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INTEGRATING INNOVATION: FRAMEWORKS FOR ENTREPRENEURIAL LEVERAGE

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ABSTRACT

Understanding the process by which innovations are adopted is a lucrative skill for entrepreneurial organizations. In practical terms accepting new ideas requires a fundamental framework which enables entrepreneurs to recognize the potential of opportunities early in the development process. Such a framework would then enable interactions and negotiations to be strategically directed for maximum entrepreneurial leverage. A model is presented here which recognizes the socio-cognitive framework for entrepreneurial leverage and innovation adoption as enacted in the acceptance and integration of emerging technologies in the Australian biotechnology industry. By recognizing the key attributes of such frameworks and further developing those processes that are conducive to entrepreneurial leverage, entrepreneurs and their organizations will be better placed to ensure the effective uptake and integration of innovation opportunities.

INTRODUCTION

Entrepreneurs face unique challenges in gaining the recognition and acceptance of key stakeholders as they introducing new ideas and innovations into the organizational agenda. To support the new product development process and enable successful integration of innovations they must adopt appropriate patterns of interactions and relationships with potential sponsors to facilitate early idea sanction. In examining and the integration of innovation, it appears the socio-cognitive influences and affects of entrepreneurial activities tend to be understated as an inevitable and an intuitively negotiated feature of innovation uptake. A framework supporting entrepreneurial leverage is presented here which acknowledges the inherent and fundamental fact that humans organize socially (Nicholson, 1998) and rely on that organization to guide their interactions and opinions.

Evidence from the Australian biotechnology industry is presented here which further advances the relevance and importance of entrepreneurial interactions in the integrating innovation and new ideas into organizations. There are clearly subtle and implicit parameters such as tacit expectations, routines, norms¹ and standards of behavior that arise as a result of the socio-psychological bonds of interpersonal interactions and political processes (Jagtenberg, 1983; Ring, 1992) and are shared through a community of practice (Seely Brown, 1991) among practitioners in the industry. The concept of an integration framework as a mechanism for entrepreneurial leverage and a tool for strategic interactions is subsequently deduced.

¹ “Norms, organizational conventions or rules governing legitimate or appropriate conduct play a very important role in underpinning the actions of individuals” (Jones, 2000)

Da Silveria, (2001) suggests the decision to adopt an innovation may be motivated by three reasons; rationalization, competitive pressures and threat of redundancy. Either way, the uptake and diffusion of new ideas are a fundamental part of the integration of innovation and depend largely on the existence of progressive collaborative agreements (Shan, 1994). Barley, (1997) similarly defined the set of interactions supporting technology integration as ‘institutions’, and noted these as the historical practices and understandings that set the conditions for particular actions. The process of institutionalization is also described by DiMaggio, (1983) as consisting of 1) increased interactions, 2) the emergence of structures of control and patterns of coalition, 3) increased transfer of information and 4) the development of awareness among participants.

This paper presents the concept of an intangible framework that can facilitate entrepreneurial leverage of new ideas and innovations through the establishment of recognized practices, norms, routines and conditions and that these structures facilitate risk reduction and stable relationships. This socio-cognitive framework of innovation acceptance and integration is seen an important structure that underlies organizational and stakeholders’ relationships and interactions, and one which is recursively informed and reflexively adapted. Evidence is presented from the Australian biotechnology industry which reveals that both tacit and explicit organizational and socio-cognitive structures provide a framework for innovation integration which supports entrepreneurial activity through the recognition of consensual and negotiable norms and practices. A framework of innovation integration is developed that enables the diverse influences of the entrepreneurs relational and contextual environments and their complex

interactions to be recognized and considered as fundamental to a dynamic recursively informed framework.

The paper is organized into five sections. This first section outlines the concept of an integration framework and introduces literature on its social and relational basis. The following section builds on this introduction with a meta-paradigm analysis of literatures which support the theoretical validity of the framework. The empirical methodology is presented subsequently in the third section and outlines the scope of the research in the Australian environment as well as the process of qualitative data collection through semi-structured interviews with bioindustry personnel. The method of qualitative thematic analysis and interpretation is then discussed with reference to the deduced framework of innovation integration in the Australian bioindustry. These results are then considered in the penultimate section. Insights are drawn for consideration by entrepreneurs in bioindustry organizations and other high technology industries as well as practitioners involved in the integration of innovations generally. The paper ends with a brief conclusion outlining the contributions to both theory and practice.

THEORETICAL ISSUES

A framework facilitating innovation integration is a challenging concept for entrepreneurs and academics alike. An open systems approach has been acknowledged by Dismukes, (2004) as important in such a process to enable the diversity of changing stakeholders to be accommodated. Merrifield, (2004) refers to the use of a “disciplined” stage gate model early in the process of technological development however simultaneously acknowledges the lack of ‘intrapreneurial’

ability in connecting the organizational research lab's with their business operations. Rogers, (2002) stages of innovation diffusion (knowledge, persuasion, decision, implementation and confirmation) extend the traditional decision making models with its specific application to innovation. These models all provide a simplification of the integration process and while in some cases attempting to express the complexity of interactions and stakeholders they generally fail to fully express the reciprocal, recursive and reflexive social processes that underlie the acceptance and integration of innovations.

Simon (2003), in exploring how to best organize for radical innovation, notes the ability to engage senior staff as a significant challenge in supporting successful innovation. Frameworks of social organization, community process, interpersonal associations and professional politics (Nicholson, 1998; Seely Brown, 1991; Ring, 1992; Jagtenberg, 1983) provide an established basis in the literature for developing a framework for innovation acceptance that acknowledges the dynamic socio-cognitive process of integration activities. Deeds (2004), writes extensively on the importance of socio-political and cognitive legitimacy in ensuring the flow of capital and resources in high technology organizations however limits the focus to organizational and industry legitimacy, and mentions technological legitimacy in passing. In that paper legitimacy is acknowledged as the conformation to accepted standards, principles, rules and norms however it too overlooks the importance of the fundamental legitimacy of the entrepreneur and primary stakeholders in the technology integration process.

The underlying social thesis in the integration framework presented here acknowledges both explicit engagement protocols as well as tacit cognitive

structures provide the strategies of association, interaction and relating that guide or facilitate stakeholders' interactions in the integration of innovation and new ideas. To further develop this social platform underlying innovation acceptance a cross-paradigm analysis was conducted across a number of bodies of literature relevant to innovation activities and a process of meta-triangulation of key themes in these literatures was undertaken (Lewis, 1999).

Multiple bodies of literature contribute here to a corpus of knowledge supporting the concept of integration frameworks supporting innovation adoption. Collectively examining these literatures creates 'simulated ecology of interacting theoretical paradigms' (Sterman, 1999). This is meta-paradigm approach to literature review which produces an intellectual nexus for understanding the socio-cognitive complexity of interactions by stakeholders and organizational entrepreneurs engaged in innovation activities. Convergent disciplinary perspectives distilled from these multiple theoretical contributions are condensed through meta-triangulation (Lewis and Grimes 1999). This approach is in keeping with recognition that the complexity of organizations creates inevitable theoretical paradoxes and so comparative analysis and juxtaposition of disciplinary perspectives provide a constructive approach to building theoretical rigor and generating insights (Poole, 1989). The result is a comprehensive understanding of the dynamic influences, activities and processes that stakeholders engage in during the integration of innovation and new ideas. This type of meta-paradigm inquiry has considerable potential for extending understanding of complex and paradoxical organizational phenomena such as interactions and relationships. It enables parallel but disparate theories to be integrated and examines

complementary themes by recognizing theoretical similarities, parallels and inter-relationships as conceptual conjunctions (Lewis and Grimes 1999).

Literature was examined in areas such as technology commercialization and transfer, research collaboration and commercialization, knowledge management, relational marketing (new product development) and the uptake and diffusion of innovations to provide a robust academic foundation to support the concept of innovation integration and acceptance as a framework of entrepreneurial leverage.

What is revealed from this theoretical cross examination is that intangible frameworks of social interaction and understanding are vital to validate, legitimize and facilitate the interactive process of stakeholders' in developing their entrepreneurial relationships and the establishment of frameworks that support and guide entrepreneurial interactions in the process of innovation leverage.

Logically this level of interaction hardly requires deduction however the strategic significance in understanding the process of innovation integration and technology acceptance provides a fundamental and powerful tool for entrepreneurs and organizations seeking to advance the establishment of their technological and innovative capabilities.

The literature presented here provides the foundation for the research question, 'what are the socio-cognitive process of innovation integration' and further 'how can that process be developed to facilitate entrepreneurial leverage and advance innovation integration activities'. Using inductive theory building, insights from the literature suggest that the frameworks that guide stakeholders' interactions in the process of innovation integration are both consciously and subconsciously

deduced through reference to existing implicit and apparent norms, standards, practices, protocols and regulations.

The proposition, ‘that the established routines, practices, norms and standards of various organizational stakeholders can facilitate or impede the integration of innovation’ is raised. Indeed, a recurrent theme in the literature of inter-organizational relationships is the significant role of relational capital (Kale, 2000; Witkowski, 1999; Grönroos, 1999; Johnston, 1999; Stuart, 2003) as an informal and implicit control mechanism through which actions such as trust, reciprocity and commitment (Larson, 1992; Dodgson, 1996; Gulati, 1995; Ring, 1992) establish the bounds of relational practice. Such cognitive structures are derived from scientific, historical, organizational, professional, political and industry contexts and experiences (Jagtenberg, 1983; Tushman, 1992) as well as the ever-present and dynamic social environment, and are formed, reinforced and modified through repeated interaction (Grabher, 1993). This process of recursive and reflexive adaptation of the interaction framework is emphasized in model of innovation integration and acceptance presented here as a fundamental part of an enabling paradigm of innovation integration.

Mesthene (1969) observed that the creation of new opportunities in technology and science appears to require “the emergence of new values, new forms of economic activity, and new political organizations”, but also that this new system of values and organization “poses problems of social and psychological displacement” (Mesthene, 1969). Clearly, accepting new ideas and innovations requires stakeholders to be open to new approaches. Amesse (2001) goes further with this view of the process of technology transfer as a specific ‘knowledge

transfer' process, reliant on the efficiency sought through creating a 'common code' between groups to facilitate the flow of information and knowledge. Large (2000) refers to "linchpins" as those individual responsible for ensuring appropriate and timely information transfer and team management in the technology commercialization process. These tacit processes confirm the foundation for a socio-cognitive framework of innovation acceptance and integration. Thus, literature reveals an intangible tool for the acceptance and entrepreneurial leverage of innovation through the recognition of the validity and importance of these inter-personal structures in the transfer and integration of new knowledge and new technologies.

The theoretical paradigm developed here supports the concept of unique frameworks of innovation acceptance and integration as it recognizes that both explicit and implicit socio-cognitive structures underlie stakeholders' interactions. Further these structures and interactions provide a necessary and fundamental framework for the various management and organizational tasks which support the leverage and uptake of entrepreneurial activity. Massini (2002) suggests these structures exist, not only as overt codes or predefined parameters for action, as in administrative and governance controls, but also as subtle and implicit parameters such as tacit expectations, routines, norms and standards of behavior. These parameters have previously been acknowledged as arising as a result of socio-psychological bonds of interpersonal interactions and political processes (Jagtenberg, 1983; Ring, 1992).

Clearly these intangible frameworks supporting innovation acceptance and integration can be seen to be not only deeply embedded in the socio-cultural

environment of the stakeholders, but also potentially codified in institutional policy and governance structures. This is significant as it acknowledges a recursive process of reflection rather than a strict practice of reference to a particular framework of innovation acceptance and integration for successful entrepreneurial integration. The role of the entrepreneur in introducing innovations and negotiating with stakeholders remains reflexive and unique as each situation and opportunity require strategic revision of the framework of activities to maximize successful interactions. This is particularly significant for those in practice who seek to create entrepreneurial leverage in dynamic and complex high technology industries. Indeed, Sydow (1998a:266) note the recursiveness of social *praxis*² is intricately involved in a developing framework of biotechnology integration

Complexity and uncertainty in high technology environments require stakeholders to seek recognizable frameworks for interaction in the less volatile structures of organizational and stakeholders norms, standards and expectations. Those shared rules, beliefs and patterns of action create a framework of ‘typifications’ that provide the blueprints for organizing (Barley, 1997), and bear out the concept of an innovation integration framework. This is also confirmed by the work of Pisano (1990), who noted that historical patterns of R&D procurement reflect deeply ingrained repertoires, rules, operating procedures and routines. Additional support of the concept of integration frameworks is provided by Van de Ven (1974) who noted that established frameworks of relating are likely to inform the emergent normative structures and expectations between new stakeholders in inter-organizational activities.

² *Praxis* refers to the day-to-day activities undertaken in normal circumstances i.e. the customary practice, the actual way something is done, routine procedures (Tulloch 1993)

In the bioindustry, practitioners relate across a range of professions and contexts to facilitate technology integration. This ability to interact proficiently and effectively between groups can be considered as a ‘community of practice’; a framework of common understandings provides the basis for ongoing relations (Grabher, 1993). Capello (1999) notes a ‘community of practice’ can be seen to occur where learning is derived from the relations and practices of members who share rules and procedures, in a socially embedded process. Such common understandings and expectations then provide a shared foundation for work, learning and innovation activities (Brown, 1991).

Further to this Wikström (1994) also confirms knowledge-sharing interactions and relationships enable stakeholders to recognize, exchange and negotiate mutual opportunities and shared values so that a consensus can be developed through a ‘community of understanding’ (Håkansson, 1995). Indeed, the accumulation of knowledge has been cited as a critical factor in the evolution of new technologies (Dosi, 1982) and can be recognized as not only an initiating factor for invention, but as now apparent, also a fundamental part of stakeholders learning process in the framework of innovation acceptance and integration. These reticulated refinements of knowledge, information and expertise through a community of learning, sharing and understanding are in fact the essence of Rothwell’s (1994) fifth generation innovation process. Thus these preceding works confirm the views of Howells (1996) and Amesse (2001) that a framework that enables the transfer of knowledge and understanding between stakeholders can facilitate acceptance and aid the motivation to integrate new technologies and innovations.

The social structure of business relationships is noted as a significant influence on the perceptions of new business ventures (Stuart, 1999). Where new ideas and innovations are a result of complex interactions, the conflicting and pluralist views of its effectiveness are not surprising, and tensions or contradictions are inherent between multiple constituents in such dynamic and uncertain environments (Sydow, 1998a; Eldred, 1997). What is clear from this is that frameworks supporting the development and integration of innovation activities and including biotechnology, exist embedded in norms of relationships and associations, and also constantly require attention, adjustment and refinement to maintain and support them. To establish an effective framework of integration between various groups, Amesse (2001) suggests building a common agenda on the basis of organizational objectives, mutual expectations and acceptable practice by creating a 'common code' or a specific knowledge transfer process to facilitate the flow of information and knowledge.

The concept of integration frameworks recognizes stakeholders as gatekeepers in the innovation process albeit embedded within their organizational, technological and professional contexts. It combines the reality of stakeholders, as complex rational beings, negotiating a shared institutional determinism in the innovation integration process (Giddens, 1979; Stein, 1997; Jagtenberg, 1983). The framework deduced from the literature here acknowledges stakeholder's individual idiosyncratic perceptions within the path-dependency of organizational operations and the community's interactive practice. As noted by Powell (1998), stakeholders clearly don't exist as isolated entities, suspended in time and space within their environments, but rather are embedded in an evolving organizational and technological community.

The socio-cognitive framework associated with the acceptance and integration of innovation and entrepreneurial activities can be seen to be a process of legitimation, as stakeholders sanction and entrepreneurs enact the activities, behaviors and practices they view as being appropriate for the inter-organizational context (Sydow, 1998a:272). Even though these methods of interacting are common and consensual, they remain personal and unique to each relationship, and are undertaken in a multitude of ways that are uniquely contextually bound, path dependent and socially embedded for different stakeholders in various organizations.

Complexity and uncertainty in high technology environments require stakeholders to seek recognizable frameworks for integration to guide interactions through the potentially volatile structures of organizational and stakeholder's norms, standards and expectations. Those shared rules, beliefs, and patterns of actions create an integration framework as a socio-cognitive means for negotiating innovation acceptance and integration and as a key tool to enable entrepreneurial leverage.

As the acceptance and integration of innovation and the strategic importance of activities that facilitate entrepreneurial leverage continue to be a challenge to organizations, many established organizations with clear systems of production, manufacturing and processing proceed with an uncertain view of the integration process, as it currently exists without guidelines for best practice. This disposition increases the uncertainty of stakeholders and raised the risk associated with the introduction and investment of innovation. Fortunately, increased uncertainty and complexity result in an increase stakeholder's interactions as they are motivated by the desire to establish stable frameworks of integration (Burkhardt, 1990). The

Australian biotechnology industry is such an environment, having multiple diverse stakeholders seeking to support emerging innovations both at the organizational and industry levels. As such it provided an environment ripe to test the concept of a framework of integration. The next section presents the details of that research.

METHODOLOGY FOR INNOVATION INTEGRATION RESEARCH

An interpretive sociological perspective was adopted for this research through the qualitative analysis of semi-structure interviews seeking to reveal the existence of frameworks supporting the acceptance and integration of biotechnologies as strategic tools for entrepreneurial leverage. The move towards interpretive philosophies as a method for grounding research in a sociological perspective is well established in management studies (Alvesson, 2000; Zammuto, 1984) and has been used to understand the relational interactions and the hermeneutics of humanistic factors in the analysis of organizational issues (Prasad, 2002; Robson, 2001). Interpretive methodologies provide a critical extension to qualitative methodologies by ensuring context and dynamics are recognized as significant contingent factors in the empirical field (Denzin, 2001; Matthyssens, 2003).

In grounding this research with an interpretive philosophy, this paper offers a new approach to understanding stakeholder's interactions in the acceptance and integration of innovation by the acknowledging multiple contexts, motivational agendas and contingent influences that inform the various entrepreneurs and stakeholders relationships. In exploring the concept of integration frameworks four case studies were undertaken. The versatility and relevance of case study analysis for theory building in contemporary and pre-paradigmatic research fields

was a fundamental rationale for using this methodology (Perry, 1998). Each case presented a different context of biotechnology research in Australia. These were a) the wider bioindustry, b) an agricultural research organization, c) a human therapeutics research laboratory and d) medical diagnostics company. Further to this these cases also represented a) industry, b) government, c) tertiary, and d) commercial perspectives respectively. Purposeful case selection was undertaken to enable dissimilar examples to contribute to theoretical development as well as to the transferability, generalisability and empirical soundness of the empirical research beyond what is possible with a homogenous sample (Eisenhardt 1989). Following individual case analysis, a cross-case analysis enabled the examination of the collective evidence to reveal empirical parallels across the cases and congruence across the bioindustry sectors.

Empirically, a multiple participant approach was adopted to provide a research methodology that makes sense of more than the observed reality of the entrepreneurial environment. Alvesson and Deetz (2000) note a multiple participant approach is not new in organizational studies and is achieved by extending interpretation through multiple 'dialogues' (Denzin and Lincoln 2000) which grounds the research outcomes in the experienced realities of stakeholders. These multiple dialogues provide a robust depiction of stakeholder interactions through the identification and subsequent exploration of dominant ideas and significant themes (Numagami 1998). In doing so this approach enables holistic theory development across diverse perspectives and positions while avoiding preconceived pattern seeking which may suppress understanding of complex social systems (Stacey 1995; Moss 2001).

The multiple participant perspective in organizational studies provides management research with a methodology that addresses the epistemological ground rules necessary for acknowledging the social construction of organizational knowledge (Jagtenberg 1983; Crotty 1998). Alternative approaches frequently imply an analytical isolation of the diverse contextual elements of entrepreneur's activities and so ignore the dynamic way in which those factors frame interactions and influence the construction of knowledge and inevitably the frameworks of acceptance and integration of innovations through their recursive expression (Dooley and Van de Ven 1999; Butel and Watkins 2000). Conversely, the multiple participant approach is able to embrace the broader interplay of stakeholders' diverse and dynamic contexts as they continually re-inform and recreate the interactive paradigm of knowledge and understanding of biotechnology innovation.

The empirical evidence for this research involved interviews with representatives from diverse positions in the bioindustry; all involved in biotechnology innovation. This was a multi-level analysis of stakeholders from diverse roles and hierarchical positions within each of the case studies to ensure representation of the perspectives of diverse participants in these innovation activities. Interviews were conducted across multiple bioindustry stakeholder groups including industry (MNC's, publicly listed Co's, spin-outs etc), research (public, private, corporate, government), government (local, state and federal) and business (financial/accounting, venture capital, entrepreneurs, marketers etc) professionals. Table 1 reveals the positions and roles of the stakeholders interviewed from the Australian biotechnology industry and research organizations.

(INSERT *Table 1* HERE)

In-depth semi-structured interviews provided over 400 hours of qualitative data which revealed significant insights into the relational experiences of stakeholders in the process of innovation acceptance and integration. The multi-level research approach which was undertaken here provides a critical view of these interactions and experiences by recognizing that biotechnology stakeholders interact in a heuristic process of innovation acceptance and integration. This critical approach is gaining greater acceptance as management research seeks to understand the co-evolutionary influences of complex environments and multiple stakeholders (Lewin, 2001). Moreover it is useful here as it enables heterogeneous knowledge inputs of stakeholders to be recognized as contributions and contingencies to their interactions and the development of integration frameworks.

Inductive theory building from the case data through thematic analysis and cross-case examination enabled the complexity and dynamism of stakeholder interactions in the bioindustry to be acknowledged by revealing common themes emergent across the diversity of interviewed groups. In this way the deduced themes extend the existing knowledge paradigm of stakeholders interacting in the bioindustry through theory development, by comparison of observable facts with the theoretically known (Webb, 1995). In keeping with the format of semi-structured interviews, interviewees were asked questions following a series of key issues under investigation however both the interviewer and the interviewee are given the flexibility to develop the discussion and disclose information that they feel is relevant or important to those issues.

In this research the key theme under investigation, the process of acceptance and integration of new biotechnologies, was apparent at the outset. Further questions introduced issues such as the 1) role and importance of relationships in research development and innovation acceptance; 2) the influence of policy, protocol, rules, resources and strategy on innovation acceptance and the integration process; 3) factors affecting the directions and motivations of research and innovation development and 4) the affect of industry and organizational expectations on competitive development, risk and innovation legitimization. Interviews were conducted on a one-to-one, face-to-face basis.

This style of idiographic research of the multiple stakeholders engaged in entrepreneurial and innovation activities facilitates discussion and reflection of the ambient conditions that influence their interactive environment and encourages these to be revealed. In this way the research investigates both the stakeholder's perspectives and their interactions to disclose the motivational objectives in the interactive agenda. This reflective duality acknowledges the existence of stakeholders' original agendas and primary motivations as well as their subsequent shared agenda and negotiated objectives in the process of innovation acceptance and integration.

INTEGRATING INNOVATION IN THE AUSTRALIAN BIOINDUSTRY

Results from the Australian bioindustry confirmed the integration of biotechnology innovations occurs through a complex and strategic process of stakeholder interactions. An integration framework that embodies the explicit and implicit routines, organizational and professional practices, norms and standards of interaction provided a known structure through which innovation activities

were developed and negotiated. These frameworks were clearly recognized as the implicitly functioning to aid the recognition (through people that can ‘see’) and negotiation of complex issues and important personal and political connections required for the acceptance of biotechnologies by potential stakeholders, and the adoption of biotechnological innovations into existing organizational systems.

“It’s very important to have people that can see ... the connections that are required. So that those connections can be managed... complex issues that need to be resolved and each of them requires negotiation... it’s the complexity and multiplicity of the relationships and conversations that need to be had to go to the next step.”

Evidence from the four cases revealed the framework of the integration of biotechnology innovations was unique for each specific collaboration and innovation. This was apparent as for each situation differing structures and contexts contributed to the support, direction and influence of stakeholders’ entrepreneurial activities. The case studies revealed that the stakeholder’s requisite activities in the interpretation and negotiation of the situation provided a unique context for the emergent integration framework, and that these procedures strongly influenced the recognition of the new ideas and innovations as potentially valid and appropriate (acceptable). Frameworks of integration were created through professional, personal and institutional socio-cognitive parameters as well as explicit and understood organizational norms and practice. They were further recognized as existing intrinsically in supportive collegial environments. Particularly where a shared agenda was recursively developed and refined by participating stakeholders, these were the preferred frameworks that provided a

platform for entrepreneurial activities and professional practice in support of biotechnology innovations.

“...there is a lot of consultation that goes on ... within the many hierarchies we have, from student to post-doc to supervisory level. I think it’s actually frowned upon if you do go off on a tangent and do your own thing – that just doesn’t happen, not at all.”

All cases presented frameworks of integration that were unique to specific stakeholders’ needs and entrepreneurial ambitions, and further, were bound by the specific authoritative and economic paradigms of the innovation in each case. Subsequently, results from the four cases revealed slightly different structures of influence and activity for integration frameworks supporting biotechnology innovation depending on the different stakeholders, innovations and contexts involved. Biotechnology recognition and acceptance could be recognized as beginning at the earliest stages by initial collegial and entrepreneurial validation interactions. These were noted as arising through the informal or casual discussions between researchers, colleagues and stakeholders as they considered (vetted) and negotiated various biotech’ research alternatives and opportunities.

“...when you have a project idea, you discuss it with your colleagues, with your supervisors, with departments working ... in that area and projects also get vetted by program managers in the departments to make sure that everything fits in.”

Knowledge networks and information conduits were recognized as very important intangible aspects of the integration frameworks in all cases and confirmed

biotechnology's place in an information and knowledge economy. Participants in the wider Australian bioindustry relied on structures of association and engagement to secure relevant tacit knowledge and implicit support for various biotechnologies; a similar framework of social sanctioning was also evident in the other cases as preliminary to the integration process.

“...we constantly seek input from other intellectual brains; it's always an ongoing thing.”

Stakeholders recognized that a unique paradigm of knowledge was developed from general information and their own expertise and experience of biotechnology integration relative to their environment. Scientific perspectives and collegial associations were the most common platform among the interviewees in these case studies for understanding new biotechnologies becoming available for integration. This situation indicates a clear reference to the importance of social norms and sanctioning in the acceptance and integration of biotechnology innovations.

“... Yeah I always have expectations of strong collegiality and cooperation and so on. It's very difficult (to integrate innovations) if that sort of environment doesn't exist.”

Relationships between stakeholders which were recognized as significantly contributing to the consideration of new biotechnologies were often historically established and frequently personal. These trusted relationships, professional associations and other inter-personal activities, provided a significant strength to the integration framework for biotechnology, through the provision of information

and opinion which could be interrogated to discern and ascertain sound opportunities and also which could provide reliable judgment supporting stakeholders' decisions relative to their goals.

“...it's very hard when you don't have the critical mass of people you can talk to...so the Centre was built to bring people together because biotechnology is such a broad area it's impossible for everybody to have all the expertise.”

The many and diverse participants involved in biotechnology decisions in the development of innovations and in each of the cases this meant stakeholders' integration frameworks required relational flexibility as well as the cognitive ability to recognize and interpret the implicit and explicit parameters of potential stakeholders. For some participants, this meant an uncertain shift in thinking from conservative research progress to recognizing ('we need to look') different expectations and skills and negotiating more applied goals.

“we need to look at ways where we can position ourselves.... It's really about how can we bring all those skills together”

Organizational research perspectives, funding directives and stakeholders goals influenced the frameworks for biotechnology integration in each case, and could be seen to directly influence the interactions and motivations for integration opportunities and innovation success. Where research perspectives and organizational goals could be directly related to personal value either through reputation, achievement or economic gain, motivation was higher than for those who felt their contributions and activities weren't recognized but would still

benefit from integration activities. The role of this level of insight in the acceptance and integration of biotechnology innovations was seen by many stakeholders as a significant driver.

“I think the more we can encourage people to ... understand how the other sector works so that they don't come into a relationship imagining where a person is coming from and having absolutely no idea of what the realities are in that industry and what the imperatives are for that person (the better).”

In keeping with these acknowledged differences in stakeholders' supporting biotechnology integration activities, within each case unique structures of influence were noted as directing integration activities. Advancing the biotechnology innovations from the initial iterative progression of scientific ideas to a complex milieu of recursive connections required that multiple stakeholders contribute to the framework of intangible structures that defined progress and outcomes in the integration process. Organizations and individuals participated in integration activities through negotiated structures of association and interaction that linked their research and commercial objectives. In this way too, stakeholders' activities in biotechnology knowledge creation, research progression and collaboration revealed implicit established frameworks of integration relevant to their diverse organizational contexts that existed as the fundamental framework for further negotiations. This was particularly significant across divergent groups such as business professionals and research scientists.

“...this has always been the central dilemma; the two cultures you're working in are completely different...”

All of the diverse professional groups of stakeholders involved in contributing to the integration framework had distinct expectations and various modes of operation contributing to achieve the shared goals and value-creation objectives with other stakeholders. These implicit structures could be recognized through the various protocols for conducting interactions and relationships, implicit norms and standards of research and innovation as well as explicit practice and accepted routines for integration activities including the acknowledged need for cooperative engagement. The recognition of these various perspectives and the push towards a convergent framework of shared standards and norms confirmed the role of an integration framework in the acceptance and integration of biotechnological innovations.

“Successful bioindustry development ... critically depend(s) upon cooperation between industry, government, and the research community”

Academic structures strongly directed the conduct of entrepreneurial stakeholders in the tertiary environments that were active in the integration of innovations and new ideas. Similar academic structures were also an influence on enterprises in close proximity and association with a tertiary environment and consequently access to knowledge resources and academic activity contributed to the activities supporting their framework of integration. Further, in two of the cases the explicit goals of tertiary research activities were seen to drive specific organizational agendas and direct the application and integration of appropriate biotechnology innovations through strategic engagement and inclusion of those perspectives in a shared framework.

“...we’re looking for an inclusive approach where all areas of business are invited to be part of the process because not all good researchers are good business people. So you need a different type of skill set to take the science concept into a business.”

In all cases the flow of information between the scientific community, project leaders and entrepreneurial stakeholders was noted as a significant mechanism to a cohesive framework for innovation integration. A deficit in the required activities or uncertainty of those requirements by stakeholders in the early stages of relationships was recognized as problematic to innovation uptake and technology acceptance largely due to the disruption in the accepted pattern of activities. The value of information about stakeholder expectations and practices in the acceptance and integration of biotechnologies was clear by the strategic pursuit of such knowledge. This confirms the fundamental importance of intangible components in the innovation integration framework.

“...It’s an intelligence gathering network”

Evidence from the four cases revealed the intangible structures of the interactive context and negotiated activities of stakeholders to be fundamental to the framework of acceptance and integration for biotechnology innovations. The routines, norms and practices of stakeholders were recognized as significant in the framework of interaction for stakeholders in each case, which informed their integration activities. These were reiterated and reinforced by their successful re-enactment, acceptance and recognition, and thus potential benefit derived from those integration activities and structures ensured continued reproduction and

evolution of suitable frameworks for the further acceptance and integration of biotechnology innovations.

DISCUSSION

A major conclusion derived from the literature and confirmed by the case results here is that both tacit and explicit organizational and socio-cognitive structures provide a framework for innovation acceptance and integration through the recognition and negotiation of acceptable norms and practices. Indeed there clearly exists a corpus of socio-cognitive knowledge in the bioindustry in Australia that underlies an acceptance and integration framework. The framework of innovation integration derived from this work reveals a dynamic model which is both reflective and recursive, and is diagrammatically depicted below (Figure 1). This illustration reveals the recursive enactment of norms and practices as well as the reflective recognition and interpretation of context dependent factors and individual idiosyncrasies provide a framework for the acceptance and integration of innovations. Clearly reciprocal interaction occurs between entrepreneurs and stakeholders as they reflect on their entrepreneurial opportunities and the contingent environment nuances as well as the explicit and intangible structures that will direct interactive decision making process.

INSERT Figure 1 HERE

The framework of acceptance and integration developed here enables the many influences of both explicit and tacit organizational and socio-cognitive structures of stakeholders' to be recognized as contributing to the complex and interactive reality of entrepreneurial activity. The left hand circle acknowledges the

significance of specific routines, norms, rules and procedures as a fundamental basis for stakeholder interactions. The right hand circle acknowledges that those structures need to be recognized, interpreted and negotiated in each case of innovation integration. This reflection is necessary for the appropriate adjustments of shared patterns and meanings that will facilitate successful integration through managed expectations, risk, competition or resources. Only when stakeholders interact in such a way i.e. via sanctioned structures³, can innovations be recognized and accepted by other stakeholders and potential partners so that the relationship can evolve towards the mutually agreeable goals, illustrated by the central box.

The various practices and protocols supporting stakeholder's interactions in the development and integration of new ideas and innovations can be recognized be explicit or codified or implicit protocols or standards of behavior. They also exist as requirements laid down by regulatory bodies or specific contractual arrangements; or they may be implicit or understood parameters of mutually negotiated agreement or shared collegial expectations. Regardless of the specific form or the nature of codification or expression, the imperative remains that the framework must be recognizable and acceptable to all parties through reflexive interpretation, insight and application to the unique set of circumstances for each collaboration and innovation experience.

Organizational structures have been viewed as the enduring characteristics of an organization⁴ which subsequently act as “conduits of technological change”

³ Jagtenberg (1983) notes the consciousness and actions of individual scientists are socially determined through shared patterns of meaning and action.

⁴ Burkhardt (1990) notes structure as being defined as the distribution of organisational units and positions as well as the systemic pattern of relationships they entail.

(Burkhardt 1990). The results of the case evidence presented here confirm that those conduits are deeply embedded in the many parameters of the stakeholder's socio-cognitive environment. Such a framework confirms that practices and interactions are both an outcome and a medium for stakeholder interactions and relationships as proposed by Sydow (1998a) and confirms the central position of shared patterns of meaning and action, as illustrated in Figure 1. A mutually dependent learning process such as that described by Miller (1999), in defining a 4th generation of R&D, would provide the strategic information and insight necessary for effective entrepreneurial leverage to be gained from such a framework.

A clear framework for innovation integration is important for entrepreneurial organizations and stakeholders because increasing levels of technological change and knowledge intensity affects all activities supporting technology transfer, research commercialization as well as the uptake and diffusion of innovation. In the case of biotechnology, the continually changing industry context means a new competitive landscape is emerging (Bettis 1995), that requires stakeholders to continually readjust their expectations and negotiation strategies to ensure maximum integration opportunities.

CONCLUSIONS

This paper presents a framework for innovation integration which contributes to the skills set of entrepreneurs, biotechnology research organizations and other high technology companies. Understanding the reciprocal and socio-cognitive basis of negotiation and acceptance is important for entrepreneurs and innovation practitioners wishing to embark on strategic relational activities. Entrepreneurial

leverage may subsequently be achieved by pursuing a fully informed framework for integration by undertaking activities such as contextual reconnaissance and deliberate engagement of key stakeholders early in the development process to facilitate the commercialization and adoption of biotechnologies and innovations into existing organizational systems.

Integrating innovation has been shown through this research to be more than just the introduction of an explicit technological asset into an established system. This work advances previous research in the area by revealing the integration process not only influences organizational change to aid negotiation and accommodation of the innovation but also that innovation acceptance and integration requires social adjustment in other parts of the system in the process. This dynamic system approach addresses some inadequacies of previous research in innovation decision making, technology transfer and innovation diffusion by enabling a holistic negotiation of the social, contextual and technical environment and its stakeholders into which the innovation is being introduced. In this way innovation integration can be seen to involve the specialist adaptation of activities and expectations to enable its inclusion into an established system. Ultimately, the successful negotiation of a shared agenda and the integration of these innovations means they become part of the dominant paradigm that goes on to inform the norms and practices of stakeholders and entrepreneurs in further leveraging activities.

While the results of the empirical research in this paper are limited to the Australian biotechnology industry and concomitant biotechnological innovations, there are clear parallels with stakeholder's interactions and entrepreneurial

activities in other innovative and high technology industries providing many opportunities for further research. Nonetheless a major conclusion derived from both the literature and results presented here is that both tacit and explicit organizational and socio-cognitive structures provide the framework for innovation acceptance and integration activities through recognition and negotiation of acceptable norms and practices. These findings are undoubtedly significant for entrepreneurial stakeholders as they seek to leverage their activities in dynamic and complex high technology industries.

This research also provides an opportunity for entrepreneurs and stakeholders in the biotechnology industry to recognize the complex nature of the frameworks that support the integration of biotechnology innovations. Further the evidence strongly supports the proposition that an essential requirement of constructive collaborative associations and alliances in the biotechnology industry, that are aimed at achieving innovation integration, is to deliberately enlist strategic stakeholders and incite known paths of interaction along common lines of practice that will provide stability and flexibility to all parties to facilitate the further relational advancement and the integration of biotechnological innovations.

This paper confirms that the transfer of knowledge, information, resources and understanding through networks of stakeholders in biotechnology, contributes to entrepreneurs ability to recognize and leverage their opportunities as well as interpret and negotiate a shared framework that supports innovation acceptance and integration. In sum, frameworks of innovation integration proposed and supported in this paper arise through the recognition of malleable norms, practices

and routines of stakeholders that define the dynamic socio-cognitive parameters for their innovation integration activities.

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Table 1. Case study interviewee details

Case Study	No. of Interviewees	Interviewee positions
Tertiary/University Human Therapeutics Research Centre	12	3 x Post-doc Researchers, 3 x Scientific Research Assistants, 2 x Scientific Research Fellows, 1 x Program Leader/Scientist, 1 x Centre Director/Scientist, 1 x Head of School/Scientist, 1 x Head of Faculty/Scientist
Government Agricultural Research Organization	11	4 x Technical Research Officers, 3 x Biotechnologists, 2 x Research Scientists, 1 x Director/Scientist, 1 x Policy Officer
Commercial Medical Diagnostics R&D Corporation	13	3 x Team Leader/Scientist 3 x Research Scientist 1 x Production Manager 1 x Marketing Manager/ Scientist 1 x New Product Manager/ Scientist 1 x Regulatory Manager 1 x Chief Financial Officer
Wider Australian Bioindustry	13	3 x Industry Executives 6 x Government Agents/Researchers 5 x Directors/Managers/CEO's 4 x Scientists/ Entrepreneurs <i>Some interviewees held more than one position relevant to the research.</i>

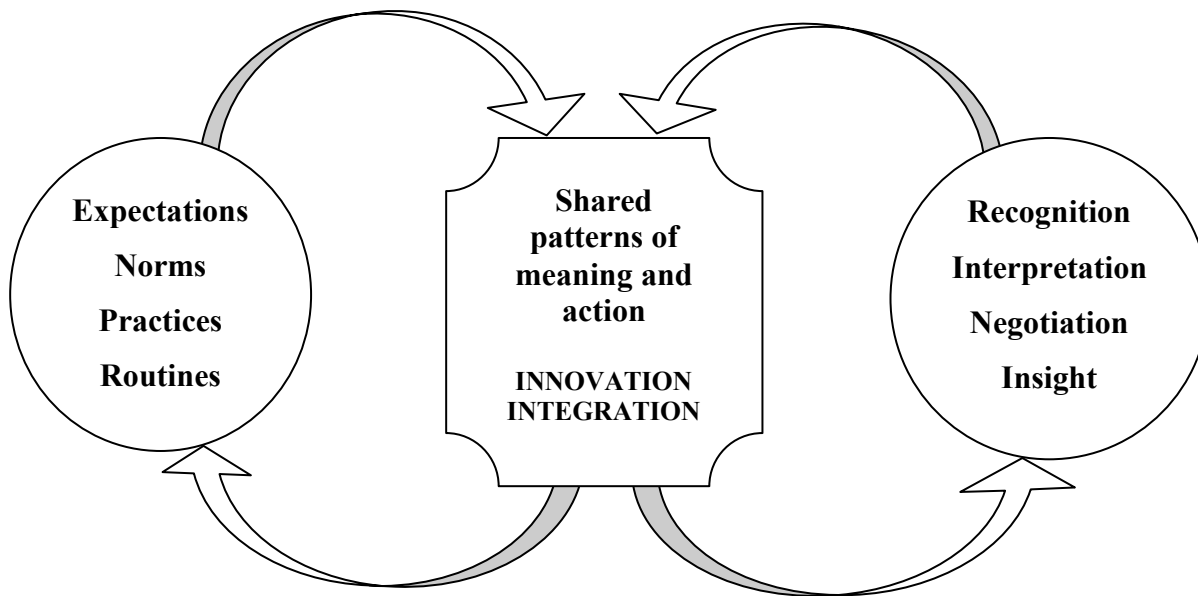


Figure 1. The framework of innovation integration is a recursively and reflexively informed system of normative activities and interpretive structures.