INNOVATION THROUGH MICRO-INTERACTIONS.

Theme: The Nature of Learning and Knowledge

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Abstract

The processes of innovation and knowledge creation remain significantly under-theorised in Organisation Studies. This paper moves towards redressing this situation by focussing on the dynamic and complex nature of social processes. By intersecting complexity sciences and personal construct psychology, the authors develop a view of social process as the perpetual construction and reconstruction of identity through micro-interactions. This insight is then translated into a four-strand model of identity construction where the strands are Social Practice, Expert Practice, Customary Practice, and Anticipated Practice. The utility of this model is then illustrated with case data from two small, highly innovative manufacturing companies.

Knowledge Management and the so-called Knowledge Economy have over recent years become a major focus of inquiry for organisational scholars. The processes of knowledge creation and organisational innovation necessarily lie at the very heart of this inquiry, but theoretical understanding of these key issues is largely confined to static classifications and step-by-step prescriptions (eg Utterback & Abernathy, 1975; Kanter, 1988; Schroeder, Van de Ven, Scudder & Polley, 2000; Wheelwright & Clark, 1992). The practical reality, however, is that innovation often arises without any set plan or blueprint, in a manner that is apparently chaotic and inherently unpredictable. A clear and urgent need exists, therefore, to revisit the theoretical foundations of this field, with a view to building fresh understandings.

Without doubt, organisational innovation is an extremely complex process that throws up many challenges and paradoxes. In recognition of this complexity, we have turned our gaze towards the nascent complexity sciences and their potential to contribute to our understanding of innovation. Complex Adaptive Systems theory (eg Goodwin, 1994; Kauffman, 1995) has its origins in the biological and ecological sciences. It essentially seeks to model bio-communities that produce spontaneous, self-organised patterns of coherence in the absence of any observable external design. These patterns of order emerge from the micro-interactions of large numbers of organisms, each of which is seeking to improve its own survival prospects. Positive, or reinforcing, feedback loops amplify the impacts of some micro-interactions, while minimising others. These self-reinforcing feedback cycles become locked in, leading to the emergence of new recurrent patterns of collective behaviour, despite the apparent chaos that lies within. Obviously this notion of order emerging out of chaos has a strong resonance with the common experience of innovation.

Stacey (2001) and his colleagues (Stacey, Griffin & Shaw, 2000; Fonseca, 2001; Griffin, 2002) have extended this biological concept of emergence into the realms of human activity, where each agent brings individualised behaviours to each and every micro-interaction. These unique responses are, of course, shaped by the particular dynamics of power and affect that exist within any micro-interaction. It is this uniqueness and individual agency that introduces genuinely novel differences or discontinuities in meaning, which then become the source of unanticipated, emergent creativity. Thus innovation may be seen as a self-organising process in which small communicative variations are reinforced and amplified by means of other micro-interactions.

The work of Stacey's group is grounded in the ideas of George Herbert Mead (1934) who described individuals and their contexts as mutually constitutive and co-constructed through

the processes of micro-interactions. Mead saw gestures and the responses that they engender as the foundation of all social acts (Griffin, 2002:150). Each action, or gesture, stimulates a response, which may either reinforce or disrupt the meanings carried by the original action. This in turn motivates some form of adjustment, wherein lies the potential for the emergence of new knowledge. Weick (1979) has similarly described this process in terms of 'double interacts', although his approach is overtly systems-based and contingent as compared with Mead's process-based orientation towards the co-construction of new understandings between the actors.

In this article, it is not our intention to assemble a comprehensive theory of innovation based on the gesture – response cycles of micro-interactions. Rather, we have chosen to focus our attention on one small element of complexity theory, namely the causality that underlies micro-interactions. Stacey et al (2000) argue that people engage in micro-interactions in their ongoing quest for meaning and identity. Meaning is formed out of actions, and it is through these actions and their consequences that people come to realise their identities. Building on this assertion, we elaborate a model for the construction of identity through micro-interactions. This model emerged from our observations and experience of organisational innovation processes. We then proceed to illustrate the utility of the model with examples drawn from observations in two small, innovative manufacturing companies. But first, what do we mean by identity?

Defining Identity

Identity is already a well worn concept to readers of the organisational literature (see for instance the Special Topic Forum dedicated to this issue in the Academy of Management Review, Volume 25(1), 2000). In fact, Wrong (2000) has suggested that it is perhaps the most widely used concept in the humanities and social sciences. At the same time however, its meaning continues to be intensely contested, with enormous problems of definition and interpretation. Stacey acknowledges that identity is both elusive and paradoxical. He suggests that the reason it is "impossible to pin down" is that "it is not a thing but a process, continuously reproduced and potentially transformed in the living present" (Stacey 2001: 168). This dynamic view of identity is also espoused by other scholars who subscribe to a constructionist orientation (eg Shweder & Miller, 1985; Ricoeur, 1992; Somers & Gibson, 1994).

This perspective is consistent with a set of underlying teleological assumptions that Stacey et al (2000) develop in considerable detail. Their position, which they call Transformative Teleology, stands in contrast to the philosophical assumptions that more usually underpin contemporary thinking and research in the Western world. The 'transformative' label signals the potential for genuine novelty and transformational change, hence the relevance of this position to our interest in innovation. In essence, Transformative Teleology envisions a future that is under perpetual construction; that is, an unknown future that is constantly evolving through the processes of micro-interactions occurring in the living present. At the same time, the human actors engaged in micro-interactions are co-evolving, as evidenced by the perpetual construction and reconstruction of their identities. Similarly, the collective identities of groups, organisations and societies emerge through these same processes. Indeed, Stacey et al (2000:37) argue that the overarching "purpose" of human micro-interactions "is the continuity and transformation of identity". In other words, the reason we

engage in micro-interactions is ultimately to affirm and elaborate our own sense of individual and collective selves.

This formulation of identity as process raises the question 'what then is it that participants bring to their micro-interactions?' From Stacey's perspective, it cannot be their identity, because this is not a tangible, material 'thing' that might be stored and retrieved at will. Rather, he argues that all micro-interactions occur through a medium of symbols, where the notion of a symbol is consistent with George Herbert Mead's usage:

> "The meaning of the word "symbol" is now most commonly taken to be a thing that represents something other than itself, such as the word "table" representing, perhaps, a wooden object upon which some other object might be placed. The word itself is derived from the Greek words *symbolon* meaning a mark or a token and *sym-ballein*, which means to throw together. Mead's use of the word is very different to common usage and more in line with the origins of the word in the sense that he takes symbols to be actions. For him, a gesture made by one animal that is responded to by another is a symbol. I understand this to mean that a gesture is thrown together with a response and together they "stand for", or better still, constitute a meaning." (Stacey, 2001:102)

In his efforts to avoid the 'thingification' of identity, Stacey ultimately resorts to defining symbols in physiological, behavioural, and external terms respectively, as bodily rhythms (protosymbols), reflective gesture – response cycles (significant symbols), and abstractions (reified symbols). He argues that none of these can take on meaning until they are actively engaged as gestures that call forth responses. These symbols may, however, be stored as latent potentials for use in deriving meaning out of actions, and as such, they are available to individuals as they engage in micro-interactions.

This is a complex and convoluted argument that we have had difficulty grappling with. Perhaps ultimately, process and substance are inextricably intertwined, so it may not be particularly profitable to continue to pick them apart. We are nevertheless left with the question 'what then is it that participants bring to their micro-interactions?' How do they translate their past experiences and learnings into the living present? And how do these aspects of the past interact with the current context and future aspirations of the participants in a micro-interaction?

At this point our inquiry has been helpfully advanced by reference to the works of George Kelly (1955/1991, 1970) who, incidentally, has been described by Shotter (1970: 224) as a "spiritual brother" to Mead, Vygotsky and Wittgenstein. Kelly's Personal Construct Psychology (PCP) explicitly recognises the dynamic, co-constructive interactions that involve individuals and their contexts, both present and past, within a universe that is ontologically defined in terms of processes rather than material substances. These foundational assumptions are clearly aligned with those of Stacey's group, but there has been great confusion amongst commentators as to the 'real' philosophical location of PCP. Kelly (1970:10) notes with a mixture of delight and amusement that his theory has been variously categorised as:

> "… an emotional theory, a learning theory, a psychoanalytic theory (Freudian, Adlerian and Jungian – all three), a typically American theory, a Marxist theory, a

logical positivist theory, a Zen Buddhistic theory, a Thomistic theory, a behaviouristic theory, an Apollonian theory, a pragmatist theory, a reflective theory, and no theory at all."

His response to this enormous diversity of interpretation is very enthusiastic. He expresses pleasure at having stirred up so much ambiguity, as, in his view, this demonstrates the difficulties associated with such categorical distinctions. He goes on to assert, "personal construct theory is no more a cognitive theory than it is an affective or a conative one" (1970:15). Raskin (2002) suggests that perhaps some of the debates about PCP may arise from a superficial misreading of the formal 'postulate and corollary' style that was originally used to present the theory. He wonders whether Kelly may have adopted this style as a 'decoy' at a time when a more humanistic presentation would have been unacceptable to the academy. In fact the theory has profoundly different implications from anything else that existed within the psychology literature of the day, and we believe there are rich dividends to be derived from an intensive intellectual engagement with it.

Our own reading of Kelly identifies significant similarities with the arguments put forward by Stacey's group. In particular, a person's sense of self (identity) is progressively constructed through their experiences (interactions in the living present). In engaging with others (gesturing), a person not only construes (derives meaning from) the response that they receive, but also, s/he may be able to construe the meaning that the responder took from the gesture. In other words, it is possible to experience ourselves as others do, as if standing in the shoes of another, by anticipating the responses that our gestures might engender. Kelly calls this ability *sociality*, and he sees it as a necessary prerequisite to the formation of any meaningful relationship.

An interesting extension of this argument is that meaningful interactions need not necessarily be between only human actors. We may equally construe non-human participants, and also, we may construe internal interactions with ourselves. Griffin (2002:152) notes that:

> "For Mead, the emergence of a self and human communication is based on the fact that individuals are capable of behaviour in which an individual can become an object to him/herself. Our communication is directed not only to others but also to ourselves. The self, as that which can be an object to itself, is essentially a social structure and emerges in social experience. This is not to deny that once a self has emerged, one can abstract from the social process and carry on a conversation of gestures within one's own mind. This is for Mead the essence of thinking…"

These broader notions of interaction are important in the context of innovation. Firstly, the ability to draw new insights through interactions with non-human participants such as prototypes, is a necessary element of any new theory of innovation. Secondly, by encompassing internal interactions, it is possible to incorporate thought experiments such as those famously undertaken by Einstein.

Moving now beyond similarities, PCP provides several valuable extensions to the work of Stacey's group. Firstly, the fundamental assumption of PCP is that the objective of all psychological processes is to allow us to anticipate, rather than react to, events – this is how

we deal with an unknown and uncertain future. Indeed, Kelly (1977) refers to PCP as the psychology of the unknown. It is a theory about how a person

> "… may aspire from one day to the next to transcend his [sic] own dogmatisms … a theory of man's personal inquiry – a psychology of the human quest." Kelly (1970:1)

Through successive experiences, we progressively elaborate our capacity for meaning-making so as to better anticipate and prepare for the unknown, unfolding future. Importantly, what we anticipate for the future is not only dependent upon past experiences, but it will also shape our activities and choices in the living present. Thus "the meaning of any event – that is to say, the meaning we ascribe to it – is anchored in its antecedents and its consequences" (Kelly, 1970:3). Although Stacey's group clearly acknowledges the path dependency of micro-interactions, they do not explicitly address the role of future anticipations.

The second area where PCP adds usefully to the work of Stacey's group is in providing an answer to the question 'what is it that participants bring to their micro-interactions?' Kelly proposes the notion of personal constructs as an organising principle that we can each use for ordering, and making sense of our experiences. Personal constructs are dichotomous dimensions of meaning, each of which makes a distinction between two groups of elements. Constructs are not produced by the events themselves, nor are they abstracted from Nature; rather, they are psychologically generated by the construing person, and may potentially be reconstrued at any time. In his later work, Kelly is emphatic that constructs "do not stand for anything or represent anything, as a symbol, for example, is supposed to do" (1970:13). A construct is a perceived contrast, and should not in any way be taken as a concept, or an abstraction, or a representation of objects. It is not something that is hard-wired into the mind; rather it is a dynamic field of choices defined by contrasting groups of elements. If we say, then, that a person brings their own constructs into any experience, then we can immediately see how their processes for meaning-making will be incorporated into the gesture – response cycle of their micro-interactions.

In the discussion so far, we have drawn from complexity theory to suggest that innovation emerges from the self-organising processes of human micro-interactions, and further, that people are motivated to engage in micro-interactions in their quest for greater meaning and identity. From the work of Stacey's group, we have inferred that these micro-interactions may be understood in terms of gesture – response cycles. PCP then provides useful insights into the purely psychological nature, as opposed to the combined physiological, behavioural and external symbols invoked by Stacey, of these gesture – response cycles, in particular showing how they are mediated by the personal constructs of participants. Whether a micro-interaction confirms or disrupts a person's constructs, PCP shows, in ways that Stacey's notion of 'symbols' does not, how the individual may choose to either retain their existing constructs, or reconstrue their experience. It is within this process of reconstrual that the origins of new knowledge creation will be found. In the next section, we continue to build on these theoretical foundations by identifying four clusters of constructs that we suggest are key factors in shaping innovation processes.

Weaving Identity

We have been involved in innovation research in over 40 small manufacturing companies for the past five years. Using an inductive approach, we have progressively identified and refined what we believe to be the four essential strands of identity construction in the context of innovation. These strands, which comprise clusters or sets of constructs, are called Social Practice, Expert Practice, Customary Practice, and Anticipated Practice. The strands are defined as follows:

Social Practice

This strand collects together all those constructs that relate to the experience of social relationships. Every individual lives in multiple social contexts, which both shape, and are shaped by, identity-seeking micro-interactions. The members of any given organization will each have social networks that operate within their work context as well as networks that extend into their non-work activities. What contacts a person has, as well as the qualities of these contacts, introduces variety into the processes of constructing social identity.

Expert Practice

This strand comprises all those constructs that relate to the means of doing – that is, the specific technical, trade and professional skills that individuals bring to their work. What skills a person has will determine what can be done and the procedures that may be used in achieving outcomes. It is particularly true in small organisations that each individual brings a unique set of skills to their work. The diversity of this skillbase stimulates the development of new areas of expertise, or expert identity, amongst organisational members.

Customary Practice

This strands draws together all those constructs that relate to the way things have traditionally or habitually been done in the past. These are the constructs of both individual and collective histories that reflect beliefs and what is valued by organizational members. They are evidenced by norms of practice including the rituals and artifacts that are embodied in an organisation's culture. When constructs from this strand are disrupted, customary practices come under scrutiny, and may be reconstrued.

Anticipated Practice

This, most Kellian of all the strands, encompasses those constructs that relate to the realms of imagination, enacted futures, and what might be. This strand is not about crystal ball gazing. Rather, it recognises that what we anticipate for the future will shape our activities and behaviours in the living present. In particular, constructs belonging to this strand typically include the setting of goals and objectives, strategic planning, and statements of vision or purpose. Organisations are often capable of accommodating a diverse range of anticipated futures.

The specific constructs within each of these strands are obviously personal, and are therefore, likely to be highly idiosyncratic. At the same time, however, they are all constantly subject to

reconstrual, which is the source of dynamism in each strand. Furthermore, even greater dynamism arises from the weaving together of constructs in different strands to create the texture of the living present. We have used the metaphor of weaving to reflect the close interconnections and intercommunications that occur between strands. This metaphor seems particularly appropriate in connection with the innovation process, which, as we have already observed is highly complex – note the Latin word plexus refers to a plaiting or a braid. Figure 1 is a frustratingly static attempt to represent the dynamic situation that we are envisaging.
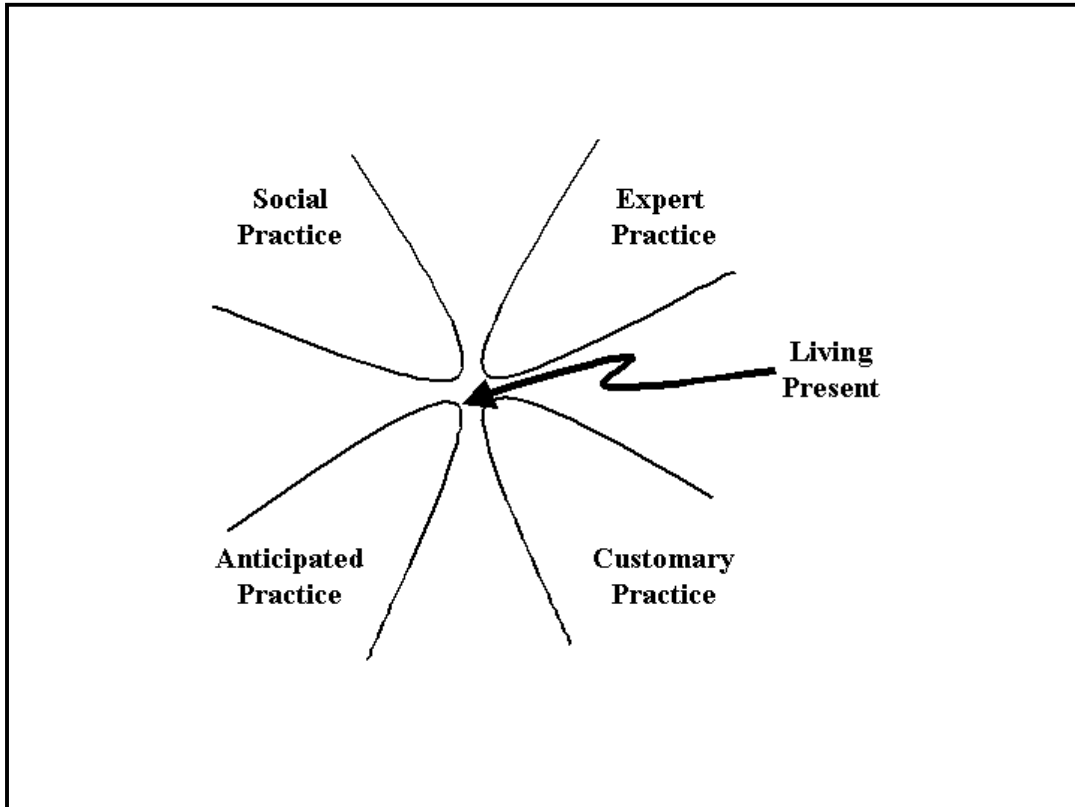

Figure 1:   Four-strand model of identity construction in innovation processes

So, in terms of this model, what exactly happens in a micro-interaction? Each participant engages their own personal constructs, broadly grouped into these four strands, to make sense of the interaction. If the micro-interaction is to be a meaningful gesture – response, then, using Kelly's term, sociality must be established. That is, each participant must be able to anticipate, at least to some extent, the response that their gesture is likely to produce. We refer to this as the convergent dynamic of micro-interactions. Without at least some convergence, the participants may simply drift past each other like ships in the night, unable to engage with or influence each other's constructs. This is not the same as suggesting that participants require identical constructs in order to form a communicative relationship. Indeed, participants inevitably have unique constructs, which are the source of those all-important variations that lead to the emergence of novelty. We refer to this latter dynamic as divergence. Both convergence and divergence may paradoxically co-exist in any micro-interaction.

Building on these dynamics of convergence and divergence, we have identified two different types of micro-interaction. The first of these we call 'routine'. Routine micro-interactions dominate all organisational activities. They are characterised by widely predictable outcomes that are based on heuristics, recipes, algorithms, habits, and standard operating procedures. Routine micro-interactions are dominated by convergent dynamics, and they serve to confirm participants' constructs, thus preserving stability and maintaining the status quo. Without them, chaos!!

The second type of micro-interaction, we call 'generative'. These result in unpredictable outcomes, and as such, may instigate the creation of new knowledge. Generative micro-interactions require both convergent and divergent dynamics that relate specifically to their outcomes. Their function is to disconfirm, and ultimately disrupt the constructs of at least one of the participants. Without them, stasis!!

Applying the model in practice

So far, the discussion has been largely abstract and theoretical. We now turn to some empirical examples to illustrate the utility of our four-strand model of identity construction. The examples have been drawn from longitudinal studies in two small (each employing about 50 staff), highly innovative companies engaged in the manufacture of medium-tech products. Various types of data were collected over a period of 18 months, including onsite observations, selected interviews, and attendance at key meetings and trade shows. The focus of the studies was to explore the micro-interactions contributing to multiple and serial innovation processes as they unfolded over time. However, as Griffin (2002:172) has said:

> "… no one can articulate all the themes in the process of communicative interaction in the living present of a particular local situation, each interpretation being yet another gesture in the on-going flow of gesture – response. It is even less probable for anyone to articulate all the interacting themes across an organization, an industry or a society. Again, any attempt is simply a localized interpretation in the living present."

Consequently, our analytical technique has been to identify and isolate specific micro-interactions that have occurred as part of an extended process of innovation. We have then subjected these selected micro-interactions to close analysis guided by the four strands of the model. Specifically, each of the selected micro-interactions was interrogated with the questions 'what contacts did each participant bring?', 'what skills did each participant bring?', 'what is valued by each participant?', and 'what might be anticipated for the future by each participant?', where these questions relate respectively to the definitions of Social Practice, Expert Practice, Customary Practice, and Anticipated Practice. The nature of convergence, and the presence of divergence were also assessed in each of the micro-interactions, allowing each to then be classified as either 'routine' or 'generative'.

The first example relates to a process innovation at Company G, which is a leading worldwide supplier of plastic playgrounds for MacDonalds Family Restaurants. The basic manufacturing process used by Company G is plastic rotational moulding. But an ongoing issue for this process is "the problem of fit-ups", where component size is not always consistent. Given the company's export focus, this is a serious problem; a great deal of time

and money is lost if components do not fit together, for example, when playgrounds are assembled overseas from pre-constructed modules.   Working with the University of Auckland, Company G developed a method of using temperature to better control the quality attributes of the rotational moulding process.   This innovation is the first practical and reliable rotational moulding temperature control process to be implemented at factory level anywhere in the world.

Table 1 analyses one specific micro-interaction that occurred during the process of this innovation. The participants are Garth and Roy, who met on this occasion to "catch up" on developments in the industry. Garth is the owner of Company G and Roy is a professor of engineering, but they had already met frequently in the past at international rotational moulding conferences and the like. So, in terms of Social Practice in the context of this specific innovation process, Garth and Roy knew each other well and there was an established level of trust in their relationship. In addition, Garth had close connections with his major customer, MacDonalds, as well as with other customers, and Roy's networks included industry contacts, academics at several universities, and of course, research students.

Table 1: Micro-interaction between Garth and Roy

	Garth	Roy
Social Practice (What contacts?)	Roy from international rotational mounding conferences; MacDonalds as a customer; other customers	Garth from international rotational moulding conferences; others in the industry; academic community
Expert Practice (What skills?)	Recognises opportunities that would arise from better temperature controls; able to allocate resources; business know-how.	Theoretical knowledge leads to practical solutions for a temperature control system; experience of trialing process innovations.
Customary Practice (What is valued?)	Innovation and innovative business solutions	Academic research that leads to practical solutions.
Anticipated Practice (What might be?)	Solution to the "problem of fit ups"; potential for competitive advantage.	New ideas for developing practical process control solutions for rotational moulding..
	Convergence: know each other, trust the relationship	**Divergence:** Theoretical knowledge – business know-how

Turning now to Expert Practice, the skills that Garth brought to this micro-interaction lay in his deep knowledge of international markets, his ability to recognise opportunities for innovation, and his capacity to marshal the skills required to capitalise on these opportunities. Roy, on the other hand, was a leading academic in the field of plastics manufacture, where he employed theoretical knowledge and research skills. An analysis of Customary Practice reveals that Garth valued innovation, and innovative solutions, while Roy valued academic rigour leading to practical solutions. And finally, in the Anticipated Practice strand, Garth's constructs related to the potential for competitive advantage if the "problem of fit ups" could be solved, while Roy was looking forward to stimulating new developments that could

produce practical results for the industry. Overall, this was a generative micro-interaction that resulted in a verbal agreement to pursue collaboration. The dynamic of convergence was supplied in the Social Practice cluster of constructs, and divergence was supplied primarily within the Expert Practice strand.

Further on in the same innovation process, Rory, a Master of Engineering student, was placed in Company G to undertake a research project. His brief was to work with Dave, the production manager, to develop a rotational moulding control process based on temperature. In one specific micro-interaction (Table 2), Rory and Dave identified one of the main challenges facing the project was to get a reliable, consistent temperature signal from inside the oven that "cooked" the plastic.

Table 2: Two more micro-interactions in the design of a new process control

	Rory	Dave	Rory	Pam
Social Practice (What contacts?)	Roy as my academic supervisor; Dave as my day-to-day colleague; factory staff.	Management team; factory staff; Rory as a colleague/student.	Dave as my day-to-day colleague; Garth as the boss; Pam as the control person I have to go through.	Management team; Garth as the boss; Rory as a student.
Expert Practice (What skills?)	Experimentation – trial-and-error; Will do whatever it takes to get the job done.	Plan production, run the plant; link between factory staff and management; make deadlines.	Understands the accountability structure; Able to articulate resource needs for experiments	Systematic and detailed; responsible for managing financial resources.
Customary Practice (What is valued?)	Getting things done; achieving high standards (ME thesis).	Practical applications so that the factory keeps running.	Getting the necessary resources	Keeping control of the purse strings; industry knowledge
Anticipated Practice (What might be?)	A reliable, consistent signal for the computer.	A reliable signal in factory conditions.	Acquire the resources that are required for the project	Able to justify R&D spending; support company development.
	Convergence: Reliable signal that ensures the day-to-day running of the plant	**Divergence:** Day-to-day running of the plant – trial-and-error procedures	**Convergence:** Find resources required to do the job	**Divergence:** None of relevance to this micro-interaction

In this micro-interaction, convergence may be found in the Anticipated Practice strand. Both men sought a reliable signal; the cabling they had provided this. If no other aspects of identity were surfaced in the micro-interaction, then the existing cabling would have remained in place. However, divergence was found in the Expert Practice strand. Rory enjoyed the process of trial-and-error and he was good at developing new ways of doing things. The trial-and-error experimentation was theoretically appealing to Rory, but Dave had other

considerations. Dave planned production and worked closely with both the factory staff and the management team. He had to make sure that production targets were met while at the same time assisting with the development of the temperature control process. In discussions with the factory staff he discovered that the cabling was only working for a short amount of time. While the specification from the manufacturer said that the cable would work in temperatures up to 483 degrees Celsius, this proved not to be the case with continued use. When the cable broke production was disrupted. While both men sought the same outcome, a reliable signal, this had to be achieved over a longer period of time than Rory required for his experimentation. Rory understood Dave's dilemma and so the action taken as a result of this micro-interaction was to source better thermocouple cabling.

This micro-interaction can be contrasted with one between Rory and Pam, the company's accountant. Pam was the person that Rory was required to go through when he ordered materials for the project. He would place a new order for cabling and Pam would action the order. The convergence in this conversation is found in the Anticipated Practice strand – Rory needed to purchase resources for the success of the project and Pam supported the project. This strand was directly relevant to this micro-interaction whereas, although the other strands of identity were present, none were surfaced in this exchange. No divergent dynamics were present to stimulate any other action to take place other than the routine action of ordering the cable. It is important to note that this routine micro-interaction in the project was as necessary as the generative micro-interactions discussed above.

So far, we have restricted our examples to person-to-person micro-interactions where each participant is a construing person. However, as discussed earlier, the theory of gesture – response cycles is equally applicable in micro-interactions that involve either non-human participants or internal interactions with ourselves. In such instances, the constructs that are associated with the 'other' (ie the non-human participant or the self as object) are those that have been construed by the subject (ie the human participant or the self as subject). We now explore these possibilities in two remaining micro-interactions both of which are derived from a company in the marine industry.

Company M now dominates the global niche market for superyacht winches, but in the 1990s it was struggling and at risk of losing one of its major customers because of a gap in its product range. Company M needed to produce a competitively priced rope and chain winch. Enter the Freedom, a ground-breaking new winch fully designed and developed by Company M. This innovation process built on the company's strength as a quality manufacturer by adding the expertise of an in-house design team led by Chris, who ultimately came to be known as the "father" of the Freedom winch. Currently the Freedom not only dominates its market segment, but has also set the standard that other winches must follow. Company M is now developing a whole family of rope and chain winches.

Major elements of the design of one of these winches were completed when Chris, the lead engineer, was taking his family on holiday. During a four-hour drive he designed the winch – manipulating the design in his head, moving key components around, and testing out possibilities.

> "I'm lucky enough that I can actually see things in 3D in my head and I can construct it and I can deconstruct it. I can see where things aren't going to work

and what's going to be the downside to it, and I just keep on and on and on."
(Interview with Chris, 2002)

This, then, is an example of an internal micro-interaction where, as Griffin (2002) has suggested, the participant is both subject and object in the flow of gesture – response. The details of this micro-interaction are mapped in Table 3, with Chris and his "imagination" as the participants. The convergent aspect in this micro-interaction was located in the Customary Practice strand. Chris and his "imagination" shared the values of reflection, creativity and imagination, and these constructs provided the basis for sociality. The dynamic of divergence was located in the Expert Practice strand. Here, "imagination" did just that for Chris – it imagined anything was possible; Chris however, had to weigh up the pros and cons and evaluate the options. Bringing together these two strands gave rise to an important generative micro-interaction, the outcome of which was a preliminary design for a new and innovative winch.

Table 3: Two micro-interactions relating to a new winch design

	Chris	Imagination	Chris	Test Rig
Social Practice (What contacts?)	Self; Jim as my boss; boating people from the UK and NZ.	Chris	Engineering staff at Maxwells.	The laws of mechanics.
Expert Practice (What skills?)	See things in 3D in my head; weigh up pros and cons; knowledge of winch components.	Challenge design elements; play devil's advocate; manipulate images; anything is possible.	Problem-solving; conceptual thinking; experience as "father" of the Freedom winch	Put a design into a working format; test possibilities – find out what does and doesn't work.
Customary Practice (What is valued?)	Creative, imaginative engineering; rigorous critique of concepts; persistence.	Creativity, imagination, and precision in design	Problem-solving; experience in engineering design; conceptual thinking.	A working model; physical manifestation of the design.
Anticipated Practice (What might be?)	Development of a preliminary design.	Test all possibilities.	Improve the pressure arm; stop it from breaking.	Improve workability of design
	Convergence: Self awareness, reflection and imagination	**Divergence:** Weigh up pros and cons – anything is possible	**Convergence:** Improve the design of the winch	**Divergence:** Problem solver – a working format of the problem

The second micro-interaction in Table 3 occurred when problems arose with the operation of the pressure arm in the new winch. To solve this particular problem a test rig was used. Here, the micro-interaction between Chris and a non-human object generated new possibilities. For this micro-interaction the convergent dynamic was located in the Anticipated Practice strand; the goal or purpose of both participants was to improve the design of the winch and make it

work. By contrast, divergence was expressed through the Expert Practice strand; Chris used problem-solving skills while the test rig provided a working format that responded to his design interventions. As a result of this micro-interaction, the spring on the pressure arm was modified, one small change that ultimately shaped the overall success of the new winch.

Concluding Comments

The examples given in the previous section make the transition from the pure theory that we developed earlier in this paper, to practical application. They show how the four-strand model of identity construction may be used as an effective framework for the analysis of micro-interactions that occur within the broader processes of organisational innovation. Furthermore, they demonstrate how the inter-weaving of the strands of each participant's identity may create dynamics of convergence (sociality) and divergence (difference). It is the presence of these dynamics that ultimately determines whether any particular micro-interaction is routine or generative. We also hint that both routine and generative types are necessary within the complex agglomeration of micro-interactions that comprise any innovation process, although we have not pursued this point with detailed examples in this paper.

In every one of the micro-interactions that we have mapped, all four strands are represented for each participant. It is by weaving together these four strands that the individual is able to construct her/his identity in the living present. Each of the strands is, of course, subject to constant reconstruction as the individual engages in micro-interactions with others who have their own unique identity constructs, which also are subject to perpetual review. This model has emerged through our own interactions with two distinct, but in our view related, streams of theory. Firstly, we have elaborated complexity theory, especially as developed by Stacey and his colleagues, with specific reference to the process of organizational innovation. Then, by introducing personal construct psychology, we have drawn new insights into the flow of gesture – response within micro-interactions.

We see these two theoretical streams as related because they both subscribe to what has come to be referred to as 'the process paradigm' (eg Mackenzie, 2000). This perspective, which gives ontological priority to process rather than material substance, traces its roots back to Heraclitus whose fundamental doctrine was 'all things flow'. More recent expression of this paradigm has been through the work of the process philosopher Alfred North Whitehead and his followers (eg Rescher, 2000). This process view has long been discounted by mainstream scholars because of its subversive critique of the positivist orthodoxy. However, the growing need to explicitly include aspects of temporality and complexity into our theoretical understandings of social action may well be the clarion call to change.

The general principles that underpin the model of identity construction presented here are equally applicable to social processes other than organisational innovation. In particular, we see considerable opportunity for application to organisational learning and change processes. The construct categories, or strands as we have called them, may need to be redefined for processes other than innovation, and indeed, this would be a worthy topic for further research. But, fundamentally, we believe that the notion of human process as a perpetual weaving of identity in the living present has great potential for future research.

Bibliography

Fonseca, J. (2001) *Complexity and innovation in organizations*. Routledge: London & New York.

Goodwin, B. (1994) *How the leopard changed its spots: The evolution of complexity*. Phoenix: London.

Griffin, D. (2002) *The emergence of leadership: Linking self-organization and ethics*. Routledge: London & New York.

Kanter, R. (1988) When a thousand flowers bloom. *Research in organization behaviour* (pp. 169-211). JAI Press: Greenwich, CT.

Kauffman, S. (1995) *At home in the universe: The search for the laws of self-organization and complexity*. Oxford University Press: Oxford & New York.

Kelly, G. (1955) *The psychology of personal constructs*. (Reprinted in 1991 by Routledge ed.). Norton: New York.

Kelly, G. (1970) A brief introduction to personal construct psychology. In D. Bannister (Ed.), *Perspectives in personal construct psychology* (pp. 1-30). Academic Press: London.

Kelly, G. (1977) The psychology of the unknown. In D. Bannister (Ed.), *New perspectives in personal construct theory* (pp. 1-19). Academic Press: London.

Mackenzie, K. (2000) Processes and their frameworks. *Management Science*, 46(1): 110-125.

Mead, G. H. (1934) *Mind, Self and Society*. Chicago University Press: Chicago.

Raskin, J. (2002) Constructivism in psychology: Personal construct psychology, radical constructivism, and social constructionism. *American Communication Journal*, 5(3).

Rescher, N. (2000) *Process philosophy: A survey of basic issues*. University of Pittsburgh Press.

Ricoeur, P. (1992) *Oneself as another* (Kathleen Blamey, Trans.). University of Chicago Press: Chicago.
Schroeder, R., Van de Ven, A., Scudder, G., & Polley, D. (2000) The development of innovation ideas. In A. Van de Ven, H. Angle, & M. Poole (Eds.), *Research on the management of innovation: The Minnesota studies* (pp. 107-134). Oxford University Press: Oxford & New York.

Shotter, J. (1970) Men, the man-makers: George Kelly and the psychology of personal constructs. In D. Bannister (Ed.), *Perspectives in personal construct psychology* (pp. 223-253). Academic Press: London.

Shweder, R., & Miller, J. (1985) The social construction of the person: How is it possible? In K. Gergen & K. Davis (Eds.), *The social construction of the person*. Springer-Verlag: New York.

Somers, M., & Gibson, G. (1994). Reclaiming the epistemological "other": Narrative and the social construction of identity. In C. Calhoun (Ed.), *Social theory and the politics of identity*. Blackwell: Oxford.

Stacey, R. (2001) *Complex responsive processes in organizations: Learning and knowledge creation*. Routledge: London & New York.

Stacey, R., Griffin, D., & Shaw, P. (2000) *Complexity and Management: Fad or radical challenge to systems thinking?* Routledge: London & New York.

Utterback, J., & Abernathy, W. (1975) A dynamic model of process and product innovation. *Omega*, 3, 639-56.

Weick, K. (1979) *The social psychology of organizing*. Addison Wesley: Reading, Massachusetts.

Wheelright, S., & Clark, K. (1992) *Revolutionizing product development*. Free Press: New York.

Wrong, D. (2000). Adversarial identities and multiculturalism. *Society*, 37(2), 10-18.