

Innovation and Knowledge Creation

There are two major aspects to innovation – the development of ideas and knowledge on the one hand, and the concrete implementation of them on the other. Knowledge creation in organisations is therefore a central tenet of innovation and must be well understood by anyone looking for ways to stimulate innovation.

This paper provides an overview of the predominant theory of organisational knowledge creation. This was first described comprehensively in the book ‘The Knowledge Creating Organisation’ by Nonaka and Takeuchi in 1995, but with its roots in an earlier HBR article from 1986 entitled ‘The New New Product Development Game’. This paper introduces the analogy of the game of rugby for team based knowledge creation and first uses the word scrum which was later picked up and used to name what is now the most widely used agile method. So agile and innovation have had a common root from their earliest days.

The ability of an organisation to create new knowledge is essential to its innovation capability [1-5]. Nonaka, Toyama et al. [6] go further stating that “The raison d’etre of a firm is to continuously create knowledge”, Drucker [7] states that knowledge is “the only meaningful resource” while Adler [8] proposes that “knowledge creation.... reaches into the heart of the process of technological innovation”. Other research has demonstrated the relationship of knowledge management on organisational competencies and hence business performance. This so called “knowledge value chain” includes dimensions of strategy, management and operations [9]. Research also differentiates tacit and explicit knowledge in this regard, where it is proposed that “sustainability of competitive advantage . . . requires resources which are idiosyncratic . . . and not so easily transferable or replicable. The criteria point to knowledge (tacit knowledge in particular) as the most strategically important resource of the firm” [10].

The SECI framework assumes that organisations are knowledge creating entities, not merely information processing ones. This ability is necessary to be successful where there is constant change in business pressures and environment requiring continuous change and adaptation. New knowledge is essential for such adaptation, making organisational knowledge creation a necessary capability. Similarly, agility at both the team and organisational level are necessary and also assume constant change. Indeed, agile ISD methods aspire to ‘embrace’ such change for competitive advantage.

Nonaka – Organisational Knowledge Creation

In his seminal 1994 paper, Nonaka introduces a theory of how new knowledge is created within an organisation. He starts by describing how much extant theory of organisations has been dominated by the view that organisations process information, rather than creating it. However, the creation and use of new knowledge is central to organisations ability to innovate, and therefore this widespread view is insufficient to explain the creation, definition and solving of problems which is innovation.

Nonaka’s theory is based on the following underlying constructs:

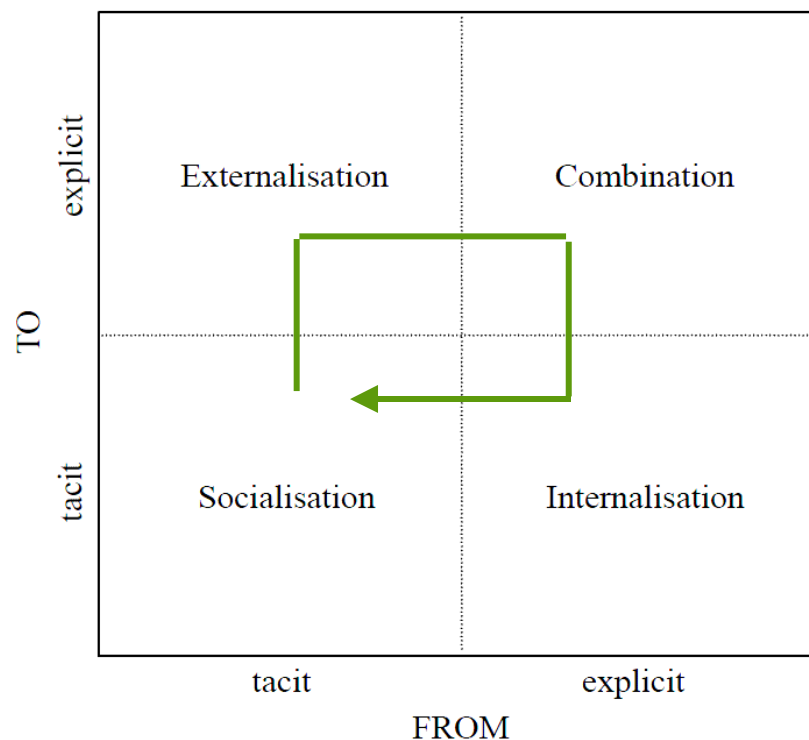
- Epistemological: There exist two forms of knowledge – tacit and explicit.
- Ontological: Although knowledge is formed by individuals, the interactions common within organisations can develop and refine it.

SECI Framework for Organizational Knowledge Creation

Using these two ‘dimensions’ of knowledge creation, Nonaka proposes a spiral model where tacit and explicit knowledge are in continuous dialogue through the interactions in communities of practice. This leads to further development, clarification and amplification of the knowledge.

For an individual to acquire knowledge, Nonaka proposes they must be ‘committed’. That is, they must have an intention, an action oriented concept which forms their approach to the world. The value of information, and the knowledge to which it can contribute, depends on the intention of the receiver, and not purely on the nature of the information itself. Therefore, the perception, context and prior knowledge of the individual affects the possibility and form of meaning derived from it. Additionally, autonomy at both individual and group level is essential to provide the freedom to absorb new knowledge – this does not need to be absolute freedom, but reflect a ‘minimum critical specification’ [11]. And lastly, knowledge creation requires ‘fluctuation’ whereby there are discontinuities in the interaction of an individuals knowledge with their perceived reality, leading to re-evaluation of assumptions underlying their current knowledge. Such breakdowns or contradictions therefore contribute to the creation of new knowledge.

With these factors in place, Nonaka postulates a ‘spiral of knowledge’ whereby knowledge is converted through 4 modes from explicit, declarative form to tacit, procedural form and vice-versa. Furthermore, the act of converting from one form to the other are complementary, leading to the knowledge expanding over a period of time.



- **Socialisation:** Representing conversion from tacit to alternate tacit forms, this can occur through shared experience (for example apprenticeship), can rarely be achieved through abstracting knowledge into an external form, and can occur without language.
- **Externalisation:** The use of metaphors to convert tacit knowledge to explicit form – writing of poetry could be regarded as an example of this whereby

SECI Framework for Organizational Knowledge Creation

complex and nuanced knowledge is transferred through metaphor to an explicit form.

- **Combination:** By combining multiple externalised knowledge sources through socialisations such as meetings and conversations, this mode allows combining of explicit knowledge to create new knowledge.
- **Internalisation:** Converting explicit knowledge to a tacit form reflects the traditional view of learning and is associated with ‘action’ based on the newly acquired knowledge.

Nonaka’s model rejects what he calls the mechanistic view of the organisation, whereby intervention in the form of training is required to bring about double loop learning and therefore innovation. This is related to the ‘information processing’ view of the organisation, whereas continual creation of knowledge is built into the concept of an organisation as a knowledge creator.

Conceptualisation is a core element of creativity, and therefore innovation.

Conceptualisation is supported by face to face communication which allows for the co-development of ideas. Dialectic intercourse in temporary and multi-faceted dialogues where participants can express their own ideas freely and openly, affirming and negating these in mutually constructive ways, leads to a synthesis of new knowledge. To allow such rich interaction requires a redundancy of information on behalf of the participants, which allows ‘learning by intrusion’ but can also limit diffusion of new perspectives to more promising directions. This effect can reduce information overload and the pursuit of less productive ideas. Such dialectic dialogue also supports more radical innovation by supporting what [12] calls abduction. He argues deduction and induction are reasoning processes that can lead to revisions or extensions of pre-existing concepts, whereby abduction involves lateral extension through the use of tacit knowledge and metaphors to arrive at more radical, and potentially meaningful, perspectives.

Moving from concepts to crystallisation involves internalisation of knowledge within the organisation. This is a cooperative activity, potentially involving a wide scope of personnel and functions, and even extending into the external value network.

Experimentation can result in refinement or abandonment of the concept. Overlapping of roles facilitated by information redundancy leads to a ‘rugby-style’ activity rather than a linear ‘pass the baton’ process involving distinct specialisations and demarcations. Empirical evidence shows this leads to faster product development in Japanese firms. One potential downside is confusion caused through changing requirements though speed of execution can mitigate this.

In developing a context for organisational knowledge creation, [13] five “enabling conditions” are proposed. Three of these - intent, autonomy and fluctuation – are derived from earlier work but are further expanded on while two new conditions – information redundancy and requisite variety - are introduced. These five enablers are described in further detail below.

1. Organisational *intent* reflects the organisations aspiration to its goals. Intent implies a collective commitment to a certain strategy and such commitment is essential to any human knowledge creation activity. The value of knowledge is only valid in relation to the intent. Therefore, strategic intent, often expressed as organisational vision, directs knowledge creating efforts in support of the goals of the business. This can be operationalised as a set of strategic technology areas which support existing or emerging products and

- services – knowledge creation within these areas are therefore aligned with the intent of the organisation.
2. Providing as much *autonomy* to individuals as circumstances permit, as well as contributing to motivation, can result in unexpected opportunities. Self-organising individuals are more flexible in acquiring and relating information and this supports information redundancy. This approach also reflects the “minimum critical specification” principle [11], or in terms of agile ISD methods, “barely sufficient methodology” [14]. Together with intention and information redundancy, this condition is reflected in the entire team operating like a rugby team, all autonomous and yet co-ordinated, as opposed to a relay team where each individual has a predefined goal and the baton is passed from one to the other.
 3. As well as inducing individual commitment, environmental *fluctuation* can create ‘creative chaos’ which can trigger organisational knowledge creation. Such crises, while seen as leading to variability and hence inefficiency in an information processing view of the organisation, can be beneficial in the learning organisation and even intentionally induced by management. Such learning, and the acting on it, can be regarded as innovation, as the organisation adapts to the new context in which it finds itself. However, Nonaka warns that addressing such chaos requires ‘reflection-in-action’ to avoid a destructive effect – such reflection should be institutionalised in the learning organisation. Fluctuation can be invoked intentionally by inducing a sense of crisis or challenge, or introducing ambiguity, a condition also advocated for innovation [15].
 4. Another core attribute is *redundancy of information*, which facilitates efficient knowledge flow and absorption, as well as empowerment of the team through participation of members on the basis of consensus and common understanding. This reflects use of knowledge to facilitate the absorption of additional learning which can in turn enable innovation [16]. Redundancy also creates resiliency within the team through the “principle of redundancy of potential command” [17] quoted in [13] and supports the development of trust between team members. To build redundancy, tactics such as strategic rotation between functions, teams and technologies have been shown to be effective. Also, developing alternate competing solutions to support set based decision making ensures the team looks at the problem from several perspectives and hence increases learning.
 5. Finally, Nonaka proposes Ashby’s principle of ‘*requisite variety*’ [18] in balancing the creation of knowledge and its effective processing. According to this principle, the diversity of knowledge at any point in the organisation should match the diversity it must process. Therefore, organisational members should know who owns what information and how to access it but should not be exposed to it all to avoid overload.

The framework also introduces a temporal element in the form of a five phase process, enabled by the conditions described above and incorporating the four knowledge transformations. The five phases are sharing of tacit knowledge, the creation of new concepts, their qualification and justification, creation of archetypes of the concepts and finally dissemination of the new knowledge across the organisation. Each phase is described below, including the knowledge transformation involved and how each enabling condition comes into play.

SECI Framework for Organizational Knowledge Creation

- **Sharing tacit knowledge:** Primarily socialisation. Employs requisite variety of the diverse team, members experience redundancy via this diversity & share organisational intent. Management adds fluctuation & autonomy. Accumulates tacit & explicit knowledge.
- **Creating concepts:** Mainly externalisation. Contradictions & paradoxes used to synthesize new knowledge. Autonomy helps free thinking, intention helps convergence. Variety provides different perspectives, fluctuation encourages use of these and redundancy helps crystallise around a common shared understanding
- **Justifying concepts:** Screening/filtering/qualifying of concepts – assessing against organisational intent – are they of value? Cost, profit margin, growth potential, but also qualitative – can be judgemental, value laden. Redundancy of Info can help make valid judgements.
- **Building an archetype :** Primarily combination – from explicit concepts to explicit archetypes. In the case of product, this could be a prototype. Combining existing with new externalised knowledge. Diversity ensures archetype satisfies all criteria. Redundancy aids in orchestrating the complex inter-departmental processes while intent can guide & stimulate the activity
- **Cross-levelling knowledge :** Primarily Internalisation. Archetype is diffused vertically & horizontally (ontological diffusion), initiating new cycles of innovation. Autonomy legitimises internalisation of knowledge, intent directs it, fluctuation facilitates it by disrupting the status quo and information redundancy and requisite variety enable it.

According to Nonaka and Takeuchi [13] the more traditional forms of management structure of top-down and bottom-up do not encourage knowledge sharing and therefore inhibit organizational learning and knowledge creation. Such structures make it difficult for individuals and groups to interact with one another and prevent the exchange of tacit and explicit knowledge. They propose a “middle up down” management model requires that top management develop and effectively articulate a vision for the organisation, supported by a clearly defined business strategy and policy. This reflects the condition of ‘intention’ described above. Middle management is then charged with leveraging the expertise in the lower levels of the organisation in achieving concrete implementation of that vision. In doing so, middle management are provided the autonomy to work out how to best to utilise the organisational assets, including knowledge, to reach the desired goal. Middle managers become the key knowledge creators of the organisation, positioned at the center of both horizontal and vertical information flows. Front line employees, being close to the market, can receive too much information, of an ambiguous kind, and may not be equipped with the conceptual frameworks with which to interpret it effectively. While top managers create the ‘grand’ theory of what ought to be, middle managers are well positioned to create the mid-range theory of how the current reality can be made approach this desired state. The contradictions and divergence of the organisation’s vision to the current reality can create the ambiguity and fluctuation wherein innovation and creativity thrives. The three roles articulated above can be represented as knowledge practitioners, knowledge engineers and knowledge officers. These correspond to front-line, middle and top management respectively and, as the names suggest, reflect the various roles in knowledge creation advocated by the middle up down management model.

REFERENCES

1. Nonaka, I., *The Knowledge-Creating Company*. Harvard Business Review, 1991. **69**(6): p. 96-104.
2. Nonaka, I., *A Dynamic Theory of Organisational Knowledge Creation*. Organization Science, 1994. **5**(1).
3. Leonard-Barton, D., *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation*. 1995, Boston: Harvard Business School Press.
4. Teece, D.J., G. Pisano, and A. Sheuen, *Firm Capabilities, Resources and the Concept of Strategy: Four Paradigms of Strategic Management*. 1990, Center for Research in Management, University of California, : Berkeley.
5. Senge, P., *The Fifth Discipline*. 1990, New York: Doubleday.
6. Nonaka, I., R. Toyama, and A. Nagata, *A Firm As A Knowledge Creating Entity: A New Perspective On The Theory Of The Firm*. Industrial & Corporate Change, 2000. **9**(1): p. 1-20.
7. Drucker, P., *Post-Capitalist Society*. 1993, London: Butterworth Heinemann.
8. Adler, P.S., *The Dynamic Relationship Between Tacit and Codified Knowledge: Comments on Ikujiro Nonaka's, "Managing Innovation as an Organizational Knowledge Creation Process"*, in *International Handbook of Technology Management*, G. Pogorel and J. Allouche, Editors. 1995: Amsterdam.
9. Carlucci, D., B. Marr, and G. Schiuma, *The knowledge value chain: how intellectual capital impacts on business performance*. International Journal of Technology Management, 2004. **27**(6/7): p. 575-590.
10. Grant, R.M., *Organizational capabilities within a knowledge-based view of the firm.*, in *Annual Meeting of the Academy of Management*. 1993: Atlanta, Georgia.
11. Morgan, G., *Images of Organization*. 1986, Beverly Hills: Sage Publications. 421.
12. Bateson, G., *Steps to an Ecology of Mind*. 1973, London: Paladin.
13. Nonaka, I. and H. Takeuchi, *The Knowledge-Creating Company*. 1995, NY: Oxford University Press.
14. Highsmith, J., *Agile Software Development Ecosystems*. 2002, Boston, MA: Pearson.
15. Lester, R. and M. Piore, *The Missing Dimension*. 2004, Boston: Harvard University Press.
16. Cohen, W.P. and D.A. Levinthal, *Absorptive Capacity: A New Perspective on Learning and Innovation*. Administrative Science Quarterly, 1990. **35**(1).
17. McCulloch, W., *Embodiments of Mind*. 1965, Cambridge, MA: MIT Press.
18. Ashby, W.R., *An Introduction to Cybernetics*. 1957, New York, N.Y.: Chapman and Hall.