managers can recognize emerging technologies and react appropriately to empower employees with the right knowledge and skills through the SHRD. The relationship between dynamic management capabilities and SHRD practice is a continuous loop to influence human resource development. Senior management must understand the components of information systems and their impact on the business. SHRD will influence seizing and transformation to ensure competitiveness.

The output of the transformation process is the alignment of existing processes and/or investment in additional capabilities. The arrows in the model show the flow of information and influence exercised by the items described in the various boxes.

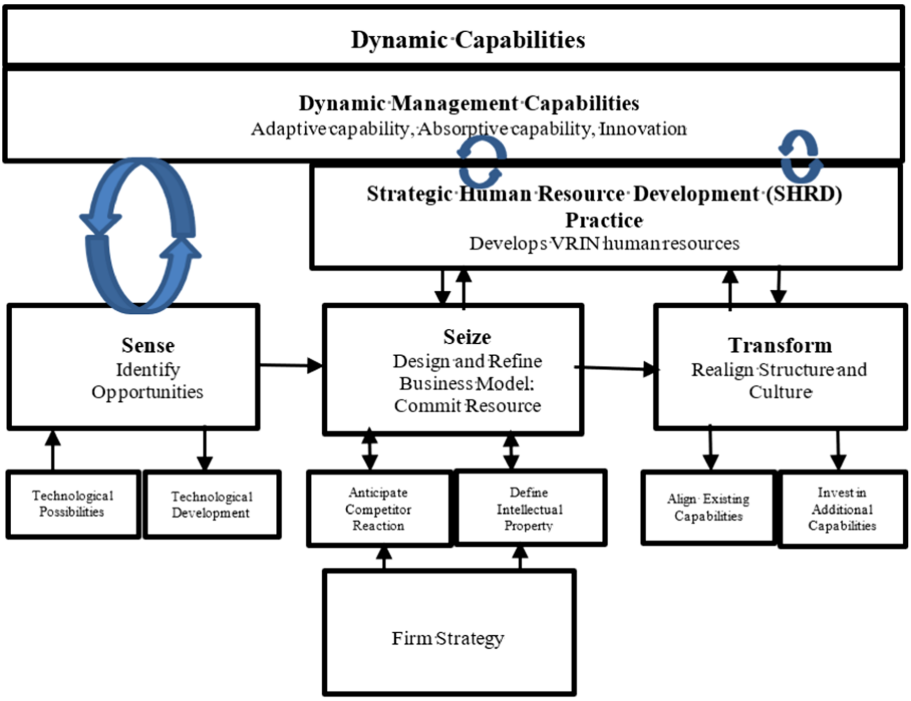

Fig. 1. Proposed dynamic capability model.

7 Conclusion

The paper developed the proposed framework that can be used to help reskill coal miners for the digital era to mitigate the societal impact of emerging mining technologies. Applying the proposed dynamic capability model (see Fig. 1) to the coal mining industry could lead to a position that enables the leadership of a mine to develop high strength dynamic capabilities to ensure that the reskilling of the coal miners will take place.

The assumption is that mining companies will adopt disruptive technologies as part of the mechanization of mines. The Minerals Council South Africa is promoting the modernization strategy of the mines by embracing automated and autonomous technologies among others, which will have a huge impact on skills and labor markets [34].

In line with the literature, coal mines need to develop dynamic capabilities within the firm to sense market changes and thereby see opportunities and threats. For example, the mechanization of the mining industry and the resulting decrease in profit margins make it difficult for businesses to realize value [34]. Coal mines will, therefore, need to seize the opportunity to mechanize their business to stay relevant and profitable. This will require dynamic managerial capability from the mines' management teams. Lastly, the mines will need to transform or reconfigure some of their capabilities and develop new capabilities. This will be done through reconfiguring human resources. One of the biggest resources in a coal mine is the human resource – the miners who go through the process

of extracting coal from the ground. In future, miners will be expected to use new digital technologies to perform their duties. This paper has attempted to highlight the need for a transformation process and to develop a conceptual framework that could guide the reconfiguration of coal miners for the future. "Substantial changes to the organizational structures and business processes will work in concert with technology improvements to enable a substantial shift in the way mining enterprises work" [35]. The organization and its people need to work together to identify changes that digitalization (prompted by the fourth industrial revolution) is bringing to the company.

A limitation of this paper is that no empirical evidence yet exists to support the design of the proposed conceptual framework. In future work, qualitative research should be conducted to provide this evidence and to refine the framework even further, based on the results of such empirical work. The specific needs of the African continent and its divergent cultures should be taken into consideration when the proposed framework is refined and implemented. It is anticipated that this paper will spark interest in learning about the impact of innovative technologies on current skills sets in the coal mining sector, and the adjustment thereof by using e-learning technologies.

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References

1. Stubbings, C., Williams, J., Sethi, B., Brown, J.: Workforce of the future: the competing forces shaping 2030. www.pwc.com (2017)
2. Brundrett, S.: Industry analysis of autonomous mine haul truck commercialization (2014). https://doi.org/10.1007/s13398-014-0173-7.2
3. OECD: Going digital: making the transformation work for growth and well-being. https://ec.europa.eu/futurium/en/system/files/ged/going_digital_longflyer_jan_2017.pdf (2017)
4. OECD: Future of work and skills (2017)
5. Valsamis, D., de Coen, A., Vanoeteren, V., Van der Beken, W.: Employment and skills aspects of the digital single market strategy. Eur. Parliament (0), 1–67 (2015)
6. Statistics South Africa: National accounts: mineral accounts for South Africa: 1990–2010. https://www.destatis.de/EN/FactsFigures/NationalEconomyEnvironment/NationalAccounts/DomesticProduct/Tables/GrossValueAddedIndustries_BWS.html (2013)
7. Vartiainen, K., Hansen, L.K.: Dynamic capabilities in information systems research – a literature review. Selected Papers of the IRIS, Issue Nr 9 (2018), vol. 2 no. 9 (2019)
8. Barreto, I.: Dynamic capabilities: a review of past research and an agenda for the future. J. Manage. **36**(1), 256–280 (2010). https://doi.org/10.1177/0149206309350776
9. Teece, D.J., Pisano, G., Shuen, A.: Dynamic capabilities and strategic management. Strateg. Manage. J. **18**(7), 509–533 (1997). https://doi.org/10.1142/9789812796929_0004
10. Gumede, H.: The socio-economic effects of mechanising and/or modernising hard rock mines in South Africa. South Afr. J. Econ. Manage. Sci. **21**(1), 1–11 (2018)

11. Wang, C.L., Ahmed, P.K.: Dynamic capabilities: a review and research agenda. Int. J. Manage. Rev. **9**(1), 31–51 (2007). https://doi.org/10.1111/j.1468-2370.2007.00201.x
12. Garavan, T.N., Carbery, R.: Strategic human resource development. J. Eur. Ind. Train. **15**(1), 23–44 (2012). https://doi.org/10.1108/EUM0000000000219
13. Breznik, L.: Deploying human resource capability for sustainable performance : a dynamic capabilities framework. In: Human Capital without Borders: Knowledge and Learning for Quality of Life, pp. 561–570. Portoroz, Slovenia (2014)
14. Helfat, C.E., Peteraf, M.A.: Understanding dynamic capabilities: progress along a developmental path. Strateg. Organ. **7**(1), 91–102 (2009). https://doi.org/10.1177/1476127008100133
15. Helfat, C., et al.: Dynamic Capabilities: Understanding Strategic Change in Organizations. Blackwell, Malden, MA, USA (2007)
16. Ahmad, M., Papert, M., Pflaum, A.: Dynamic capabilities related implementation skills for internet of things solutions in the digital economy. In: Proceedings of the 51st Hawaii International Conference on System Sciences, pp. 3996–4005. Hawaii (2018). https://doi.org/10.24251/HICSS.2018.502
17. Doherty, N., Morgan, T., Jobs, S., Doherty, N.F.: Incremental innovation by design: a dynamic capabilities perspective. In: UK Academy for Information Systems Conference Proceedings, p. 14. Spring, UK (2016)
18. Paul, R.J.: What an information system is, and why is it important to know this. J. Comput. Inf. Technol. **18**(2), 95 (2010). https://doi.org/10.2498/cit.1001800
19. Garavan, T., Shanahan, V., Carbery, R., Watson, S.: Strategic human resource development: towards a conceptual framework to understand its contribution to dynamic capabilities. Hum. Resour. Dev. Int. **19**(4), 289–306 (2016). https://doi.org/10.1080/13678868.2016.1169765
20. Kamoche, K.: Strategic human resource management within a resource – capability view of the firm. J. Manage. Stud. **33**(2), 213–233 (1996). https://doi.org/10.1111/j.1467-6486.1996.tb00158.x
21. Fallon-Byrne, L., Harney, B.: Microfoundations of dynamic capabilities for innovation: a review and research agenda. Ir. J. Manage. **36**(1), 21–31 (2017). https://doi.org/10.1515/ijm-2017-0004
22. Vartiainen, K.: In search of the? How? Of dynamic capabilities in digital transformation: contradictions as a source of understanding. In: 26th Americas Conference on Information Systems, AMCIS 2020, pp. 0–5 (2020)
23. Eisenhardt, K.M., Martin, J.A.: Dynamic capabilities: what are they? Strateg. Manage. J. **1121**(21), 1105–1121 (2000)
24. Arora, S.K., Li, Y., Youtie, J., Shapira, P.: Measuring dynamic capabilities in new ventures: exploring strategic change in US green goods manufacturing using website data. J. Technol. Transfer **45**(5), 1451–1480 (2019). https://doi.org/10.1007/s10961-019-09751-y
25. Teece, D.J.: Business models and dynamic capabilities. Long Range Plann. **51**(1), 40–49 (2018). https://doi.org/10.1016/j.lrp.2017.06.007
26. Mikalef, P.: IT-enabled dynamic capabilities, environmental uncertainty, and competitive performance: a configurational approach. In: Americas Conference on Information Systems AMCIS, pp. 1–10 (2018)
27. Garavan, T.N.: A strategic perspective on human resource development. Adv. Dev. Hum. Resour. **9**(1), 11–30 (2007). https://doi.org/10.1177/1523422306294492
28. Teece, D.J.: Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. Strateg. Manage. J. **28**(13), 1319–1350 (2007). https://doi.org/10.1002/smj.640
29. Zahra, S.A., Sapienza, H.J., Davidsson, P.: Entrepreneurship and dynamic capabilities: a review, model and research agenda. J. Manage. Stud. **43**(4), 917–955 (2006). https://doi.org/10.1111/j.1467-6486.2006.00616.x

30. El Gizawi, N.: The dynamic capabilities theory: assessment and evaluation as a contributing theory for supply chain management. In: 3rd IBA Bachelor Thesis Conference, pp. 1–15 (2014)
31. Konlechner, S., Müller, B., Güttel, W.H.: A dynamic capabilities perspective on managing technological change: a review, framework and research agenda. Int. J. Technol. Manage. **76**(3/4), 188 (2018). https://doi.org/10.1504/IJTM.2018.091285
32. O'Callaghan, J., et al.: We need to talk about the future of mining (2017)
33. Kareem, M.A., Mijbas, H.A.: Mediating role of dynamic capabilities on the relationship between human resource development and organizational effectiveness. Organizacija **52**(3), 187–203 (2019). https://doi.org/10.2478/orga-2019-0012
34. Leeuw, P., Mtegha, H.: The significance of mining backward and forward linkages in reskilling redundant mine workers in South Africa. Resour. Policy **56**, 31–37 (2018). https://doi.org/10.1016/j.resourpol.2018.02.004
35. Bassan, J., Srinivasan, V., Knights, P., Farrelly, C.T.: A day in the life of a mine worker in 2025. In: 1st International Future Mining Conference and Exhibition, no. 10, pp. 71–78 (2008)