

Core entrepreneurial competencies and their interdependencies: insights from a study of Irish and Iranian entrepreneurs, university students and academics

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Abstract The purpose of this paper is to advance our understanding of core entrepreneurial competencies and their interdependencies. Developing entrepreneurial competencies is increasingly seen as important to foster entrepreneurship. Studies to date have highlighted different entrepreneurial competencies in the context of different sectors, regions and countries. However, there has been a lack of consensus in relation to the perceived relative importance of core entrepreneurial competences and their interdependencies among students, academic and entrepreneurs. Our paper focuses on two key questions: *first*, what are the core entrepreneurial competencies that need to be developed in educational contexts? *Second*, what are the interdependencies between these entrepreneurial competencies that need to be developed in educational contexts? Using a collective intelligence methodology a comparative study of Iran and Ireland was undertaken that involved three stakeholder groups of students, academics and entrepreneurs. This methodology was used to identify, rank, and structure entrepreneurial competencies considered important for university students. The results of the study indicated that productive thinking, motivation, interpersonal skills and leadership are core entrepreneurial competences that need to be developed in educational contexts.

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Findings also highlight critical interdependencies between entrepreneurial competencies and the relative influence of different competencies across groups and regions. We outline the implications of our findings for designing a curriculum for improving students' entrepreneurial competencies.

Keyword Entrepreneurial competencies · Entrepreneurship · Interactive management (IM) · Cross-cultural

Introduction

Entrepreneurs play an important role in pioneering economic development (Li et al. 2006), in new venture creation (Baron 2007), in the life of society (Seelos and Mair 2005; Hannafey 2003), in the creation and development of new innovations (Lee et al. 2012; Windrum 2008), and in developing and commercializing new technologies (Kropp and Zolin 2005). Thus, it is important to know more about how some people come to display entrepreneurial intentions and behaviour, while in the same context, others do not. Comparative entrepreneurship research shows variations across countries in levels of entrepreneurship and new venture formations (GEM 2013). In major economies at a policy level there has been an increased focus on developing entrepreneurial skills and experiences among students at all levels, with a particular focus on third level institutions (Lambert 2003). The response of third level institutions to addressing this demand is varied and includes provision of teaching programmes and modules, creation of campus incubators, entrepreneurial societies, business plan competitions, and lean start-up programmes (Guerrero et al. 2014; Gately and Cunningham 2014a).

Within the entrepreneurship literature the importance of entrepreneurial competencies has been viewed from two perspectives. The first perspective views competencies as essential factors for a successful start-up. Wong et al. (2005) suggest that the success of a start-up depends on key competencies (e.g. risk-taking propensity and need for achievement) of the entrepreneur as founder. The second perspective views competencies as prerequisites for sustaining business success (Bird 1995). Kellermanns et al. (2008) suggest that specific entrepreneurial competencies (e.g., opportunity identification and networking skills) help firms to adapt and respond to environmental changes, such as consumer preferences, competitor actions, and technological developments. Moreover, Filatotchev et al. (2005) reports that founder characteristics can have a direct impact on the firm's development and success in the long-run.

Previous studies on entrepreneurial competencies have not explored interdependencies among competencies or their relative influence. This is important to understand as different entrepreneurial competencies may co-function as part of a system of affordances that support and maintain entrepreneurial behaviours. Reviewing eighty nine published studies in the area of entrepreneurial competencies, Mitchelmore and Rowley (2010) concluded that while it is often acknowledged that there are interrelationships between competencies, these interrelationships are generally ignored in studies investigating entrepreneurial competencies. They suggest that further research is needed to understand the relationship between different entrepreneurial competencies. A variety of previous studies have used structural equation modelling to evaluate the direct and indirect effect of entrepreneurial competencies on entrepreneurial

intentions and behaviours and related outcomes, such as problem identification for different types of new venture (Gartner 1984), growth of personal entrepreneurial resources and business idea generation (Obschonka et al. 2010), business creation (Rauch and Frese 2007), internationalisation (Ruzzier et al. 2007), organisational performance (Garcia-Morales et al. 2007), entrepreneurial performance (Luthans and Ibrayeva 2006), and venture growth (Baum and Locke 2004). Despite the significant attention paid to the interrelationships between entrepreneurial competencies, entrepreneurial behaviours and related outcomes, we found no study that directly examines interdependencies between entrepreneurial competencies. Our paper addresses this gap in the literature by examining interdependencies between core entrepreneurial competencies that need to be developed in educational contexts.

In previous studies that have sought to identify core entrepreneurial competencies widespread stakeholder involvement has been limited and there has been no effort in these studies to rank order the relative importance of entrepreneurial competencies (see Rezaei-Zadeh et al. 2014, 2011, and Rezaei-Zadeh 2014 for a review). Importantly, stakeholders and users of the concept of entrepreneurial competency are important in shaping the meaning associated with the entrepreneurial competency concept (Mitchelmore and Rowley 2010). A small number of previous studies have worked with different stakeholder groups, such as academics and practitioners (Hayton and McEvoy 2006), as well as educators and politicians (Burgoyne 1993). Obtaining stakeholder input in the definition of core entrepreneurial competencies is important as it helps to address the needs, expectations (Rezaei-Zadeh et al. 2013) and perspectives of those stakeholders, without which educational programmes for enhancing entrepreneurial competencies are likely to be ineffective (Béchar and Grégoire 2005). Moreover, Czuchry et al. (2004) and Hynes and Richardson (2007) highlighted the tangible benefit of strategic cooperation between internal and external stakeholder groups, for example, between entrepreneurship teaching staff and external business representatives including entrepreneurs and business owners/managers. Set against this context our study sought to firstly identify and rank core entrepreneurial competences that need to be developed in educational contexts. Our second focus was to investigate and structure interdependencies between entrepreneurial competences using a consensus-based approach with key stakeholder groups—students, academics, and entrepreneurs.

In this study, we make use of a qualitative collective intelligence method to develop a consensus-based understanding of core entrepreneurial competencies, their ranking and their interdependencies, specifically, from the perspective of stakeholders in both Iran and Ireland. In the “**Entrepreneurial competencies**” section of the paper we provide an overview of the literature on entrepreneurial competencies that provided part of the starting point for the application of collective intelligence, and which also helps to contextualise the findings of our collective intelligence analysis. In the “**Methodology**” section we elaborate on the collective intelligence method used in this study, Interactive Management (IM), and how we applied IM as a method of working with key stakeholder groups in both Ireland and Iran. In “**Findings**” we present our key findings in relation to important entrepreneurial competencies that need to be developed among university students and key structural interdependencies between entrepreneurial competencies described by our stakeholder groups. Finally, in the “**Discussion**” and “**Conclusions**” sections we discuss our findings, posit some implications of our findings for universities, researchers, and policy makers, and offer concluding remarks.

Entrepreneurial competencies

It has been argued that an important antecedent of firm performance includes the key competencies of the firm creator, which have been described as ‘entrepreneurial competencies’. As noted by Ghoshal (1997), Stuart and Lindsay (1997), Lau et al. (1999) and Sánchez (2011), entrepreneurial competencies have been understood in three broad ways, by reference to: (1) personal attributes/traits, that is, a distinguishing quality or feature regarded as a characteristic or inherent part of someone; (2) skills/abilities, that is, the ability and expertise to do something well; and (3) knowledge/experience, including, facts, information, and talent acquired through education; practical contact with and observation of facts/events; the theoretical or practical understanding of a subject.

A number of studies have attempted to define what entrepreneurial competencies are and evaluate the relationship between entrepreneurial competencies and business outcomes. Man et al. (2002) note that entrepreneurial competences can be considered high level characteristics representing the ability of the entrepreneur to perform a job successfully. Rasmussen et al. (2011) note the necessity for a competency focus to consider the ‘human aspects of the entrepreneurial process’. In defining entrepreneurial competencies different studies have developed frameworks that have highlighted the variety of entrepreneurial competences that are required for success in entrepreneurial settings. For example, in their study of entrepreneurial competencies of Dutch dairy farmers, Bergevoet and Woerkum (2006) categorise entrepreneurial competencies into five domains: opportunity, conceptual, strategy, organizing, and relationship competencies. Similarly, Man et al. (2002) identified six competency categories—opportunity, relationship, conceptual, organizing, strategic, and commitment competencies. Mitchelmore and Rowley (2010) posit an entrepreneurial competency framework that includes entrepreneurial, business management, human relations, and conceptual and relationship competencies. These entrepreneurial competencies do influence firm performance, with a variety of studies reporting significant positive relationships (see Baum et al. 2001; Chandler and Jansen 1992; Chandler and Hanks 1994; Man et al. 2002). Moreover, a limited range of studies focusing on antecedents of entrepreneurial competencies suggest that education, experience and family situation are important influencing factors (see Bird 1995 and Herron and Robinson 1993).

As noted, previous studies have examined the direct and indirect effects of entrepreneurial competencies on entrepreneurial intentions and behaviours and related outcomes, including problem identification for different types of new venture (Gartner 1984), growth of personal entrepreneurial resources and business idea generation (Obschonka et al. 2010), business creation (Rauch and Frese 2007), internationalisation (Ruzzier et al. 2007), organisational performance (Garcia-Morales et al. 2007), entrepreneurial performance (Luthans and Ibrayeva 2006), and venture growth (Baum and Locke 2004). Some of these outcomes as highlighted in recent studies are listed in Table 1, specifically, from a range of studies which focused on the impact of entrepreneurial competencies on outcomes.

Drawing upon findings of the previous empirical studies, Man et al. (2002) concluded that six major areas of entrepreneurial competencies including opportunity, relationship, conceptual, organizing, strategic, and commitment competencies are positively related to three principal entrepreneurial tasks in SMEs, namely (1) forming competitive

Table 1 A summary of some studies focused on the outcomes of entrepreneurial competencies

Author	Year	Method	Key finding(s)
Man et al.	2002	Reviewing the academic literature; measuring the impact of entrepreneurial competencies on constructs of SME competitiveness.	The opportunity, organising, strategic, commitment, relationship, and conceptual competencies of the entrepreneur are positively related to the competitive scope, organizational capabilities, and performance of an SME.
Man and Lau	2000	19 entrepreneurs from SMEs in the Hong Kong services sector; Semi-structured Interviews assessing the impact of entrepreneurial competencies on firms' performance	35 entrepreneurial competencies were identified and classified in six competency areas. They report how these competencies have a positive impact on SMEs' performance.
Rasmussen et al.	2011	Longitudinal multiple comparative case-study of four university spin-off processes in the UK and Norway in order to examine the impact of entrepreneurial competencies on creating new ventures within the non-commercial academic environment.	Three entrepreneurial competencies of opportunity refinement, leveraging, and championing appeared crucial for the university ventures to gain credibility.
Sánchez	2011	Using a pre-test-post-test quasi-experimental design, data were collected from 864 university students of Castilla & León (Spain), from 863 students (403 taking the programme and 460 in a control group).	The higher the self-efficacy, pro-activeness and risk taking with respect to self-employment, the stronger the students' intention to become self-employed.
Obschonka et al.	2010	In a cross-sectional sample of 496 German scientists, using structural equation modelling (SEM), they investigated a path model for the effects of entrepreneurial personality, control beliefs, and recalled early entrepreneurial competence in adolescence on entrepreneurial intentions.	Entrepreneurial personality and early entrepreneurial competence predicted entrepreneurial intentions. Furthermore, they revealed indirect effects via control beliefs.
Ahmad	2007	20 entrepreneurs from Australia and Malaysia were interviewed in the first phase and 250 entrepreneurs were surveyed in the second phase measuring entrepreneurial competencies and their impact on business success.	Entrepreneurial competencies were strong predictors of business success in SMEs for both Australia and Malaysia.

scope; (2) creating organizational capabilities; and (3) setting goals and taking actions towards achieving the goals. On the basis of their review, they suggested that developing

entrepreneurial competencies is more important than providing more resources and a positive environment for entrepreneurs.

In another study, Rasmussen and colleagues (2011) selected four university spin-offs in the UK and Norway and conducted a longitudinal multiple case study across two contrasting research disciplines: biological sciences and engineering. They found that three entrepreneurial competencies including opportunity refinement, leveraging, and championing are needed to successfully launch a university spin-off venture.

The impact of entrepreneurial competencies on adults' entrepreneurial intentions was the focus of another study conducted by Obschonka and colleagues (2010). Utilizing structural equation modelling in a cross-sectional sample of 496 German scientists, they examined the effects of a range of entrepreneurial competencies including entrepreneurial personality, control beliefs, and recalled early entrepreneurial competence in adolescence (early inventions, leadership, commercial activities) on entrepreneurial intentions. They found that both entrepreneurial personality and early entrepreneurial competence predicted entrepreneurial intentions both directly and also indirectly via control beliefs.

Prompted by repeated calls to develop a deeper understanding of the core competencies that facilitate people working as entrepreneurs (cf. Tajeddini and Mueller 2009), researchers are increasingly focused in their efforts to identify entrepreneurial competencies and develop entrepreneurial competency frameworks. However, there has been a lack of consensus in relation to identifying the most important competencies associated with entrepreneurship. A number of important entrepreneurial competencies previously identified include: rational decision making and management (Cantillion, circa 1700, Cited in Kilby 1971), risk-bearing (Mill 1848), innovation (Schumpeter 1934), need for achievement (McClelland 1961), leadership, responsibility, desire for independence and career achievement (Collins and Moore 1964), commercial, production and marketing experience (Gasse and d'Amboise 1997), opportunity refinement, leveraging, and championing (Rasmussen et al. 2011). As reported by Rezaei-Zadeh et al. (2014), using the constant comparative method in the context of a systematic literature review, we identified 82 entrepreneurial competencies from a review of 63 journal papers published in the area of entrepreneurship (see Table 2 for full listing of competencies). While the studies selected for inclusion in the review were conducted in a variety of different contexts and were driven by diverse research goals and hypotheses, the majority of papers shared a common focus on evaluating the quantitative impact of entrepreneurial competencies on entrepreneurial outcomes, while others described competencies and related entrepreneurial outcomes using qualitative analysis. Given the variety of competencies identified some may be more or less important as a focus of university students' entrepreneurial education, but none of the studies in the systematic literature review have provided any rank order of the importance of entrepreneurial competencies. Therefore, the current study sought to rank order the relative importance of entrepreneurial competencies.

Entrepreneurial competencies and interdependencies

In the context of a large-scale literature review of entrepreneurial competencies, Mitchelmore and Rowley (2010) noted that while it is often acknowledged that there are interdependencies between competencies, these interdependencies have not been a focus of any empirical investigation. They suggested that further work is needed to examine

Table 2 A comprehensive list of entrepreneurial competencies extracted from the literature (adapted from Rezaei-Zadeh et al. 2014)

	Entrepreneurial competency	Author		Entrepreneurial competency	Author
1	Accepting of responsibility	Kordnaeij et al. 2007	43	Long-term vision	Timmons 1979
2	Ability to motivate others	Izquierdo and Deschoolmeester 2010	44	Making a Total Commitment to Their Cause	Mitton 1989
3	Adaptability and flexibility	Tajeddini and Mueller 2009	45	Marketing and sales skills	Izquierdo and Deschoolmeester 2010
4	Analytical ability	Kumara and Sahasranam 2009	46	Multi-experience identity	Mendes and Kehoe 2009
5	Applied in orientation	Mendes and Kehoe 2009	47	Need for achievement	McClelland 1961; 1965
6	Approachability	Martin and Staines 1994	48	Need for autonomy	Schjoedt 2009
7	Assertiveness	Keogh 2006	49	Need for feedback	Schjoedt 2009
8	Belief in effect of personal effort on outcomes	Crandall and McGhee 1968	50	Need for power	Barkham 1994
9	Challenge ability	Sadeghi and Esteki 2010	51	Need for Total Control	Mitton 1989
10	Commercial experience	Murray 1996	52	Need for Variety	Hackman and Oldham 1976
11	Commercial understanding	Izquierdo and Deschoolmeester 2010	53	Negotiation	Keogh 2006
12	Communication skills	Izquierdo and Deschoolmeester 2010	54	Networking & Team-building	Kumara and Sahasranam 2009
13	Competitiveness	Man et al. 2002	55	Non-traditional	Mendes and Kehoe 2009
14	Conceptual skills	Hynes et al. 2009	56	Opportunity identification, grasping, evaluation	Mitton 1989
15	Concern for high quality of work	Izquierdo and Deschoolmeester 2010	57	Optimistic	Mendes and Kehoe 2009
16	Creativity	Martin 1982	58	Persistence	Schmitt-Rodermund 2004
17	Critical Thinking	San Tan and Ng 2006	59	Practical work experience	Hynes et al. 2009
18	Decision making ability	Cantillion, 1700 (Cited in Kilby 1971)	60	Previous contact with venture capitalists	Murray 1996
19	Desire to have high earning	Pistrui et al. 2001	61	Pro-activity	Leko-Šimić et al. 2007
20	Determination	Zali et al. 2007	62	Problem solving ability	Boojihawon et al. 2007

Table 2 (continued)

	Entrepreneurial competency	Author		Entrepreneurial competency	Author
21	Embracing	Mitton 1989	63	Production and marketing experience	Murray 1996
22	Engineering skills	Izquierdo and Deschoolmeester 2010	64	Responsiveness to local environmental conditions	Leko-Šimić et al. 2007
23	Estimation skills	Nekka and Fayolle 2010	65	Risk bearing	Mill 1848
24	Experiential learning	Mars and Hoskinson 2009	66	Risk taking	Brockhaus 1980
25	Finance management	Izquierdo and Deschoolmeester 2010	67	Seeing a Big Picture Perspective	Mitton 1989
26	Global vision	Boojihawon et al. 2007	68	Seeing the market from a different angle	Izquierdo and Deschoolmeester 2010
27	Goal-driven	Timmons 1979	69	Self-confidence	Martin and Staines 1994
28	Goal-setting skills	Boojihawon et al. 2007	70	Self-evaluation	Wong et al. 2005
29	Having a Utilitarian View of What's Right	Mitton 1989	71	Self-understanding	Hynes et al. 2009
30	High extraversion	Schmitt-Rodermund 2004	72	Social abilities	Gasse and d'Amboise 1997
31	High level of drive and energy	Thomas and Mueller 2000	73	Strategic thinking	Lans and Gulikers 2010
32	ICT proficient	Hynes et al. 2009	74	Stress and failure coping	Haglund 2004
33	Idea generation	Mitchelmore and Rowley 2010	75	Task motivation	Izquierdo and Deschoolmeester 2010
34	Implementation abilities	Green 2009	76	Time-management skills	Boojihawon et al. 2007
35	Independence	Badri et al. 2006	77	Tolerance for ambiguity	Mitton 1989
36	Information seeking ability	Gholipor et al. 2009	78	Using Contacts and Connections	Mitton 1989
37	Innovation	Schumpeter 1934	79	Venture and career evaluation	Izquierdo and Deschoolmeester 2010
38	Integrity	Izquierdo and Deschoolmeester 2010	80	Visionary	Sadeghi and Esteki 2010
39	Internal locus of control	Sapuan et al. 2009	81	Willing to have productive collaboration with others	Timmons 1979
40	Intuitive ability (sixth sense)	Sadler-Smith 2010	82	Willing to learn from failures	Timmons 1979

Table 2 (continued)

	Entrepreneurial competency	Author	Entrepreneurial competency	Author
41	Job involvement	Maleki et al. 2009		
42	Leadership / Management	Collins and Moore 1964		

interdependencies between different entrepreneurial competencies, specifically, but not exclusively, to facilitate deeper understanding of the broader entrepreneurial competencies concept. Also, while stakeholders of the concept of entrepreneurial competency have been important in shaping the meaning associated with the entrepreneurial competency concept (Mitchelmore and Rowley 2010), the full extent of stakeholders' involvement and their impact on identifying and highlighting entrepreneurial competencies remains unclear (Matlay 2009). As noted above, very few studies have worked directly with different stakeholder groups when developing their definition of entrepreneurial competencies. Entrepreneurial competencies and interdependencies between competencies may also be judged to differ across cultures. In the design of entrepreneurial training programmes it is important to work directly with stakeholders to understand these differences. Are entrepreneurial competencies universal or do they vary systematically across cultures? A major study in this area is the study conducted by McGrath et al. (1992). They compared 1217 entrepreneurs to 1206 non-entrepreneurs (career professionals) in eight countries and concluded that entrepreneurs are more like each other than non-entrepreneurs and they score consistently higher than non-entrepreneurs in power-distance, individualism, and masculinity, and lower in uncertainty avoidance. However, since most of the entrepreneurship research has been conducted in the US and Western Europe countries, with a few exceptions (e.g. Kiggundu et al. 1983), the generalisability of these research findings to developing countries is open to question (Thomas and Mueller 2000; Alder 1991). Thomas and Mueller (2000) highlighted the importance of conducting comparative entrepreneurship research in the context of different cultures including industrialised and developing countries. In an effort to fill this gap, the current study sought to examine similarities and differences in the nature, relative importance, and interdependencies between entrepreneurial competencies from the perspective of stakeholders in Iran and Ireland. In doing so, we used a collective intelligence (CI) methodology, Interactive Management (IM), which provided a systematic approach when working with Irish and Iranian stakeholders, thus supporting international theoretical saturation and generalisability of findings. Interactive Management is a methodology that has been successfully used in previous studies (Sato 1979; Feeg 1988; Keever 1989; Broome 1995a, b; Broome and Christakis 1988; Broome and Cromer 1991). In the current study, we used IM to 1) elucidate the way key internal and external stakeholder groups understand important entrepreneurial competencies, 2) develop novel consensus-based models describing the interdependencies between highly ranked entrepreneurial competencies, and 3) obtain a deeper understanding of the context of entrepreneurship in different countries. In the next section, we describe why the collective intelligence and applied systems science method adds value as a method of understanding entrepreneurial competencies.

Methodology

To address our research questions we used Interactive Management (IM) among stakeholder in Ireland and Iran.

Using interactive management in the university entrepreneurial curriculum design process

In business and educational settings, working groups often fail to solve complex problems because their method of collaborative problem solving is ineffective. Decades of research in social psychology and cognitive science highlight the many limitations of group problem solving, including the tendency to focus on a limited set of ideas, select ideas based on biased ‘rules of thumb’, and failure to build trust, consensus and collective vision. These problems pervade efforts to understand competency systems that might be the focus of curriculum design efforts in school and university settings. John Warfield (1925–2009), past president of the International Society for the Systems Sciences, devoted most of his career to the task of building a viable systems science that could inform consensus-building efforts, collective intelligence and collection action in variety of problematic situations. In his view, systems science is best seen as a science that consists of five nested sub-sciences, which can be presented most compactly using the notation of set theory (Warfield 2006). Let **A** represent a science of description. Let **B** represent a science of design. Let **C** represent a science of complexity. Let **D** represent a science of action (praxiology). Let **E** represent systems science. Then

$$\mathbf{A} \subset \mathbf{B} \subset \mathbf{C} \subset \mathbf{D} \subset \mathbf{E} \quad (1)$$

This suggests that we can learn something of systems science by first learning a science of description (e.g., physics, chemistry, biology, psychology, sociology, economics). Then we can learn a science of design that includes a science of description. The science of design is fundamental if our goal is to redesign systems (e.g., the intelligent redesign of school systems via effective knowledge import from psychology, sociology, economics, business, marketing). The science of design implies the use of tools that facilitate the building of structural hypotheses in relation to any given problematic situation, a problematic situation that may call upon the import of knowledge from any given field of scientific inquiry. Next we can learn a science of complexity that includes a science of description and a science of design. The science of complexity is fundamental if our goal is to integrate a large body of knowledge and multiple disparate functional relations that different stakeholders believe to be relevant to the problematic situation. Next we can learn a science of action that includes a science of description, a science of design, and a science of complexity. The science of action is fundamental if our goal is to catalyze collective action for the purpose of bringing about system changes that are grounded in the sciences of description, design, and complexity.

Warfield’s vision for applied systems science is instantiated in part in the systems science methodology he developed, Interactive Management (IM). IM is a software-assisted thought and action mapping process that helps groups to develop outcomes that integrate contributions from individuals with diverse views, backgrounds, and perspectives. Central to IM is a matrix structuring process that facilitates groups in developing structural hypotheses that

map systems of interdependencies, based on the consensus-based logic of the group. Although the mathematical algorithms that underpin Warfield's IM software are relatively complex—drawing in particular upon the mathematics of matrices—the application of the software for the purpose of generating a structural hypothesis in relation to any given problematic situation is reasonably straightforward. In fact, the rationale for separating the computational complexity of structuring from the process of dialogue, information search, deliberation, and voting in a group was very explicit in Warfield's view. The IM software is designed to alleviate the group of computational burden and thus allow them the opportunity to maximize the processes of creative idea generation, dialogue, information search, critical thinking and voting in relation to key binary relations in the overall problem structure. Warfield argued that the tools of systems science will be most effective if they integrate our capacity to share meaning using words, represent causality using graphics, and model complexity using mathematics. IM integrates all three of these components in its design. Warfield also highlights the distinction between the mathematics of content and the mathematics of structure. IM draws upon the mathematics of structure to convert matrix voting structures of users into a graphical representation of the relations they have mapped in their problematique. At the same time, it is possible to test quantitative structural models that are analogues or extensions of the models generated by a group in an IM session (cf. Chang 2010). Although detailed mathematical specification is beyond the scope of this paper, consistent with Maani and Cavana (2000), we believe that IM modelling can be used as a foundational step for groups that seek to develop consensus-based computational models in a team setting.

Methods for integrating systems science tools into the curriculum and curriculum design process are still poorly developed. In order to advance Warfield's vision of systems science education and further develop applied systems science, we are developing a tool and a teaching framework that integrates IM, critical thinking and systems modelling in a broader pedagogical framework (cf. Hogan et al. 2014a, b). As noted, IM was designed to assist groups in dealing with complex issues (see Ackoff 1981; Argyris 1982; Cleveland 1973; Deal and Kennedy 1982; Kemeny 1980; Rittel and Webber 1974; Simon 1960), and the theoretical constructs that inform IM, developed over the course of more than 2 decades of practice, draw from both behavioral and cognitive sciences, with a strong basis in general systems thinking. The IM approach carefully delineates content and process roles, assigning to participants responsibility for contributing ideas and to the facilitator responsibility for choosing and implementing selected methodologies for generating, clarifying, structuring, interpreting, and amending ideas. Emphasis is given to balancing behavioral and technical demands of group work (Broome and Chen 1992) while honoring design laws concerning variety, parsimony, and saliency (Ashby 1958; Boulding 1966; Miller 1956). IM has been applied in a variety of situations to accomplish many different goals, including developing instructional units (Sato 1979), designing a national agenda for pediatric nursing (Feeg 1988), creating computer-based information systems for organizations (Keever 1989), assisting city councils in making budget cuts (Coke and Moore 1981), improving the U.S. Department of Defense's acquisition process (Alberts 1992), promoting world peace (Christakis 1987), improving Tribal governance process in Native American communities (Broome 1995a, b; Broome and Christakis 1988; Broome and Cromer 1991), and training facilitators (Broome and Fulbright 1995). Similar to the current study, IM has also been recently used in a variety of basic science applications, for example, to design a national well-being measurement system (Hogan et al., 2015), to understand the adaptive functions

of music listening (Groarke & Hogan, 2015), and to design a student-centred conceptualisation of critical thinking (Dwyer, Hogan, Harney, & O'Reilly, 2014).

In a typical IM session, a group of participants who are knowledgeable about a particular situation engage in (a) developing an understanding of the situation they face, (b) establishing a collective basis for thinking about their future, and (c) producing a framework for effective action. In the process of moving through these phases, group members can develop a greater sense of teamwork and gain new communication and information-processing skills. IM utilizes a carefully selected set of methodologies, matched to the phase of group interaction and the requirements of the situation. The most common methodologies are the nominal group technique, ideawriting, interpretive structural modeling, and field and profile representations. The first two methodologies are primarily employed for the purpose of generating ideas that are then structured using one or more of the latter three methodologies. The current study presents an application of the IM methodology to the challenge of building a consensus-based understanding of core entrepreneurial competencies and a model of competency interdependencies that can be used to inform the design of new entrepreneurial educational programmes. To our knowledge this study represents the first application of IM to the study of interdependencies between entrepreneurial competencies and cross-cultural differences in entrepreneurial competencies.

Participants

In our study we sought to investigate the consensus view of the five groups, each of whom (1) evaluated the importance of a large set of entrepreneurial competencies derived from a large-scale literature review (see Table 2 presented in literature review section), and (2) worked to build a consensus structural model as to the logical interdependencies between a selected set of entrepreneurial competencies.

Five groups participated in the study. Seven Irish Entrepreneurs, 8 Irish postgraduate students, 6 Irish academics teaching entrepreneurship, 8 Iranian entrepreneurs, and 6 Iranian postgraduate students were invited to participate in five separate Interactive Management (IM) sessions at either the Enterprise Research Centre, University of Limerick or the Faculty of Entrepreneurship, University of Tehran. All of the postgraduate students and academics selected to participate in this research were studying/teaching in the area of entrepreneurship and had extensive knowledge of research, theory, and applications in the area. Selected entrepreneurs in both countries had valuable experience in the area of business start-up and all entrepreneurs had their own businesses in different industries. The selected entrepreneurs had both successful and unsuccessful experiences through their start-ups and running their businesses. The entrepreneurs had between 15 and 20 years business experience. A sixth group, comprising four academic experts in the field of entrepreneurship and learning sciences, participated in an additional IM session that focused on categorising all the ideas generated by the other five groups. All participants were informed about the study procedure and gave their consent at the beginning of the IM sessions which were conducted in six face-to-face group interactions.

The process

There were five steps involved in the IM process: (1) generate and clarify ideas, (2) vote, rank order, and select elements for structuring, (3) structure elements using ISM software,

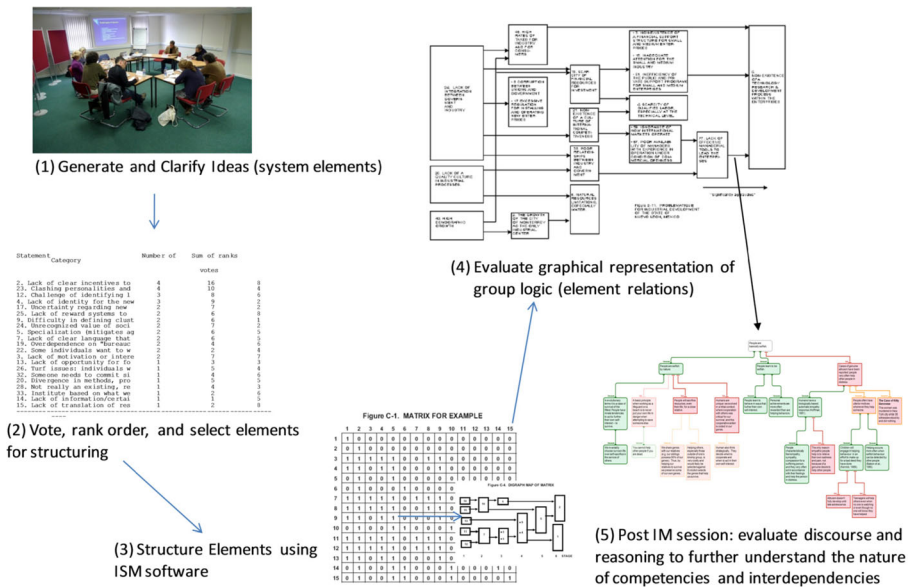


Fig. 1 Steps involved in the Interactive Management (IM) process in the current study

(4) evaluate graphical representation of group logic with the group and amend if necessary, (5) transcribe the audio recorded group discussion and evaluate discourse and reasoning to further understand the nature of competencies and interdependencies (see Fig. 1). The most common IM techniques are the Nominal Group Technique (NGT), idea-writing, Interpretive Structural Modeling (ISM), and field and profile representations. The first two techniques are primarily employed for the purpose of generating ideas that are then structured using one or more of the latter three techniques. Our study used both NGT¹ and ISM to identify, clarify, and model a set of entrepreneurial competencies that were selected as critical competencies by five groups of experts in this area.

The *nominal group technique* (NGT; Delbec et al. 1975) is a method that allows individual ideas to be pooled, and is best used in situations in which uncertainty and disagreements exist about the nature of possible ideas. A modified version of the standard NGT method was used in the current study, with participants initially working to identify entrepreneurial competencies that they consider most important to cultivate in an educational context from a list of competencies derived from a literature review and made available by the IM facilitation team. However, much like standard NGT, participants were also allowed to generate their own unique items and add to the list of competencies derived from the scientific literature.

Interpretive structural modelling (ISM; Warfield 1994) is a computer-assisted methodology that helps a group to identify relationships among ideas and to impose

¹ NGT involves five steps: (a) presentation of a stimulus question to participants; (b) silent generation of ideas in writing by each participant working alone; (c) “round-robin” presentation of ideas by participants, with recording on flipchart by the facilitator of these ideas and posting of the flipchart paper on walls surrounding the group; (d) serial discussion of the listed ideas by participants for sole purpose of clarifying their meaning (i.e., no evaluation of ideas is allowed at this point); and (e) implementation of a closed voting process in which each participant is asked to select and rank five ideas from the list, with the results compiled and displayed for review by the group.

structure on those ideas to help manage the complexity of the issue. Specifically, the ISM software utilizes mathematical algorithms that minimize the number of queries necessary for exploring relationships among a set of ideas (see Warfield 1976).

In the third step of developing a structural map, questions are generated by the ISM software and are projected onto a screen located in front of the group. The questions take the following form:

“Does idea A relate in X manner to idea B?”

“A” and “B” are pairs of ideas from the list developed by participants in the first step of ISM and the question of whether they “relate in X manner” is the statement identified in the second step.

For example, if a group is developing an influence structure with problem statements, the question might read:

“Does problem A significantly aggravate problem B?”

However, in the current study, given our research focus on examining the interdependencies between competencies, we focused on enhancement relations, specifically, by asking the following question:

“Does entrepreneurial competency A significantly enhance entrepreneurial competency B?”

In the sixth IM session, in order to categorise all ideas generated across all five sessions to highlight higher-order competencies identified across the sample as a whole, the question below was used in conjunction with the categorisation function of the IM software:

“Does entrepreneurial competency A belong in the same category with entrepreneurial competency B?”

Using the ISM methodology, groups engaged in discussion about each relational question and a vote was taken to determine the group’s judgment about the relationship. A “yes” vote was entered in the ISM software by the computer operator if a majority of the participants judged that there was a significant relationship between the pair of ideas; otherwise, a “no” vote is entered.

The length of time required to complete discussion of all necessary pairs of ideas was 2 h for each of our 6 IM sessions (12 h in total). The influence structuring work conducted with ISM can be considered an activity in “mapping perceptions” of the group members. Participants are given the opportunity to explore connections and links between ideas in ways that probably would have gone undetected without such structuring work. ISM can, thus, provide participants with useful insights into the relationships between ideas and it generates a product, a structural map of those relationships, which can guide their thinking as they design potential solutions (e.g., to the problem of how best to enhance specific entrepreneurial competencies). In the current study, many of the relations that appeared in the final structures were selected only after considerable discussion and participants were

sometimes slow to arrive at a consensus view in relation to key structural interdependencies.

Discourse analysis

To complement the IM analysis and evaluate potential overlaps between similar competencies which were identified by different groups but worded differently, discourse analysis was used to understand the meaning of specific competencies as described by participants (Schiffrin et al. 2001). Specifically, we listened to and transcribed the discussion of participants during the IM sessions and grouped competencies which were defined similarly by different groups together. Reading the transcripts also helped us to further understand the reasoning of participants in relation to key structural relations in the influence structures.

The entrepreneurial contexts of Iran and Ireland

Our study was conducted in both Iran and Ireland. The entrepreneurial contexts of Iran and Ireland have been shaped by the economic and social developments in each country (see Table 3 for some general comparisons). The Global Entrepreneurship Monitor placed Iran third in Nascent Entrepreneurship Rate, ninth in Established Business Ownership Rate, twenty second in Entrepreneurial Intention, and twenty sixth in Perceived Capabilities (GEM Iran Report 2012).

Table 3 Iranian and Irish Economic and Entrepreneurial Environment data derived from the Global Competitiveness Report (2011–2012) and Global Entrepreneurship Monitor Report (2013)

Factor	Iran	Ireland
Population, million	75.1	4.6
GDP (US\$ billions)	357.2	204.3
Unemployment (%)	11.5	13.7
Nascent entrepreneurship rate	10.8	4.3
New business ownership rate	3.9	3.1
Fear of failure	36.4	40.4
Entrepreneurial intentions	30.6	12.6
Entrepreneurship as a good career choice	64.1	49.6
High status to successful entrepreneurs	82.4	81.2
Media attention to successful entrepreneurs	59.9	59.9
Early-stage entrepreneurial activity (TEA)	14.5	7.2
Established business ownership rate	11.2	8
Discontinuation of businesses	5.7	2.5
Infrastructure (Rank—Out of 142)	67	29
Macroeconomic environment (Rank—Out of 142)	27	118
Financial market development (Rank—Out of 142)	123	115
Technological readiness (Rank—Out of 142)	104	17
Market size (Rank—Out of 142)	21	56
Innovation (Rank—Out of 142)	70	23

Iran is also placed fourth in the world with respect to entrepreneurial education across vocational, professional, college, and university levels (Razavi et al. 2008). This growth has been supported by 110 academic centres for entrepreneurship operating within Iranian universities (Mahdavi Mazdeh et al. 2012). Fooladi and Spence (2009) argue that while much of the export activities of Iran centre on oil, Iran is trying to diversify its economy and encourage greater levels of entrepreneurship. A difficult situation can be seen in Iran due to the world-wide sanctions and recent subsidy reform plan implemented in December 2010. Compounding these struggles is mounting unemployment, soaring to a rate of 15 % (Berber 2013) as factories and businesses lay off workers because they are unable to import vital goods and raw materials (Peterson 2013). Also, inflation has been rising dramatically in Iran since 2010 and has already approached 24 % in 2012 (Berber 2013).

Ireland, as one of the stronger emerging industrializing economies (Mac Sharry et al. 2000), experienced a significant increase in the number of SMEs during the 1990s and the Irish economy saw unprecedented growth in many sectors and the establishment of many multinational companies (Humbert et al. 2010). At a national level there has been no explicit entrepreneurship policy and the levels of entrepreneurship have been impacted by the global down turn in 2008 and this is reflected in the latest Global Entrepreneurship Report 2012. In reflecting on a 10 year period GEM (2012) noted improvements in intended internationalization of start-up businesses, positive culture and media, and recognition of starting a business as a career option. GEM (2012) reported educational attainment levels among early stage entrepreneurs in Ireland as one of the highest internationally. However, they noted challenges around numbers of people considering starting a business, the perception of opportunities for new business remains low and prevalence of early stage entrepreneurs in Ireland is at an all-time low. Ireland had the lowest rate of entrepreneurial activity of all 21 EU countries in the GEM (2000), accounting for only 1.2 % of GDP. Less than 1 in 100 Irish people invest in new business start-ups, the lowest amongst GEM participating European countries (Low 2005). The provision of entrepreneurship programmes and activities within the Irish third level system has grown (see Cooney and Murray 2008).

Findings

This section presents findings in relation to the core entrepreneurial competences identified by groups in the current study and their views in relation to interdependencies between these entrepreneurial competencies. In presenting our findings we begin by presenting individual group findings from entrepreneurs, students and academics, specifically, by focusing on the entrepreneurial competency enhancement structures generated by each group. We then present findings in relation to common categories of competencies identified by the sample as a whole, before examining commonalities and differences in the rank order of category influence scores across groups.

Entrepreneurial competency enhancement structures

Irish and Iranian entrepreneurs

For Irish Entrepreneurs in our study Positivity and Competitiveness were seen as critical drivers of other competencies in the system (see Fig. 2).² Determination is seen as both a highly valued characteristic (with 7 votes) and a key driver of many other skills and dispositions. The outcome of this enhancement structure is the ability to take an idea and add value.

Self-Confidence is one of the critical drivers of all other competencies for Iranian entrepreneurs (see Fig. 3). Persistence, Opportunity Identification as well as a set of 4 different competencies including Imagination, Emotional Quotient (EQ), Need for achievement, and Creativity are located in the second level of their model and influence other competencies in the influence structure.

Irish and Iranian students

Unlike the Iranian Entrepreneurs, Irish students regard networking ability as the most important driver of all other competencies, rather than being driven by other more fundamental competencies (see Fig. 4). A set of four competencies including Risk taking, Stress and Failure coping, Willing to take on challenges, and Change management are reciprocally interrelated and significantly enhanced by Networking ability. In turn, these four competencies enhance Independence and Communication at level 3. Iranian students perceive Tolerance for ambiguity as one of the critical drivers of all other competencies. Adaptability and flexibility, Risk-taking as well as a cluster of 4 interdependent competencies including Persistence, Negotiation, Initiative and Opportunity identification are located at level 2 in the structure (see Fig. 5).

Irish academics

Irish academics report that Belief in the effect of personal efforts on outcomes and Commercial Understanding are the two most fundamental competencies which affect all other competencies either directly or indirectly (see Fig. 6). Both of these competencies directly enhance Tolerance for ambiguity at level 2 in the enhancement structure, as well as the cluster of interdependent competencies at level 4. Persistence, Adaptability and flexibility as well as Proactivity and hardworking are three competencies at level 3 that are enhanced by Tolerance for ambiguity and in turn enhance a set of 5 competencies at level 4 including: Financial and Cash Management, Opportunity Identification, Enthusiasm, Creativity and Innovation, and Deal Making and Negotiation.

² Note: for Figs. 2, 3, 4, 5, and 6, numbers in parenthesis beneath competencies refer to the total number of votes the competency received during step 5 of NGT.

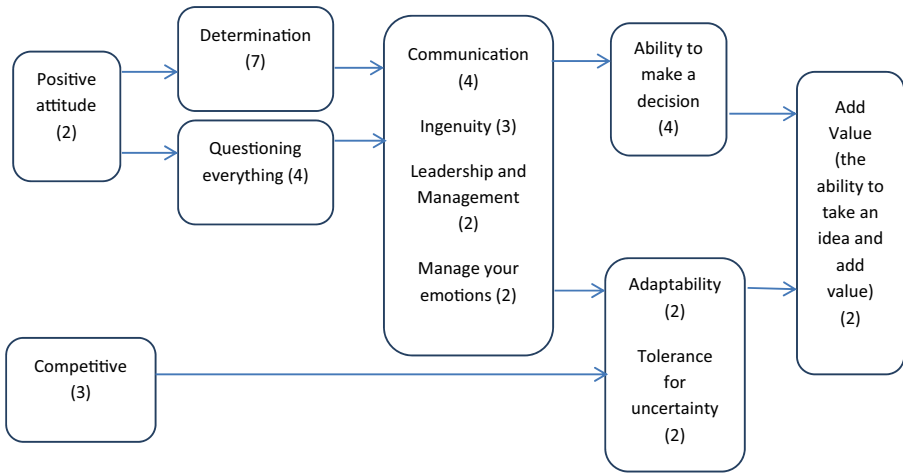


Fig. 2 Irish Entrepreneurs’ entrepreneurial competencies enhancement structure

Scoring, categorising, and ranking selected competencies

Based on the results of the five groups combined a total of 37 entrepreneurial competencies were selected. Using ISM software and its outputs, an algorithm was generated for scoring and ranking competencies across the full sample of participants. This algorithm used the following formula:

$$\begin{aligned}
 & \textit{The final Score(weight) of each Competency} \\
 & = \textit{Commonality} + \textit{Votes} + \textit{Level(Reversed)} + \textit{Succedent interrelations}
 \end{aligned}$$

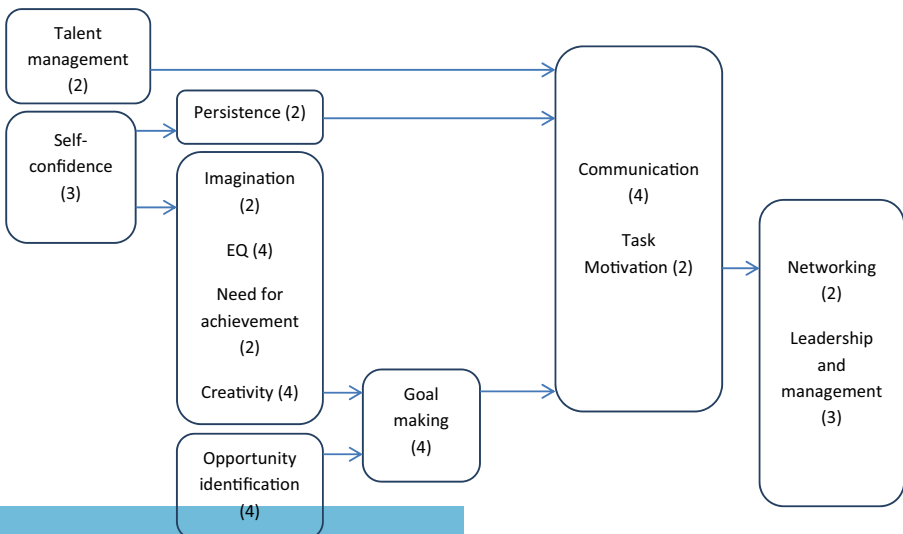


Fig. 3 Iranian Entrepreneurs’ entrepreneurial competencies enhancement structure

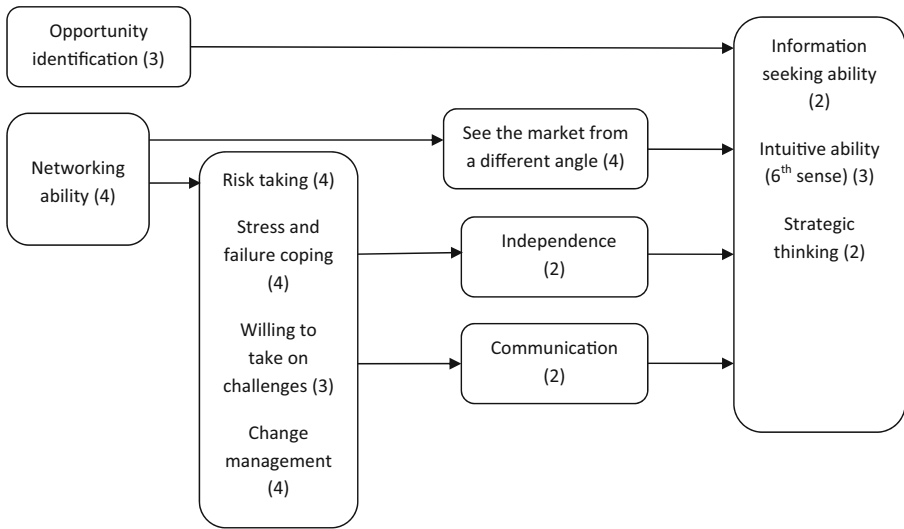


Fig. 4 Irish students’ entrepreneurial competencies enhancement structure

Table 4 provides a definition for each element in the formula, scores for each of the 37 identified competencies, and ranks competencies according to their total score.

Five competencies including Creativity, Innovation and ingenuity, Opportunity identification, evaluation and grasping, Tolerance for ambiguity and uncertainty, Persistence, and Communication skills obtained scores greater than 30 and emerged as some of the most influential competencies across the five groups. Toward the bottom of Table 4 are competencies with lower scores ranging from 4 to 9, including Enthusiasm, Talent Management,

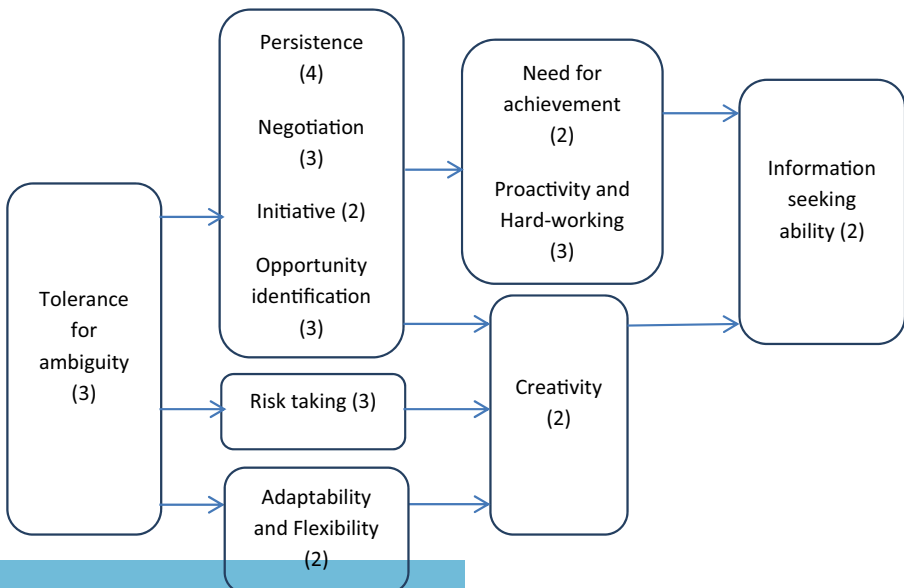


Fig. 5 Iranian students’ entrepreneurial competencies enhancement structure

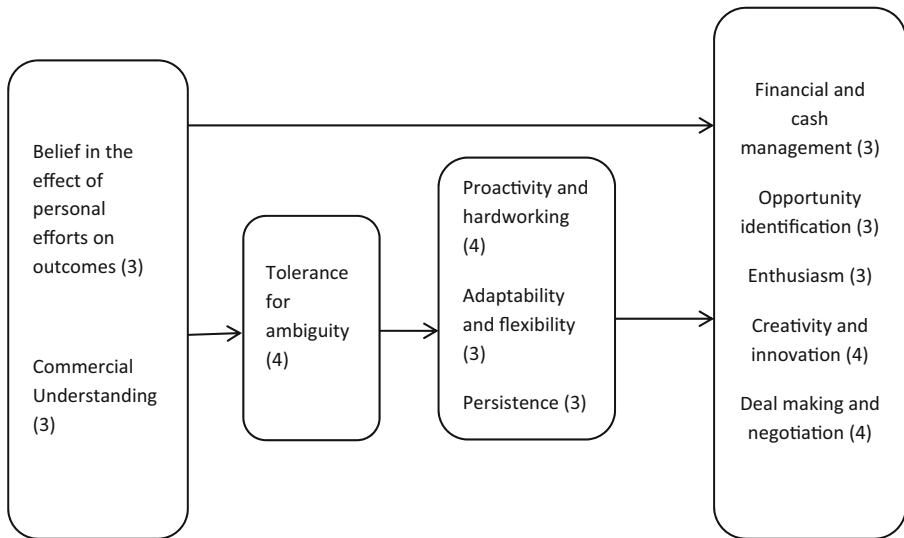


Fig. 6 Irish academics' entrepreneurial competencies enhancement structure

Manage your emotions, Task motivation, Ability to make a decision, Independence, Intuitive ability (6th sense), Strategic Thinking, and Add Value.

Categorising competencies

The focus of our sixth IM session was on categorising the full set of entrepreneurial competencies generated by our five expert groups. A total of 37 competencies were included in the set. The same question was asked of each pair of competencies in turn: Does competency A belong in the same category as competency B? After a series of over 100 decisions, 7 different categories were generated and labelled as follows: Productive thinking, Motivation, Interpersonal Skills, Leadership, Positivity, Domain Knowledge, and Emotional Objectivity. All 37 competencies were distributed amongst these seven categories and, consequently, a category score was calculated by summing the scores of its component competencies using the data available (see Table 5).

From Table 5 the highest ranked competency category labelled Productive Thinking includes 14 competencies with a total score of 297; Motivation, the second-highest ranking competency category includes 8 components and has a total category score of 176. Interpersonal skills and Leadership also emerged as important categories, with 99 and 65 votes, respectively.

Commonalities and differences across groups

A number of commonalities and differences in entrepreneurial competencies were identified by Iranian and Irish expert groups. While some competencies were selected by just one group, most were selected by more than one group. This can be seen in the commonality score in Table 4. To further examine similarities and differences in how

Table 4 Rank order list of the most important Entrepreneurial Competencies from across five IM sessions

Rank	Competency	Score				
		Commonality	Votes	Level (Reversed)	Succedent interrelations	Total net
1	Creativity, Innovation and ingenuity	4 ^{a, b, d, e}	4+6+3+2	1+3+4+2	4+7+8+1	49
2	Opportunity identification, evaluation and grasping	4 ^{b, c, d, e}	3+4+3+3	1+4+2+3	4+5+3+7	46
3	Tolerance for ambiguity and uncertainty	3 ^{a, d, e}	4+2+3	3+2+4	8+2+10	41
4	Persistence	3 ^{b, d, e}	3+2+4	2+4+3	7+4+7	39
5	Communication skills	3 ^{a, b, c}	4+4+2	3+2+2	7+3+3	33
6	Adaptability and Flexibility	3 ^{a, d, e}	3+2+2	2+2+3	2+7+2	28
7	Risk taking	2 ^{c, e}	4+3	3+3	9+2	26
8	Networking	2 ^{b, c}	2+4	1+4	1+11	25
9	Deal making and negotiation	2 ^{d, e}	4+3	1+3	4+7	24
10	Proactivity and Hardworking	2 ^{d, e}	3+4	2+2	7+2	20
11	Need for achievement	2 ^{b, c}	2+2	4+2	8+2	20
12	Determination	1 ^a	7	4	8	20
13	Self confidence	1 ^b	3	5	10	19
14	Leadership and Management	2 ^{a, b}	2+3	3+1	7+1	19
15	Positive attitude	1 ^a	2	5	10	18
16	Questioning everything	1 ^a	4	4	8	17
17	Emotional Quotient (EQ)	1 ^b	4	4	8	17
18	Belief in the effect of personal efforts on outcomes	1 ^d	3	4	9	17
19	Stress and failure coping	1 ^c	4	3	9	17
20	Change management	1 ^c	4	3	9	17
21	Willing to take on challenges	1 ^c	3	3	9	16
22	Imagination	1 ^b	2	4	8	15
23	Initiative	1 ^e	2	3	7	13
24	Commercial understanding	1 ^d	3	4	5	13
25	Goal making	1 ^b	4	3	4	12
26	Competitiveness	1 ^a	3	5	3	12
27	Information seeking ability	2 ^{c, e}	2+2	1+1	2+0	10
28	See the market from a different angle	1 ^c	4	2	3	10
29	Enthusiasm	1 ^d	3	1	4	9
30	Talent Management	1 ^b	2	3	4	9
31	Manage your emotions	1 ^a	2	3	3	9
32	Task motivation	1 ^b	2	2	3	8
33	Ability to make a decision	1 ^a	4	2	1	8
34	Independence	1 ^c	2	2	3	8
35	Intuitive ability (6th sense)	1 ^e	3	1	2	7

Table 4 (continued)

Rank	Competency	Score				
		Commonality	Votes	Level (Reversed)	Succedent interrelations	Total net
36	Strategic Thinking	1 ^c	2	1	2	6
37	Add Value	1 ^a	2	1	0	4

“Commonality” refers to the number of times each competency appears in the different Enhancement Structures. Groups for which competencies are common are coded: a = Irish Entrepreneurs, b = Iranian entrepreneurs, c = Irish students, d = Irish academics, e = Iranian students. “Votes” refers to the total number of votes assigned to each competency by the groups. “Level” represents the location of each competency in the enhancement structure, with scores reversed as competencies at level 1 have the highest influence in the enhancement structure, followed by competencies at level 2, 3, and so on. For an enhancement structure with 5 levels, those competencies located at level 1 receive a score of 5, competencies at level 2 receive a score of 4, etc. “Succedent interrelations” indicates the number of competencies that are influenced by a competency within the enhancement structure

groups judged the relative influence of competencies, we focused on the enhancement structures and computed influence scores for the top four competency categories—productive thinking, motivation, leadership, and interpersonal skills—for each group, separately. These analyses focused on both the *total influence* of competency categories within the enhancement by summing the structure scores for all elements in the category using the formula $Sum(\text{Level score} + \text{Succedent score})$, and also their *average influence* within the enhancement system, that is, correcting for the number of competencies in each category using the formula $Sum(\text{Level score} + \text{Succedent score})/\text{number of competencies in the category}$. The results of this analysis can be found in Figs. 7 and 8, and includes, for the average influence figure, information in relation to the standard deviation of category influence scores and the number of competencies included in the calculation of these scores for each group. While the total influence scores provide an indication of the overall influence of competency categories in the system of enhancement relations, and variations across groups in the rank order of these influence patterns, the average influence scores provide an indication of the relative influence of each type of competency across groups, controlling for variation across groups in number of competencies in each category.

Analysis of the total influence scores for the full sample revealed a similar rank order as presented in Table 4. Specifically, by excluding information in relation to votes and commonalities across groups and focusing exclusively on the influence of competencies within the system of enhancement relations described by participants, it can be seen that productive thinking has the higher total influence score, with motivation, interpersonal skills, and leadership ranked as the second, third, and fourth most influential categories, respectively. While Irish entrepreneurs and Iranian students showed a rank order of competency categories similar to the full sample (excluding leadership, which was absent from the Iranian student influence structure and had a higher total influence score than interpersonal skills in the Irish entrepreneur influence structure) other groups showed different rank orders. For example, the total influence score for motivation was slightly higher than productive thinking for Iranian entrepreneurs and Irish academics. Conversely, Irish students’ interpersonal skills influence score was higher than their motivation influence score. Interestingly, controlling for the number of competencies in each category, an

Table 5 Categorisation of the most important entrepreneurial competencies

Category number	Category name	Category components	Component total score	Category total score
1	Productive thinking	Creativity, Innovation and ingenuity	49	297
		Opportunity identification, evaluation and grasping	46	
		Tolerance for ambiguity and uncertainty	41	
		Adaptability and Flexibility	28	
		Risk taking	26	
		Questioning everything	17	
		Stress and failure coping	17	
		Willing to take on challenges	16	
		Imagination	15	
		Initiative	13	
		See the market from a different angle	10	
		Information seeking ability	10	
		Intuitive ability (6th sense)	7	
Add value	4			
2	Motivation	Persistence	39	176
		Proactivity and Hardworking	37	
		Need for achievement	34	
		Determination	20	
		Belief in the effect of personal efforts on outcomes	17	
		Task motivation	8	
		Competitiveness	12	
3	Interpersonal skills	Independence	8	99
		Communication skills	33	
		Networking	25	
		Deal making and negotiation	24	
4	Leadership	Emotional Quotient (EQ)	17	71
		Leadership and Management	19	
		Change management	17	
		Goal making	12	
		Talent Management	9	
		Ability to make a decision	8	
5	Positivity	Strategic Thinking	6	46
		Self confidence	19	
		Positive attitude	18	
6	Domain knowledge	Enthusiasm	9	13
		Commercial understanding	13	
7	Emotional objectivity	Manage your emotions	9	9

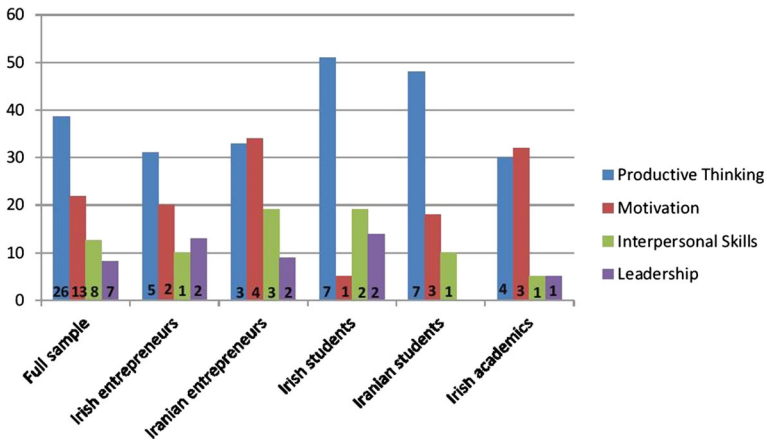


Fig. 7 Total influence scores for four categories of entrepreneurial competencies in the full sample and across five groups

analysis of average influence scores in the full sample revealed that interpersonal skills had the highest average influence score, with motivation, productive thinking and leadership ranked second, third, and fourth, respectively. Although fewer interpersonal skills were selected for structuring, thus reducing their total influence, their average influence was higher than other competencies in the Irish and Iranian student groups and equally influential as motivation in the Irish entrepreneurs group. Productive thinking competencies did emerge as the most influential on average amongst the Iranian entrepreneurs, whereas motivation had the highest average influence amongst Irish academics.

Discussion

Over the last decades researchers have sought to identify and understand the most important entrepreneurial competencies that support entrepreneurial behaviour in

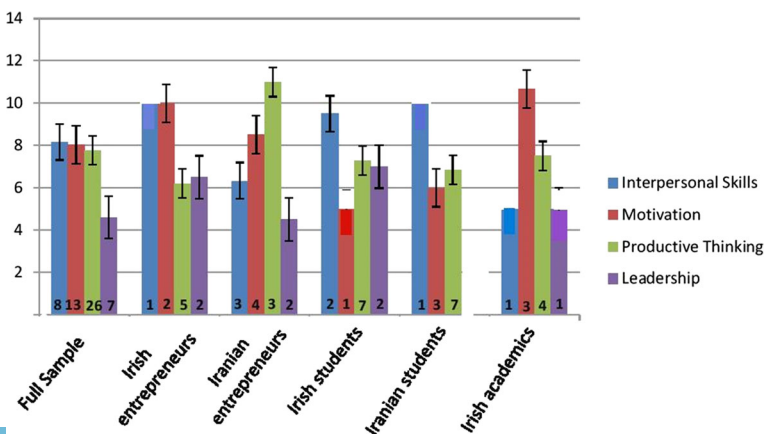


Fig. 8 Average influence scores for four categories of entrepreneurial competencies in the full sample and across five groups

different contexts. Our study used a collective intelligence methodology, *Interactive Management*, to identify, rank, structure, categorise, and examine the relative influence of entrepreneurial competencies that students, academics, and entrepreneurs believe need to be developed amongst students in a third level educational context. Set in Ireland and Iran, the study revealed a number of important findings that advance our understanding of entrepreneurial competencies.

Focusing first on key categories of entrepreneurial competencies and the voting, commonality, and influence scores across these categories, a consensus that emerged across groups in the current study is that Productive Thinking, Motivation, Interpersonal Skills, and Leadership are four of the most influential, high-level entrepreneurial competencies that need to be developed in students. These results are both consistent with and advance upon the findings of previous research on entrepreneurial competences. The major findings and advances of the current study in relation to these four high-level competencies are discussed further below.

Productive thinking

In our study, creativity, innovation and ingenuity were identified as the highest ranked components of Productive Thinking. The importance and central position of creativity and innovation for entrepreneurial endeavour has been highlighted in previous research by Schumpeter (1934), McClelland (1961), Martin (1982), and Carland et al. (2007). The other two top components of productive thinking, opportunity identification and tolerance for ambiguity and uncertainty, were also seen as highly important competencies by academics, students and entrepreneurs. Notably, opportunity identification is often highlighted in the entrepreneurial competency literature. For example, Byrne (2010) argues that a firm's entrepreneurial success is positively associated with its efforts to put key individuals in a position to detect opportunities, train them to be able to do so, and reward them for doing so. Also, Weaver et al. (2009) point out that successful entrepreneurs are capable of recognizing and capitalizing on opportunities. In the current study, discourse analysis suggested that opportunity identification and adding value were conceptually related competencies. Examining more closely the enhancement structures, the current study revealed a number of novel findings in relation to observed similarities in the antecedents and succeedents of these conceptually related competencies. Notably, opportunity identification and add value were found to be driven by a similar set of competencies including tolerance for ambiguity, adaptability and flexibility. Furthermore, discourse analysis revealed another set of conceptually overlapping competencies—tolerance for ambiguity, tolerance for uncertainty, and risk-taking—which were all found to be similarly placed in the enhancement structures and which also influenced a number of common competencies, including adaptability and flexibility, persistence, creativity and innovation. In this regard, our results highlight interesting and important findings in relation to interdependencies between the sub-competencies of productive thinking.

Interestingly, tolerance for ambiguity, the third most highly ranked component of productive thinking, was an important driver of other productive thinking competencies. Tolerance for ambiguity refers to the extent to which one is comfortable and able to function in situations where there is a high degree of uncertainty and ambiguity as to the nature of the rules governing success or the nature of the problem one is faced with.

There is some evidence suggesting that entrepreneurs have a higher tolerance for ambiguity than either senior executives or general managers (Pearson and Chatterjee 2001; Sapuan et al. 2009). Furthermore, Mitton (1989) notes that entrepreneurs not only operate in an uncertain environment, they eagerly undertake the unknown and willingly seek out and manage uncertainty. In our study, tolerance for ambiguity was selected as important by three out of the five expert groups and was mostly placed at level 1 and 2 in the enhancement structures, which suggests that independent groups perceived it to be a critical driver of other entrepreneurial competencies. Tolerance for ambiguity was argued to enhance many other entrepreneurial competencies including adaptability, negotiation, opportunity identification, persistence, creativity and need for achievement. Another interesting finding from our study is that participants also highlighted competitiveness, belief in the effect of personal efforts on outcomes, and commercial understanding as three critical drivers of tolerance for ambiguity.

Awareness of the top three components of productive thinking identified in the current study may have implications for how entrepreneurial competencies are developed in education settings. Traditional teaching approaches for entrepreneurship focused for example on developing a business plan may be inadequate in nurturing and developing entrepreneurial competencies. New approaches such as the lean start-up (LSU) approach may be more aligned with developing the top three component competencies of productive thinking. The LSU approach is tailored to the needs and demands of entrepreneurship, allows for active validation with customers, iterative experimentation, testing of assumptions, and it can be undertaken quickly, thus accelerating learning gains (Blank 2013). Such a collective consensus amongst students, academics, and entrepreneurs in both Ireland and Iran suggests the need for entrepreneurship faculty to experiment with new teaching approaches to develop these specific and important productive thinking entrepreneurial competencies (see Gately and Cunningham 2014a).

Motivation competencies

In relation to motivation, research to date highlights the importance of both push and pull factors as motivators of entrepreneurs (Moore and Buttner 1997; Duchéneau and Orhan 2000). While push factors are factors that are likely to drive people into entrepreneurship (e.g. the need for greater income, or dissatisfaction with their current employment), pull factors are factors that encourage people to become entrepreneurs, such as the desire for autonomy and independence. It is generally argued that a combination of both push and pull factors capture most of the fundamental entrepreneurial motivations (Orhan and Scott 2001; Deakins and Whittam 2000). Notably, all motivational competencies identified in this study belong to the pull category. Since the study focused on students' intra-personal competencies it is not surprising that all of the motivational competencies identified are internal pull motivational factors. At the same time, a focus on these pull factors is important for entrepreneurship educators and policy makers. For example, authors have argued that it is important to promote the acquisition of "enterprise" skills and, more specifically, support venture start-up activity through human, physical and working capital provision (Dawson and Henley 2012). The challenge in educational settings is how these pull factors might be allowed to flourish and grow in the context of knowledge and skill development coupled with more experiential learning.

Notably, persistence was collectively ranked as the number one competence amongst all motivation competencies. This is a novel finding that has implications for first time entrepreneurs. The educational environment and context of training and development created in a university setting through formal and informal supports may be essential in reinforcing persistence in the pursuit of entrepreneurial goals (Lee and Wong 2004). Drawing upon the logic of participants in our study, in their influence structures, it may be that building confidence, promoting stress and failure coping, and sustaining tolerance for ambiguity in the face of dynamic and changing task demands may need to be integrated into the curriculum as development goals in order to foster persistence as a core motivational competency.

Interpersonal skills

Interpersonal skills identified by this study include communication skills, networking, deal making and negotiation, and emotional intelligence. As noted previously, although fewer interpersonal skills were selected for structuring across groups, interpersonal skills had the highest average influence score in the sample as whole, with the average influence of interpersonal skills being higher than other competencies in the Irish and Iranian student groups and equally influential as motivation amongst Irish entrepreneurs. Researchers have long recognised interpersonal skills as critical to job performance, career advancement, and organizational success. For example, many prior studies have examined the relationship between communication skills and job performance (Roebuck et al. 1995). Izquierdo and Deschoolmeester (2010) and Hynes et al. (2009) argue that communication is important for entrepreneurship as entrepreneurs have to be able to persuade people and communicate with various stakeholders including customers, clients, suppliers, competitors, and service providers. Furthermore, Baum et al. (2001) found that the ability to communicate a vision affected subsequent venture growth amongst entrepreneurs. Networking has been identified as an important entrepreneurial competency by Boojihawon et al. (2007) and Kumara and Sahasranam (2009). Our study extends previous research by highlighting that these entrepreneurial competences are important to develop among students.

Networking, deal making and emotional intelligence are aligned to the development of relational capital which emphasizes the development of productive business networks (Pena 2002). Hormiga et al. (2011) describe relational capital as the value generated by entrepreneurs via their relations with suppliers, customers, investors but equally with internal stakeholders in their organisation and friends and family (Gately and Cunningham 2014b). Research in this area highlights the value added through relational capital, for example, in building reputation with clients, suppliers and other stakeholders. Further, the emotional support and active participation by family, friends and the entrepreneur's personal network are also linked to new venture success (Pena 2002; Hormiga et al. 2011). As noted, a novel finding of the current study is that, controlling for the number of competencies in each category, an analysis of average influence scores in the full sample revealed that interpersonal skills had the highest average influence score. As such, cultivating interpersonal skills may be critical to the success of students who seek to become entrepreneurs. A focus on cooperative learning methods (Johnson and Johnson 1989, 1999) and experiential learning (Kolb 1984) may be critical for building interpersonal entrepreneurial skills in an educational context.

More generally, a network of proactive peers, engaged academics, and a wider business community involved in entrepreneurship training programmes could provide a crucial starting point for the further development of professional and personal networks that sustain entrepreneurial intentions and behaviours after students complete their university training.

Managerial and leadership competencies

A number of previous studies conducted in the 1990s and early 2000s highlighted managerial skills as important entrepreneurial competencies (see for example, Man et al. 2002; Gasse and d'Amboise 1997). Our study further confirms managerial and leadership competencies as important for students to develop in an educational context. The business failure literature further highlights that lack of managerial competence is an internal cause of business failure (see Walsh and Cunningham 2015). The emphasis on managerial competency has a long tradition in the literature on entrepreneurship and was highlighted in one of the earliest definitions of an entrepreneur: Cantillon (circa, 1700) described an entrepreneur as a rational decision maker who assumed the risk and provided management for the firm (see Kilby 1971). In our study, participants highlighted the importance of leadership and management ability, and also change management, goal making, talent management, and the ability to make a decision. Providing an entrepreneurial experience in an education environment that develops these competences can be difficult, but a starting point is providing students with basic knowledge and understanding of management and leadership and opportunities to engage in group activities where the leadership role is distributed and shared throughout the group during different phases of the group work. Different educational paradigms, including experiential and cooperative learning, may be appropriate for entrepreneurship education programmes and could be used to future develop managerial and leadership competencies (see Cope and Watts 2000; Dhliwayo 2008; Soriano et al. 2013). For example, the Pro Academy approach created in Finland and now adopted in many other European institutions reflects a disruptive change in the entrepreneurial educational paradigm, with a focus on empowering students to exercise innovation and their managerial and leadership competencies.

Interdependencies between sub-competences and similarities and differences across groups

To our knowledge our study is the first study to address the interdependencies between entrepreneurial competences. Analysis of influence scores in the sample as a whole and across groups in the study highlight a number of similarities and differences in the interdependencies between sub-competences identified by participants in the study. In the study as a whole, the total influence scores across categories of competencies suggest that a focus on productive thinking competencies may serve to significantly enhance specific motivation, interpersonal, and leadership competencies. At the same time, different groups showed different patterns of influence relations. For example, while Irish entrepreneurs and Iranian students showed a total influence category score rank order that was similar to the sample as a whole, Iranian entrepreneurs and Irish academics had higher total influence scores for motivation when compared with

productive thinking. Furthermore, Irish students' interpersonal skills influence score was higher than their motivation influence score, suggesting that in the student group motivation was not considered as influential as other competency categories. It may be that an understanding of the critical importance of motivation develops later in life as entrepreneurs and academics learn from experience and by observing factors at play in the success and failure of entrepreneurial ventures. Again, focusing on average rather than total influence scores, although fewer interpersonal skills were highlighted, Irish and Iranian student groups judged interpersonal skills to be highly influential and fundamental drivers of other competencies. Conversely, productive thinking competencies emerged as the most influential competency category on average amongst the Iranian entrepreneurs, whereas motivation was the most influential on average amongst Irish academics.

A focus on specific competencies also revealed some interesting differences across groups. These differences are highlighted in Table 6. As can be seen from Table 6, some competencies such as Task motivation, Need for achievement, Imagination, and Talent management were only identified by Iranian entrepreneurs and were not identified by any of the Irish groups. Interestingly, with regard to task motivation and need for achievement, Pillis (1998) found no relationship between level of achievement motivation and entrepreneurial intentions in an Irish sample, suggesting that level of achievement motivation is not a critical marker of entrepreneurial activity in an Irish context. Also, while a broad literature supports that Irish people are innovative in areas such as literature, drama, visual arts (Bayliss 2004), and traditional dance and music (Cinneida and Henry 2007), Pillis (1998, p.11) suggested that, in the Irish context "it may be difficult to conceive of venturing outside expected norms of behaviour to become an entrepreneur".

In relation to talent management, which refers to a deliberate effort by an organization to ensure leadership continuity in key positions and encourage individual advancement (Rothwell 1994), one possible explanation for why Iranian entrepreneurs, but no Irish group, highlighted talent management as important is that the macroeconomic environment in Iran may support talent management to a greater extent than is the case in Ireland. According to the Global Competitiveness Report, while the world-wide rank of Iran's macroeconomic environment is 27 out of 142, Ireland's macroeconomic environment ranking is last out of all 142 countries in the sample (Schwab 2011). Differences in

Table 6 Differences between the IM groups in regards to their identified entrepreneurial competencies

IM group	Competencies identified ONLY by this group
Irish entrepreneurs	Positive attitude, Competitive, Determination, Questioning everything, Ingenuity, Manage your emotions, Ability to make a decision
Irish students	Stress and failure coping, Willing to take on challenges, Change management, See the market from a different angle, Independence, Intuitive ability (6th sense), Strategic thinking
Irish academics	Belief in the effect of personal efforts on outcomes, Commercial Understanding, Financial and cash management, Enthusiasm
Iranian Entrepreneurs	Talent management, Self-confidence, Imagination, EQ, Goal making, Task Motivation
Iranian students	Initiative

entrepreneurship education across countries could also explain the focus on talent management in Iran, as large scale access to formal entrepreneurship courses through universities and colleges is more common in Iran than in Ireland (Zali and Razavi 2012). In our study, talent management was located at level three of the Iranian entrepreneurs' enhancement structure and is seen to have a significant positive effect on communication, task motivation, networking and leadership. Interestingly, there is no driver for talent management in this structure, which suggests that it is a fundamental driver of other entrepreneurial competencies that may be an important product of infrastructure design.

In contrast, some competencies were identified by Irish experts only, including competitiveness, independence and financial and cash management. Competitiveness was defined by Irish experts as the ability of a person, firm or country to supply and sell goods and services in a competitive market. It was located at level 1 in the structure and was seen to significantly enhance adaptability and flexibility, tolerance for ambiguity, and adding value. In relation to independence, there are cultural differences between Iran and Ireland. For example, traditional Iranian culture values dependency and interdependency among youth and adults (Gable 1959), and the Iranian National Curriculum Policy (Iranian Ministry of Education 2012) does not seek to explicitly enhance students' independence as such; in contrast, it focuses on reinforcing the role of students' family as a key factor in students' educational success. Conversely, the stated objectives of Irish universities often includes fostering students' independent thinking (Kenny et al. 2009) and the overall objective of Irish first level curriculum includes: "Fostering children's natural curiosity to develop independent enquiry and creative action" (Irish Department of Education and Science 2004). Finally, the emphasis on financial and cash management amongst Irish groups may be related to Ireland's recent economic recession and the government's bailout of the banking sector. It has to be noted that while the inflation rate in Iran is high due to the imposed global sanctions against Iranian companies, Iran's economy has not yet been pushed into the recession (O'Sullivan 2010).

On the other hand, there are many commonalities among Iranian and Irish stakeholders regarding the most important entrepreneurial competencies. Competencies which were identified as important by both Iranian and Irish experts include the following: leadership and management, belief in the effect of personal efforts on outcomes, determination, need for achievement, communication skills, deal making and negotiation, creativity and innovation, opportunity identification, evaluation and grasping, persistence, willing to take on challenges, self-confidence, and a positive attitude. It may be that these competencies are necessary for entrepreneurs working in a variety of different contexts and are less determined by social and cultural environments. However, further research is needed to clarify this issue. Interestingly, there was also some consensus in the level placement of these common competencies across different enhancement structures. For example, communication was placed at levels 3 and 4 in three structures (i.e., Irish entrepreneurs, Irish students, and Iranian entrepreneurs) and it was driven by common motivational competencies—determination and persistence—in two of these structures. As noted above, persistence was ranked as the most influential motivational competency in the sample as a whole, and there was a strong consensus across Iranian students and Irish academics, who suggested persistence drives proactivity, opportunity identification, creativity and deal-making and negotiation. Moreover, tolerance for ambiguity was identified as a common driver of persistence in both structures.

Tolerance for ambiguity and uncertainty provides another instance of consensus between Irish entrepreneurs and academics as well as Iranian students. All three groups argued that it significantly impacts adaptability and flexibility. Furthermore, Irish entrepreneurs and academics highlighted two motivational factors as critical drivers of Tolerance for ambiguity, specifically, Competitiveness and Belief in the effect of personal efforts on outcomes.

Conclusions

Our study contributes further to our understanding of core entrepreneurial competencies and their interdependencies. Firstly, using a novel collective intelligence method for a comparative study of entrepreneurial competencies in an educational setting our study builds upon existing research by identifying and rank ordering core entrepreneurial competencies among key stakeholders that need to be cultivated in educational contexts. While previous research identified categories of core entrepreneurial competencies our study has furthered this work by ranking these among key stakeholders. The ranking of these core entrepreneurial competencies among key stakeholders is essential if education programmes for students are to provide meaningful development that enables transformation and creation of value added through the appropriate use of resources to meet market opportunities as Bird (1995) argued. Furthermore, our study findings reinforce that within the productive thinking category, creativity, innovation and ingenuity (the highest component score) is deemed common and central to the entrepreneurship process. Our findings extend the work of Mitchelmore and Rowley (2010) by identifying and ranking the actual leadership and management category components. Moreover, through the consensus-based approach of IM and the systematic identification, clarification, categorisation and rank ordering of components, our study has provided a clearer breakdown as to the different components of motivation. This in turn should provide entrepreneurial educationalists with points of reference for this and other ranked ordered categories in providing some indications of what is important and necessary in developing core entrepreneurial competencies among students. This clearer consensus based understanding of rank order of core entrepreneurial competencies and their constituent elements has implications for how entrepreneurship education initiatives are developed, delivered and assessed to meet the needs of different stakeholders. In essence, our study provides some guidance to entrepreneurship educators as to a rank order of entrepreneurial competencies they should focus on developing.

Our second modest contribution is that the interdependencies amongst these core entrepreneurial competencies are explored for the first time, highlighting the importance of this work in facilitating a deeper understanding of competency systems. While there are key differences between Ireland and Iran, our study has clearly shown that there are strong interdependencies and considerable agreement as to the core entrepreneurial competencies and interdependencies irrespective of country context. Understanding how competency systems operate in context may be essential in the creation and successful growth of any business. Leadership and management, determination, creativity and innovation and opportunity recognition to highlight just a few are core entrepreneurial competences irrespective of context. We acknowledge the need for

further research on interdependencies of core entrepreneurial competences, for example, using quantitative cross-sectional and longitudinal modelling, but our modest contribution in this regard should provide future researchers with clear category sets of core entrepreneurial competencies. Furthermore, we suggest that key driver competencies, including productive thinking, motivation, and interpersonal skills, may be best developed through the use of new educational approaches, including experiential and cooperative learning approaches that may help to foster and accelerate the development of these entrepreneurial competencies and facilitate their synergistic functioning in business contexts. These educational innovations (moving from traditional to non-traditional cooperative-experiential teaching methods) may help to increase the impact of entrepreneurship education programme by further engaging stakeholders in the curriculum implementation process.

Our third contribution relates to the use of a new methodology to identify, rank, and structure core entrepreneurial competencies among stakeholders through the use of IM and in generating consensus amongst experts working together to model interdependencies between entrepreneurial competencies. The method could be similarly applied to understanding how objectives or goals of entrepreneurship development programmes might work to enhance one another as part of a system of training goals, which would allow for further engagement with key stakeholders in the curriculum and training design process. The IM methodology also provides a rigorous structure to facilitate a concatenation process whereby other researchers can systematically acquire further data to work towards a theoretical saturation that confirms (or denies) the centrality of productive thinking, motivation, and interpersonal skills as fundamental entrepreneurial competencies. In essence, the IM methodology used in the current study can be readily replicated with other groups in other context to further refine our understanding of key entrepreneurial competencies and their interdependencies, which in turn can form the basis for the construction of integrative scales and quantitative modelling of the relationship between competency systems and entrepreneurial outcomes. These emerging models and systems can also be used as measurement frameworks for the evaluation of new, emerging entrepreneurial training programmes.

Recognising these potential contributions, we also recognise that our study is not without limitations. The possible impact of cultural and socio-economic factors on models of entrepreneurial competencies generated by Irish and Iranian experts was discussed by this study. However, further research is needed to understand how social and cultural factors influence the development of entrepreneurial mind-sets and behaviours in different contexts. Furthermore, the current study is exploratory and further research is needed to confirm the models of entrepreneurial competency generated by groups in this study. While the study highlights the value of Interactive Management as a collective intelligence and systems thinking tool that may help us to further understand the cultural, social and economic contexts of entrepreneurship, further research is needed to examine the implications of this form of systems thinking on the design of entrepreneurship development programmes, particularly across types of entrepreneurs.

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