

Annexure 1: Literature review categorising ECs in the four EC categories

Cognitive competencies		Meta competencies	
Competencies	Authors	Competencies	Authors
Synthesis and transfer of knowledge	(Cheetham & Chivers, 1996); (Boyatzis, 2006)	Communication	(Cheetham & Chivers, 1996)
Conceptualisation	(Cheetham & Chivers, 1996)	Self-development	(Cheetham & Chivers, 1996)
Theory application	(Cheetham & Chivers, 1996)	Creativity	(Cheetham & Chivers, 1996)
Taking calculated risks	(Nassif et al., 2010)	Analysis	(Bharwani and Talib, 2017)
Establishing partnerships	(Nassif et al., 2010)	Problem-solving	(Bharwani and Talib, 2017)
Defining goals	(Nassif et al., 2010)	Comprehensive knowledge	(Sopegina et al., 2016)
Planning skills (know-how)	(Nassif et al., 2010) (Bharwani and Talib, 2017)	Free and critical thinking	(Sopegina et al., 2016)
Knowing the business, market and products	(Nassif et al., 2010)	Personal approach readiness	(Sopegina et al., 2016)
Knowing one's limits	(Nassif et al., 2010)	Professional and personal development strategy	(Sopegina et al., 2016)
Eloquence	(Nassif et al., 2010)	Self-actualisation capacity	(Sopegina et al., 2016)
Communication skills	(Nassif et al., 2010)		
Analytical skills and critical thinking	(Ryan et al., 2009) (Bharwani and Talib, 2017)		
Conceptual thinking	(Ryan et al., 2009)		
Expertise	(Ryan et al., 2009)		
Attentive behaviour	(Ye et al., 2016)		

Verbal and non-verbal intellectual ability	(Ye et al., 2016)		
Working memory	(Ye et al., 2016)		
Pattern recognition / Associational thinking	(Dyer et al., 2008); (Boyatzis, 2006); (Bonesso et al., 2018)		
Lateral thinking / Creative problem-solving	(Bonesso et al., 2018)		
Systems thinking	(Bonesso et al., 2018); (Boyatzis, 2006) (Bharwani and Talib, 2017)		
Strategic thinking	(Bharwani and Talib, 2017)		
Decision-making	(Bharwani and Talib, 2017)		
Creativity and innovation	(Bharwani and Talib, 2017) (Boyles, 2012)		
Information gathering	(Bharwani and Talib, 2017)		
Risk-taking	(Bharwani and Talib, 2017)		
Change management	(Bharwani and Talib, 2017)		
Logical reasoning	(Boyles, 2012)		
Complex problem-solving	(Boyles, 2012)		
Literacy	(Boyles, 2012)		
Divergent thinking	(Boyles, 2012)		
Inventive thinking	(Boyles, 2012)		
Opportunity recognition	(Boyles, 2012)		
Alertness	(Boyles, 2012)		
Ability to apply systematic search	(Boyles, 2012)		


Functional competencies		Social competencies	
Competencies	Authors	Competencies	Authors
Planning	(Cheetham & Chivers, 1996) (Botha et al., 2015)	Self-confidence	(Cheetham & Chivers, 1996)
Monitoring	(Cheetham & Chivers, 1996)	Thinking on feet	(Cheetham & Chivers, 1996)
Implementing	(Cheetham & Chivers, 1996)	Calmness	(Cheetham & Chivers, 1996)
Delegating	(Cheetham & Chivers, 1996)	Task-centeredness	(Cheetham & Chivers, 1996)
Evaluating	(Cheetham & Chivers, 1996)	Stamina	(Cheetham & Chivers, 1996)
Literacy & numeracy	(Cheetham & Chivers, 1996) (Botha et al., 2015)	Presentation	(Cheetham & Chivers, 1996)
IT literacy	(Cheetham & Chivers, 1996) (Bharwani and Talib, 2017)	Intra-professional skills	(Cheetham & Chivers, 1996)
Diagnosis	(Cheetham & Chivers, 1996)	Empathy	(Bonesso et al., 2018)
Evaluating	(Cheetham & Chivers, 1996)	Organisational awareness	(Bonesso et al., 2018)
Manual dexterity	(Cheetham & Chivers, 1996)	Service orientation	(Bonesso et al., 2018)
Marketing management	(Botha et al., 2015) (Schneider, 2017)	Conflict management	(Bonesso et al., 2018) (Bharwani and Talib, 2017)
Financial management	(Botha et al., 2015) (Bharwani and Talib, 2017) (Schneider, 2017)	Coaching and mentoring	(Bonesso et al., 2018)
Operational	(Botha et al., 2015)	Influence	(Bonesso et al., 2018) (Veliu & Manxhari: 2017)

Legal skills	(Botha et al., 2015) (Bharwani and Talib, 2017)	Inspirational leadership	(Bonesso et al., 2018)
General management	(Botha et al., 2015a)	Teamwork	(Bonesso et al., 2018) (Bharwani and Talib, 2017) (Amini et al., 2018) (do Carmo et al., 2019)
ICT skills	(Botha et al., 2015)	Being a change catalyst	(Bonesso et al., 2018)
Human resources management	(Botha et al., 2015) (Bharwani and Talib, 2017)	Effective communication	(Bharwani and Talib, 2017)
Networking	(Botha et al., 2015)	Cultural intelligence	(Bharwani and Talib, 2017) (do Carmo et al., 2019) (Velu & Manxhari: 2017)
Research and development	(Botha et al., 2015)	Networking	(Bharwani and Talib, 2017) (Amini et al., 2018)
Business systems management	(Botha et al., 2015)	Diversity management skills	(Bharwani and Talib, 2017)
Value chain management	(Botha et al., 2015)	Fostering motivation	(Bharwani and Talib, 2017)
Technical skills	(Botha et al., 2015)	Active listening skills	(Bharwani and Talib, 2017)
Communication	(Botha et al., 2015)	Developing others	(Bharwani and Talib, 2017)
Service orientation	(Bharwani and Talib, 2017)	Leadership	(Amini et al., 2018) (do Carmo et al., 2019)
Business and industry expertise	(Bharwani and Talib, 2017)	Problem solving	(Boyles, 2012)
Commitment to quality	(Bharwani and Talib, 2017)	Innovation	(Boyles, 2012)
Resource allocation skills	(Bharwani and Talib, 2017)	Emotional intelligence	(Boyles, 2012)
Crisis management skills	(Bharwani and Talib, 2017)	Interpersonal abilities	(do Carmo et al., 2019)

Ability to manage stakeholders	(Bharwani and Talib, 2017)	Communication	(do Carmo et al., 2019) (Velu & Manxhari: 2017)
Sales strategy	(Schneider, 2017)	Ability to work in international contexts and global awareness	(do Carmo et al., 2019)
		Acquiring of ethical commitments	(do Carmo et al., 2019)
		Effective relations	(Velu & Manxhari, 2017)
		Orientation to customer	(Velu & Manxhari, 2017)
		Goal-setting	(Velu & Manxhari: 2017)
		Delegation of authority	(Velu & Manxhari: 2017)
		Change management	(Velu & Manxhari: 2017)
		Performance management fairness	(Velu & Manxhari: 2017)
		Responsibility	(Velu & Manxhari: 2017)
		Flexibility	(Velu & Manxhari: 2017)
		Development skills	(Velu & Manxhari: 2017)

Source: Own compilation

Annexure 2: Conceptual and operational definitions and categories of entrepreneurial competencies for the 4IR

ENTREPRENEURIAL COMPETENCIES						
THEORY LEVEL 						RESEARCH LEVEL
“Great Eight” Competencies	20 Dimensions General Conceptual Definitions (SHL Competency Framework)		Conceptual Components (Constructs)	Conceptual Definitions	Operational Definitions	Observation Level
LEADING AND DECIDING Takes control and exercises leadership. Initiates action, gives direction and takes responsibility.	Deciding and initiating action Takes responsibility for actions, projects and people; takes initiative and works under own direction; initiates and generates activity and introduces changes into work processes; makes quick, clear decisions which may include tough choices or considered risks. Leading and supervising Provides others with a clear direction; motivates and empowers others; recruits staff of a high calibre; provides staff with development opportunities and coaching; sets appropriate standards of behaviour.	Q11 - 14 Q15 - 18 Q19 - 22	Decision-making capability	Considering the relative costs and benefits of potential actions to choose the most appropriate one (Gray, 2016).	I take initiative and work under my own direction. I like to take charge of situations. I make quick, clear decisions, which may include tough choices or considered risks. I initiate and generate activity and introduce changes into work processes.	Response to questionnaire COGNITIVE COGNITIVE SOCIAL
			Proactiveness	Proactive behavior involves acting in advance of a future situation, rather than just reacting. It means taking control and making things happen rather than just adjusting to a situation or waiting for something to happen.	When I have a problem, I tackle it head-on. Nothing is more exciting than seeing my ideas turn into reality. I am always looking for better ways to do things in my business. If I believe in an idea, no obstacle will prevent me from making it happen.	
			Leadership skills	Minimizes politics in the workplace; Expects excellence from all employees; Demonstrates good people skills; Shares information with employee; Is a good coach or mentor (Dixon et al., 2005).	It is extremely unlikely that I feel uncomfortable leading a group. I often use persuasion to motivate others. I often seek to understand what motivates others. It is very likely that I trust, and thus empower, others.	
INTERACTING AND PRESENTING Communicates and networks effectively. Successfully persuades and influences others. Relates to others in a confident and relaxed manner.	Relating and Networking Easily establishes good relationships with customers and staff; relates well to people at all levels; builds wide and effective networks of contacts; uses humour appropriately to bring warmth to relationships with others.	Q23 - 26	Networking ability	Uses deliberate strategies to influence or persuade others; uses key people as agents to accomplish objectives; acts to develop and maintain business contracts (Santandreu-Masarell et al., 2013).	I often participate in social gatherings with people that I work with. I often attend social functions for purposes of building professional relationships. I often participate in community projects. I serve on a community board, committee or task force.	

ANALYZING AND INTERPRETING	Analyzing	Q27 - 42	Cognitive ability	The ability to generate or use different sets of rules for combining or grouping things in different ways (Gray, 2016).	I am good at organizing information. I am good at remembering information. I try to use strategies for my business that have worked in the past. I find myself using helpful learning strategies automatically. I use different learning strategies (plans of action) depending on the situation. I know when each strategy I use will be most effective. I take into consideration what I really need to learn before I begin a task. I think of several ways to solve a problem and choose the best one. I consciously focus my attention on important information. I draw pictures or diagrams to help me understand while learning. I ask myself periodically if I am meeting my goals. I ask myself if I considered all options when solving a problem. I change strategies when I fail to understand a task or problem at hand. I stop and go back over new information that is not clear. I ask myself if there was an easier way to do things after I finish a task. I ask myself how well I accomplished my goals once I'm finished.	Response to questionnaire META
Shows evidence of clear analytical thinking. Gets to the heart of complex problems and issues. Applies own expertise effectively. Quickly learns new technology. Communicates well in writing.	Analyses numerical data and all other sources of information, to break them into component parts, patterns and relationships; probes for further information or greater understanding of a problem; makes rational judgments from the available information and analysis; demonstrates an understanding of how one issue may be a part of a much larger system.	Q43 - 46	Problem solving	Demonstrates good analysis skills; Has the ability to prioritize problems; Can prioritize problems; Has good critical thinking skills; A problem solver (Dixon et al., 2005).	I have good analysis skills. I have the ability to prioritize problems. I have good critical thinking skills (Critical thinking is the objective analysis and evaluation of an issue in order to form a judgement) I use information to make decisions.	META

CREATING AND CONCEPTUALIZING						
<p>Open to new ideas and experiences. Seeks out learning opportunities. Handles situations and problems with innovation and creativity. Thinks broadly and strategically. Supports and drives organizational change.</p>	<p>Creating and Innovating Produces new ideas, approaches, or insights; creates innovative products or designs; produces a range of solutions to problems.</p>	<p>Q47 - 51</p>	<p>Creative Problem Solving and Imaginativeness</p>	<p>The ability to relate previously unrelated variables or objects to produce novel and appropriate or useful outcomes (Morris et al., 2013).</p>	<p>I am creative when asked to work with limited resources. I think outside the box. I identify opportunities for new services/products. Freedom to be creative is extremely important to me. Originality is very important to me.</p>	<p>Response to questionnaire</p> <p>COGNITIVE</p> <p>COGNITIVE</p> <p>FUNCTIONAL</p>
	<p>Q52 - 55</p>	<p>Innovating/ Innovation</p>	<p>Innovating: make changes in something established, especially by introducing new methods, ideas, or products. Innovation: Introduction, establishment, institution, commencement, novelty, departure from the old, introduction of new and improved methods and things, modernization, drastic change, breaking of a precedent (Antonites, 2017).</p>	<p>I generate new innovations that differ from competitors' offering. I improve existing products and services. I exploit (use/utilize) innovations developed by others. I successfully implement creative ideas within my business.</p>		
	<p>Q56 - 60</p>	<p>Value creation</p>	<p>Capable of developing new products, services, and/or business models that generate revenues exceeding their costs and produce sufficient user benefits to have a fair return (Morris et al., 2013).</p>	<p>I am constantly asking questions to understand why products and projects underperform. New business ideas often come to me when directly observing how people interact with products and services. I have a continuous flow of new business ideas that come through observing the world. I love to experiment to understand how things work. I love to create new ways of doing things.</p>		

<p>ADAPTING AND COPING</p> <p>Adapts and responds well to change. Manages pressure effectively and copes with setbacks.</p>	<p>Adapting and Responding to Change</p> <p>Adapts to changing circumstances; tolerates ambiguity; accepts new ideas and change initiatives; adapts interpersonal style to suit different people or situations; shows an interest in new experiences.</p>	<p>Q61 - 64</p>	<p>Resilience</p>	<p>The ability to cope with disturbances and stresses in such a way that one remains well, recovers, or even thrives in the face of adversity (Morris et al., 2013).</p>	<p>I believe that I can grow in positive ways by dealing with difficult situations. I only set goals which I know I can reach without the help of others. I actively look for ways to replace the losses I encounter in life. I look for creative ways to alter difficult situations.</p>	
<p>ENTERPRISING AND PERFORMING</p> <p>Focuses on results and achieving personal work objectives. Works best when work is related closely to results and the impact of personal efforts is obvious. Shows an understanding of business, commerce and finance. Seeks opportunities for self-development and career advancement.</p>	<p>Achieving Personal Work Goals and Objectives</p> <p>Accepts and tackles demanding goals with enthusiasm; works hard and puts in longer hours when necessary; seeks progression to roles of increased responsibility and influence; identifies own development needs and makes use of developmental or training opportunities.</p> <p>Entrepreneurial and Commercial Thinking</p> <p>Keeps up to date with competitor information and market trends; identifies business opportunities for the organization; maintains awareness of developments in the organizational structure and politics; demonstrates financial awareness; controls costs and thinks in terms of profit, loss and added value.</p>	<p>Q65 - 68</p>	<p>Positive attitude</p>	<p>An attitude is defined as "a mental position with regard to a fact or state; a feeling or emotion toward a fact or state." The dictionary goes on to state that the word "positive" can be used as "having a good effect; favourable; marked by optimism."</p>	<p>Being an entrepreneur implies more advantages than disadvantages for me. Being an entrepreneur provides great satisfaction for me. Among various employment options, I would rather be an entrepreneur.</p>	<p>SOCIAL</p>
		<p>Q69 - 72</p>	<p>Opportunity recognition</p>	<p>The capacity to perceive changed conditions or overlooked possibilities in the environment that represent potential profit or return to a venture (Morris et al., 2013).</p>	<p>I am an avid information seeker. I often make novel connections and perceive new or emergent relationships between various pieces of information. I often see connections between previously unconnected domains of information. I am good at "connecting dots".</p>	<p>COGNITIVE</p>

Response to questionnaire

Source: Own compilation

Annexure 3: Summary of the articles and proportion of sources used

	Authors	Title	Published	Publisher	Country	Source
1	(Chandler and Jansen, 1992)	The founder's self-assessed competence and venture performance	Journal of Business Venturing	Elsevier	United States	Journal Article
2	(Cheetham & Chivers, 1996)	Towards a holistic model of professional competence	Journal of European Industrial Training	Emerald	United Kingdom	Journal Article
3	(Man et al., 2002)	The competitiveness of small and medium enterprises: A conceptualization with focus on entrepreneurial competencies	Journal of Business Venturing	Elsevier	China	Journal Article
4	(Le Deist & Winterton, 2005)	What is competence?	Human Resource Development International	Routledge	France	Journal Article
5	(Hisrich, Peters & Shepherd, 2005)	Entrepreneurship	Book	McGraw-Hill/Irwin	New York	Book
6	(Dixon et al., 2005)	The critical entrepreneurial competencies required by instructors from institution-based enterprises: A Jamaican study	Journal of Industrial Teacher Education	Unknown	Jamaica	Journal Article
7	(Winterton et al., 2006)	Typology of knowledge, skills and competences: clarification of the concept and prototype	Book		Office for Official Publications of the European Communities Luxembourg	Book
8	(Man et al., 2008)	Entrepreneurial competencies and the performance of small and medium	Journal of Small Business &	Routledge	Hong Kong	Journal Article

		enterprises: An investigation through a framework of competitiveness	Entrepreneurs hip			
9	(Hussler & Ronde, 2009)	Investing in networking competences or establishing in hot spots?: The innovation dilemma	Journal of Technology Management & Innovation	Unknown	France	Journal Article
10	(Hazlina Ahmad et al., 2010)	Is entrepreneurial competency and business success relationship contingent upon business environment? A study of Malaysian SMEs	International Journal of Entrepreneurial Behavior & Research	Emerald	Malaysian	Journal Article
11	(Nassif et al., 2010)	Understanding the entrepreneurial process: a dynamic approach	BAR-Brazilian Administration Review	Unknown	Brazil	Review
12	(Boyles, 2012)	21st century knowledge, skills, and abilities and entrepreneurial competencies: A model for undergraduate entrepreneurship education	Journal of Entrepreneurship Education	Unknown		Journal Article
13	(Santandreu-Mascarell et al., 2013)	Entrepreneurial and innovative competences, are they the same?	Management Decision	Emerald	USA	Journal Article
14	(Morris et al., 2013)	A competency-based perspective on entrepreneurship education: conceptual and empirical insights	Journal of Small Business Management		USA	Journal Article
15	(Racela, 2014)	Customer orientation, innovation competencies, and firm performance: A proposed conceptual mode	Procedia-Social and Behavioral Sciences	Elsevier	Thailand	Journal Article

16	(Botha et al., 2015)	An integrated entrepreneurial performance model focusing on the importance and proficiency of competencies for start-up and established SMEs	South African Journal of Business Management	OASIS	South Africa	Journal Article
17	(Matthews and Brueggemann, 2015)	Innovation and entrepreneurship: A competency framework	Book	Routledge		Book
18	(Robles and Zárraga-Rodríguez, 2015)	Key competencies for entrepreneurship	Procedia economics and finance	Elsevier	Prague, Czech Republic	Journal Article
19	(Alipour and Taleghani, 2016)	The relationship between entrepreneurial skills of managers and organisational effectiveness in small and medium enterprises – case study: representatives of Iran Khodro in Mazandaran Province	Journal of Administrative Management, Education and Training		Iran	Journal Article
20	(Gray, 2016)	Ten work skills for the postnormal era	World Economic Forum web page article		United Kingdom	Web Page
21	(Erol et al., 2016)	Tangible Industry 4.0: a scenario-based approach to learning for the future of production	Procedia CIRP	Elsevier	Austria	Journal Article
22	(Boyd, 2017)	Ten work skills for the post-normal era	Web article			Web article
23	(Prifti et al., 2017)	A competency model for "Industrie 4.0" employees	13th International Conference on Wirtschaftsinformatik	Unknown	Switzerland	Conference paper
24	(Grzybowska and Łupicka, 2017)	Key competencies for Industry 4.0	Economics & Management	Volkson Press	Poland	Journal Article

Source: Own compilation