How firms in emerging economies can learn industry 4.0 by extracting knowledge from their foreign partner. A view point from strategic management perspective.

Saqib Shamim1 , Shuang Cang2, Hongnian Yu3,4, Yun Li4, Leo Yi Chen4 , Xifan Yao5 1Kent Business School, University of Kent, Canterbury, UK 2School of Economics and Management, Yanshan University, Qinhuangdao, Hebei, China, 066004 3* Faculty of Sciences & Technology, Talbot Campus, Bournemouth University, UK 4Dongguan Industry 4.0 Artificial Intelligence Laboratory, Dongguan University of Technology, Dongguan 523808, China 5School of Mechanical and Automotive Engineering, South China University of Technology, Guangzhou 510640, China

Abstract
This study offers a view point from a strategic management perspective that how firms in emerging economies can learn industry 4.0 from their foreign partners operating from developed economies, by developing knowledge based dynamic capabilities [KBDCs]. It emphasises on the importance of management inclination towards Industry 4.0. Integration of literature and logical beliefs show that management inclinations towards Industry 4.0 in terms of leadership, talent management, culture, and technology can facilitate the development of KBDCs which facilities knowledge activities. Firms in the emerging and underdeveloped economies are in special need of these kind of capabilities because of institutional voids. By developing these capabilities they can extract knowledge from their foreign partners from developed industrial economies who are doing well in terms of Industry 4.0. This study suggests that it need a right combination of leadership, talent management, technology, and culture to learn and implement Industry 4.0 in the firm.

Key words: Industry 4.0; Management inclination; Knowledge based dynamic capabilities; Knowledge extraction; Emerging economy.

Introduction
Due to the recent technological leaps and pace of innovation, industry faces paradigm shifts, also known as industrial revolutions [1]. The first three industrial revolutions are characterized by mechanization, high electric energy usage, and automation and electronics, respectively [1]. Today's economy is heading toward the fourth industrial revolution, characterized by the use of Cyber Physical Systems [CPS], smart factories, digital transformations, and service innovations [2, 3]. Germany played the leading role in planning the next paradigm shift, and they came up with an idea of Industry 4.0 for the fourth industrial revolution [3]. The concept of Industry 4.0 originates from a German government project to promote digitalization and computerization. It is expected that implementation of the Industry 4.0 strategy can give a boost of 267 billion euro to the German economy [2]. It does not mean that this concept is only applicable for Germany; in fact, Industry 4.0 is becoming a general strategy for the fourth industrial revolution, and it became a global phenomenon, being discussed by a number of researchers in different contexts and economies, e.g., [4].

Elicited by the internet, Industry 4.0 enables communication between humans as well as machines in CPS to acquire and process data and to self-control certain tasks. It is radically transforming the performance of manufacturing activities. Consequently, many developed and emerging economies such as Germany China, japan, and Malaysia are exploring ways to revolutionize and renew their existing manufacturing competencies [7]. In this context, new manufacturing capabilities need to be established to enable firms to extend and renew their resources bases in order to respond effectively to rapid technological developments. A radical technological change often creates capability gaps for manufacturing firms because it introduces new ways of performing manufacturing activities, and new ways of creating value. This is particularly challenging for firms from emerging and underdeveloped economies which have been heavily leveraging labor-intensive, low specialist and technological skills to produce simple products in order to serve low cost market segments [5]. With historically low emphasis on R&D and consequently weak technological capabilities, many firms from emerging economies have relied upon buying new technologies from industrialized economies [6]. However, the process and mechanism of developing new capabilities to respond to the radical technological

changes associated with Industry 4.0 are theoretically distinct from R&D based on learning before doing.

Furthermore, the institutional characteristics of emerging economies are also greatly different from those of industrialized economies [7]. Indeed, resource scarcities such as low availability of domestically produced capital equipment and technologies [5], the pervasive role of government institutions and the absence of market supporting institutions further hinder the development of manufacturing firms in emerging economies. This raises a very important question: how can manufacturing firms from emerging economies respond to such radical technological change? As technologies associated with Industry 4.0 are poised to fundamentally challenge established theories and the practices of manufacturing firms [[8, 9]], another question emerges, to what extent, can the lessons learned from developed economies are transferable to the emerging economies?

Emerging economy firms usually operate in an environment which is dynamic and evolving. It is also characterized by lack of intermediaries, weak institutions, nascent innovation ecosystem and limited financial support for innovative activities from government which is key institutional player [10]. Such institutional immaturity is often referred to as "Institutional voids" making it very difficult for the firms in emerging economy to perform innovative activities [10, 11]. In such a context, sources of external knowledge becomes extremely important for the firms in emerging economy to pursue revolutionary activities [10], such as Industry 4.0. [10] argued that foreign partners e.g. suppliers and other players in value chain from developed economies are important source of knowledge extraction for firms in emerging economies. [10] Emphasis on the importance of absorptive capacity in the process of knowledge extraction from foreign partners. Furthermore importance of dynamic capabilities [DCs] to operate in digital environment such as Industry 4.0 is acknowledge by researcher [12]. Particularly knowledge based dynamic capabilities [KBDCs] can play a critical role in knowledge extraction from foreign partners.

It is established that absorptive capacity and KBDCs are crucial to enable firms to extract knowledge from external environment [10; 12]. However it is equally important to that how firms develop absorptive capacity and KBDCs. Literature suggests that role of management inclination is critical in order to develop DCs [12] and adopt digital transformations [13]. Particularly, combination and right inclination of leadership, talent management, culture, and technology is important for the development of desired capabilities. Based on literature and logical beliefs, this study offers a view point on, how management inclination towards Industry 4.0 can develop absorptive capacity and DCs to extract Industry 4.0 related knowledge from foreign partners. This type of knowledge extraction can facilitate the industry 4.0 orientation of firms in emerging economies. These concepts are explained in more detail below

Knowledge based dynamic capabilities

DCs refer to the ability to build, integrate, and reconfigure the internal and external competencies to respond against rapidly changing environment [14, 15]. DC view suggests that reconfiguration of capabilities according to changing environment is essential for sustainable competitive advantage [14]. DC is actually extension of resource based view [RBV], which suggests that organizations should leverage their strategic resources which are unique and not easy to imitate, for sustainable competitive advantage [16]. DC emphasizes on tangible and intangible assets, human capital and organizational capabilities as well. DC framework suggests that having the unique resource is not sufficient for sustainable competitive advantage, there is need to effective management practices to create value from strategic resources [14, 16]. Knowledge based view argues that knowledge is the main strategic resource of organization and individuals leading to competitive advantage [17, 18] . RBV received criticism because it is not very useful in turbulent environment, where firms need DC. DCs are the processes that can operate in both dynamic and static business environment. Learning mechanisms, especially knowledge management [KM] activities are prominent drivers of DCs [19]. Knowledge based view states that organizations are knowledge bearing entities and the basic purpose of the organization is to integrate and use this knowledge for value creation [18, 20]. Synthesis of these different streams of work forward the KBDC framework, which refers to the ability to acquire, generate, and combine knowledge resources to sense, explore, and address the environment dynamics. The underlying phenomenon of KBDCs includes knowledge related activities of both external and internal knowledge [16] .

In KBDCs framework knowledge includes tacit and explicit knowledge, information and know-how, management, technological and marketing knowledge. Knowledge acquisition, knowledge generation, and knowledge combination capabilities are the sub-capabilities, represents the dimensions of KBDCs [16]. Based on these arguments it can be assumed that KBDCs can facilitate the firms in emerging economy to extract industry 4.0 knowledge from technologically advanced foreign partner firms. [21] also argues that knowledge related capabilities are important for firms to gain knowledge from external environment which leads to inbound and outbound innovations.

Management inclination towards Industry 4.0

Theory of DCs suggests that the DCs can be influenced by managerial practices. Inclination of management towards the desired capabilities and outcome is vital. Particularly to develop the DCs to operate in a digital environment such as Industry 4.0, human resource, technology, and culture are important [22]. [13] also argued that leadership, talent management, culture, and technology are key factors to make a company more data driven. Shamim et al., [2018] also acknowledges the importance of leadership, talent management, culture, technology in the process of DCs development for big data driven decision making. These arguments show the importance of management inclination for successful development of DCs required for Industry 4.0 implementation.

Leadership

Leadership is an effective way of providing direction to the organization and it also plays a critical role in the development and modification of desired DCs [23]. This is also consistent with the contingency theories of leadership, suggesting that leadership style should be adapted according the environment and desired outcomes [24]. Importance of leadership inclination in the context of Industry 4.0 is well acknowledged in the existing literature [3, 17] . Furthermore literature also provides evidences of crucial role of leadership in the process of development and reconfiguration of DCs. Particularly DCs are associated with the leadership proclivity towards change. Furthermore there are evidences in literature that leadership can influence the ability of knowledge extraction [17], which can play a critical role to learn from foreign firms from developed countries with high orientation of industry 4.0. [21] also emphasises on the importance of leadership to create KBDCs in the firm to enable the firm to adapt new advancements in international environment. Researchers acknowledge the importance of leadership in the process of Industry 4.0 implementation in difference sectors, for example [25] suggested that leadership can play a key role to enable hospitality firms to embrace Industry 4.0/

Talent management

Leadership is an essential tool to provide the direction to the organization, however when it is accompanied with the right talent management it can produce even better results. Talent management is emerging as key challenge for the firms in the process of digital transformations [13; 12]. For example, data is crucial in the Industry 4.0 era i.e. it is characterized by implementation of CPS, and IOTs which create data, more often big data. This phenomenon is increasing the importance of data scientists. Data is becoming more and more affordable now a days, and data scientist are becoming more expensive, and hard to retain. This situation needs well directed talent management to hire, retain and train suitable employees to work in the environment of Industry 4.0. Traditional statistical skills are not enough in the big data era, as it requires more sophisticated data analysis techniques. [26] also argued that talent management plays a critical role in the digital transformations by managing the talent which is able to speak both technical and business language, thus facilities the leaders by formulating the ways to tackle Industry 4.0.

[27] suggested set of technical and personal skills required for Industry 4.0, which should be considered in talent management activities of firms operating in Industry 4.0 environment. [24] argues that technical skills required for Industry 4.0 are IT knowledge and abilities, data processing and analytics, organizational and processual understanding, knowledge management, awareness of data security, specialized knowledge of manufacturing process, computer programming and coding abilities, knowledge or ergonomics, and understanding of legal affairs. Personal skills required for Industry 4.0 are time and time management, ability to change, social skills, communication skills, and trust in knowledge, continuous improvement and lifelong learning [23]. So talent management in the organizations should focus on these skills, to strengthen the required DCs. By creating the required KBDCs, talent management can enable the firms to extract knowledge form the external knowledge sources i.e. foreign partners, who have this set of skills. Skills suggested by [27] are summarized in figure 1.

	Must…	Should…	Could…
	be included in the skillset of the skilled labor of the future		
Technical	IT knowledge and abilities	Knowledge Management	Computer programming and coding abilities
	Data and information processing and analytics	Interdisciplinary/generic knowledge about technologies and organizations	Specialized knowledge about technologies
	Statistical knowledge	Awareness for It security and data protection	Awareness for ergonomics
	Organizational and processual understanding	Specialized knowledge of manufacturing activities and processes	Understanding of legal affairs
	Ability to interact with modern interfaces		
Personal	Self- and time management	Trust in new technologies	
	Adaptability/ability to change	Continuous improvement and lifelong learning	
	Team work abilities		
	Social skills		
	Communication skills		

Figure 1. *Set of skills for Industry 4.0 [27]*

Technology

Combining the right technology with leadership and talent management is equally important. DCs view is widely examined in the technology management context, because technology is one of the most important influencer of DCs in the firms [28]. Providing the right technology to the right talent, with right leadership is must for facilitating the development of DCs for Industry 4.0, particularly KBDCs to extract knowledge from external sources i.e. foreign partners. [13] also argued that digital transformations require the cutting edge technology for example to collect, store, visualize, and analyse data. China is evidence where indigenous technological capabilities are improved through technological imports. Collaboration, knowledge exchange and big data analytics etc. can be enhanced by the use of suitable technologies [12].

In the era of Industry 4.0, technology should drive the change in product-supply side, such as assistance systems, production technologies, support systems. Technology can also enhance the product-demand side by making demand forecasting processes more smart and digital. There are several technologies aiming to facilitate the production industry, in the fourth industrial revolution [27]. Such technologies can help the organizations to cope with changing market demands and maintain global competitiveness in the global technological environment. By adopting these technologies organizations can make their products and production process smarter. However, successful adaptation of these technologies depends on the firm's technology readiness level [27], which required KBDCs at firm level. For the underdeveloped and emerging economies, technology is not very advanced and institutional support is rare, KBDCs can play a critical role to learn these technologies from partners in developed economies. [27] highlighted number of technologies with the potential to play critical role in the era of Industry 4.0. These are shown in figure 2.

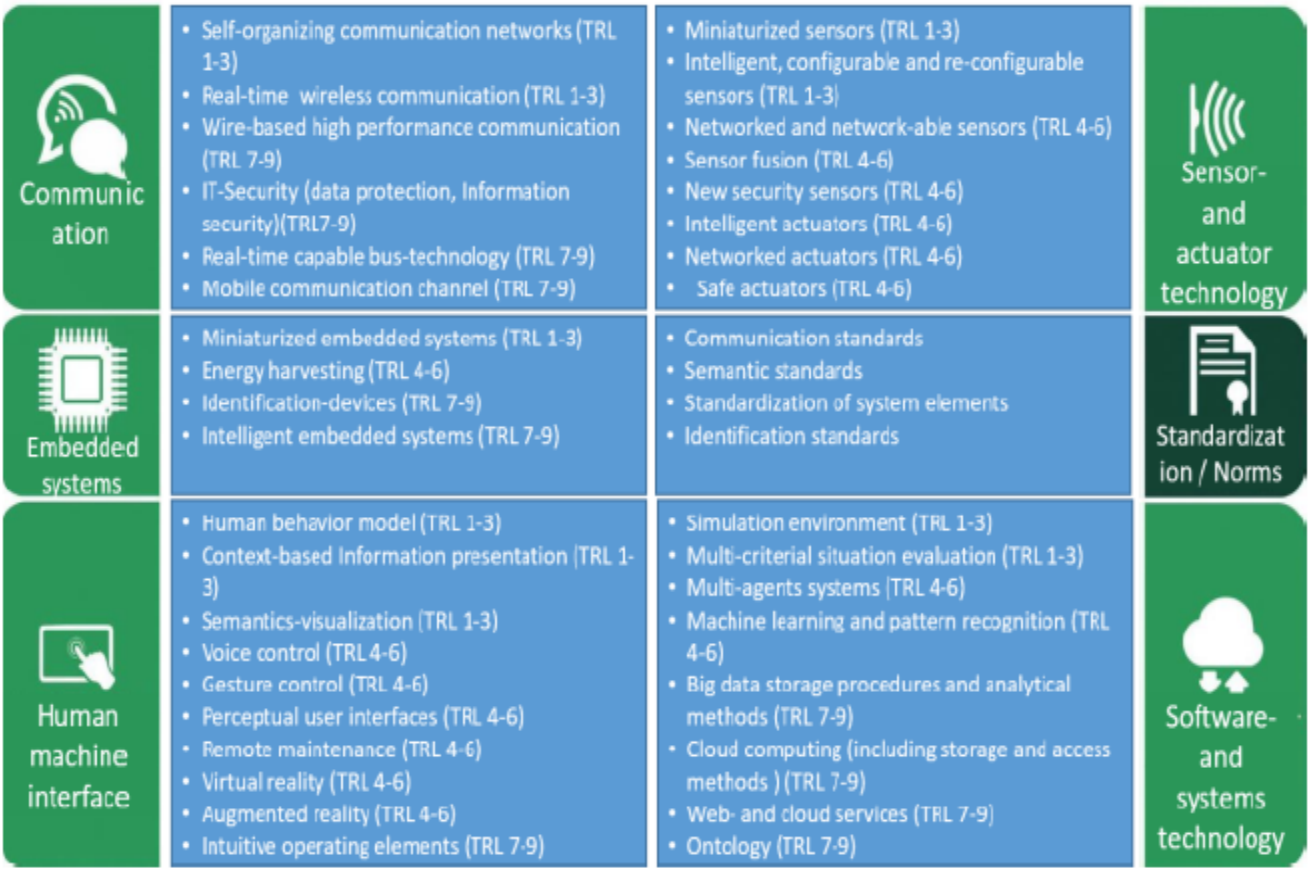

Figure 2. *Technologies for Industry 4.0 [27]*

Culture

When firm is equipped with right leadership, talent management, and technological inclination towards the Industry 4.0 and DCs required for industry 4.0, it can lead to an Industry 4.0 culture in the organization. Culture refers to the set of values, norms, patterns of behaviours, and attitude, which defines the organization's core identity [29]. Literature shows that culture can influence DCs, for example a learning culture can influence the firm's capability of adapting marketing program according the environment. [13] also argued that for successful adaptation of digital transformations, firms need to develop a culture of digital work environment. This argument is validated by [12] that culture has the ability to influence the KBDCs related to digital transformation, which can facilitate Industry 4.0. Flexible and change oriented culture is essential for the development of DCs [22]. Culture affects the processes designed to acquire, exchange and transform external resources. Considering knowledge as most important strategic resource, it can be argued that suitable culture can influence the firm's ability to extract knowledge from foreign partners by enhancing KBDCs. Suitable culture can develop the consistent behaviours in the firms required for Industry and to gain knowledge of Industry 4.0 from foreign partners, by enhancing KBDCs.

Discussion and conclusion

This study offers a view point from a strategic management perspective that how firms in emerging economies can learn industry 4.0 from their foreign partners from developed economies by developing KBDCs. It emphasises on the importance of management inclination towards Industry 4.0. Integration of literature and logical beliefs show that management inclinations towards Industry 4.0 in terms of leadership, talent management, culture, and technology can facilitate the development of KBDCs which facilities knowledge activities. Firms in the emerging and underdeveloped economies are in special need of these kind of

capabilities because of institutional voids. By developing these capabilities they can extract knowledge from their foreign partners from developed industrial economies who are doing well in terms of Industry 4.0. This study suggests that it need a right combination of leadership, talent management, technology, and culture to learn and implement Industry 4.0 in the firm. All these management practices should be in same direction which should be towards Industry 4.0. Combined result of the managerial factors can be successful adaptation of Industry 4.0, by developing KBDCs which facilitate knowledge extraction. The proposed conceptual model is presented in figure 1.

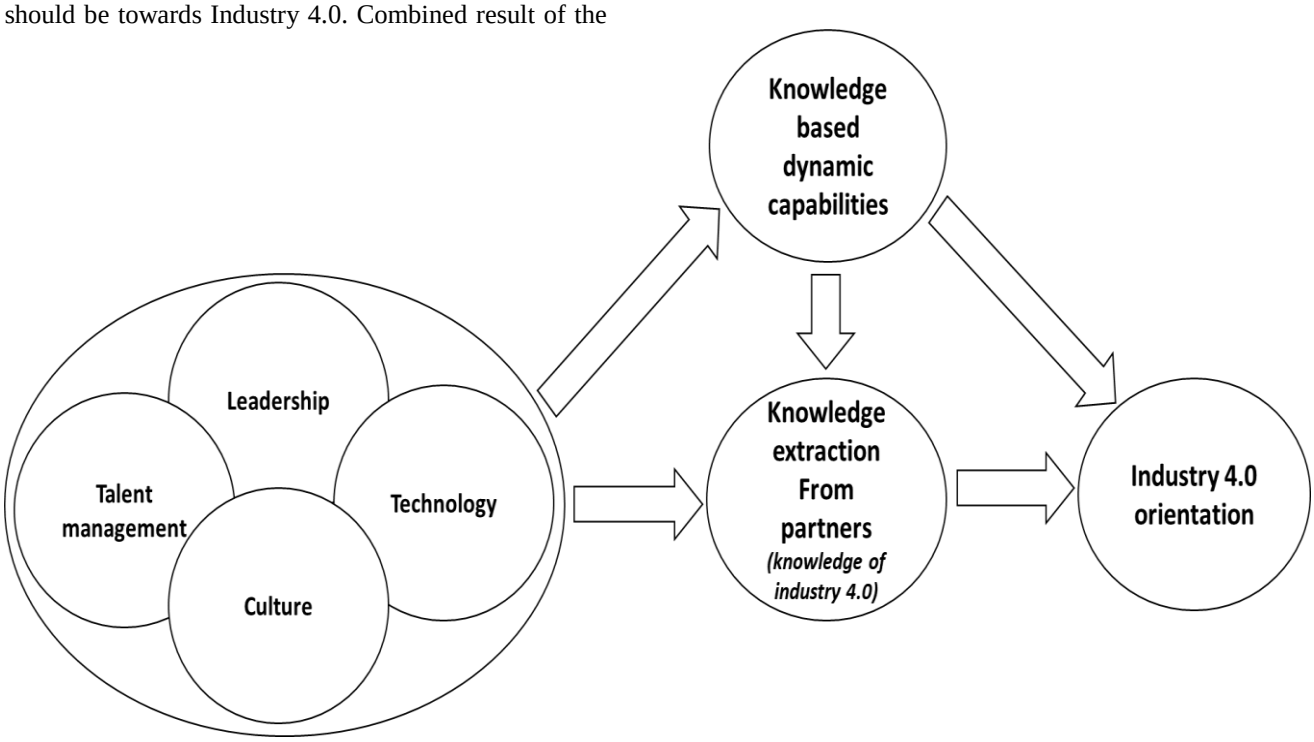

Figure 1. *Conceptual model*

This study contributes towards the existing body of knowledge by suggesting a framework of how management practise can facilitate Industry 4.0 by developing KBDCs to facilitate knowledge extraction. Existing literature on Industry 4.0 mainly focuses on engineering designs. However, what kind of capabilities are required for Industry 4.0 needs specialized research. This framework provides solid grounds for future empirical research on this topic to go in more depth and to explore the process of how KBDCs facilitates the process of knowledge extraction from external sources e.g. foreign partners. One of the major limitation of this study is that it is a view point based on the integration of literature and logical beliefs, which need empirical validation. Future research can follow a qualitative method to explore the phenomenon in more detail, which should be followed the quantitative validation.

References

1. Lee J, Kao H, Yang S. Service innovation and smart analytics for industry 4.0 and big data environment. Procedia Cirp. 2014;16:3-8.

2. Heng S. Industry 4.0: Huge potential for value creation waiting to be tapped. Deutsche Bank Research. 2014.

3. Shamim S, Cang S, Yu H, Li Y. Management approaches for Industry 4.0: A human resource management perspective. Evolutionary Computation [CEC], 2016 IEEE Congress on; IEEE; 2016.

4. Saldivar AAF, Goh C, Li Y, Yu H, Chen Y. Attribute identification and predictive customisation using fuzzy clustering and genetic search for Industry 4.0 environments. Software, Knowledge, Information Management & Applications [SKIMA], 2016 10th International Conference on; IEEE; 2016.

5. Malik OR, Kotabe M. Dynamic capabilities, government policies, and performance in firms from emerging economies: Evidence from India and Pakistan. Journal of Management Studies. 2009;46[3]:421-50.

6. Page West III G, DeCastro J. The Achilles heel of firm strategy: Resource weaknesses and distinctive

inadequacies. Journal of Management Studies. 2001;38[3]:417-42.

7. Meyer KE, Peng MW. Probing theoretically into Central and Eastern Europe: Transactions, resources, and institutions. J Int Bus Stud. 2005;36[6]:600-21.

8. Baur C, Wee D. Manufacturing's next act. McKinsey Quarterly, Jun. 2015.

9. Porter ME, Heppelmann JE. How smart, connected products are transforming companies. Harv Bus Rev. 2015;93[10]:96-114.

10. Khan Z, Lew YK, Marinova S. Exploitative and exploratory innovations in emerging economies: The role of realized absorptive capacity and learning intent. International Business Review. 2018.

11. Wu J. Diverse institutional environments and product innovation of emerging market firms. Manage Int Rev. 2013;53[1]:39-59.

12. Shamim S, Zeng J, Shariq SM, Khan Z. Role of big data management in enhancing big data decision-making capability and quality among Chinese firms: A dynamic capabilities view. Information & Management. 2018.

13. McAfee A, Brynjolfsson E, Davenport TH. Big data: the management revolution. Harv Bus Rev. 2012;90[10]:60-8.

14. Teece DJ. Explicating dynamic capabilities: the nature and microfoundations of [sustainable] enterprise performance. Strategic Manage J. 2007;28[13]:1319-50.

15. Teece DJ, Pisano G, Shuen A. Dynamic capabilities and strategic management. Strategic Manage J. 1997;18[7]:509-33.

16. Zheng S, Zhang W, Du J. Knowledge-based dynamic capabilities and innovation in networked environments. Journal of Knowledge Management. 2011;15[6]:1035-51.

17. Shamim S, Cang S, Yu H. Impact of knowledge oriented leadership on knowledge management behaviour through employee work attitudes. The International Journal of Human Resource Management. 2017:1-31.

18. Grant RM. Toward a knowledge-based theory of the firm. Strategic Manage J. 1996;17[S2]:109-22.

19. Eisenhardt KM, Martin JA. Dynamic capabilities: what are they? Strategic Manage J. 2000;21[10-11]:1105-21.

20. Donate MJ, de Pablo, Jess D Snchez. The role of knowledge-oriented leadership in knowledge management practices and innovation. Journal of Business Research. 2015;68[2]:360-70.

21. Jasimuddin SM, Naqshbandi MM. Knowledge-oriented leadership and open innovation: Role of knowledge management capability in France-based multinationals. International Business Review. 2018.

22. Gupta M, George JF. Toward the development of a big data analytics capability. Information & Management. 2016;53[8]:1049-64.

23. Nonaka I, Toyama R, Konno N. SECI, Ba and leadership: a unified model of dynamic knowledge creation. Long Range Plann. 2000;33[1]:5-34.

24. Robbins S, Judge TA, Millett B, Boyle M. Organisational behaviour: Pearson Higher Education AU. . 2013.

25. Shamim S, Cang S, Yu H, Li Y. Examining the Feasibilities of Industry 4.0 for the Hospitality Sector with the Lens of Management Practice. Energies. 2017;10[4]:499.

26. Angrave D, Charlwood A, Kirkpatrick I, Lawrence M, Stuart M. HR and analytics: why HR is set to fail the big data challenge. Human Resource Management Journal. 2016;26[1]:1-11.

27. Kleindienst M, Wolf M, Ramsauer C, Pammer V. What Workers in Industry 4.0 Need and What ICT Can Give–An Analysis. . 2016.

28. Cetindamar D, Phaal R, Probert D. Understanding technology management as a dynamic capability: A framework for technology management activities. Technovation. 2009;29[4]:237-46.

29. Denison DR. Bringing corporate culture to the bottom line. Organ Dyn. 1984;13[2]:5-22.