

Nurhas, Irawan; Geisler, Stefan; Pawlowski, Jan

Article — Published Version

An intergenerational competency framework: Competencies for knowledge sustainability and start- up development in the digital age

Sustainable Development

Provided in Cooperation with:

John Wiley & Sons

Suggested Citation: Nurhas, Irawan; Geisler, Stefan; Pawlowski, Jan (2022) : An intergenerational competency framework: Competencies for knowledge sustainability and start-up development in the digital age, Sustainable Development, ISSN 1099-1719, John Wiley & Sons, Inc., Chichester, UK, Vol. 30, Iss. 6, pp. 1733-1748, <https://doi.org/10.1002/sd.2338>

This Version is available at:

<https://hdl.handle.net/10419/287925>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<http://creativecommons.org/licenses/by/4.0/>

RESEARCH ARTICLE

An intergenerational competency framework: Competencies for knowledge sustainability and start-up development in the digital age

Irawan Nurhas^{1,2}  | Stefan Geisler¹ | Jan Pawlowski^{1,2}

¹Institute of Positive Computing, Hochschule Ruhr West University of Applied Sciences, Bottrop, Germany

²Faculty of Information Technology, University of Jyväskylä, Jyväskylä

Correspondence

Irawan Nurhas, Institute of Positive Computing, Hochschule Ruhr West University of Applied Sciences, Lützowstraße 5, 46236, Bottrop, Germany.
Email: irawan.nurhas@hs-ruhrwest.de

Funding information

Ministry of Culture and Science of the State of North Rhine-Westphalia

Abstract

In this study, we looked at the competencies and changes in the competency spectrum required for global start-ups in the digital age. Specifically, we explored intergenerational collaboration as an intervention in which experienced business-people from senior adult groups support young entrepreneurs. We conducted a Delphi study with 20 experts from different disciplines, considering the study context. The results of this study shed light on understanding the necessary competencies of entrepreneurs for intergenerationally supported start-up innovation by providing 27 competencies categorized as follows: intergenerational safety facilitation, cultural awareness, virtues for growth, effectual creativity, technical expertise, responsive teamwork, values-based organization, and sustainable network development. In addition, the study results also reveal the competency priorities and the minimum requirements for each competency group based on the global innovation process and can be used to develop a readiness assessment for start-up entrepreneurs.

KEYWORDS

global innovation, intergenerational competency, intergenerational innovation, start-ups entrepreneurs, sustainable start-ups

1 | INTRODUCTION

Born global or die local: A scalable start-up usually necessitates a local population of more than 100 million people. However, only a few countries meet this criteria, including the United States, China, Russia, Brazil, India, and Indonesia. Most countries do not have a large enough population to sustain start-up scale with only their local market, and must instead be global players from the outset.

—Steve Blank

Intergenerational collaboration is a promising approach to support emerging start-ups through mentoring and sharing

entrepreneurial expertise (Basly, 2007; Edelman et al., 2016; Matlay & Gimmon, 2014; Underdahl et al., 2018) for succession and business internationalization (Shi et al., 2019) and to develop sustainable business model (Perez-Encinas et al., 2021), particularly in family-based business (Bjuggren & Sund, 2001; Shi et al., 2019). There could be an untapped nexus between older and young potential entrepreneurs who are not in a family business. Thus, the diversity of perspectives and competency backgrounds could provide a balance for organizational development in the knowledge economy (Østergaard et al., 2011; Won et al., 2021), which is highly linked to sustainable business development and knowledge succession, regardless of family ties (Littunen & Hyrsky, 2000; van Kleef & Roome, 2007).

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2022 The Authors. *Sustainable Development* published by ERP Environment and John Wiley & Sons Ltd.

However, appropriate skills are critical to intergenerational collaboration, and researchers have emphasized the importance for global start-up founders to identify both competency and success characteristics (Giardino et al., 2014; Massis et al., 2018; Pirkkalainen & Pawlowski, 2014; Rasmussen & Tanev, 2015; Tanev, 2012; van der Westhuizen & Goyayi, 2020; Yin & Luo, 2018), especially in the early stages of business development, when strategic organizational decisions are often urgently needed (Basly, 2007; Giardino et al., 2014; Rasmussen & Tanev, 2015; Tanev, 2012). Given the variety of perspectives on innovation, in this study, we understand the innovation as processes and activities that add strategic value to the current status quo. In this regard, processes and activities that related to the internationalization of digital start-ups.

Human factors are one of the three pillars of innovation in digital business development (Ramdani et al., 2022) which include skills and abilities, or competencies (Foucrier & Wiek, 2019; Littunen & Hyrsky, 2000; Sánchez, 2013; van Kleef & Roome, 2007; Wu, 2009). Managing available knowledge, networks and resources is an important part of developing an internationalization strategy for global start-ups (Bailetti, 2012). Therefore, start-up stakeholders need to understand various competencies in order to act quickly and adapt human capacities to global requirements (Jensen, 2017; Li et al., 2016; Littunen & Hyrsky, 2000; Massis et al., 2018). On the one hand, the Entrepreneurship and Business Development studies identified different personal competencies for entrepreneurs and business internationalization (Arafah, 2016; Bacigalupo et al., 2016; Colombo & Piva, 2008; Dijkman et al., 2016; Jensen, 2017; Wu, 2009), to overcome a variety of challenges, particularly in the development of digital start-up in global scale (Bailetti, 2012; Edelman et al., 2016; Müller et al., 2019; Tanev, 2012). On the other hand, however, little attention has been given to the dynamic changes in the required competencies of global innovation process (Chang, 2012; Santoro et al., 2019), the importance of intergenerational collaboration for global innovation (Shi et al., 2019), as well as in the age of digitalization, with higher degree on the use of digital technology to support collaboration and business model development (Hevner & Gregor, 2020; Li et al., 2016; Pilková et al., 2022; Vuorikari et al., 2016). Therefore, this study aims to investigate which competencies should be prioritized for start-up entrepreneurs' leveraging intergenerational setting to support the global innovation process in the digital age?

Fostering global start-ups innovation through intergenerational collaboration in the digital age consists of multiple domains (Jensen, 2017; Wu, 2009), furthermore, prioritizing specific requisite competencies for innovation processes and practices necessitates expertise, experiences, or profound understanding (van Gelderen et al., 2021). Numerous studies have highlighted the importance of understanding the framework of entrepreneurial competencies to run a successful business (Dijkman et al., 2016; Kyndt & Baert, 2015; Shi et al., 2019; Vuorikari et al., 2016; Wu, 2009), especially in the digital age and in the age of demographic change (Harvey, 2012; Pilková et al., 2022; Shi et al., 2019). In this study, we developed a competency-based intergenerational collaboration framework for global start-ups entrepreneurs. The competency-based framework

was built iteratively by incorporating the domains of digital learning and innovation (Li et al., 2016; Lyashenko & Frolova, 2014; Müller et al., 2019; Pilková et al., 2022; Vuorikari et al., 2016), intercultural and intergenerational collaboration (Jensen, 2017; Martins & Terblanche, 2003), and global innovation (Jensen, 2017; Zakaria et al., 2004) into the entrepreneurial domain. The overlap of the various domains was chosen to support the study setting in light of past research that has the potential to enrich the status quo and complement the previously existing competency framework for global innovation and entrepreneurship (Bacigalupo et al., 2016; Jensen, 2017; Wu, 2009).

The study's outcome is an eight-group competency framework that includes, including intergenerational safety facilitation, growth virtues, effectual creativity, technical domain, responsive teamwork, value-driven organizing, sustainable networking, and cultural awareness. The sub-competencies of each competency group, more or less consist of competency regarding intergenerational and digital context. The results of the study will contribute twofold. First, we expand the current literature on the competencies of start-up entrepreneurs in global and intergenerational innovation. From a management perspective, we have identified the eight competency groups as the human capital needed by start-ups to internationalize innovation by leveraging intergenerational collaboration and finding partners to complement the competency requirements. Moreover, as a practical contribution based on the proposed framework, we have presented a self-assessment tool that can be used by young start-up entrepreneurs to reflect on the current state of readiness for global innovation and to identify competencies to foster intergenerational collaboration within their start-ups.

2 | THEORETICAL BACKGROUND

Advances in the digital economy and information technology management over the last decade have enabled start-ups to shift from local business development to global knowledge-intensive digital business innovation. Start-ups are similar to small and medium-sized businesses, based largely on the use of technology, while having limited resources and little to no operating track record (Giardino et al., 2014). It is important to conduct research on start-ups since they have emerged as a primary driver of global economic development in the digital age (Ramdani et al., 2022), particularly for technology oriented business model (Rasmussen & Tanev, 2015; Tanev, 2012), which are currently prevalent, particularly across Asia, Africa, and Latin America (Chege et al., 2020; Quinones et al., 2021; Wamuyu, 2015). Despite the opportunities offered by information technology and the shift to global business, challenges and barriers to the development of global start-ups remain, for instance cultural and linguistic differences (Jensen, 2017; Nurhas et al., 2019), geographical distance, lack of trust, or fear of imitation, as well as lack of skills (Jensen, 2017; Nurhas et al., 2019; Pirkkalainen & Pawlowski, 2014; Zakaria et al., 2004). A more nuanced approach could address these issues through intergenerational collaboration (Matlay &

Gimmon, 2014; Underdahl et al., 2018). Intergenerational collaboration has attracted a great deal of interest due to the challenges of demographic change and the workplace's current diversity, which can cover a diversity of generations (Becker et al., 2020; Nurhas et al., 2019).

In this study, global start-ups are defined as technology-based companies that have target markets in more than one country, have limited resources, and are still searching for the right business model. Global start-ups are an important phenomenon to study, partly because of local market constraints (Knight & Cavusgil, 2004; Rasmussen & Tanev, 2015), but also because globalization offers young entrepreneurs in different countries the new market opportunity to collaborate across borders, help start-ups scale, and drive local economic development as well as knowledge and technology transfer between countries, not only between developed and developing countries, but also between developing or developed countries themselves (Boutellier et al., 2013; Halewood & Kenny, 2008; Jensen, 2017; Rasmussen & Tanev, 2015; Tanev, 2012).

Identifying competencies and how to manage organizational knowledge in digital age (Carayannis et al., 2021; Müller et al., 2019) for global innovation (Bailetti, 2012; Boutellier et al., 2013; Pawlowski, 2013; Tanev, 2012) and intergenerational collaboration (Becker et al., 2020; Bjuggren & Sund, 2001; Sabri et al., 2016) have quickly become an important issues for start-up innovation due to the sustainability of workplace diversity as one of the main sources of global innovation (Becker et al., 2020; Gordon, 2018; Müller et al., 2019; Nurhas et al., 2019), the promotion of sustainable business through mentorship and knowledge sharing (Basly, 2007; Matlay & Gimmon, 2014), fostering entrepreneurial well-being (Wiklund et al., 2019) and global business development (Basly, 2007; Paul & Rosado-Serrano, 2019; Shi et al., 2019).

The terms competence and competency are used interchangeably in many cases to describe a skill or required knowledge for an activity or process (Holtkamp et al., 2015). We used the term competency for this study. The term competency usually refers to knowledge, skills, and abilities to solve problems in a specific context (Holtkamp et al., 2015; Pawlowski & Holtkamp, 2012). In this study, we consider integrating attitudes (Bosma & Schutjens, 2011), including individual preferences, virtues, and traits (Bosma & Schutjens, 2011; Karlson & Fergin Wennberg, 2014), to solve a problem in a given context. At the group level, individuals' competencies were combined as human resources that complement each other to form a specific group of expertise or organizational capabilities (Saa-Perez & Garcia-Falcon, 2002). In the context of start-ups, the competency set is one of the most important prerequisites for assessing the potential success of start-up development (Colombo & Piva, 2008; Hafeez et al., 2002; Yin & Luo, 2018).

Intergenerational collaboration is characterized for this study context as a collaboration between younger and older adults in work environments where the age difference is 20 years or more (Nurhas et al., 2019; Pilotte & Evangelou, 2012). The decision to engage in intergenerational collaboration is not an easy path for organizations;

several barriers have been identified, including individual, perceptual, and technical/operational (Giardino et al., 2014; Nurhas et al., 2019). Moreover, intergenerational collaboration in global environments becomes even more complex as it depends on dynamic changes in global innovation activities (Foucrier & Wiek, 2019; Nurhas et al., 2019; Shi et al., 2019). As a result, technology is being widely used to support intergenerational collaboration and demographically segregated teams, becoming increasingly important in the era of digitalization (Lyashenko & Frolova, 2014; Nurhas et al., 2019; Shi et al., 2019; Underdahl et al., 2018).

The collaboration between different age groups, known as intergenerational collaboration, is widespread in entrepreneurship and business engineering (Shi et al., 2019). For example, intergenerational collaboration can occur in family businesses (Basly, 2007; Edelman et al., 2016), in the workplace (Gordon, 2018), in knowledge-intensive organizations (Harvey, 2012), higher education (Lyashenko & Frolova, 2014) and global business development (Shi et al., 2019). On the one hand, the competency of entrepreneurs has been studied in research for decades (Wu, 2009). In the age of digitalization and globalization, start-up founders as entrepreneurs are expected to have global intercultural competence and collaborate across borders and age groups (Shi et al., 2019; Underdahl et al., 2018). Being a global entrepreneur in a cross-generational environment requires different competencies, including social and communication (Bandera & Thomas, 2018; Jensen, 2017; Wu, 2009), confidence (Arafah, 2016; Lans et al., 2010), a shared understanding and vision, creativity, problem-solving, taking calculated risks (Arafah, 2016; Hevner & Gregor, 2020; Knight & Cavusgil, 2004; Kyndt & Baert, 2015; Lyashenko & Frolova, 2014), making informed decisions, and developing a sense of urgency (Arafah, 2016; Griffith et al., 2016). Other aspects of intergenerational collaboration also include responsiveness and flexibility (Edelman et al., 2016; Lyashenko & Frolova, 2014; Martins & Terblanche, 2003; Underdahl et al., 2018).

However, the intergenerational competency for start-up entrepreneurs is mainly discussed in family businesses, although intergenerational collaboration can also occur outside the family business context. There are currently few approaches to assessing specific competencies that encompass intergenerational and global innovation, especially in the digital age and outside the family business context. On the other hand, established competency frameworks focus only on identifying competencies without further exploring the dynamic changes in required competencies, complex depending on the particular start-up phase or activity (Foucrier & Wiek, 2019). Thus, when it comes to enhancing or finding suitable partners, start-up entrepreneurs may need to find a super-collaborator with a complete set of competencies at once and narrow down the potential of collaboration based on a specific point of collaboration activity, in the global innovation process. Therefore, based on the previously presented studies on gaps and limitations, this study aims to answer the main research question:

How do the required competencies of global start-up entrepreneurs dynamically evolve as they innovate in an intergenerational space?

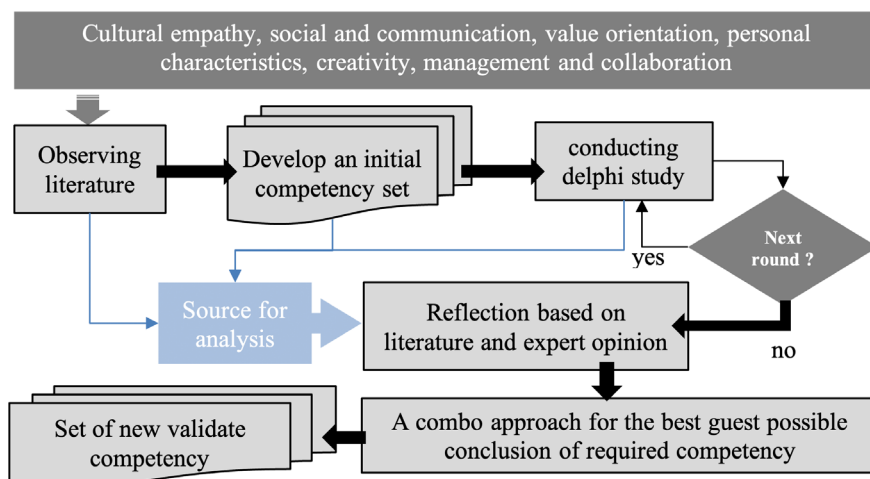


FIGURE 1 Research process [Colour figure can be viewed at wileyonlinelibrary.com]

To answer the main research question, it is important to first identify the (relevant) required competencies and then determine the pattern of importance. In the next section, we will explain the method used in this study in more detail.

3 | METHOD

To answer the main research question, we conducted an online Delphi study (Linstone & Turoff, 1975) to provide flexibility in location and time for participants. The Delphi method was employed as the primary method for developing a competency-based system because it allows researchers to explore critical phenomena on a given topic based on expert preferences. The Delphi method was used to evaluate and validate the competency analysis build consensus, and prioritize competencies (Heiko, 2012; Holtkamp et al., 2015).

The list of the issue to be assessed in the Delphi method can be developed in two ways (Holtkamp et al., 2015; Kendall, 1977; Linstone & Turoff, 1975): first, from scratch and based solely on the expert panel's suggestions; second, by recommending an initial list of competencies to be improved (combined, added, or deleted) and evaluated by experts panel. The second choice was selected for this study. Initial issues of competencies were created by listing competencies mentioned in the literature (Nurhas et al., 2021), intending to gain insights from the scientific community before sending it to the expert panel that can trigger the improvement of the competency list in the Delphi process.

An initial competency group was created from combining the competency framework that focuses on family business succession of different generations which are open-mindedness, risk-taking, social and communication, value orientation, and different type of personal characteristics (Samei & Feyzbakhsh, 2015), with framework of global innovation that include creativity, cultural empathy and collaboration (Jensen, 2017). Based on literature review (Nurhas et al., 2019, 2021), several competencies were assigned, including having vision, networking skills, ability to act, perseverance, continuous development, and financial competency under the

entrepreneurial aspect (Arafah, 2016; Bacigalupo et al., 2016; Jensen, 2017; Knight & Cavusgil, 2004; Wu, 2009). Flexible and pluralist thinking, conflict management and mediation, support each other, listening skill, reflection and open leadership for aspect of intergenerational collaboration (Dohmen et al., 2014; Harvey, 2012; Lyashenko & Frolova, 2014; Shi et al., 2019), and creativity and legal aspect (Griffith et al., 2016; Jensen, 2017; Knight & Cavusgil, 2004) were also added for the initial competencies. Manual and iterative content analytic coding and back-and-forth searches were used to expand the initial list (Elo & Kyngäs, 2008). Similar concept in term content and context based on the verb and object in the sentences are combined to create a more abstract level of competency to cover a wide range of different competencies. The overall conceptual framework development was ultimately an abductive process typical of the conceptualization process (Dong et al., 2015). Abductive reasoning was used to find the best way to describe the competencies and group of competencies found in the literature. The overall process is presented in the Figure 1.

In the first round, we created a questionnaire in the form of a six-point Likert scale (1 [strongly disagree]–6 [strongly agree]) to assess the importance, accuracy, understandability, and relevance of each competency for start-up entrepreneurs in the digital age for the global innovation process. Example of the form for the first phase can be seen in Table 1.

The average Likert scale score for each competency was calculated and sorted. The result of the first round was used as the pre-determined ranking for the second round. In the next round question form, the competencies were displayed pre-sorted, based on the ranking from the previous round for the overall ranking. Participants were asked to read the ranking carefully and, if they had a different opinion, to reorder the ranking and provide more insight. We identified the criteria for consensus-building (Heiko, 2012). We calculated the value of Kendall's coefficient in each round (Kendall, 1977). The ranking was considered to have consensus if the Kendall coefficient was greater than 0.5. There were no significant proposed changes. The number of participants in the round was at least half the number of participants in the previous round (Kendall, 1977).

TABLE 1 Design form of the first round

Competency and the description	Evaluation criteria and rating point (1: Strongly disagree—6: Strongly agree)																							
	I understand the meaning						The description of the competency is accurate.						The competency is relevant for the intergenerational and global (iGOAL) context.						The competency is important for the start-up innovation in the iGOAL context.					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Pluralist thinking																								
The ability to suspend judgment and actively engage with social diversity (multi-perspective view) without leaving one's own identity.	Space for opinion, proposed modifications (competence name and the description):																							
Other competency																								
Description of other competency	Space for opinion, proposed modifications (competence name and the description):...																							

Note: Please evaluate the proposed competencies of the start-up in the intergenerational collaboration to support global innovation by marking [x] of each evaluation criterion on the “Likert scale.”

Participants in the Delphi study were selected based on their knowledge and suitability for the Delphi study (Heiko, 2012; Linstone & Turoff, 1975). Comprehensive international representation was ensured through objective sampling based on their expertise. To recruit experts for the panels, we assembled a list of experts using the networking connections of members of a study group focused on global innovation. Second, several senior advisory associations were contacted and asked to notify their members of any interest in participating in the study. A total of 20 academic and industry experts (presented in Table 2), including four senior experts from professional organization, participated in the study (number of participant:20; country origin = less-developed: 30%, developed: 60%; gender = male:85%, female:15%; workplace-background = academic:40%, industry/startups:30%, both:30%; educational-background = practical or vocational training: 5%, bachelor's: 5%, master's: 30%, PhD-candidate: 20%, PhD: 25%, other:15%; member of an association of senior experts = senior-expert-organization: 20%; other organization:80%). Each Delphi round began with a standardized email containing a unique link to the panel's survey and binding instructions. The online survey ensured that no data were lost. Up to three reminder emails were sent to participants who did not respond.

A Delphi study was conducted in two rounds. The first round suggested the restructuring of competencies, modified, combine or the addition of new competencies that are important in the digital era. The calculation results of Kendal W in the first round also indicate values below 0.5 ($W = 0.11$). All of these conditions suggest the need for a second round. For the second round, 11 panels of experts participated in the online analysis. The expert panel's participation rate was over 50%, enabling us to use the findings for review and consensus-building. We also provided open-ended questions for the pooling of competencies and questions to select the global innovation process's top 10 competencies (the process of ideation, matching, design and development, and commercialization). No

significant suggestions were made in the second round, and new competencies were included. Besides, the Kendal coefficient was assigned a value of 0.92, which means that the coefficient value met the consensus criterion.

4 | RESULT: A COMPETENCY-BASED FRAMEWORK OF GLOBAL START-UPS' INNOVATORS IN INTERGENERATIONAL SETTINGS

Based on the observation of literature that iteratively developed through the list of competencies, comments, and recommendations from expert panels in Delphi rounds, we identified 27 competencies. The competencies based on the similarity of content, verb and object were grouped into eight categories. The overview of the competency framework is shown in Figure 2. The result of the Likert scale provides a higher overall score (>3). The framework earned a mean score of 4.84 for understandability, 4.86 for significance, and 5.02 for importance. Some remarks were made about the completeness of the competency framework:

(P15): “Very complete, slightly too detailed...”

(P16): “Complete competency for digital people...”

(P17): “The list contains the essential criteria for a successful foundation as well as successful company management...”

Next, we present eight classification of the competency and the ranking results on the competency of start-ups in global and intergenerational innovation, including references, comments and the importance rank of particular competency to the more specific innovation process. It is important to remember that only one specific category of competencies has the phrase “intergenerational” in its name. However, other groups of competencies are also used in this sense.

TABLE 2 List of expert panels for the Delphi study

ID	Origin country (classification)	Fields of expertise							Years of expertise
		DI	DL	Et	GI	HR	IcC	IgC	
P1	Less developed	X	X						3–7
P2	Less Developed	X		X	X	X			1–2
P3	Developed	X	X		X		X		1–2
P4	Developed							X	7–10
P5	Less developed		X			X			3–7
P6	Developed		X		X		X		8–10
P7	Developed	X	X	X	X		X	X	>10
P8	Developed	X	X	X					3–7
P9	Developed		X	X	X		X	X	>10
P10	Developed	X	X	X		X	X		>10
P11	Less developed	X	X	X					3–7
P12	Developed			X	X	X		X	>10
P13	Less developed			X					>10
P14	Developed		X				X		>10
P15	Developed	X	X	X	X	X	X		>10
P16	Less developed		X			X		X	1–2
P17	Developed	X		X	X	X	X	X	>10
P18	Developed			X		X		X	>10
P19	Developed	X		X	X	X	X	X	>10
P20	Developed			X	X	X		X	>10

Note: Field of Expertise: DI: Digital Innovation; DL: Digital Learning; Et: Entrepreneurship; GI: Global Innovation; HR: Human Resource Development; IcC: Intercultural Collaboration; IgC: Intergenerational Collaboration.

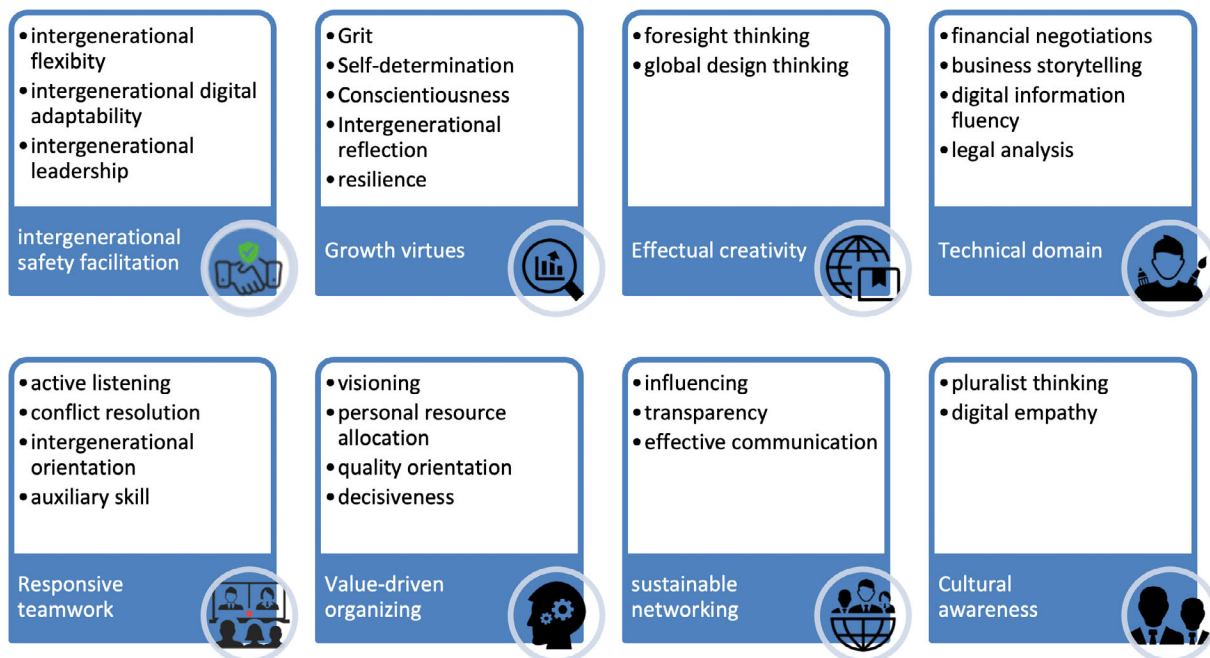


FIGURE 2 Intergenerational competency framework for digital start-ups entrepreneurs in global innovation process [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 3 Ranking of competencies for intergenerational safety facilitation

Competency (sorted based on final rank)	rel	Ranking			
		1st round		2nd round	
		\bar{x}	rk	\bar{x}	Final-rk
Intergenerational flexibility	4.95	6.00	2	4.13	2
Intergenerational leadership	4.89	13.67	16	17.06	19
Intergenerational digital adaptability	4.21	23.33	25	24.94	27

Note: \bar{x} : mean ranking; final-rk: final rank; rk: rank; rel: relevancy.

TABLE 4 Ranking of competencies for cultural awareness

Competency (sorted based on final rank)	rel	Ranking			
		1st round		2nd round	
		\bar{x}	rk	\bar{x}	Final-rk
Pluralist thinking	4.68	20.67	23	21.13	23
Digital empathy	4.45	24.67	26	23.31	26

Note: \bar{x} : mean ranking; final-rk: final rank; rk: rank; rel: relevancy.

4.1 | Intergenerational safety facilitation

The capability that deals with nurturing psychological safety in intergenerational collaboration. Competencies include are (Table 3):

- Intergenerational flexibility: Open-mindedness, especially when working with different generations and with new ideas (Fantini & Tirmizi, 2006; Griffith et al., 2016; Lim et al., 2013; Martins & Terblanche, 2003; Reid et al., 2014; Reid & Brentani, 2015; Várhegyi & Nann, 2011; Watts et al., 2013). Moreover, intergenerational flexibility was classified as top 10 competency in matching (5th place) and in the process of design and development (3rd place). Based on the Delphi study, some participant provides comments related to the competency:
P13: "...the ability to swiftly changing perspectives in generating new ideas or approaches. It is the result of the ability to provoke one's mind to explore and probe the matter at hand..."
P9: "Pursuing instead of change."
- Intergenerational digital adaptability: Ability to optimize the use of digital media to fit into new, intergenerational innovation space (Boughzala et al., 2012; Fantini & Tirmizi, 2006; Goldsmith & Eggers, 2005; Griffith et al., 2016; Sarker & Sahay, 2003; Wei et al., 2011; Xu et al., 2007; Zimmermann & Ravishankar, 2014)
- Intergenerational leadership: Ability to actuate people from different generational backgrounds toward the desired destination coordinately (Boughzala et al., 2012; Duhan et al., 2001; Getha-Taylor, 2008; Hertel et al., 2006; Lans et al., 2010; Nielsen, 2015; Watts et al., 2013; Wu, 2009; Xu et al., 2007)

Intergenerational flexibility helps provide a sense of safety and encourages expressing rich and diverse opinions and ideas. Through the use of digital technology, each generation may have different experiences and backgrounds. Consequently, improving virtual

working conditions requires intergenerational digital adaptability for diversity in the workforce, and no generation feels left out. Besides, the importance of intergenerational leadership in intergenerational differences helps to achieve innovation goals better.

4.2 | Cultural awareness

This competency group is about competencies that emphasize the importance of esteeming cultural differences between generations and foreign partners. In this category, a global start-up innovator seeks to travel to another country with a different culture, find partners, and develop products and services based on the global and local values in line with their goals. Two competencies to consider in this category are (Table 4):

- Pluralistic thinking: Ability to avoid a negative judgment on the heterogeneity of cultural and physical functions of different generations (Abbott et al., 2013; Blackburn et al., 2003; Fantini & Tirmizi, 2006; Hertel et al., 2006; Sahay, 2004; Várhegyi & Nann, 2011; Watts et al., 2013; Zakaria et al., 2004; Zimmermann et al., 2013; Zimmermann & Ravishankar, 2014). Moreover, pluralist thinking was classified as top 10 competency in ideation process (7th place). Some remarks were made about the completeness of the competency framework:
P13: "pluralist thinking is growing in importance since working with diverse co-workers, clients, and employees are inevitable... The definition is quite accurate, although it is still not satisfying."
- Digital empathy: The ability to appropriately understand and express feelings to other generations or emotions in digital environments (Fantini & Tirmizi, 2006; Getha-Taylor, 2008; Sahay, 2004; Sarker & Sahay, 2003; Várhegyi & Nann, 2011; Wu, 2009; Zimmermann et al., 2013). Moreover, digital empathy

Competency (sorted based on final rank)	rel	Ranking			
		1st round		2nd round	
		\bar{x}	rk	\bar{x}	Final-rk
Grit	4.84	9.33	5	5.63	3
Self-determination	4.84	13.00	13	8.25	6
Conscientiousness	4.95	10.67	8	8.81	7
Intergenerational reflection	4.90	13.67	15	11.38	13
Resilience	4.89	13.00	12	13.00	14

TABLE 5 Ranking of competencies for growth virtues

Note: \bar{x} : mean ranking; final-rk: final rank; rk: rank; rel: relevancy.

was classified as top 10 competency in design and development (10th place), and commercialization (10th place). Based on the Delphi study, some participant provides comments related to the competency:

P13: “empathy is a subject of growing importance since it is something that embedded in humans and cannot be transferred... The emphatic digital skill requires a higher degree of empathy compared to that exercised in the physical environment.”

P7: “This skill is very difficult. And usually, it needs a more developed self-awareness.”

Pluralistic thinking is necessary to develop a mindset about cultural diversity and avoid negative judgments between generations and cultures. At the same time, digital empathy is closely linked to the cultural empathy needed to understand cultural cues in virtual environments.

4.3 | Growth virtues

Virtues are a characteristic valued by an individual(s); in this context, we derived the growth virtues competency from personal competencies. Growth virtues was defined as values that belong to start-ups' actor(s) to evolve and grow to meet various global innovation challenges in the intergenerational setting. Five competencies fall into this group, namely (Table 5):

- **Grit:** Passion for striving of long-term goals (Arafeh, 2016; Bacigalupo et al., 2016; Bala et al., 2017; Duckworth et al., 2007; Hertel et al., 2006; Kyndt & Baert, 2015; Watts et al., 2013; Wu, 2009) the competency was found both in the domain of global innovation and intergenerational collaboration, the competency focuses on the personal competency that has low to moderate involvement of technology. Moreover, grit was classified as top 10 competency in ideation (5th place), and design and development (5th place). Based on the Delphi study, some participant provides comments related to the competency:
P7: “personal matters are significant, too. Supporting the family situation,...”
P13: “grit is acknowledged as the single ability that predicts success.”

- **Self-determination:** The ability to confidently make independent decisions (Arafeh, 2016; Bacigalupo et al., 2016; Dimitratos et al., 2014; Hertel et al., 2006; Kyndt & Baert, 2015; Martins & Terblanche, 2003; E. Rasmussen et al., 2011, 2014; Sánchez, 2013).
- **Conscientiousness:** Passion for an effective accomplishment of organizational objectives (Arafeh, 2016; Bacigalupo et al., 2016; Bala et al., 2017; Blackburn et al., 2003; de Quadros Carvalho et al., 2013; Dijkman et al., 2016; Dimitratos et al., 2014; Duhan et al., 2001; Hertel et al., 2006; Li et al., 2016; Markham & Lee, 2013; Ojala, 2016; Sánchez, 2013). Moreover, conscientiousness was classified as top 10 competency in commercialization process (9th place).
- **Intergenerational reflection:** Continuous learning through self-and other generational experiences (Bacigalupo et al., 2016; Bala et al., 2017; Blackburn et al., 2003; Dijkman et al., 2016; Duhan et al., 2001; Fantini & Tirmizi, 2006; Hertel et al., 2006; Kyndt & Baert, 2015; Li et al., 2016; Martins & Terblanche, 2003; Wu, 2009; Zimmermann et al., 2013).
- **Resilience:** The capacity to recover from failure physically and emotionally (Arafeh, 2016; Bacigalupo et al., 2016; Dohmen et al., 2014; Lim et al., 2013; Martins & Terblanche, 2003; Sarker & Sahay, 2003).

These five competencies are included in growth virtues because they referred to individual values acquired through learning and experience and practiced in developing start-ups. Growth virtue must be present to develop and innovate further amid religion's global innovation and intergenerational cooperation challenges.

4.4 | Effectual creativity

This competency group is associated with creativity start-up actor(s) of utilizing local and available resources for global innovation. Two competencies are included in this category (Table 6):

- **Foresight thinking:** The ability to validate factors influencing the formulation of innovative strategies for the future of the business (Arafeh, 2016; Dijkman et al., 2016; Duhan et al., 2001;

TABLE 6 Ranking of competencies for effectual creativity

Competency (sorted based on final rank)	rel	Ranking			
		1st round		2nd round	
		\bar{x}	rk	\bar{x}	Final-rk
Foresight thinking	5.10	10.33	7	8.88	8
Global design thinking	4.75	18	22	19.63	21

Note: \bar{x} : mean ranking; final-rk: final rank; rk: rank; rel: relevancy.

TABLE 7 Ranking of competencies for technical domain expertise

Competency (sorted based on final rank)	rel	Ranking			
		1st round		2nd round	
		\bar{x}	rk	\bar{x}	Final-rk
Financial negotiation	4.80	6.67	3	7.00	5
Business storytelling	Proposed by panel expert			11.05	11
Digital information fluency	4.95	11.33	11	15.38	18
Legal analysis	4.74	17.67	21	22.94	25

Note: \bar{x} : mean ranking; final-rk: final rank; rk: rank; rel: relevancy.

Goldsmith & Eggers, 2005; Kyndt & Baert, 2015; Lans et al., 2010; Li et al., 2016; Lim et al., 2013; Martins & Terblanche, 2003; Nielsen, 2015; Ojala, 2016; de Quadros Carvalho et al., 2013; Rasmussen et al., 2011, 2014; Reid et al., 2014; Reid & Brentani, 2015; Watts et al., 2013; Wu, 2009). Moreover, foresight thinking was classified as top 10 competency in ideation (4th place) and commercialization (8th place).

- Global design thinking: The ability to systematically demonstrate global products/solutions based on local value/design (Abbott et al., 2013; Bacigalupo et al., 2016; Boughzala et al., 2012; Dimitratos et al., 2014; Duhan et al., 2001; Hertel et al., 2006; Kyndt & Baert, 2015; Lans et al., 2010; Markham & Lee, 2013; de Quadros Carvalho et al., 2013; Rasmussen et al., 2011, 2014; Watts et al., 2013; Wu, 2009). Moreover, global design thinking was classified as top 10 competency in ideation (3rd place), matching (7th place), as well as design and development (2nd place).

By focusing on global innovation, both competencies are related to creating a global business model focused on available capital, local values, and stakeholders. Effectual creativity creates products or services by managing future performance based on the availability of resources. (Jensen, 2017) stressed the importance of global ideas and innovative thinking in supporting the global innovation culture.

4.5 | Technical domain expertise

In this category, several competencies are remarkably similar, namely the operationalization of specific technical abilities and the use of tools. Competencies in this category include (Table 7):

- Financial negotiations: The ability to gain and leverage funding (Bacigalupo et al., 2016; Kyndt & Baert, 2015; Li et al., 2016). Moreover, this competency was classified as top 10 competency in ideation process (10th place) and commercialization (2nd place).
- Business storytelling: The ability to formulate an engaging narration of the desired business idea(s) (Li et al., 2016; Watts et al., 2013). Business storytelling was proposed through external validation. Moreover, business storytelling was classified as top 10 competency in all innovation process including ideation (6th place), matching (3rd place), design and development (9th place), and commercialization (3rd place). Some remarks were made about the completeness of the competency framework:
P20: "The most important competency of the founder is a great sales affinity for customer acquisition. And the ability to put oneself in the position of the customer and his wishes without ignoring one's own goals and ideas."
- Digital information fluency: The ability to analyze and optimize the use of digital information and technology (Blackburn et al., 2003; Duhan et al., 2001; Li et al., 2016; Lim et al., 2013; Martinsons & Ma, 2009; Sahay, 2004; Vuorikari et al., 2016; Wei et al., 2011; Wu, 2009; Xu et al., 2007). Moreover, digital information fluency was classified as top 10 competency in matching (9th place), and in the innovation process of design and development (6th place).
- Legal analysis: The ability to assess the intellectual property's potential value for innovation (de Quadros Carvalho et al., 2013; Dijkman et al., 2016; Markham & Lee, 2013)

Business storytelling is associated with specific presentation skills and presents a business idea. Financial negotiations require technical knowledge of financial returns and losses to present and determine the business's economic value to all stakeholders (e.g., customers and investors)—the digital capabilities associated with operating digital

TABLE 8 Ranking of competencies for responsive teamwork

Competency (sorted based on final rank)	rel	Ranking			
		1st round		2nd round	
		\bar{x}	rk	\bar{x}	Final-rk
Intergenerational orientation	5.21	14.00	18	6.25	4
Conflict resolution	4.95	10.33	6	17.75	20
Active listening	4.95	17.33	20	19.81	22
Auxiliary skill	4.74	21.33	24	21.25	24

Note: \bar{x} : mean ranking; final-rk: final rank; rk: rank; rel: relevancy.

devices to optimize digital information for innovation collaboration purposes.

4.6 | Responsive teamwork

Responsive teamwork is a group of competencies highlighting the importance of start-up actor(s) on providing constructive peer feedback for teamwork progression. We classified these competencies to this capability (Table 8):

- **Active listening:** The ability to confirm understanding of what others express verbally (Dimitratos et al., 2014; Watts et al., 2013). Some remarks were made about the completeness of the competency framework:
P13: "...In the era of openness (open innovation, open leadership, open business model, etc.), only those who can effectively listen can craft meaningful values for others." Moreover, active listening was classified as top 10 competency in ideation (8th place), matching (10th place), and commercialization (7th place).
- **Conflict resolution:** The ability to turn any potential for social conflict into an opportunity (Bala et al., 2017; Blackburn et al., 2003; Martins & Terblanche, 2003). Moreover, conflict resolution was classified as top 10 competency in matching process (6th place).
- **Intergenerational orientation:** Passion for empowering intergenerational cooperation in the innovation process (Bacigalupo et al., 2016; Dijkman et al., 2016; Li et al., 2016; Martins & Terblanche, 2003; Nielsen, 2015; Watts et al., 2013). Moreover, intergenerational orientation was classified as top 10 competency in matching process (1st place) as well as the process of design and development (4th place).
- **Auxiliary skill:** The ability to support others in making progress (Dijkman et al., 2016; Goldsmith & Eggers, 2005; Lans et al., 2010; Li et al., 2016; Martins & Terblanche, 2003; Wu, 2009; Zimmermann et al., 2013). Based on the Delphi study, some participant provides comments related to the competency:
P13: "in the digital era, organizational assets are manifested not only by ownership of machinery or facilities. More importantly, they are represented by ownership of a vital role in the strategic partnership. The ability to capture a vital position or role is largely determined by auxiliary skills. It helps us to instill trust in others."

This competency group shares common features supporting interpersonal relationships in working with teams within a generation or different generations. Furthermore, auxiliary skill is vital to help their peers overcome their challenges and difficulties, supporting their organization in long-term collaboration.

4.7 | Value-driven organizing

For this category, the competency group for start-up actor(s) focuses on empowering human capital based on shared value. The competencies associated with this category are (Table 9):

- **Visioning:** The ability to clearly pursue and coordinate team goals and standards with other (generations) team members. Imagine the business's future (Arafeh, 2016; Audzeyeva & Hudson, 2016; Bala et al., 2017; Blackburn et al., 2003; Dijkman et al., 2016; Goldsmith & Eggers, 2005; Sarker & Sahay, 2003; Watts et al., 2013). Moreover, visioning was classified as top 10 competency in all innovation process including ideation (1st place), matching (2nd place), design and development (1st place), and commercialization (1st place). Based on the Delphi study, some participant provides comments related to the competency:
P14: "...having a clear goal and convince the team..."
P13: "...in the era of abundance, vision is becoming even more important. We will found ourselves in pressing need of purpose to screen and prioritize activities and resources..."
- **Personal resource allocation:** The ability to optimally mobilize the use of personal resources (Audzeyeva & Hudson, 2016; Bacigalupo et al., 2016; Bala et al., 2017; de Quadros Carvalho et al., 2013; Dijkman et al., 2016; Duhan et al., 2001; Goldsmith & Eggers, 2005; Griffith et al., 2016; Lans et al., 2010; Li et al., 2016; Martins & Terblanche, 2003; Vuorikari et al., 2016; Watts et al., 2013; Zimmermann et al., 2013). Moreover, personal resource allocation was classified as top 10 competency in ideation process (9th place).
- **Quality orientation:** Consistent focus on the quality to be achieved (Arafeh, 2016; Kyndt & Baert, 2015; Martinsons & Ma, 2009; Watts et al., 2013; Wu, 2009). Moreover, quality orientation was classified as top 10 competency in design and development (7th place), and commercialization (4th place).

TABLE 9 Ranking of competencies for value-driven organizing

Competency (sorted based on final rank)	rel	Ranking			
		1st round		2nd round	
		\bar{x}	rk	\bar{x}	Final-rk
Visioning	5.35	2.67	1	3.19	1
Personal resource allocation	4.68	9.00	4	9.69	9
Quality orientation	4.68	12.50	15	13.06	15
Decisiveness	5.00	15.33	19	14.06	16

Note: \bar{x} : mean ranking; final-rk: final rank; rk: rank; rel: relevancy.

TABLE 10 Ranking of competencies for sustainable networking

Competency (sorted based on final rank)	rel	Ranking			
		1st round		2nd round	
		\bar{x}	rk	\bar{x}	Final-rk
Effective communication	5.20	11.00	9	10.56	10
Transparency	4.89	11.00	10	11.06	12
Influencing	4.74	13.33	14	14.88	17

Note: \bar{x} : mean ranking; final-rk: final rank; rk: rank; rel: relevancy.

- Decisiveness: The ability to quickly put calculated risks into actionable policies (Arafah, 2016; de Quadros Carvalho et al., 2013; Dimitratos et al., 2014; Goldsmith & Eggers, 2005; Lans et al., 2010; Li et al., 2016; Martins & Terblanche, 2003; Nielsen, 2015; Reid et al., 2014; Reid & Brentani, 2015; Sahay, 2004; Sánchez, 2013; Watts et al., 2013; Wu, 2009). Moreover, decisiveness was classified as top 10 competency in design and development (8th place).

P13: “Decisiveness is so important in promoting innovation... Without the ability to exercise good judgment related to the risk and benefits, the rapid process of innovation will be suffered, and progress will be hampered.”

Visioning is included in this category due to the essential role of value in guiding corporate strategy's conceptual development. In addition to global innovation, the ability to control and maximize human capital, emphasis on quality and determination by simplified action is more natural in implementing the organizational strategy and minimizing all risk types.

4.8 | Sustainable networking

This competency group category brings together all the competencies closely linked to professional bonds outside the organization. Three competencies are (Table 10):

- Influencing: The ability to influence other (generations) from a specific perspective (Abbott et al., 2013; Arafah, 2016; Bala et al., 2017; Blackburn et al., 2003; Boughzala et al., 2012; Dimitratos et al., 2014; Goldsmith & Eggers, 2005; Kyndt & Baert, 2015; Li et al., 2016; Sarker & Sahay, 2003; Várhegyi &

Nann, 2011; Watts et al., 2013; Wu, 2009). Moreover, quality orientation was classified as top 10 competency in matching (4th place), and commercialization (6th place).

- Transparency: The ability to share clarified and updated information with others (generation) (Blackburn et al., 2003; Dohmen et al., 2014; Hertel et al., 2006; Martinsons & Ma, 2009; Zakaria et al., 2004; Zimmermann et al., 2013)
- Effective communication: Ability to communicate comprehensively by all necessary means (Abbott et al., 2013; Audzeyeva & Hudson, 2016; Blackburn et al., 2003; Duhan et al., 2001; Fantini & Tirmizi, 2006; Goldsmith & Eggers, 2005; Hertel et al., 2006; Li et al., 2016; Markham & Lee, 2013; Nielsen, 2015; Sahay, 2004; Watts et al., 2013; Wu, 2009; Zimmermann & Ravishankar, 2014). Moreover, effective communication was classified as top 10 competency in ideation (2nd place), matching (8th place), and commercialization (5th place).

In the context of global and intergenerational innovation, global start-up innovators require the optimization of long-term professional networks with partners and senior collaborators. This requires the ability to influence professional networks' functions and ensure transparency and communication effectiveness of the use of different channels and foreign languages. This section developed and validated a competency-based framework for global start-up entrepreneurs in intergenerational settings. Next, we will discuss the implications of the study findings.

5 | DISCUSSION

This study examines the competencies required to promote intergenerational collaboration for global start-up entrepreneurs in the

digital age. We took a Delphi poll. The results provided a set of competencies and competency groups for the study context. In this section, we discuss some implications of the study as important takeaways for start-up management research that leverages inter-generational collaboration for sustainable knowledge management.

5.1 | Theoretical contributions

This study uncovers 27 competencies cover the concept of competency in a broader sense, including values, virtues, and mindsets. The broad coverage also complements previous studies on entrepreneurship and innovation management that focus more on (social) competency and knowledge (Bandera & Thomas, 2018; Fligstein, 1997) but little attention was given to the importance of values or virtues. Previous studies demonstrate the need for digital skills and entrepreneurship (Foucrier & Wiek, 2019; Vuorikari et al., 2016; Wu, 2009). While there is no consensus on the complexity of internationalization and business growth, there is little awareness that different phases require different competencies (Chang, 2012; Foucrier & Wiek, 2019; Santoro et al., 2019). This study, on the one hand shows the general ranking of competencies in inter-generational settings, on the other hand, shows the importance of competencies in more detail in different activities within innovation process.

Fostering all competencies requires time, energy, and human resources, which can negatively impact entrepreneurs' well-being (Wiklund et al., 2019). Information and communication technology is an important innovation tool. However, it can also pose challenges to

innovation processes. Often, collaborative technologies facilitate communication with others. However, in other contexts, such as cultural differences, technical expertise, and different technological infrastructures, face-to-face communication may work better with tangible materials such as paper or whiteboards.

Different features of technologies force people to be more versatile and adapt to the situation at hand. In this study, we show that specific competencies are needed more or less in the digital age. We have studied the complex changes in required competencies and shown that certain competencies are relevant at certain stages of the innovation process (in other words, it is not necessarily essential to have all competencies simultaneously). These development conditions are dynamic and depend on the organization and the phase within the innovation process itself. The findings also validate research on the importance of visioning work needed at the forefront of all global innovation processes (Arafah, 2016; Dijkman et al., 2016; Hevner & Gregor, 2020). Therefore, based on the competency group dynamics presented in this study, we suggest that start-up actors can develop certain competencies by focusing on which stages of the innovation process they are currently in and matching the state with the required competencies that process (Chang, 2012; Foucrier & Wiek, 2019; Santoro et al., 2019).

Moreover, the study suggests fostering a flexible and inclusive leadership style that promotes diversity collaboration (Won et al., 2021) between younger and older generations to support start-up innovation. To make sure it is an environment where every generation feels safe, for sustainable knowledge society (Perez-Encinas et al., 2021; Qian et al., 2019; Won et al., 2021), digital technology

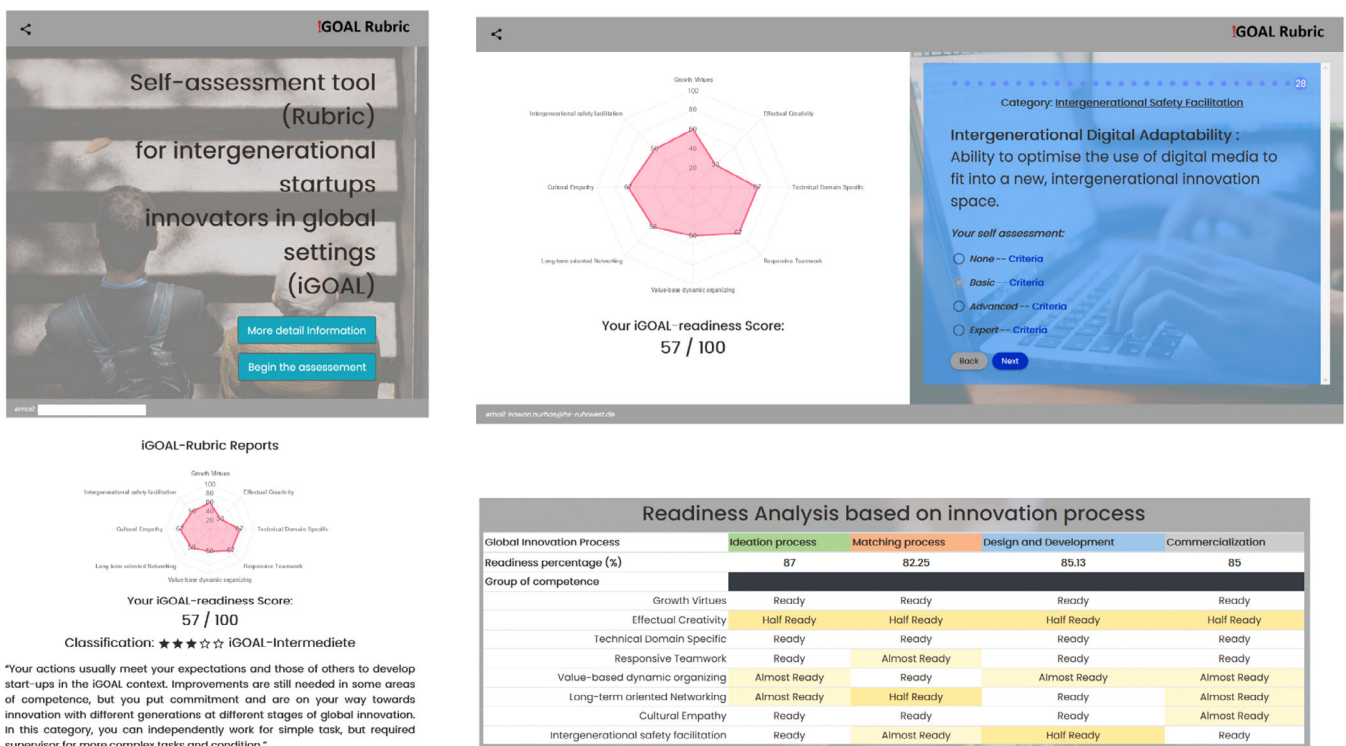


FIGURE 3 Web-based interactive self-assessment tool for start-up readiness in global and intergenerational innovation [Colour figure can be viewed at wileyonlinelibrary.com]

needs to be more adaptable to different ages' needs (Perez-Encinas et al., 2021; Qian et al., 2019). The present findings show various competencies that can be used for developing system requirements (Klendauer et al., 2012) for an intergenerational context.

5.2 | Practical contributions

For practical contributions, this study can assess the intergenerational readiness of start-up entrepreneurs at various stages of global innovation processes (Foucrier & Wiek, 2019; Nurhas et al., 2021). The result can be used as a self-assessment tool to understand target competencies and help start-ups find a qualified partner to complement current competencies. Investors can also use the competencies to assess start-ups' readiness to collaborate and leverage cross-generational collaboration for innovation (Kleine & Yoder, 2011; Yin & Luo, 2018). A competency-based rubric can be developed as an example of an application of the study result.

In Figure 3, a web-based rubric was developed based on the proposed competency-framework to assess entrepreneurial competencies by asking entrepreneurs to rate their competency level for each competency, modifying each competency level criteria (Dijkstra, 2012; Popovic, 2003). The prototype for instance can be developed as open source html5 app that can be downloaded in open repository.¹ The interface of self-assessment rubric prototype can be seen in Figure 3. After the self-assessment of competencies is completed, the result provides a score for readiness for intergenerational collaboration. The Delphi study results can be used as a basis for weighting the competency scores and provide information for a more detailed analysis of the global innovation process.

Besides, universities offering entrepreneurship programs can support a competency-based curriculum by using the competency framework (Kleine & Yoder, 2011; Panadero & Romero, 2014). The competency-based approach has been shown to increase student learning outcomes and improve career-related behaviors. Colleges and universities can use game-based learning to identify, develop, and assess essential competencies (Hafeez et al., 2002). Finally, the study results can be used for organizational management to support innovation through actor(s) in intergenerational collaboration, provide training and assessment for actor(s) development (Carayannis et al., 2021; Dorado, 2005; Reid & Brentani, 2015; Saa-Perez & Garcia-Falcon, 2002) that promotes intergenerational entrepreneurship to support the rapidly changing work environment in the digital age. The detailed results can be used for human resource development management to identify competency gaps and initiate appropriate interventions (in training or hiring processes).

5.3 | Limitations and recommendations

Several limitations of the study were identified. First, the limitation relates to the literature, which may not cover all relevant literature due to the study context's broader disciplines. However, the literature

was only used to develop the initial conceptual model of competencies, which was validated and refined through several rounds of Delphi study and abductive thinking. Each new relevant study that comes after the literature review process will be assigned to one of the predefined concepts. Further studies could focus on finding the relevant literature by focusing on a specific field of study. Resources outside the literature can also be used to analyze and develop the framework, for example, blogs, online magazines, and social media discussions. Second, regarding the limited number and demographic characteristics of participants, a further study could include more expert participants, equal numbers of participants of all genders and from developed and developing countries, more detailed information on the age of participants to allow further analysis, and a limited number of use cases to generalize the results of the proposed study.

ACKNOWLEDGMENT

Thanks to the IHK-Detmold for enabling the participation of senior experts in the expert pool of the study. Irawan Nurhas's work is supported by the Ministry of Culture and Science of the State of North Rhine-Westphalia at the Institute of Positive Computing-Hochschule Ruhr West. Open Access funding enabled and organized by Projekt DEAL.

ORCID

Irawan Nurhas  <https://orcid.org/0000-0002-2211-8857>

ENDNOTE

¹ <https://doi.org/10.5281/zenodo.4545594> (last accessed: May 19, 2022).

REFERENCES

- Abbott, P., Zheng, Y., Du, R., & Willcocks, L. (2013). From boundary spanning to creolization: A study of Chinese software and services outsourcing vendors. *The Journal of Strategic Information Systems*, 22(2), 121–136.
- Arafeh, L. (2016). An entrepreneurial key competencies' model. *Journal of Innovation and Entrepreneurship*, 5(1), 26.
- Audzeyeva, A., & Hudson, R. (2016). How to get the most from a business intelligence application during the post implementation phase? Deep structure transformation at a UK retail bank. *European Journal of Information Systems*, 25(1), 29–46.
- Bacigalupo, M., Kamylyis, P., Punie, Y., & van den Brande, G. (2016). *EntreComp: The entrepreneurship competence framework* (Vol. 10, 593884). Publication Office of the European Union.
- Bailetti, A. J. (2012). What technology startups must get right to globalize early and rapidly. *Technology Innovation Management Review*, 2, 5–16.
- Bala, H., Massey, A. P., & Montoya, M. M. (2017). The effects of process orientations on collaboration technology use and outcomes in product development. *Journal of Management Information Systems*, 34(2), 520–559.
- Bandera, C., & Thomas, E. (2018). The role of innovation ecosystems and social capital in startup survival. *IEEE Transactions on Engineering Management*, 66(4), 542–551.
- Basly, S. (2007). The internationalization of family SME. *Baltic Journal of Management*, 2(2), 154–180.
- Becker, K. L., Richards, M. B., & Stollings, J. (2020). Better together? Examining benefits and tensions of generational diversity and team performance. *Journal of Intergenerational Relationships*, 1–21 (in press).

- Bjuggren, P.-O., & Sund, L.-G. (2001). Strategic decision making in inter-generational successions of small-and medium-size family-owned businesses. *Family Business Review*, 14(1), 11–23.
- Blackburn, R., Furst, S., & Rosen, B. (2003). Building a winning virtual team. In C. B. Gibson, & S. G. Cohen (Eds.), *Virtual teams that work: Creating conditions for virtual team effectiveness* (pp. 95–120). John Wiley & Sons.
- Bosma, N., & Schutjens, V. (2011). Understanding regional variation in entrepreneurial activity and entrepreneurial attitude in Europe. *The Annals of Regional Science*, 47(3), 711–742.
- Boughzala, I., de Vreede, G.-J., & Limayem, M. (2012). Team collaboration in virtual worlds: Editorial to the special issue. *Journal of the Association for Information Systems*, 13(10), 6–734.
- Boutellier, R., Gassmann, O., & von Zedtwitz, M. (2013). *Managing global innovation: Uncovering the secrets of future competitiveness*. Springer Science & Business Media.
- Carayannis, E., Del Giudice, M., Tarba, S., & Soto-Acosta, P. (2021). Building entrepreneurial ecosystems: Exploring ambidexterity in technology and engineering management. *IEEE Transactions on Engineering Management*, 68(2), 347–349.
- Chang, C.-C. (2012). Exploring IT entrepreneurs' dynamic capabilities using Q-technique. *Industrial Management & Data Systems*, 112, 1201–1216.
- Chege, S. M., Wang, D., & Suntu, S. L. (2020). Impact of information technology innovation on firm performance in Kenya. *Information Technology for Development*, 26(2), 316–345.
- Colombo, M. G., & Piva, E. (2008). Strengths and weaknesses of academic startups: A conceptual model. *IEEE Transactions on Engineering Management*, 55(1), 37–49.
- Dijkman, B., Roodbol, P., Aho, J., Achtschin-Stieger, S., Andruszkiewicz, A., Coffey, A., Felsmann, M., Klein, R., Mikkonen, I., & Oleksiw, K. (2016). *European core competences framework for health and social care professionals working with older people*. ELLAN European Union.
- Dijkstra, K. A. (2012). *Intuition versus deliberation: The role of information processing in judgment and decision making*. Delft University of Technology.
- Dimitratos, P., Liouka, I., & Young, S. (2014). A missing operationalization: entrepreneurial competencies in multinational enterprise subsidiaries. *Long Range Planning*, 47(1–2), 64–75.
- Dohmen, T., Falk, A., Huffman, D., & Sunde, U. (2014). *The inter-generational transmission of risk and trust attitudes*. IZA Discussion Papers.
- Dong, A., Lovallo, D., & Mounarath, R. (2015). The effect of abductive reasoning on concept selection decisions. *Design Studies*, 37, 37–58.
- Dorado, S. (2005). Institutional entrepreneurship, partaking, and convening. *Organization Studies*, 26(3), 385–414.
- Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, 92(6), 1087–1101.
- Duhan, S., Levy, M., & Powell, P. (2001). Information systems strategies in knowledge-based SMEs: The role of core competencies. *European Journal of Information Systems*, 10(1), 25–40.
- Edelman, L. F., Manolova, T., Shirokova, G., & Tsukanova, T. (2016). The impact of family support on young entrepreneurs' start-up activities. *Journal of Business Venturing*, 31(4), 428–448.
- Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, 62(1), 107–115.
- Fantini, A., & Tirmizi, A. (2006). *Exploring and assessing intercultural competence*. Federation EIL.
- Fligstein, N. (1997). Social skill and institutional theory. *American Behavioral Scientist*, 40(4), 397–405.
- Foucrier, T., & Wiek, A. (2019). A process-oriented framework of competencies for sustainability entrepreneurship. *Sustainability*, 11(24), 7250.
- Getha-Taylor, H. (2008). Identifying collaborative competencies. *Review of Public Personnel Administration*, 28(2), 103–119.
- Giardino, C., Wang, X., & Abrahamsson, P. (2014). Why early-stage software startups fail: A behavioral framework. In *International Conference of Software Business* (pp. 27–41). Springer.
- Goldsmith, S., & Eggers, W. D. (2005). *Governing by network: The new shape of the public sector*. Brookings Institution Press.
- Gordon, P. A. (2018). Age diversity in the workplace. In C. Aquino, & R. Robertson (Eds.), *Diversity and inclusion in the global workplace* (pp. 31–47). Springer.
- Griffith, R. L., Wolfeld, L., Armon, B. K., Rios, J., & Liu, O. L. (2016). Assessing intercultural competence in higher education: Existing research and future directions. *ETS Research Report Series*, 2016(2), 1–44.
- Hafeez, K., Zhang, Y., & Malak, N. (2002). Core competence for sustainable competitive advantage: A structured methodology for identifying core competence. *IEEE Transactions on Engineering Management*, 49(1), 28–35.
- Halewood, N., & Kenny, C. (2008). Young people and ICTs in developing countries. *Information Technology for Development*, 14, 171–177.
- Harvey, J.-F. (2012). Managing organizational memory with inter-generational knowledge transfer. *Journal of Knowledge Management*, 16, 400–417.
- Heiko, A. (2012). Consensus measurement in Delphi studies: Review and implications for future quality assurance. *Technological Forecasting and Social Change*, 79(8), 1525–1536.
- Hertel, G., Konradt, U., & Voss, K. (2006). Competencies for virtual teamwork: Development and validation of a web-based selection tool for members of distributed teams. *European Journal of Work and Organizational Psychology*, 15(4), 477–504.
- Hevner, A., & Gregor, S. (2020). *Envisioning entrepreneurship and digital innovation through a design science research lens: A matrix approach* (103350). Information & Management.
- Holtkamp, P., Jokinen, J. P. P., & Pawlowski, J. M. (2015). Soft competency requirements in requirements engineering, software design, implementation, and testing. *Journal of Systems and Software*, 101, 136–146.
- Jensen, K. R. (2017). *Leading global innovation: Facilitating multicultural collaboration and international market success*. Springer.
- Karlson, N., & Fergin Wennberg, E. (2014). *Virtue as competence in the entrepreneurial society*. The Ratio Institute.
- Kendall, J. W. (1977). Variations of delphi. *Technological Forecasting and Social Change*, 11(1), 75–85.
- Kleine, R. E., & Yoder, J.-D. (2011). Operationalizing and assessing the entrepreneurial mindset: A rubric based approach. *The Journal of Engineering Entrepreneurship*, 2(2), 57–86.
- Klendauer, R., Berkovich, M., Gelvin, R., Leimeister, J. M., & Krcmar, H. (2012). Towards a competency model for requirements analysts. *Information Systems Journal*, 22(6), 475–503.
- Knight, G. A., & Cavusgil, S. T. (2004). Innovation, organizational capabilities, and the born-global firm. *Journal of International Business Studies*, 35(2), 124–141.
- Kyndt, E., & Baert, H. (2015). Entrepreneurial competencies: Assessment and predictive value for entrepreneurship. *Journal of Vocational Behavior*, 90, 13–25.
- Lans, T., Biemans, H., Mulder, M., & Verstegen, J. (2010). Self-awareness of mastery and improvability of entrepreneurial competence in small businesses in the agrifood sector. *Human Resource Development Quarterly*, 21(2), 147–168.
- Li, W., Liu, K., Belitski, M., Ghobadian, A., & O'Regan, N. (2016). E-leadership through strategic alignment: An empirical study of small-and medium-sized enterprises in the digital age. *Journal of Information Technology*, 31(2), 185–206.
- Lim, J.-H., Stratopoulos, T. C., & Wirjanto, T. S. (2013). Sustainability of a firm's reputation for information technology capability: The role of senior IT executives. *Journal of Management Information Systems*, 30(1), 57–96.
- Linstone, H. A., & Turoff, M. (1975). *The delphi method*. Addison-Wesley Reading.

- Littunen, H., & Hyrsky, K. (2000). The early entrepreneurial stage in Finnish family and nonfamily firms. *Family Business Review*, 13(1), 41–53.
- Lyashenko, M. S., & Frolova, N. H. (2014). LMS projects: A platform for intergenerational e-learning collaboration. *Education and Information Technologies*, 19(3), 495–513.
- Markham, S. K., & Lee, H. (2013). Product development and management association's 2012 comparative performance assessment study. *Journal of Product Innovation Management*, 30(3), 408–429.
- Martins, E.-C., & Terblanche, F. (2003). Building organisational culture that stimulates creativity and innovation. *European Journal of Innovation Management*, 6, 64–74.
- Martinsons, M. G., & Ma, D. (2009). Sub-cultural differences in information ethics across China: Focus on Chinese management generation gaps. *Journal of the Association for Information Systems*, 10(11), 2.
- Massis, A. d., Frattini, F., Majocchi, A., & Piscitello, L. (2018). Family firms in the global economy: Toward a deeper understanding of internationalization determinants, processes, and outcomes. *Global Strategy Journal*, 8(1), 3–21.
- Matlay, H., & Gimmon, E. (2014). Mentoring as a practical training in higher education of entrepreneurship. *Education+ Training*, 56(8/9), 814–825.
- Müller, S. D., Päske, N., & Rodil, L. (2019). Managing ambidexterity in startups pursuing digital innovation. *Communications of the Association for Information Systems*, 44(1), 18–298.
- Nielsen, J. A. (2015). Assessment of innovation competency: A thematic analysis of upper secondary school teachers' talk. *The Journal of Educational Research*, 108(4), 318–330.
- Nurhas, I., Aditya, B. R., Geisler, S., Ojala, A., & Pawlowski, J. (2019). We are “not” too (young/old) to collaborate: Prominent key barriers to intergenerational innovation. In D. Xu, J. Jiang, & H.-W. Kim (Eds.), *PACIS 2019: Proceedings of the 23rd Pacific Asia Conference on Information Systems. Barriers to Intergenerational Innovation in Global Context (Article 132)*. Association for Information Systems.
- Nurhas, I., Geisler, S., & Pawlowski, J. (2021). Developing a competency framework for intergenerational startup innovation in a digital collaboration setting. In Proceedings of the 13th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management (Vol. 2021, pp. 110–118). SCITEPRESS. <https://doi.org/10.5220/0010652100003064>
- BLINDED FOR REVIEW**
- de Quadros Carvalho, R., dos Santos, G. V., de Neto, B., & Clementino, M. (2013). R&D+ i strategic management in a public company in the Brazilian electric sector. *Journal of Technology Management & Innovation*, 8(2), 235–250.
- Ojala, A. (2016). Business models and opportunity creation: How IT entrepreneurs create and develop business models under uncertainty. *Information Systems Journal*, 26(5), 451–476.
- Østergaard, C. R., Timmermans, B., & Kristinsson, K. (2011). Does a different view create something new? The effect of employee diversity on innovation. *Research Policy*, 40(3), 500–509.
- Panadero, E., & Romero, M. (2014). To rubric or not to rubric? The effects of self-assessment on self-regulation, performance and self-efficacy. *Assessment in Education: Principles, Policy & Practice*, 21(2), 133–148.
- Paul, J., & Rosado-Serrano, A. (2019). Gradual internationalization vs born-global/international new venture models. *International Marketing Review*, 36, 830–858.
- Pawlowski, J. M. (2013). Towards born-global innovation: The role of knowledge management and social software. In *European conference on knowledge management* (pp. 527–534). Academic Conferences International.
- Pawlowski, J. M., & Holtkamp, P. (2012). Towards an internationalization of the information systems curriculum. In D. C. Mattfeld, & S. Robra-Bissantz (Eds.), *Multikonferenz Wirtschaftsinformatik* (pp. 437–449). GITO Verlag.
- Perez-Encinas, A., Pablo, I. d., Bueno, Y., & Santos, B. (2021). Intergenerational entrepreneurship to Foster sustainable development: A methodological training proposal. *Sustainability*, 13(17), 9654.
- Pilková, A., Holienka, M., & Mikuš, J. (2022). Drivers of SME digital transformation in the context of intergenerational cooperation in Slovakia. In *Handbook of research on smart Management for Digital Transformation* (pp. 357–381). IGI Global.
- Pilotte, M., & Evangelou, D. (2012). Building bridges—identifying generational communication characteristics to facilitate engineering collaboration and knowledge transfer across field-practicing engineers. *Engineering Studies*, 4(1), 79–99.
- Pirkkalainen, H., & Pawlowski, J. M. (2014). Global social knowledge management—understanding barriers for global workers utilizing social software. *Computers in Human Behavior*, 30, 637–647.
- Popovic, V. (2003). General strategic knowledge models connections and expertise development in product design. *Expertise in Design: Design Thinking Research Symposium*, 6.
- Qian, Q. K., Ho, W. K. O., Ochoa, J. J., & Chan, E. H. W. (2019). Does aging-friendly enhance sustainability? Evidence from Hong Kong. *Sustainable Development*, 27(4), 657–668.
- Quinones, G., Heeks, R., & Nicholson, B. (2021). Embeddedness of digital start-ups in development contexts: Field experience from Latin America. *Information Technology for Development*, 27(2), 171–190.
- Ramdani, B., Raja, S., & Kayumova, M. (2022). Digital innovation in SMEs: A systematic review, synthesis and research agenda. *Information Technology for Development*, 28(1) 56–80.
- Rasmussen, E., Mosey, S., & Wright, M. (2011). The evolution of entrepreneurial competencies: A longitudinal study of university spin-off venture emergence. *Journal of Management Studies*, 48(6), 1314–1345.
- Rasmussen, E., Mosey, S., & Wright, M. (2014). The influence of university departments on the evolution of entrepreneurial competencies in spin-off ventures. *Research Policy*, 43(1), 92–106.
- Rasmussen, E. S., & Tanev, S. (2015). The emergence of the lean global startup as a new type of firm. *Technology Innovation Management Review*, 5(11), 12–19.
- Reid, S. E., & Brentani, U. d. (2015). Building a measurement model for market visioning competence and its proposed antecedents: Organizational encouragement of divergent thinking, divergent thinking attitudes, and ideational behavior. *Journal of Product Innovation Management*, 32(2), 243–262.
- Reid, S. E., Brentani, U. d., & Kleinschmidt, E. J. (2014). Divergent thinking and market visioning competence: An early front-end radical innovation success typology. *Industrial Marketing Management*, 43(8), 1351–1361.
- Saa-Perez, P. D., & Garcia-Falcon, J. M. (2002). A resource-based view of human resource management and organizational capabilities development. *International Journal of Human Resource Management*, 13(1), 123–140.
- Sabri, S. M., Haron, H., Jamil, N., & Ibrahim, E. N. M. (2016). Intergenerational knowledge transfer strategy framework for family firm. In *Regional Conference on Science, Technology and Social Sciences (RCSTSS 2014)* (pp. 957–969). Springer.
- Sahay, S. (2004). Beyond utopian and nostalgic views of information technology and education: Implications for research and practice. *Journal of the Association for Information Systems*, 5(7), 1.
- Samei, H., & Feyzbakhsh, A. (2015). Predecessors competency framework for nurturing successors in family firms. *International Journal of Entrepreneurial Behavior & Research*, 21, 731–752.
- Sánchez, J. C. (2013). The impact of an entrepreneurship education program on entrepreneurial competencies and intention. *Journal of Small Business Management*, 51(3), 447–465.
- Santoro, G., Thrassou, A., Bresciani, S., & Del Giudice, M. (2019). Do knowledge management and dynamic capabilities affect ambidextrous entrepreneurial intensity and firms' performance? *IEEE Transactions on Engineering Management*, 68(2), 378–386.

- Sarker, S., & Sahay, S. (2003). Understanding virtual team development: An interpretive study. *Journal of the Association for Information Systems*, 4(1), 1–38.
- Shi, H. X., Graves, C., & Barbera, F. (2019). Intergenerational succession and internationalisation strategy of family SMEs: Evidence from China. *Long Range Planning*, 52(4), 101838.
- Tanev, S. (2012). Global from the start: The characteristics of born-global firms in the technology sector. *Technology Innovation Management Review*, 2(3), 5–8.
- Underdahl, L., Isele, E., Leach, R. G., Knight, M., & Heuss, R. (2018). Catalyzing cross-generational entrepreneurship to Foster economic growth, employ youth, and optimize retiree experience. In *ICIE 2018 6th international conference on innovation and entrepreneurship: ICIE 2018* (p. 434). Academic Conferences and Publishing.
- van der Westhuizen, T., & Goyayi, M. J. (2020). The influence of technology on entrepreneurial self-efficacy development for online business start-up in developing nations. *The International Journal of Entrepreneurship and Innovation*, 21(3), 168–177.
- van Gelderen, M., Wiklund, J., & McMullen, J. S. (2021). Entrepreneurship in the future: A Delphi study of ETP and JBV editorial board members. *Entrepreneurship Theory and Practice*, 45(5), 1239–1275.
- van Kleef, J. A. G., & Roome, N. J. (2007). Developing capabilities and competence for sustainable business management as innovation: A research agenda. *Journal of Cleaner Production*, 15(1), 38–51.
- Várhegyi, V., & Nann, S. (2011). *Framework model for intercultural competences*. European Commission.
- Vuorikari, R., Punie, Y., Gomez, S. C., & van den Brande, G. (2016). *DigComp 2.0: The digital competence framework for citizens. Update phase 1: The conceptual reference model*. Joint Research Centre.
- Wamuyu, P. K. (2015). The impact of information and communication technology adoption and diffusion on technology entrepreneurship in developing countries: The case of Kenya. *Information Technology for Development*, 21(2), 253–280.
- Watts, F., Le Aznar-Mas, Penttilä, T., Kairisto-Mertanen, L., Stange, C., & Helker, H. (Eds.) (2013). Innovation competency development and assessment in higher education. In *Proceedings of the 7th International Technology, Education, and Development Conference* (pp. 6033–6041). IATED.
- Wei, K.-K., Teo, H.-H., Chan, H. C., & Tan, B. C. Y. (2011). Conceptualizing and testing a social cognitive model of the digital divide. *Information Systems Research*, 22(1), 170–187.
- Wiklund, J., Nikolaev, B., Shir, N., Foo, M.-D., & Bradley, S. (2019). Entrepreneurship and well-being: Past, present, and future. *Journal of Business Venturing*, 34(4), 579–588.
- Won, D., Hwang, B.-G., & Chng, S. J. (2021). Assessing the effects of workforce diversity on project productivity performance for sustainable workplace in the construction industry. *Sustainable Development*, 29(2), 398–418.
- Wu, W. W. (2009). A competency-based model for the success of an entrepreneurial start-up. *WSEAS Transactions on Business and Economics*, 6(6), 279–291.
- Xu, Q., Chen, J., Xie, Z., Liu, J., Zheng, G., & Wang, Y. (2007). Total innovation management: A novel paradigm of innovation management in the 21st century. *The Journal of Technology Transfer*, 32(1–2), 9–25.
- Yin, B., & Luo, J. (2018). How do accelerators select startups? Shifting decision criteria across stages. *IEEE Transactions on Engineering Management*, 65(4), 574–589.
- Zakaria, N., Amelinckx, A., & Wilemon, D. (2004). Working together apart? Building a knowledge-sharing culture for global virtual teams. *Creativity and Innovation Management*, 13(1), 15–29.
- Zimmermann, A., Raab, K., & Zanotelli, L. (2013). Vicious and virtuous circles of offshoring attitudes and relational behaviours. A configurational study of German IT developers. *Information Systems Journal*, 23(1), 65–88.
- Zimmermann, A., & Ravishankar, M. N. (2014). Knowledge transfer in IT offshoring relationships: The roles of social capital, efficacy and outcome expectations. *Information Systems Journal*, 24(2), 167–202.

How to cite this article: Nurhas, I., Geisler, S., & Pawlowski, J. (2022). An intergenerational competency framework: Competencies for knowledge sustainability and start-up development in the digital age. *Sustainable Development*, 30(6), 1733–1748. <https://doi.org/10.1002/sd.2338>