Fostering Entrepreneurial Intention Among Engineering Students

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Abstract: - Engineering graduates need a broad range of skills and knowledge beyond that of the technical. The role of the engineer has evolved from lone specialist to team player, from internally focused to globally aware, from reactionary to entrepreneur. Entrepreneurial intention is a state of mind that directs and guides the actions of the entrepreneur toward the development and implementation of a business concept. Diverse factors that influence the Entrepreneurial Decision do exist. These factors may be intrinsic such as the personal capabilities (personality traits and psychological attributes), and prior knowledge or extrinsic as the environmental (social) factors. Stimulating innovative and growth-oriented entrepreneurship is a key economic and societal challenge to which universities and colleges have much to contribute. Students with more positive attitudes, stronger subjective norms, and more perceived behavioral control with respect to entrepreneurship, will have stronger entrepreneurial intentions. In this paper we consider intention (willingness) and personal capabilities as the predisposing factor, the environmental (social) background as the nutrient medium, and entrepreneurial education as the precipitating factor for the entrepreneurial process.

Key-Words: - Entrepreneurship, Engineering education, Entrepreneurial intention, Entrepreneurial intention models – Cognition.

1 Introduction
Entrepreneurship has been hailed as the new engine of economic growth in both developed and developing countries [1]. It is paradigmatically referred to as the process of innovatively exploring and exploiting opportunities in the midst of risks and uncertainty by synthesizing resources to create novel outputs often within the context of new organisational formation [2]. Exalted as the driving force of innovation, entrepreneurship offers the benefits of increased economic efficiencies, bringing innovation to the market, job creation, and sustained employment [3].

Kuratko (2007) developed a definition of entrepreneurship which includes these necessary attributes: the willingness to take calculated risks, the ability to formulate an effective venture team, the creative skills to marshal necessary resources, the skill to build a solid business plan, and the vision to recognize opportunity when others just see chaos, contradiction, and confusion [4]. It should be pointed out, however, that entrepreneurship does not require, but can include, the creation of new organizations. Entrepreneurship can also occur within an existing organization. Moreover, opportunities can be sold to other individuals or to existing organizations [5].

Entrepreneurship involves the nexus of two phenomena: the presence of lucrative opportunities and the presence of enterprising individuals [6]. The academic field of entrepreneurship incorporates, in its domain, explanations for why, when and how entrepreneurial opportunities exist; the sources of those opportunities and the forms that they take; the processes of opportunity discovery and evaluation; the acquisition of resources for the exploitation of these opportunities; the act of opportunity exploitation; why, when, and how some individuals and not others discover, evaluate, gather resources for and exploit opportunities; the strategies used to pursue opportunities; and the organizing efforts to exploit them [5].

Ardichvili (2003) identified entrepreneur’s personality traits, social networks, and prior knowledge as antecedents of entrepreneurial alertness to business opportunities. Entrepreneurial alertness, in its turn, is a necessary condition for the success of the opportunity identification triad: recognition, development, and evaluation [7]. The development process begins when entrepreneurial alertness exceeds a threshold level. Alertness is likely to be heightened when there is a coincidence of several factors: certain personality traits (creativity and optimism); relevant prior knowledge and experience; and social networks.
Encouraging entrepreneurship has become an accepted wisdom in economic management and government decisions. One crucial element to foster entrepreneurship is to motivate individuals to become entrepreneurs and equip them with the right skills to turn opportunities into successful ventures. An engineer is assumed to be endowed with a certain stock of knowledge; accordingly, he will be confronted with the choice of how best to appropriate the economic return from that knowledge. So, future engineers have to be trained how to recognize and develop new technologies and to take the technologies to market and to practice industry proven commercialization processes within an academic environment.

2 Antecedents of Entrepreneurial Intentions

The decision to become an entrepreneur may be plausibly considered as voluntary and conscious (Krueger et al., 2000) [8]. Therefore, it seems reasonable to analyze how that decision is taken. There exist good reasons for becoming self-employed. These reasons include, but are not confined to:

- Economic factors: economic opportunity, to receive compensation based on merit, to keep a large proportion of the result.
- Challenge: to have a challenging job, to have an exciting job, to have an interesting job, to have a motivating job.
- Autonomy: freedom, independence, to be his own boss, to be able to choose his own work tasks.
- Authority: to have power to make decisions, to have authority.
- Self-realisation: to realise one's dreams, to create something, to take advantage of his creative needs.
- Involvement in the whole process: to follow work-tasks from A to Z.

Diverse factors that influence the Entrepreneurial Decision do exist. These factors may be intrinsic such as the personal capabilities (personality traits and psychological attributes), and prior knowledge or extrinsic as the environmental (social) factors. Most approaches distinguish between internal (personality) and external (contextual or environmental) factors. Lüthje and Franke (2003) [9] analyzed the causes of entrepreneurial intent among engineering students by testing a covariance structure model and concluded that contextual factors and personality traits play a significant role in explaining entrepreneurial intent (both factors seem to have a similar effect).

2.1 Personal Capabilities

2.1.1 Personality Traits

Biographic background and personality characteristics of entrepreneurs as variables that could influence entrepreneurial behavior of individuals, has been studied extensively. Some personality traits have been shown to be related to successful opportunity recognition. Optimism

The connection between optimism and higher opportunity recognition has been observed by a number of researchers. Studies by Krueger and Brazeal (1994) [10] showed that entrepreneurial optimism is related to self-efficacy beliefs. It is important to point out that optimism about one's ability to achieve specific, difficult goals (self-efficacy) is not related to optimism in the sense of higher risk taking.

Creativity

Schumpeter (1934) was the first to introduce the notion that successful entrepreneurs discover opportunities that others do not see. Hills and co-authors (1997) [11] have found that 90% of those surveyed by them find creativity very important for opportunity identification. However, solo entrepreneurs found it significantly more important than did the networked entrepreneurs. Ardichvili (2003) [7] postulated that high levels of entrepreneurial alertness are related to high levels of entrepreneurial creativity and optimism (based on high self-efficacy).

2.1.2 Psychological Attributes

The extant literature shows that who becomes an entrepreneur is correlated with a variety of psychological attributes. As noted by Kamineni (2002), the use of psychological attributes ‘has found a prominent place in the entrepreneurship literature and hence cannot be ignored’. Furthermore, Kamineni, argued that most of the research within the entrepreneurship literature has concentrated on: need for achievement; risk-taking propensity; and locus of control [12]. A study conducted by Teixeira and Forte (2009) [13] on 2431 students enrolled in 60 different undergraduate courses of 14 Portuguese schools/faculties, found that psychological factors, such as risk propensity, leadership profile, and
creativity, are the most important (positive) determinants of students’ entrepreneurial intents.

**Need for Achievement**
Achievement motivation, or the need for achievement, is evident in an individual who: aspires to accomplish difficult tasks; maintains high standards; works toward the attainment of distant goals; responds positively to competition; or is willing to put forth effort to attain excellence. Need for achievement has long been recognized as being associated with entrepreneurs. McClelland (1961) pioneered the work in this area and showed that individuals with a high need for achievement required more achievement satisfaction and, therefore, would seek an entrepreneurial type job rather than a job from which they would obtain less satisfaction [14]. Subsequent empirical studies have supported the existence of a link between ‘entrepreneurship’ and need for achievement. Begley and Boyd (1987) [15] reported that founders (a proxy for entrepreneurs) had a higher need for achievement than non-founders and Stewart and co-authors (1999) [16] established that entrepreneurs had a higher need for achievement compared to both managers and small business owners.

**Risk-taking Propensity**
Risk-taking propensity has been ‘conceptualized by Sexton and Bowman (1985) [17] as one’s orientation toward taking chances in a decision-making situation’.

**Locus of Control**
Locus of control refers to the ability an individual believes they have to influence events in their lives.

**Preference for Innovation**
A creative and inventive individual, capable of originality of thought; motivated to develop novel solutions to problems; values new ideas; likes to improvise. Koellinger (2008) [18] argued that entrepreneurial innovativeness depends both on individual factors and on the environment in which the individual acts. In particular, high educational attainment, unemployment, and a high degree of self-confidence are significantly associated with entrepreneurial innovativeness at the individual level.

**2.1.3 Genetic Factors**
Nicolaou and co-authors (2008) [19] suggested that differences between entrepreneurs and non-entrepreneurs exist because of genetic factors that interact with environmental stimuli increasing the likelihood that some will become entrepreneurs. Genetic differences, in this view, are the source of variation that influence psychological attributes that might make some individuals more prone to become entrepreneurs.

**2.2 Prior Knowledge**
Shalley and Perry-Smith (2008) argued that the source of differences between creative individuals and noncreative individuals is exposure to diverse perspectives, ideas, experiences, norms, and so on via social contacts that, in combination with existing information and knowledge, result in creative solutions to problems. Diverse social contacts trigger individual’s cognitive processes that translate into creative thinking beyond a particular task domain and into other settings [20].

**2.2.1 Exposure to Entrepreneurship through Family and Direct Experience**
Prior exposure to entrepreneurial activity could be in the form of early exposure to a family business, which influences attitudes toward entrepreneurship (Krueger 1993) [21]. Drennan, Kennedy, and Renfrow (2005) [22] found that those who reported a positive view of their family’s business experience perceived starting a business as both desirable and feasible. They found that other childhood experiences that involved facing adversity or frequent relocation also had a positive effect on individuals’ perceived autonomy and attitude toward self-employment. At the same time, it can be argued prior exposure in the form of direct experience in starting or attempting to start a new business would affect attitudes and perceptions about entrepreneurship as a career.

The Theory of Entrepreneurial Opportunity Identification (Ardichvili, 2003) [7] identifies entrepreneur’s personality traits, social networks, and prior knowledge as antecedents of entrepreneurial alertness to business opportunities. Each person’s idiosyncratic prior knowledge creates a “knowledge corridor” that allows him/her to recognize certain opportunities, but not others. According to Ardichvili, three major dimensions of prior knowledge are important to the process of entrepreneurial discovery: prior knowledge of markets, prior knowledge of ways to serve markets, and prior knowledge of customer problems. Basu and Virick (2008) [23] found that prior exposure to entrepreneurship education has a positive effect on students’ attitudes toward a career in entrepreneurship and on perceived behavioral control or entrepreneurial self-efficacy. At the same time, individuals’ prior exposure to entrepreneurship in practice, both direct and indirect through their family background in business, is significantly linked to their attitudes, norms, and perceived
behavioral control regarding entrepreneurship. More specifically, having a self-employed father is significantly related to the student’s positive attitudes, stronger norms, and greater self-efficacy with respect to entrepreneurship. Students with self-employed fathers gain exposure to and tacit knowledge of entrepreneurship from an early age, which in turn affects their attitudes and perceptions of self-efficacy toward entrepreneurship. Prior experience of starting a business or trying to start a business is significantly linked with a positive attitude toward entrepreneurship and a greater degree of self-efficacy but not significantly related to subjective norms. This implies that students who have had direct experience of starting their own business have a more favorable attitude toward an entrepreneurial career and are more confident in their own ability to repeat that behavior. The finding regarding subjective norms suggests that students who are more confident in their ability behavior. The finding regarding subjective norms suggests that students who are more confident in their ability based on practical experience are less influenced by perceived social norms about entrepreneurship.

2.2.2 Exposure to Entrepreneurship Education
Students who have had prior exposure to entrepreneurship education will have more positive attitudes toward entrepreneurship, stronger subjective norms favoring entrepreneurship, and more perceived behavioral control. This will be discussed in details in a following section.

2.3 Social Factors
Both the macro environment (i.e., markets, capital markets, and governmental policy) and the micro environment (i.e., the university with its tasks of initiating, developing and supporting entrepreneurship inspiring, training, actively supporting, and networking students), are crucial for new venture creation.

Ardichvili (2003) [7] postulated that Successful opportunity identification is associated with the existence and use of an extended social network, which includes the following four elements: weak ties (a network used to gather general information that could lead to identifying an opportunity or to answering a general question), inner circle (the set of people with whom an entrepreneur has long-term, stable relationships, they are not partners in the venture), action set (people recruited by the entrepreneur to provide necessary resources for the opportunity), and partnerships (start-up team members). Weak ties (including casual acquaintances) are “bridges” to information sources not necessarily contained within an individual’s strong-tie network (including friends and family). The lack of any of these elements reduces the probability of such success.

Aldrich and Kim (2007) [24] have adopted a social network perspective on entrepreneurship. Networks can provide many benefits to entrepreneurs. These include greater information flows, which are absolutely vital as entrepreneurs seek to learn about technologies, industry practices, and markets. Other benefits include a greater diversity of ideas, increased prospects for innovation, and possibly more rapid decision making.

Baron (2007) [25] suggested that research should focus upon the actual activities and tasks performed by the entrepreneur. He devoted particular attention to how entrepreneurs identify and recognize opportunities, with particular emphasis upon innovative ventures. In considering the important question of why some have ideas and others do not, he suggests that organizing concepts, better access and use of information, active search, alertness, prior knowledge, and social networks all may play a role. The cognitive frameworks of entrepreneurs, including their use of concepts to organize data and their abilities in pattern recognition, may bear upon why some see opportunities and others do not. In considering the processes of acquisition of human and financial resources, he suggests that the entrepreneur’s social skills and social networks are both important.

3 Entrepreneurial Intention Models
In the early 80’s the entrepreneurial research, which focused on personal characteristics of the entrepreneur, the ‘trait line’ of research began to lose ground when more studies explaining entrepreneurial behavior and approaches building on cognitive aspects and reasoned action began to emerge in the field of entrepreneurial research. The intention models have become a widely accepted approach in entrepreneurial research and it has been attested to explain entrepreneurial behavior reliably [8]. They offer a framework, which enables linking all relevant elements: personal perceptions, individual behavior, environment, and resources together [26].

3.1 The Entrepreneurial Event Model
(Shapero, 1982)
Shapero and Sokol (1982) introduced the concept of the entrepreneurial event, which considers the business creation as an event that can be explained with the interaction between initiatives, abilities, management, relative autonomy and risk. According to this study, the personal choice to start a new venture depends on three elements: (a) the perception of the desirability, (b) the propensity to act, and (c) the perception of feasibility [27]. Perceptions of desirability and feasibility are products of cultural and social environments and are argued to make an individual to determine which actions will be seriously considered and subsequently taken. Perception of desirability affects the entrepreneurial event through individual value systems and is dependent on the social system the individual is part of (family, peer groups, ethnic groups, educational and professional contexts). Concerning perceived feasibility Shapero and Sokol refer to availability of financial support and to would-be partners. Would-be partners may pull a nascent entrepreneur into the act by providing funding, moral support, labor, a necessary skill and perhaps shared risk. This approach was tested empirically by Krueger, Reilly, and Carsrud (2000) [8], Audet (2002) [28], and Peterman and Kennedy (2003) [29].

3.2 The Theory of Planned Behavior (Ajzen, 1991)

Ajzen (1991) defined the theory of Planned Behavior with the premise that much human behavior is planned and is therefore preceded by intention toward that behavior. The theory of planned behavior postulates three conceptually independent determinants of intention: attitudes toward the behavior, subjective norms with respect to the behavior, and perceived control over the behavior [30]. Attitudes refer to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question. The second predictor is a social factor termed subjective norm; it refers to the perceived social pressure to perform or not to perform the behavior. The third antecedent of intention is the degree of perceived behavioral control which refers to the perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles. According to this theory behavioral achievement depends jointly on motivation (intention) and ability (behavioral control). An important aspect of the theory is that the behavior is also dependent on such non-motivational factors as availability of requisite opportunities and resources (e.g. time, money, skills, cooperation of others etc.). These factors represent people’s actual control over the behavior.

In the context of entrepreneurship, self-employment is the target behavior and ‘intention’ refers to the state of mind directing a person’s attention and action towards self-employment as opposed to organizational employment [31]. The theory of planned behavior asserts that entrepreneurial intention is dependent on an individual’s attitude toward the desirability of an entrepreneurial career, subjective norms including perceived family expectations and beliefs to perform the behavior, and perceived behavioral control or the perceived ability to execute the intended behavior of entering entrepreneurship.

The theory of planned behavior asserts that intention is an accurate predictor of planned behavior, especially in cases where the behavior is difficult to observe, rare, or involves unpredictable time lags. Entrepreneurial behavior displays these characteristics, which explains why several empirical studies of entrepreneurship have applied the theory of planned behavior to the study of entrepreneurship from a psychological perspective, for example Krueger, Reilly, and Carsrud (2000) [8], Audet (2002) [28], and Souitaris et al. (2007) [31].

Ajzen pointed out later (Ajzen, 2001) [32] that research has shown that a distinction can be drawn between perceived controllability and perceived difficulty of performing a behavior (self-efficacy) and that the latter may be a more important antecedent of intentions and actions; that the relative contributions of attitudes and subjective norms vary across behaviors and subject populations; that other predictors may have to be added to the theory; and that behavior may contain automatic, habitual aspects not accounted for in models of reasoned action.

Shapero’s Entrepreneurial Event Model explains entrepreneurial intention on the basis of perceived desirability, perceived feasibility and the propensity to act, whereas Ajzen’s Theory of Planned Behavior explains intentions by means of attitudes, subjective norms and perceived behavioral control. The two theories overlap to a large extent. Shapero’s perceived desirability and perceived feasibility correspond to Ajzen’s attitudes and perceived behavioral control, respectively. So in both models intentions are explained by willingness and capability.
3.3 Entrepreneurial Attitude Orientation (Robinson, Stimpson, Huefner, and Hunt, 1991)

Robinson and coauthors (1991) [33] described the attitude of the entrepreneur with more than personality and demographic characteristics. These authors generated the Entrepreneurial Attitude Orientation scale that explains the attitude prediction through four different sub-scales (achievement, self-esteem, personal control, and innovation) and three types of reactions (affective, cognitive or conative). Robinson et al. (1991) [33] argue that using attitudes to predict entrepreneurial behaviour can be a more profitable approach than using personality traits as fore-runners of entrepreneurial actions. This view is justified by stating that attitudes are nearer to behaviour than personality traits are. Attitudes are also more domain specific than personality traits. When relationships between attitudes and entrepreneurial behaviour are studied, unexplained variance should therefore be less and the correlation between predictors (entrepreneurial attitudes) and dependent variables (entrepreneurial actions) should be stronger.

Robinson et al. (1991) [33] also indicate that attitudes do change more easily and more often than personality traits. Attitudes can therefore also be changed deliberately to be, for instance, more favourable towards entrepreneurship. It seems to be more viable to change an individual's attitudes than his/her other personality characteristics. More information on entrepreneurial attitudes could therefore be useful when entrepreneurship and the development thereof are important.

Robinson et al. (1991) brought the argument closer to the theoretical lens of planned behavior, claiming that the attitude model of entrepreneurship has ramifications for entrepreneurship education programmes, as attitudes are open to change and can be influenced by educators and practitioners [31].

3.4 Intentional Basic Model (Krueger and Carsrud, 1993)

Krueger and Carsrud (1993) [34] examined the relationship between attitudes and entrepreneurial intentions using a scale to permit greater flexibility in the analysis of exogenous influences, attitudes and intentions. According to this, to start a new business is an intentional process that can be influenced by the attitudes and behavior. This model has developed Shapero’s entrepreneurial event concept further by studying prior entrepreneurial exposure’s impact on entrepreneurial intentions. It treated prior exposure as an exogenous factor, which affects intentions through attitudes, perceived desirability and feasibility. Two different dimensions were used to define entrepreneurial experience: breadth and positiveness. In addition, it offers a mechanism to assess the relative impact of various hypothesized exogenous influences like perceived resource availability.

3.5 Entrepreneurial Potential Model (Krueger & Brazeal, 1994)

On 1994, Krueger and Brazeal [10] defined the Entrepreneurial Potential Model using a socio-psychological perspective and considering that environmental factors (specifically the informal factors like the attitudes towards entrepreneurship) affect the decision to create a new firm. The potential to start a business is defined on three critical constructs: perceived desirability (attitudes and social norms), perceived feasibility (self-efficacy) and propensity to act (stable personal characteristics).

Krueger and Brazeal (1994) suggested that entrepreneurship education should improve the perceived feasibility for entrepreneurship by increasing the knowledge of students, building confidence and promoting self-efficacy. It should also improve the perceived desirability for entrepreneurship by showing students that this activity is highly regarded and socially acceptable and that it can be personally rewarding work [31].

3.6 Davidsson Model (Davidsson, 1995)

Davidsson's Model tested an economic-psychological pull of factors that influence individual’s intentions to go into business. According to this model, intention can be influenced by two elements: (a) the conviction defined by general attitudes (willingness to change, competitiveness, money orientation, achievement, and autonomy) and domain attitudes (payoff, social contribution and know-how), and (b) the current situation [35]. Davidsson pointed out that the challenge for entrepreneurial education is to create an inspirational effect and make it interact with the confidence building that substantive knowledge provides.

3.7 The Cognitive Model (Baron, 1998 and 2004)
According to authors such as Baron (1998; 2004), [36, 37] the cognitive perspective has much to offer in the understanding of the entrepreneurial process. Entrepreneurial cognition is a quite broad concept and may include many different topics. In this sense, Baron and Ward (2004) [38] specifically include the study of entrepreneurial intentions within it. There is still much to be learned to really understand the mental processes leading to the start-up decision.

4 Temporal Entrepreneurial Intention Studies
Several studies have applied intention models to explain the decision to start a firm. However, very little attempts have already been made to analyse the temporal progression in intention (whether intention is stable along time); or the intention-behaviour link [39]. In relation to education effectiveness, changes in attitudes and intentions have been measured. In this sense, Souitaris and co-authors (2007) [31] used a longitudinal design to measure the effectiveness of an entrepreneurship education programme. Liñán and co-authors (2008) [39] have studied the temporal stability of entrepreneurial intention and its motivational antecedents (attitude, subjective norm and perceived behavioural control). It has been found that, even after a substantial time lag, entrepreneurial intention is a strong and significant predictor of the start-up decision. The relevance of understanding the intention-generation process is, therefore, confirmed.

5 Fostering Entrepreneurial Intention Among Engineering Students
Entrepreneurship education is made up of all kinds of experiences that give students the ability and vision of how to access and transform opportunities of different kinds. It goes beyond business creation. It is about increasing students’ ability to anticipate and respond to societal changes. Entrepreneurship education is education and training which allows students to develop and use their creativity, and to take initiatives, responsibility and risks. The role of entrepreneurial education is to turn out a new generation of students who can start new enterprises or renew existing businesses. Fostering a robust entrepreneurial culture will maximize individual and collective economic and social success on a local, national, and global scale. People exposed to entrepreneurship frequently express that they have more opportunity to exercise creative freedoms, higher self esteem, and an overall greater sense of control over their own lives.

Available studies indicate that entrepreneurship courses have a positive effect on student career paths. Dabbagh and Menasce (2006) conducted a study to examine students’ overall perceptions of the engineering profession in a first-year course in engineering, and the effect of a pedagogical approach aimed at exposing students to engineering entrepreneurship and their perceptions of engineering entrepreneurship [40]. Results indicated that students’ overall perceptions of the engineering profession significantly improved by the end of the course. The authors argued that these findings are of considerable interest to engineering schools that want to increase student retention and are looking for novel approaches to assist freshmen in choosing their majors.

Souitaris and co-authors (2007) [31] have studied the effect of entrepreneurship programs on entrepreneurial attitudes and intention of science and engineering students in order to confirm (or disconfirm) conventional wisdom that entrepreneurship education increases the intention to start a business. The results showed that the programs raise some attitudes and the overall entrepreneurial intention and that inspiration (a construct with an emotional element) is the programs' most influential benefit. Basu and Virick (2008) [23] found that prior exposure to entrepreneurship education has a positive effect on students’ attitudes toward a career in entrepreneurship and on perceived behavioral control or entrepreneurial self-efficacy.

6 Conclusion
The decision to become an entrepreneur may be plausibly considered as voluntary and conscious. Therefore, it seems reasonable to analyze how that decision is taken. Available studies indicate that entrepreneurship courses have a positive effect on student career paths. The role of entrepreneurial education is to turn out a new generation of students who can start new enterprises or renew existing businesses. Fostering a robust entrepreneurial culture will maximize individual and collective economic and social success on a local, national, and global scale. In this paper we consider intention (willingness) and personal capabilities as the predisposing factor, the environmental (social) background as the nutrient medium, and entrepreneurial education as the precipitating factor for the entrepreneurial process.
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