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FORMALIZING THE CONCEPT OF ENTREPRENEURIAL CAPACITY

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ABSTRACT

This study develops a definition of the concept of *entrepreneurial capacity* and formalizes it in two models explaining how value is created in the innovation process. The formalization integrates the influential opportunity-based definition of entrepreneurship research offered by Shane and Venkataraman (2000) with the consensus prevailing in the management, strategy, economics and entrepreneurship literatures that innovation is a process for transforming the inherent economic value of new knowledge into realized economic value for identified stakeholders. The linear flow and mathematical models presented in the study possess the clarity and richness required of a theoretical framework for generating and testing insightful hypotheses. This study, regarding Penrose (1959) more as theorist of entrepreneurship than of resources, deepens scepticism about the relevance to entrepreneurship of the literatures on the resource-based view of the firm (RBV) and dynamic capabilities (DC). Finally, the arguments and perspectives of the study imply several pedagogic possibilities and challenges for entrepreneurship educators.

INTRODUCTION

This study is a quest to harmonize and formalize the principal elements of two schools of thought. The first is what might be called the ‘opportunity perspective’ school of entrepreneurship research (Shane and Venkataraman 2000) or the ‘opportunity management’ approach to defining entrepreneurship. The second is what might be called the ‘value school’ of innovation. This is the perspective anecdotally summarized in the phrase that ‘innovation equals invention plus implementation’. More precisely, it is the school of thought that holds that innovation is the process of transforming the inherent potential that is latent in new knowledge into measurable economic value (Rogers 1962; Sundbo 1998: 19). Achieving the desired synthesis of the two schools of thought would establish a formal statement of the relationship between

entrepreneurship and innovation. There is already common ground. In both schools the essential thing that has to be done by the entrepreneurial actor is, implicitly, to design a feasible transformation process. New knowledge must become new value: that *is* the opportunity. Accordingly, my quest in this study translates to a search for a detailed, justified definition of a concept that can describe and explain the ability to *discover*, *evaluate* and *exploit* (the three endogenous aspects of opportunity articulated by Shane and Venkataraman 2000) the opportunity to create value from new knowledge. My ‘candidate’ term is *entrepreneurial capacity*, hitherto used very diversely and imprecisely in the literature of entrepreneurship, management, strategy and economics (Collins, Alison, et al. 2006; Audretsch and Lehman 2006; Kuratko, Ireland et al. 2005; Edwards and Muir 2005; Hindle and Yenken 2004; Bygrave, Hay et al. 2003; Hindle 2002; De Soto 1999; Otani 1996; Merli 1996; Rosen 1972).

DEVELOPING A FORMAL DEFINITION OF ENTREPRENEURIAL CAPACITY

Predicate Perspectives

Innovation as a knowledge transforming and value creating process

The following definition of innovation is typical of the ‘value school’ but not that of a professional scholar. It comes from Katherine Livingstone, a woman who, at the time of penning it, was the CEO of Cochlear, a truly entrepreneurial venture.

I will interpret (successful) innovation as meaning ‘the process whereby new ideas are transformed, through economic activity, into a sustainable value-creating outcome’. (Livingstone 2000: 3).

It is beyond the scope of this paper to attempt to embrace a substantial review of even a small section of the vast, multi-disciplinary literature of innovation. There are multiple perspectives on and definitions of innovation that are often closely related to the particular disciplines. A distillation of the innovation literature in the field of management and economics reveals broad accord for the perspective summarized in Livingstone’s definition. It is fair to say that the management and economics literature contains substantial support for summarising the essential features of ‘innovation’ as follows. Abstracted to a very broad level, value (wealth) creation is the output of a combination of two inputs. First, an item of new knowledge (which is often called by synonymous terms such as ‘invention’, ‘intellectual property’ etc) must exist and be

discovered. Second, *a capacity to transform* that new knowledge (or selected aspects of it) into economic value must exist. Economic value creation results from the *application* of the transformational capacity to the latent value (potential) residing in the new knowledge.

The opportunity perspective on entrepreneurship research

Davidsson (2003, 2004) has distinguished two principal schools of thought within the entrepreneurship discipline: the ‘emergence’ perspective (Katz and Gartner 1998; Gartner 1985, 1989, 1990, 1993) and the ‘opportunity’ perspective (Shane and Venkataraman 2000). The latter argued, following Casson (1982), that the truly distinctive characteristic of entrepreneurship lies not in the act of organisational creation and development but in the management of entrepreneurial opportunities.

We define the field of entrepreneurship as the scholarly examination of how, by whom and with what effects opportunities to create future goods and services are discovered, evaluated and exploited. (Shane and Venkataraman 2000: 218).

Of fundamental importance to the opportunity perspective of entrepreneurship is that entrepreneurial opportunities involve the discovery and evaluation of *new* relationships between means and ends. This is quite distinct from improvement or optimisation within existing means-ends frameworks. Functionally, opportunities are defined as ‘situations in which new goods, services, raw materials, markets and organizing methods can be introduced through the formation of new means, ends, or means-ends relationships’ (Eckhardt and Shane, 2003: 4). Figure 1, originated by Klyver (2005) and developed by the present author, is a device for clarifying the distinctions between the two contending schools of thought on the nature of entrepreneurship.

		Principal Action Focus	
		Creation of new means and ends relationships	Maximising existing means and ends relationships
Organisational Context	New Organisations	(A) Innovation oriented venture creation	(B) Non-innovation oriented venture creation
	Existing Settings	(C) Innovation oriented venturing in existing contexts (e.g. corporate venturing; licensing via markets etc)	(D) Traditional Management

Figure 1 Distinguishing the two main perspectives of entrepreneurship research

Sources: Klyver 2005; developed by the current author.

Figure 1 illustrates two main dimensions distinguishing the emergence view from the opportunity view. Quadrant *D* is not entrepreneurship from either the opportunity or the emergence perspective but the realm of traditional management. The ‘emergence perspective’ as a school of thought embraces activities lying in quadrants *A* and *B*. The ‘opportunity perspective’ embraces activities lying in quadrants *A* and *C*. Clearly the emergence view deems the evolutionary and dynamic aspects of entrepreneurship to be crucial. The focus is on organising activities in a Weickian sense (Davidsson 2003). The opportunity view essentially argues that entrepreneurship is about the discovery, evaluation and exploitation of *opportunities* whatever the organisational mode of pursuit. The opportunity school is thus closely associated with the Schumpeterian tradition (Schumpeter, 1912 and 1942) emphasising entrepreneurship as a disequilibrium activity closely associated with value creation in an innovation process and economic theories of endogenous growth (Romer 1990, Helpman 2004, Warsh 2006).

Getting to the Essence

The four dimensions of entrepreneurial opportunity

Shane and Venkataraman’s (2000) extensive analysis of a large literature led them to classify four principal, essential sub-components of the phenomenon of entrepreneurial opportunity: existence; discovery; evaluation and exploitation. A full discussion of all the ramifications of the theoretical, investigative and pedagogical issues entailed by consideration of the ‘opportunity perspective’ is clearly beyond the scope of the present paper. In particular, there is a massive philosophical debate centred on the association between the existence and the discovery of opportunity. Is the existence of opportunity an objective reality or are all opportunities socially constructed? If the latter is the case, then the distinction between the existence of opportunity and its discovery melts into a continuum (which in extreme social constructionist theories also includes removal of the discrete status of evaluation). Given the constraints of this of this paper, there is presently no space to argue the reasons for my views on this issue. There is only space to state them in stark, summary form.

EXISTENCE. Whether an entrepreneurial opportunity is considered by general theorists to exist objectively (like some nugget in the ground awaiting discovery by a purposive miner) or whether it is ‘socially constructed’ is a moot point from the

perspectives of both the practical strategy of any given entrepreneur in a real-world situation and the theory building endeavours of the theorist seeking to understand and model the essence of an ability 'to do entrepreneurship'. For modelling purposes, the *existence* dimension of opportunity can be treated as an exogenously determined variable. It is in a different category from *discovery*, *evaluation* and *exploitation*. These three are endogenously controllable within the organisational setting containing the entrepreneurial protagonists (e.g. a firm).

DISCOVERY OR EVALUATION? Notwithstanding the work of Fiet (1994, 2002, 2007), discovery of opportunity (in the Shane and Venkataraman perspective), while an essential predicate to an entrepreneurship or innovation process, is a *managerial* rather than an *entrepreneurial* skill and can often be done by someone other than the entrepreneur. Effectively, even if the entrepreneur herself does the discovery, this act is not the true essence of entrepreneurship. Evaluation is the core entrepreneurial skill.

EXPLOITATION. The act of exploitation could feasibly be performed by people other than members of the entrepreneurial team. A really good evaluation (call it a business plan or whatever else you like) possesses its merit because it articulates exactly *what needs to be done* to achieve specified results. The evaluator/planner could die, yet the plan would live and be carried into effect by heirs and successors. The specific skill of evaluation is the most distinctive, the primary, entrepreneurial skill. Because it can be applied in a wide range of cases, it can be thought of as *a specific skill to do general things*. However, many scholars, epitomized by Davidsson (2004), start with Shane and Venkataraman's definition of entrepreneurship research and then promptly modify it or flout it, depending on your point of view. They do this by consciously or unconsciously eliminating 'evaluation' from any detailed consideration¹. They concentrate on discussion and appraisal of 'discovery' and 'implementation'. 'Evaluation' mysteriously disappears. In contrast, I would argue that in determining the *essence* of what entrepreneurs do, in their *capacity* as entrepreneurs, evaluation is both fundamental and distinctive and is, therefore, the most important of the four components of entrepreneurial opportunity. So, at the heart of what might now be called *entrepreneurial capacity* is the ability to evaluate an opportunity: not the ability

¹ Another leading scholar to do exactly this was Zoltan Acs in a keynote address to the AGSE 4th International Entrepreneurship and Research Exchange, in Brisbane, February 2007.

to discover it or exploit it. The question now becomes: is this term, *entrepreneurial capacity*, appropriable? Who has used it before and in what ways? Before considering these in a brief literature review, I will present the reason that the term ‘capacity’ is semantically superior to ‘competence’ and ‘capability’ to describe the core attributes and skills of entrepreneurship.

What’s in a name? What should we call the essence of what entrepreneurs do?

The distinctive core of all meanings of the word ‘capacity’ (Little et al. 1973) is: ‘present possession of future potential to act’. An evaluation process conveys an articulated vision of the path to a different or desired future. Using the term ‘capacity’ with respect to an attribute or a skill possessed by a human being, places the focus on the *current inherent ability* of someone to do something *in the future*, rather than the detailed mechanics of actually doing something right now. So, the term ‘capacity’ involves not only the notion of ability but also the issues of futurity and potential. The appropriate analogy in the natural world is that of potential versus kinetic energy. For example, in the context of hydroelectricity, the components of the energy system are a dam, the water it contains, barriers that hold back the water, mechanisms for opening the barriers and a range of complicated operational artefacts (such as turbines) and distributional sub-systems (such as pipelines) for deriving value from the water as it is converted from stored potential to kinetic realisation. The hydro dam example helps clarify and distinguish the primary from the secondary and lower-order components of any system. In thinking about a hydro dam as a part of an energy system, we speak about the ‘capacity’ of the dam (its ability to hold water for future release). We measure it in litres. The water in the dam at any given time is a percentage of full capacity. The percentage of total capacity available for deployment is a truly fundamental issue for the functioning of the system². The first of many constraints in the hydro system are literally called barriers: the gates whose setting will determine the possible volume of water that can flow in any period. For the purposes of the current study, the value of this analogy is its starkness. It shows that the primary determinant of the efficacy of any kinetic result, once barriers have been removed, is the stored potential of the essential ingredient. It is the water in the dam: not the intricacy of the

² The basic mathematical innovation process model presented in the next section of the paper will employ a measure of total entrepreneurial capacity as a fundamental system component.

pipings system or any other network of sub-systems. In the entrepreneurship context this translates to focusing on the entrepreneurial capacity of the essential human actors.

Summary literature review of extant definitions of entrepreneurial capacity

Systematic investigation has revealed that the term ‘entrepreneurial capacity’ appears intermittently and unsystematically within the literature of economics, management and entrepreneurship research, but is not yet fully explored, developed or defined as a unique or specialized term within any field. So, the ‘good news’ for this study is that the term is appropriate: no scholar has hitherto closely argued a substantial, evidence and logic based case for use of the term with detailed specificity. Even better news is that the majority of extant definitions of entrepreneurial capacity are highly compatible with the arguments and eventual definition produced in this study. Only 11 of 78 scrutinized works provided either a direct definition of the term ‘entrepreneurial capacity’ or a deep enough discussion for a definition to be inferred. These definitions and discussions included both pattern and diversity, as illustrated in table 1.

Table 1 Works offering argued definitions of entrepreneurial capacity

Author(s)	Definition
Collins, Smith, Hannon (2006)	EC constitutes the basic necessary and sufficient conditions for the pursuit of effective entrepreneurship behavior: individually, organizationally, and societally, in an increasingly turbulent and global environment.
Audretsch, Lehmann (2006)	Accessing and absorbing ideas generated externally from other firms and knowledge sources, such as universities and research institutions is an EC.
Kuratko, Ireland, Covin, Hornsby (2005)	EC is the ability of middle-level managers to endorse, refine, and shepherd entrepreneurial opportunities and identify, acquire, and deploy resources needed to pursue those opportunities.
Edwards, Muir (2005)	Learning is a factor in EC and is defined as having the relevant skills that prepare individuals for venturing.
Hindle, Yencken (2004)	EC is the experience and skills of the entrepreneur, both as a manager of new technological ventures and possibly also from his familiarity with the business sector in which the venture will operate; nature of entrepreneurial capacity inputs will be different for the different phases of a new venture’s development.
Bygrave, Hay, Ng, Reynolds (2003)	EC was determined by answers to the following: ‘You have to the knowledge, skill and experience to start a new business’.
Hindle (2002)	EC which, in any innovation process (‘Big-I’ innovation), is the principal mechanism for transforming new knowledge (‘small-i’ innovation) into economic value.
De Soto (1999)	EC is a requisite skill and nature within human beings to understand and respond to market processes (Austrian School). POPE JP II: "creative human action as the decisive factor in society".
Otani (1996)	EC is determines the long-run size of the firm, but is a black box, or a gift, an exogenous parameter which is beyond economic explanation or evaluation. the concept of EC is formulated as a kind of human capital based on Hayek and Coase. Lucas (1978) considers EC as an innate exogenous talent that is heterogeneous amongst individuals. OTANI assumes that EC is also exogenous but an acquired ability, and assumes that individuals are homogenous and that only capital goods are heterogeneous. It is the knowledge of the manager that directs resources to the most profitable choice of uses.
Merli (1996)	Conceptually, operating effectiveness can be thought of as EC applied to

Rosen (1972)	managing; to choose the real priorities of the business, to be coherent in their pursuit, and to be effective in their achievement. EC defines the decision making abilities of managers in the firm constrained by scales of economy; if knowledge vested in owners, market value of firm is zero in absence of owner/entrepreneur; specific knowledge vested in firm, asset is transferable, and realized in market value.
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No author has yet formulated their definition or treatment sufficiently to produce a framework or model, sharp enough to inform research via theoretical or empirical studies. On the basis of the arguments developed in this study, I now proceed to do so.

Synthesis: A Formal Definition of Entrepreneurial Capacity

In light of all the preceding arguments, I offer the following definition.

Entrepreneurial capacity is the ability of individual or grouped human actors (entrepreneurial protagonists) to evaluate the economic potential latent in a selected item of new knowledge, and to design ways to transform that potential into realizable economic value for intended stakeholders.

Several key words in the definition are laden with consequences for entrepreneurship research and education.

Ability – from the point of view of the human actor, ‘ability’ has both exogenous (legal, political, social, competitive) and endogenous (calibre of internal human and physical resources) components.

Individual or grouped human actors – Gone from this definition is any emphasis on particular organisational configurations including even that vague abstraction, ‘the firm’. In short, for the fundamental conceptualisation and formulation of entrepreneurial capacity, being ‘human’ is vital, having a set of skills relevant to the transformation process is vital but being in a firm, or creating one is not. This distinguishes the current definition of entrepreneurial capacity from both the emergence perspective in the entrepreneurship literature and the resource-based view of the firm (and associated discussions of ‘dynamic capabilities’) in the economics, management and strategy literatures. (Cf. the discussion section, below).

Evaluate – Evaluation, the quintessential entrepreneurial skill, can be thought of as a *specific* skill to achieve a generalizable outcome. To evaluate in entrepreneurship is to conceptualize and plan whatever may be needed, in particular circumstances to turn the dollar profit potential of new knowledge into actual profits.

Economic potential – The use of this term clearly positions the kind of entrepreneurship being envisaged as a for-profit activity in a free market

environment. The definition is amenable to amendment and development to produce variant definitions suitable to different aims and particular contexts (e.g. social entrepreneurship; Indigenous entrepreneurship; regional entrepreneurship etc)

Selected item of new knowledge – The past tense of ‘selected’ is significant. It downplays the *relative* importance (relative to evaluation) of both the existence and the discovery of an opportunity and clearly distinguishes the entrepreneurial function from the inventing (new knowledge creation) function.

Latent – This word stresses that new knowledge in and of itself may have no commercial value. It is the entrepreneurial act, i.e. the application of entrepreneurial capacity, that is the creative force in the value-creation process.

To design – The result of an evaluation is a design for action, not the action itself. The possession of capacity is not a guarantee of action. However, without design, in the sense of conscious articulated purposiveness, action is likely to be misdirected and ineffective. This again emphasizes the primacy of evaluation over exploitation.

Ways – This is a vague, general, plural term and deliberately so. It indicates that entrepreneurial capacity can be achieved via a wide variety of paths. Context and versatility will always be important.

To transform – The essence of value creation via entrepreneurship is knowledge transformation. A potentially good idea, (piece of new knowledge, intellectual property, prototype, etc) is developed and transformed to a commercial reality.

Realizable – The futurity of this adjective is deliberate. Entrepreneurship involves a future orientation and the quest for knowledge transformation and value creation is always of uncertain outcome. There is no guarantee that value will be realized.

Economic value – This is the ‘dependent variable’ of the innovation process.

For intended stakeholders – First, this phrase indicates that this definition has a micro economic focus. Macroeconomic consequences, such as endogenous growth of the economy as a whole (Schumpeter 1912 1942; Romer 1990; Helpman 2004; Warsh 2006) are, from the point of view of the entrepreneur, by-products not first-order issues. Second, the phrase implies that there may be consequences for non-intended stakeholders and that there is an ever-present risk of a significant value of the transformation process being appropriated by competitors of various kinds.

A NEW BASIS FOR MODELING VALUE CREATION

This section of the paper extends the formalization process beyond the definition of entrepreneurial capacity to the modelling of the general system of value creation in the innovation process featuring entrepreneurial capacity as the driver of that process. First, I present a basic linear flow model. Second, the generic ingredients for mathematical modelling using the conceptual schema of this study are presented and illustrated through creation of a simple, highly-abstracted model: the innovation process function.

A Linear Flow Model

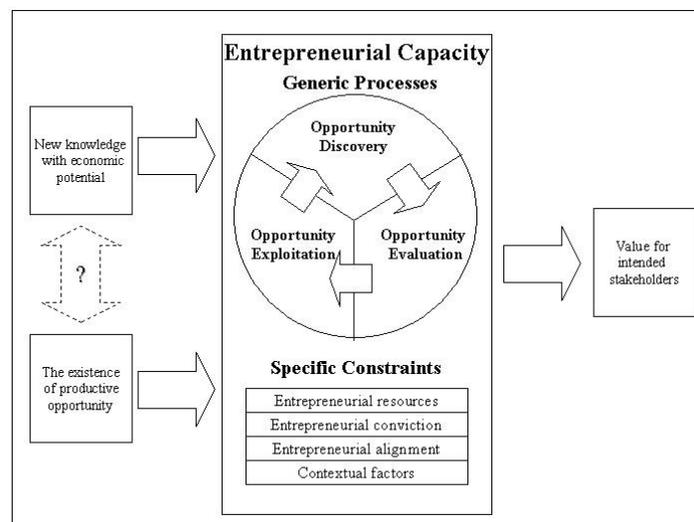


Figure 2. A linear flow model of value creation in the innovation process

The upshot of all arguments delivered in this study so far amount to this. Where an opportunity exists, the *application* of available entrepreneurial capacity can convert the latent economic potential of new knowledge to measurable economic value. The linear flow model, figure 2, represents the value creation process.

Given the existence of productive opportunity and the existence of a particular piece of new knowledge (invention, intellectual property, prototype etc), the *application* of entrepreneurial capacity by an entrepreneurial individual or team produces a valuable outcome for intended stakeholders. The dotted double-headed arrow with a question mark symbolizes that there sometimes may be a direct link between the existence of productive opportunity (fundamentally an overt or latent demand for

some development or application of the new knowledge) and the new knowledge itself. Within the boundaries defining the entrepreneurial team (for instance, a firm) there exists a degree of entrepreneurial capacity (as defined in the previous section). In any given instance of a value-creating innovation process, entrepreneurial capacity has both generic and specific components. It may be thought of as embracing three generic process capacities and four specific categories of circumstantial constraint. The generic process capacities are those, following Shane and Venkataraman (2000), discussed at length in previous sections of this article: discovery, evaluation and exploitation, of which, the most important is evaluation. The four categories of specific circumstantial constraint are: resources, conviction, alignment and any other contextual issues.

‘Resources’ are any and all resources, required for a successful transformation of the potential inherent in the new knowledge into a realized economic value. For instance, the evaluation process might recognize and develop a superb original business model for building a revolutionary ‘world car’ of very high quality and very low price. The concomitant resource set either controlled now or that must be acquired would have to include massive plant capacity to realize economies of scale. The ‘entrepreneurial conviction’ constraint recognizes that a great plan (the result of a detailed evaluation) will be useless unless the people charged with executing it are convinced of its desirability and feasibility. The ‘alignment’ constraint refers to the degree of matching or ‘fit’ between the skills and resources of the entrepreneurial team and its allies and the specific nature of the task³. These three constraints will apply in all cases of an innovation process. Other constraints will be specific to circumstances (e.g. political constraints on the freedom of economic action will vary from country to country; different industry settings will impose different priorities, etc). The conceptual model depicted in figure 2 can be operationalized using appropriate constructs, variables and measures and can thus serve as a useful theoretical framework to inform a wide range of empirical studies.

³ This paper lacks space to develop any the concepts and relationships of the model in any detail. In particular, I would like the scope to explain where my concepts of entrepreneurial ‘conviction’ and ‘alignment’ agree and disagree with some of the arguments advanced by Sarason, Dean and Dillard (2006). A longer, post-conference version of the paper will address all elisions.

Mathematical Modelling: Generic Components, a First Example and Future Potential

Formalising the elements of any generic mathematical model

The arguments developed in this study lend themselves very well to formulation for various kinds of mathematical modelling. Seven generic components will underpin any such mathematical modelling process based on the definition of entrepreneurial capacity and its role in the innovation process that I have introduced in this paper.

(1) The result of any formal model of value creation in the innovation process might be termed ‘the micro economic value of a given innovation process’ or, more briefly, ‘innovative value’. Determination of this value is the *raison d’être* and endpoint of the mathematical exercise. It may be thought of as the micro economic net profit resulting from the innovation process appropriable by the initiators of the process. As discussed at length above, it is a function of: the potential value of the new knowledge; the entrepreneurial capacity of economic actors consciously seeking to create value for themselves; the receptivity of the environment (what Penrose [1959: 31-42 and *passim*] called the ‘productive opportunity’ conditioning the receptivity of the market to the application of ‘entrepreneurial services’).

(2) The model will require, as an input or inputs, one or more measures of the maximum conceivable (or estimable) value of the particular piece of new knowledge (intellectual property, new combination, etcetera, as discussed above) at the heart of the particular innovation process. This measure or measures will represent the entrepreneur’s estimates of all *potential* value *inherent* in all conceivable value-creating transformation processes that could possibly be applied to it, not only by the original entrepreneurs but also by all other stakeholders whatsoever.

(3) The model will need, as a *predicate*, one or more measures to represent the total productive opportunity⁴ available in the total market place over time. This may be thought of as a bounded estimate, articulated by a single entrepreneur or entrepreneurial team, of the maximum *realizable* value *achievable* in all conceivable transformation processes applicable to a given piece of new knowledge for as long as any value can be derived from it. This includes not only value realizable by the original entrepreneurial

⁴ The notion of ‘productive opportunity’ here and subsequently expressed is effectively identical to Penrose’s (1959: 31-42 and *passim*) use of the term.

protagonists, but by all other stakeholders whatsoever. It will amount to a measure of total market opportunity realizable by all players as a predicate to determining what percentage of this total that the entrepreneurial protagonists can capture.

(4) The model will require, as an input or inputs, a measure or measures of the *productive opportunity available to the original entrepreneurial protagonists*. This can be thought of as a bounded estimate, articulated by a single entrepreneur or entrepreneurial team, of the proportion of total productive opportunity realisable by them as distinct from any other economic actor. Crudely, it will be the estimate of the maximum percentage of all productive opportunity that the original entrepreneurial protagonists can hope to capture given the most sanguine of their forecasts.

(5) The model will require, as an input or inputs, one or more measures of *entrepreneurial capacity*, as discussed and defined in this article.

(6) The model will need to cater for temporal effects. The transformation of new knowledge potential to realized economic value does not take place instantly. It occurs over time through what may be thought of as an entrepreneurial opportunity cycle, which may be thought of as the iterative application, by the original entrepreneurial protagonists, of entrepreneurial capacity to productive opportunity. Each iteration constitutes a phase of the cycle. Iterations terminate either by exhaustion of the value potential inherent in the new knowledge or evaluation of a replacement opportunity.

(7) The model will have to articulate both the endogenous and exogenous limitations and constraints affecting it. In particular, relevant exogenous constraints may be thought of as the ‘entrepreneurial environment’ defined as ‘the set of resources and their potential services which provide objective limits both to the total productive opportunity potential of any new knowledge and to the firm’s ultimate entrepreneurial capacity.’ These objective limitations will restrict any entrepreneurial process (and the resultant value achievable from it) irrespective of protagonists’ entrepreneurial capacity. Endogenous constraints will affect entrepreneurial capacity itself.

The generic tasks and components of any formal mathematical model of the innovation process as articulated and developed in this paper can thus be summarized as follows. Within a given entrepreneurial environment, the iterative process of converting the latent potential inherent in a selected piece of new knowledge is a function of: the total

conceivable value of that new knowledge; productive opportunity; and entrepreneurial capacity.

Illustration of mathematical modelling potential: a highly-abstracted, simple innovation process function

EQUATION 1 THE INNOVATION PROCESS FUNCTION

$$V = k \sum_{n=1}^f (\Omega_n E_n)$$

Where:

‘V’ is the net present value of a completed, multi-period, innovation process.

‘n’ is the number of periods in the entrepreneurial opportunity cycle.

‘f’ is the number of the final period of the entrepreneurial opportunity cycle.

‘k’ is the estimated net present value of the total productive potential of the new knowledge (invention, intellectual property, etc, as discussed above).

‘ Ω_n ’ is the proportion of all the productive opportunity available to the entrepreneurial protagonist(s) that is potentially realisable in period n.⁵

‘ E_n ’ is an estimate of *the proportion the firm can actually achieve* of all the entrepreneurial capacity required for full realisation of Ω_n in period n.

Utility of the simple model and potential for future mathematical modelling

At first glance, the utility of a mathematical model of such generality and simplicity is not obvious. However, Hindle (2002) has demonstrated its efficacy as a tool of policy analysis, using three cases drawn from the model (first case: $V = k$; second class of cases: $V < k$; third case: $E_n = 0$) to criticize and suggest improvements to the national innovation system of Australia. Other applications abound. Furthermore, this first model is a beginning not an endpoint. The conceptual framework developed in this

⁵ A key concept is the entrepreneurial team’s estimate of its productive opportunity: ‘ Ω ’. This is the proportion of the *total* productive opportunity (i.e. the productive opportunity available to all players through all time periods) that the entrepreneurial team expects to be able to realise over the full duration (all periods) of the innovation process, as they perceive it. Total productive opportunity, for all entities – the entrepreneurial team’s and other entities capable of exploiting any value from the innovation process based on ‘k’ - is always measured as unity; 100 percent. Thus if an entrepreneurial team expects, over all time periods, that the maximum share of the total productive opportunity that it could possibly hope to exploit would be 80 percent, the value of Ω for the team would be 0.8. If, say forty percent, of Ω was expected to be achieved in period one then Ω_n would be $0.8 \times 0.4 = 0.32$.

article is capable of serving as the basis for development of a range of specialized mathematical instruments, including equilibrium and econometric models. The author, and colleagues, hope to produce many more sophisticated models as tools of analysis in the near future and we hope others will find the underlying schema developed here sufficiently stimulating to serve as the basis for a wide variety of model production .

DISCUSSION

Key Implications for Entrepreneurship Theory and Research

Balancing the ‘emergence’ perspective: the ‘opportunity’ view of ‘what they do’

Part of the motivation for the quest pursued in this article was desire to provide the opportunity perspective school of entrepreneurship research with a parsimonious counterpart to the emergence perspective school’s core question: what do entrepreneur’s do? The answer has been provided. Whereas, in the emergence perspective, entrepreneurs create new ventures, in the opportunity perspective, they transform new knowledge into economic value. Neither answer has a moratorium on wisdom but, given the very distinct differences between the two major schools of thought about the essential nature of entrepreneurship, it is fair to say that two answers to the question are better than one.

Revisiting Penrose and followers: featuring entrepreneurship not resources

The inspiring economic theorist Edith Penrose (1959) never personally talked about the ‘resource-based view of the firm’ (RBV) or ‘dynamic capabilities’. She did use two other phrases: ‘innovative capabilities’ and ‘entrepreneurial services’ (1959: 31, 35 and *passim*). In my view, any consideration of Penrose should place more emphasis on her role as definer of entrepreneurship than most users of her work are inclined to do. She wrote that the term ‘entrepreneur’ referred:

... to individuals or groups within the firm providing entrepreneurial services, whatever their position or occupational classification may be. Entrepreneurial services are those contributions to the operations of a firm which relate to the introduction and acceptance on behalf of the firm of new ideas

Entrepreneurial services are contrasted with managerial services, which relate to the execution of entrepreneurial ideas and proposals and to the supervision

of existing operations. The same individuals may, and more often than not probably do, provide both types of services to the firm. (Penrose 1959: 31).

This definition strongly accords with the definition of innovation as a process of creating new value by transforming knowledge (Rogers 1962, Livingstone 2000). To adopt Penrose's definition wholeheartedly, one needs only note that it has one non-obvious and one obvious virtue. First, her characterisation of entrepreneurship as future-oriented value creation is not restricted to existing firms as a superficial reading may indicate. It encompasses organizational emergence – i.e. the creation of new firms - as a particular case of the general proposition. Garnsey (2002) has discussed the application of Penrosian ideas to new venture creation and the non-firm context. Second, Penrose, in the quoted passage, also embraces an opportunity-oriented perspective of entrepreneurship. Her distinction of managerial and entrepreneurial services, even if performed by the same person, informs my argument for the primacy of new knowledge *evaluation* as the dominant component of entrepreneurial capacity, without in any way belittling the importance of organisational context and issues. So, the possibility of an eventual synthesis of the two contending perspectives on entrepreneurship – the 'emergence' and the 'opportunity' schools - may lie in re-consideration of Penrose as an entrepreneurial theorist rather than a resource theorist – a task that is beyond the scope of the current paper.

I am unconvinced by most post-Penrose arguments in the prolix literature of the 'resource-based view of the firm' (RBV) and 'dynamic capabilities' (DC). RBV-DC attempts to embrace *every* resource, physical, human and organizational (Eisenhardt and Martin 2000:1107) that might ever be involved in any strategic process. This it seems to me, returning to the hydro dam analogy developed earlier in the article, is akin to talking too much about the barriers and the pipe-work and too little about the capacity of the dam and the current volume of water in it. Zahra, Sapienza and Davidsson (2006) have endeavoured to establish a better fit between entrepreneurship and the dynamic capabilities literature. However, their effort is still confronted by the sheer, plural volume of 'capabilities', spanning every form of resource and the inescapable, non-entrepreneurial fact that RBV-DC is predicated on the importance of routines and the existence of already-controlled resources in an already-existing firm.

This militates against success. The first sentence they write in their article is for me, their best sentence:

The emergent literature on dynamic capabilities and their role in value creation is riddled with inconsistencies, overlapping definitions and outright contradictions. (Zahra, Sapienza and Davidsson 2006:917)

In contrast, the definition of the concept of entrepreneurial capacity and its formalization in two models of how value is created in the innovation process offered in this article is derived from and consistent with both the opportunity based definition of entrepreneurship research and mainstream consensus on the nature of innovation as a value creating process. This paper has presented three research tools: a linear flow model, a set of principles for mathematical modelling and a particular example based on these principles. These tools offer both the clarity and the richness appropriate for use as a theoretical framework to generate and test insightful hypotheses. The flow model is highly amenable to operationalization.

Key Implications for Entrepreneurship Education

The major vocational implication and attendant issues

From the point of view of teaching and learning specifically *entrepreneurial* skills (as distinct from *management* skills which both managers and entrepreneurs need to have), the main point of the conceptual formalization performed in this article is as follows. In getting at the entrepreneurial essence, it matters less *who* you are; or *where* you are (in a ‘firm’, in solo circumstances etc); or *what* you ultimately do (i.e. what implementation/exploitation path, such as new venturing, is eventually adopted). The distinctive, generic attribute of entrepreneurial capacity is *how you conceive of what to do*. That is what ‘evaluation’ means. In a highly reductionist sense this indicates that the essential entrepreneurial capacity lies in the ability to design a business model and conceive of an efficacious plan for implementing it.

A business model is a well-articulated plan for turning effort into profit using identified resources and stakeholders. (Hindle 2004: 275)

Accordingly, a teacher seeking to impart entrepreneurial capacity to students could safely start the first lecture on the first day with the following statement.

‘Good morning class. In this course you are going to learn the general principles of how to design a business model – by which I mean a way to make money out of the opportunity associated with any good idea or new knowledge. Once you can do this,

you will have the capacity to be an entrepreneur, whether or not you ever choose to become one. If someone ever asks you, “What do entrepreneurs do?”, you can answer: “They design business models”. Now, let’s get started.’

It has been said that the end of all our journeys is to arrive at where we first began and know it for the first time. The definition of entrepreneurial capacity developed in this article portends enhanced status for pedagogic approaches that stress opportunity evaluation and business planning as crucial skill sets. Teaching the skills of entrepreneurial business planning has always been a staple of the majority of entrepreneurship education globally. The justification for this approach has been based on anecdotal and inertial factors to a greater extent than formal conceptual reasoning. Moreover, in recent times, the value of emphasizing the business plan as a both a skill set that needs to be acquired and a pedagogic device for entrepreneurship education has been questioned quite trenchantly (Hindle and Mainprize 2006). It can now be argued with greater conviction that educators trying to teach the core vocational skills of entrepreneurship were right all along to emphasize opportunity evaluation and entrepreneurial business planning. To test this argument, the linear flow model presented in this article has substantial potential to be employed as the theoretical framework for research aimed at quantitative comparison of the performance and efficacy of various entrepreneurship education courses and programs.

Vocational transcendence issues

Hindle (2007) has provided a detailed argument that entrepreneurship education in a university context must be about more than mere vocation. He adopts the philosophy of A.N. Whitehead (1929), arguing that a student who learns to see aspects of the universal in the deep study of the particular can grow as a whole person, and not remain merely the practitioner of a specialized economic function. Very much in this vein, De Soto (1999) argues that entrepreneurial capacity (on the moral authority of no less a figure than the late Pope John Paul II) is an important human attribute, which when developed, can help to show that ‘[economic] efficiency and [social] justice, far from being a trade-off, appear to be two sides of the same coin’. Imaginative reflection upon the arguments entailed in a structured endeavor to understand entrepreneurial capacity may bring transcendent benefits to the student as a person and society as a whole.

CONCLUSION

The formulations presented in this article take the emphasis in entrepreneurship off ‘the doing’ and put it squarely on the ‘capacity to do’. One may have the ability to play the piano brilliantly without ever choosing to exercise that ability in public or become a professional musician. Musical capacity is different from musical performance. What is certain is that if you lack musical capacity you will not play any instrument well if you ever do decide to perform in public. So it is with entrepreneurial capacity.

It can be argued that computers are generally good at solving specific problems, not specifically good at solving general ones. In the world of chess:

Deep Blue [the first machine ever to beat a world chess champion] did not learn to play chess from experience. It was painstakingly programmed with thousands of “tactical weighting” errors devised by human experts. So, whenever it selected a move, it used these to work through multitudes of possible options and their possible responses. No one is quite sure how Mr Kasparov’s [the world chess champion at the time] processor operates but it certainly does not do that. One theory goes that the human brain recognizes strategic positions in a general way, and that this helps to reduce the problem to a manageable size. (The Economist 2007: 73)

When it comes to entrepreneurship it seems to me that the ‘dynamic capabilities’ portrayed in conjunction with the resource based view of the firm in an ever-burgeoning literature resemble a ‘laborious set of routines that convey the ability to ‘work through multitudes of possible options and their possible responses’. And hey! This stuff works. After all, the machine beat the man. But chess is not life. Laborious, routine procedure may not always be an option in the time-poor, complicated arena of commercial life where many variables are not measurable let alone programmable. As a general statement it is fair to say that a person possessing the specific skill to evaluate entrepreneurial opportunities will have the capacity to adapt this specific skill to a wide variety of new knowledge and circumstances, just as Mr Kasparov can use his specific skill as a chess grandmaster and adapt it to a wide variety of actual positions on the chessboard. There is surely a place for the entrepreneur who has the capacity to be specifically good at solving general problems rather than generally good at solving specific problems. This is a human capacity that machines do not yet share.

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