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EMERGENT COMMUNITIES OF PRACTICE: A COMPLEXITY THEORY LENS

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Second Track processes are an emerging type of community of practice (CoP) that offer a powerful way to generate innovative solutions to wicked problems. The core research team behind BESS proposes a theoretical framework to understand Second Track processes by approaching them as complex adaptive systems in terms of organisation (complexity), interaction (social) and thinking (intelligence).

INTRODUCTION

In this paper, we conceptualise a new type of external community of practice (CoP), called Second Track processes, that generates social intelligence as solutions to wickedly complex societal problems. CoPs have traditionally been viewed as opportunities for like-minded individuals to cooperatively create new knowledge to solve organisational problems.[1] The concept of CoPs began as autonomous self-regulating social systems driven by emergent processes. Over time, researchers have questioned the effectiveness of the voluntary nature of CoPs, particularly given the typical normative goal of requiring them to increase organisational performance,[2] suggesting need for management to guide CoPs. This control/autonomy debate has settled on the idea that CoPs require a careful balance between guided and self-directed modes, as too much pressure might destroy them.[3] However, there is little understanding of the different driving forces inside CoPs which interact to balance the need for control and autonomy[4] and sustain voluntary knowledge creation necessary to solve wicked problems.

1. Brown and Duguid, 1998
2. Contu and Willmott, 2003
3. Anand, Gardner and Morris, 2007
4. Borzillo and Kaminska-Labbe, 2011

There are many social systems that tackle complex problems, e.g., committees, taskforces, working groups, and so on. CoPs are different in the sense that they are not necessarily authorised, nor always identified groups in the organisation.[5] CoPs' defining characteristic is their voluntary nature. Their existence as non-mandated groups is both their strength and weakness. The strength is the enhanced cooperation and boundary spanning[6] generated by the absence of management interference such as tasks and roles. This gives CoP members freedom to adapt and evolve and create. The weakness is that CoPs' voluntary nature resists management control,[7] making it difficult to monitor or capture positive outcomes from their social interactions. The current view in the literature is that management must exert some control because the knowledge CoPs create may be strategically useful.[8] The literature uses four factors – knowledge objectives, leadership, collaboration, and boundary spanning – to understand how management may exert an appropriately balanced level of control on CoPs.[9]

This paper contributes to our understanding of the driving forces inside CoPs which sustain voluntary knowledge creation necessary to solve wicked problems. We extend Borzillo and Kaminska-Labbe's[10] framework by using complexity theory to explain a unique type of CoPs called Second Track processes. Second Track involves principles of international diplomacy and conflict resolution which have been widely practiced as a diplomacy aid by the United Nations, departments of foreign affairs, and international legal firms for peace building, sustainable development, and conciliation.[11] Second Track involves cognitive and behavioural processes associated with stakeholder engagement in policy development and decision making to fast-track solutions to key societal problems. Complexity theory explains that problem-solving teams, such as CoPs, should form a learning network that stretches within as well as outside the organisation, to help their learning as well as the organisation as a whole.[12] Second Track processes represent a crucial part of learning networks. In this current paper, we develop a conceptualisation of Second Track emergent forces used to solve wickedly complex problems. We turn now to complexity theory to begin our conceptualisation.

COMPLEXITY THEORY

Complexity

Complexity theory deals with the dynamic non-linear behaviour of systems.[13] Complexity theory provides an 'integrative and dynamic framework to understand the interaction patterns in networks of interdependent agents who interact and are bound by their common needs or objectives'.[14] Complexity thinking lies somewhere between a belief in a 'fixed and fully knowable universe' and 'a fear that meaning and reality are so dynamic' that their discovery is delusional.[15] According to Johnson,[16] complexity seems to have its roots in 'critical accounts of metropolitan space'. Wordsworth, Milton, Engels,

5. Büchel and Raub, 2002
6. Borzillo and Kaminska-Labbe, 2011
7. Büchel and Raub, 2002
8. Lank et al., 2008
9. Borzillo and Kaminska-Labbe, 2011
10. Ibid.
11. Conflict resolution relies increasingly on diplomatic back channels, *The Economist*, 21 Jan 2020
12. Fisser and Browaeys, 2010
13. Ibid.
14. Borzillo and Kaminska-Labbe, 2011
15. Davis and Sumara, 2006, p. 4
16. Johnson, 2001, p. 38

for example, all found the city overwhelming and their works sought to understand its personality.[17] Johnson describes how complexity was initially examined by Turing, Shannon, and Weaver leading to the concept of organised complexity as a 'constructive way of thinking about urban life'.[18]

According to Davis and Sumara,[19] Weaver was among the first to distinguish between simple, complicated, and complex events. Simple systems involve the interaction of a few variables, e.g. 'trajectories and collisions'.[20] Complicated systems use probability and statistics to examine patterns that might involve millions of interactions of variables, e.g. 'molecular interactions, subatomic structures, and weather'.[21] According to Davis and Sumara,[22] 'the behaviours of simple and complicated systems are mechanical' and may be 'described and reasonably predicted on the basis of precise rules'. They can be broken up and put back together exactly the same way. The characteristics of complex systems, on the other hand, are 'destroyed when the relationships among components are broken'.[23]

Complex systems are not chaotic. Chaos theory cannot explain the 'structure, the coherence, the self-organising cohesiveness of complex systems'.[24] Complex systems are organised by their self-regulation and adaptability. The most elemental form of complex behaviour is defined as 'a system with multiple agents dynamically interacting in multiple ways, following local rules and oblivious to any higher-level instructions'.[25] The characteristics of a complex phenomenon are: self-organised, bottom-up emergent, short-range relationships, nested structure, ambiguously bounded, organisationally closed, structure determined, and far from equilibrium.[26] These properties find a special balance between autonomy and control, a point often called the edge of chaos, 'where the components of a system never quite lock into place, and yet never quite dissolve into turbulence, either'.[27] The edge of chaos is where new ideas are 'forever nibbling away at the edges of the status quo'.[28] The processes of 'nibbling away' are explained by the theory of emergence.

Emergence

The beginnings of emergence may be found in 'higher-level patterns arising out of parallel complex interactions between local agents'.[29] Johnson suggests the initial thinking about the relationship between complexity, emergence, and problem solving may be attributed to Selfridge who announced that 'a model of a process which we claim can adaptively improve itself to handle certain pattern-recognition problems which cannot be adequately specified in advance'.[30] Emergence, therefore, involves complex interaction and adaptation. Emergence is when 'the whole becomes greater than the sum of its parts',[31] or when the individual agents interact in ways that 'transcends

17. Johnson, 2001, p. 38-41
18. Johnson, 2001, p. 52.
19. Davis and Sumara, 2006, p. 8
20. Ibid., p. 9
21. Ibid., 10
22. Ibid., p. 11
23. Ibid.
24. M. Waldrop, 1992, p. 12.
25. Johnson, 2006, p. 19
26. Davis and Sumara, 2006, pp. 5–6
27. Waldrop, 1992, p. 12
28. Waldrop, 1992
29. Johnson, 2006, p. 19
30. Ibid., p. 54
31. Waldrop, 1992, p. 288

themselves and becomes something more'.[32] The challenge is to discover how this happens. Waldrop argues that this may be understood by 'connectionism: the idea of representing a population of interacting agents as a network of nodes linked by connections'.[33] The emergent properties of complex adaptive systems are revealed in the connections themselves. According to Waldrop, 'surprising and sophisticated outcomes emerge in how the nodes send messages like on and off switches'.[34] In problem-solving groups, the messages are knowledge flows, and the decision to share (on and off switch) is explained by adaptive properties.

Adaptive systems

Adaptive properties explain the function of emergent complexity. This ability gives emergence the ability to change the world.[35] Johnson explains that a system only becomes emergent when 'local interactions result in some kind of discernible macro-behaviour'.[36] This behaviour is the capacity to adapt. Johnson explains that emergent complexity is not just a 'nice pattern of behaviour'.[37] There are two main functions of system adaptability: recruitment and learning. Adaptive behaviour functions as recruitment 'when the system interacts within a larger ecosystem assuming that it is in the interests of the system to attract new members'.[38] Adaptive behaviour functions as learning through 'dynamic self-regulation'.[39] Waldrop explains that their dynamism is what makes 'every one of these complex, self-organising systems… qualitatively different from other static objects like computer chips or snowflakes, which are merely complicated'.[40] Johnson[41] concludes that 'emergence has always been about giving up control, letting the system govern itself as much as possible, letting it learn from the footprints'. Dynamism makes each system unique. Dynamic properties are revealed in how the system attracts and absorbs new knowledge (members) and adapts to their interaction with existing members to solve wickedly complex problems.

Wickedly Complex Problems

'Wicked problems' were first introduced by Rittel and Webber[42] to describe societal problems that are inherently different from those associated with the industrial age. These problems are 'quintessential social justice and social change problems'.[43] Wicked problems 'are complex and messy' and 'their solutions are unique to the circumstance'.[44] These problems are difficult to solve, i.e., 'stubborn',[45] and 'tough to manage'.[46] Wicked problems characterised the 'social complexities and policy chaos' in the United States at the time of Rittel and Webber's paper which had created 'relentless social challenges'.[47] A dilemma emerged over whether it was the problem, or lack of competence to solve it; that made it wicked. Critics argue that there is no inherent incapacity to

32. Waldrop, 1992, p. 289
33. Waldrop, 1992
34. Ibid.
35. Johnson, 2006, p. 21
36. Ibid., p. 19
37. Ibid., p. 20
38. Ibid., pp. 19–20
39. Johnson, 2006
40. Waldrop, 1992, pp. 11–12
41. Johnson, 2006, p. 234
42. Rittel and Webber, 1973, pp. 155–169
43. Yawson, 2015, p.68.
44. Yawson, 2015
45. Rittel and Webber, 1973, p. 156
46. Camillus, 2008
47. Crowley and Head, 2017, p. 540

define social problems.[48] The literature on wicked problems has focused on finding fault in the nature of social problems rather than in professional competence. Wicked problems are technically difficult to manage,[49] but the focus has been on why they are so difficult rather than how to solve them. Rittel and Webber framed the topic by arguing that problem solving inherent in the industrial age was appropriate for what they call 'benign' or 'tame' problems, those that are simple or complicated.[50] While NASA's challenge to place a man on the moon was certainly not a simple task, it was achieved using the tools of scientific management inherent in the industrial age's technological systems, such as 'rationality, order and control',[51] and therefore may be described as complicated.

Rittel and Webber's goal was to reject the rational-scientific approach to problem solving, and 'replace the classical paradigm of science and engineering as a basis for framing social science and modern professionalism'.[52] Rittel and Webber explained why these problems and how to solve them were too difficult for the rational-scientific approach. The difficulty of wicked problems lies in 'the colliding of complex systems'.[53] Rittel and Webber[54] explained how wicked problems have 'consequences for inequity', and are the result of growing societal awareness of 'pluralism', 'differentiation of values', and 'sensitivity to the waves of repercussions that ripple through' 'interacting open systems'. The theme of Rittel and Webber's paper was to propose wicked problems as a new capability for 'the cognitive and occupational styles of the professions'.[55] This new capability requires a new type of knowledge that may be defined as 'the ability to negotiate politically, under conditions of uncertainty, and to work effectively in networks and at the boundaries between science, stakeholders, and politics'.[56] Wicked problems are created by complex social systems and are solved by people or groups that are able to navigate these systems with social intelligence which in itself is wickedly complex.

Complexity and Communities of Practice

Complex adaptive system (CAS) theory involves reflective feedback loops between individuals inside and outside the CoP,[57] and helps the CoP evolve and survive. The exploration of Second Track processes, as an external CAS, which may sit on the boundary of an internal CoP sharing its social intelligence, may be an important contribution to the use of complexity theory for understanding CoPs.

A review of the literature on the four factors driving social interaction in CoPs.[58] These factors explain:

- **Knowledge objectives:** encourage CoP members to participate more actively in the process of knowledge creation.
- **Leadership:** assigned roles motivate community members to form relationships necessary to share knowledge.
- **Collaboration:** actively sustain knowledge creation processes.
- **Boundary Spanning:** establish linkages beyond the CoP boundaries enabling knowledge to be shared with other CoP, internally and externally, perpetuating knowledge creation.[59]

48. Crowley and Head, 2017, p. 542
49. Camillus, 2008, p. 100
50. Rittel and Webber, p. 160
51. Crowley and Head, 2017, p. 540
52. Ibid., p. 541
53. Yawson, 2015, p. 68
54. Rittel and Webber, 1973, p. 156
55. Ibid.,, p. 160
56. Crowley and Head, 2017, p. 540
57. Brown and Duguid, 1991, 1998
58. Borzillo and Kaminska-Labbe, 2011
59. Ibid., p. 355

However, Borzillo and Kaminska-Labbe argue that the theory fails to explain how these factors interact and combine to sustain knowledge creation.[60] This current paper aims to extend Borzillo and Kaminska-Labbe's research in this area.

METHOD

This is a conceptual paper that theorises about a new type of problem-solving social system called Second Track processes. The ideas presented in the paper emerged from discussions with the co-founders of Global Access Partners (GAP), Peter Fritz AO and Catherine Fritz-Kalish, over a period of 24 months. GAP initiates strategic debate on the most pressing social, economic and structural issues facing Australia and the world today.[61] GAP acts as a catalyst for policy implementation and new economic opportunities. Since 1997, GAP has had more than 4,000 members, with 1,000 members actively involved in various GAP projects at any one time.

GAP has used Second Track processes to solve problems that are too difficult for the rational-scientific approach. The methodological challenge for this paper is to articulate what is a highly tacit process in conceptual terms. Alhadeff-Jones[62] explains that researchers trying to interpret a complex phenomenon naturally reject the normal order of knowledge and instead focus on disorder in the pursuit of knowledge. Conventional thinking about complexity and disorder considers the role of chance, dispersion, perturbation, accident, noise, or error.[63] These factors create tensions, paradoxes, and contradictions in the way knowledge is produced.[64] The research method adopted by this paper is to organise the heterogeneous forms of disorder in complex systems, following the definition above that complex systems are self-organised and adaptive.

The method used in this paper to examine heterogeneous disorder of Second Track processes adopts Alhadeff-Jones[65] three stages: (1) define the process and its subsystems (author, system of ideas, object), (2) introduce a model to represent the process using Le Moigne's general system theory, and (3) conceive a strategic mindset focusing on the emerging and unpredictable path followed by the research itself.

Stage 1 process: GAP's aim was to translate their tacit knowledge of Second Track processes into theory to make it more accessible for researchers and to encourage wider research in this exciting area. The researchers were also members of GAP committees and, therefore, had their own perspective about Second Track processes and how it works in practice. The researchers understood that GAP's processes were unique and complex, making them unable to be explained by a single discipline and, therefore, they adopted a transdisciplinary approach to the conceptual development outlined in this paper.

Stage 2 model: The conceptualisation proceeded in this way. Discussions with GAP surfaced themes about how the external CoP was organised, how members interacted, and how they solved problems. These themes were then assessed by the researchers to identify characteristics which were different to traditional CoPs. The researchers then searched for theory across multiple disciplines to help understand these unique characteristics. This search laid the platform for the critical values (see Figure 1).

60. Borzillo and Kaminska-Labbe, 2011
61. www.globalaccesspartners.org
62. Alhadeff-Jones, 2013, pp. i–vii
63. Alhadeff-Jones
64. Ibid.
65. Ibid.

Stage 3 strategic mindset: This platform was further discussed with GAP and this iterative process continued until the team agreed that their collective tacit understanding of Second Track processes was now translated into our codified conceptual model.

SECOND TRACK PROCESSES: AN OVERVIEW

Second Track processes invite thought leaders from the public service, industry, academia and civil society to discuss a pertinent issue in a personal capacity, rather than as representatives of particular interests. Members then suggest practical remedies and design, undertake, and oversee concrete projects or pilots to test their ability to generate tangible outcomes. Once their efficacy is proven on a limited scale, these solutions can be presented with confidence to public policymakers or larger organisations for wider implementation to benefit society.

Our conceptualisation of Second Track processes has three parts: complexity horizon, social horizon, and intelligence horizon.

COMPLEXITY HORIZON

This section establishes how Second Track processes establish a balancing point at the edge of chaos where new ideas are 'nibbling away' at the edges of the status quo established by conventional problem-solving social systems, i.e., first track processes. The Second Track balancing point is called the complexity horizon.

Second Track's complexity horizon is a social system capable of creating new order (self-organisation) and producing new knowledge (emergence).[66] The complexity horizon involves deciding on a topic, identifying who has the knowledge resources to tackle the topic, assembling the group, and determining how the group should work together to find a solution. There are two emergent forces which identify the 'nibbling away' properties of Second Track's complexity horizon: adaptive tension and enabling leadership.

Adaptive Tension

Adaptive tension is an energy differential between the system and its environment.[67] This differential is the gap between where the system is and where it wants to be. Second Track processes begin with a wickedly complex problem (where system is) and search for a solution (where system wants to be). Waldrop explains that 'complex systems… just don't passively respond to events… they actively try to turn whatever happens to their advantage'.[68] Second Track processes' advantage is the capacity to exploit the energy differential as a positive force. Adaptive tension is the system dynamics that explain the proactive search for balance within the systems' larger environment. Second Track processes' positive force is the unique way it uses adaptive tension to coalesce members around the search for a solution. Second Track processes' adaptive tension has three critical values: boundary setting, dissemination effects, and weak ties. The emergent properties of these critical values use Second Track's ability to attract and absorb new members and learn from collective experience to create value for the group and its members. This value builds and sustains the system's creative momentum.

66. Borzillo and Kaminska-Labbe, 2011, p. 356
67. Nicolis and Prigogine, 1989
68. Waldrop, 1992, p. 11

Boundary Setting

Boundary setting defines what issues are to be included, excluded or marginalised in analyses (cognitive limits) and who is to be consulted or involved (social limits).[69] Boundary setting is an important general cognitive perspective for CoP members in the recruitment of members and in their willingness to contribute. Adaptive tension may be balanced by employing critical systems heuristics exploring what CoP members believe the current situation is, and what, in their view, it ought to be.[70] This method identifies whether there is a gap in members' cognitive boundary setting in four areas:

1. **Motivation:** focuses on the purpose and beneficiaries of the system and whose interests are being served.
2. **Control:** establishes who has decision-making authority and what resources they have at their disposal.
3. **Knowledge:** describes what forms of knowledge are necessary, and where that knowledge resides.
4. **Legitimacy:** considers the worldview and potential sources of oppression inherent in a social system.[71]

Conventional CoPs tend to allocate different importance to these four critical systems heuristics. Control tends to dominate, particularly perceptions of expert power, which then influences motivation, legitimacy, and finally knowledge. Second Track processes are able to avoid demarcation conflict within the group by focusing on knowledge and common attitude formation around the problem space. Second Track processes focus members' boundary setting on the outcome, rather than the CoP itself, which resolves demarcation disputes about the problem space.

Dissemination Effects

CoPs involve informal social groups of people who participate voluntarily with no formal requirement to interact. This voluntary membership creates potential for problems which must be resolved. Organisation theory has recognised the challenge of integrating the separate efforts of multiple individuals who may have varying motivation and capacity to interact.[72] This creates social group inefficiency because the scale economies of being an expert must be traded off against the time it takes to engage with others. Jun and Sethi[73] explain that individuals choose one of two options: cooperate or defect. It has been suggested that the CoP trade-off decision involves cognitive assessment about the group's knowledge integration, i.e., how well the group shares knowledge.[74]

Individuals stuck in conventional CoPs often do not see the total system, and see only a reduced order, and then try to enforce this onto the bigger system. CoPs tend to restrict discussion within silos of policy issues for example. Silos of activity occur when social systems are unaware of other projects being conducted concurrently. There is greater impact if complex problem-solving groups work in tandem with other initiatives taking place in other sectors.[75] Second Track processes enable the group to share the outputs of their work beyond the participants. Its dissemination strategies drive Second Track networks' political and social change.

Dissemination strategies may be described as insider and outsider categories. Insider strategies include working with elite insiders who are close to decision makers and negotiators, such as experts and advisors. Outsider strategies seek to influence decision makers through a bottom-up approach, such as influencing public opinion by

69. Midgley, 208, pp. 467–479
70. Ulrich, 1983
71. Ibid.
72. Grant, 2002
73. Jun and Sethi, 2009, p. 385
74. M. Körner et al., 2016
75. Çuhadar and Dayton, 2012

mobilising peace campaigns. To what extent insider strategies have successfully disseminated the effects and outcomes of track two initiatives remains a major question facing practitioners.[76] Second Track processes establish a functional role for the group with structural connections to other related Second Track groups and an insider strategy. The first connection generates redundancy (overlap) in informal social networks via overlapping participants enabling opportunities to interact both formally and informally and discuss similar issues. The second connection is the group's capacity to develop insider strategies and connections with first track decision makers. These connections produce positive dissemination effects which increase participants' motivation to interact because they know their contribution will make a difference. Second Track processes focus members on the dissemination effects of its structural connections integrating mechanisms, which resolve their trade-off decision about whether to cooperate.

Weak Ties

The strength of ties, i.e., relationships, is traditionally seen as a positive force in network studies and is conceptualised as coherence.[77] Coherence is a measure of network efficiency generated by establishing norms and relationships through mutual engagement, which 'binds CoP members together by a sense of joint enterprise'.[78] CoP tend to develop strong ties built on like-mindedness and social interaction around common interests. However, CoPs characterised by strong ties are unlikely to transfer any novel information,[79] because friends often know the same people and they know the same things. Therefore, conventional CoPs may not be effective problem solvers. Wickedly complex problems require CoPs with weak ties because they more likely than strong ones to access and share new knowledge across disconnected segments of social networks.[80] Second Track processes focuses members on relationships with the problem, not the other participants, which makes strong ties redundant.

Enabling Leadership

Enabling leadership creates conditions that enhance the socialisation between individuals[81] and protect CoPs from paralysing bureaucracy.[82] Rather than the traditional command and control hierarchy; complexity leadership involves designing systems in which social intelligence can emerge.[83] Whereas traditional CoP literature addresses leadership by trying to find a balance between control and autonomy and not placing too much pressure on the CoP; Borzillo and Kaminska-Labbe propose that complexity thinking accelerates social network dynamics by adjusting motivational activators.[84] A system that is complex involves 'a great many independent agents interacting with each other in a great many ways'.[85] The 'very richness of these interactions allows the system as a whole to undergo spontaneous self-organisation'.[86] Johnson illustrates this point by describing the interaction of

76. Ibid.
77. Wenger, 1998
78. Wenger, 1998, p. 72
79. Granovetter, 1983
80. Granovetter, 2005
81. Nonaka, 1994
82. Borzillo and Kaminska-Labbe, 2011, p. 356
83. Borzillo and Kaminska-Labbe, 2011
84. Ibid.
85. Waldrop, 1992, p. 11
86. Waldrop, 1992

billiard balls when struck on a billiard table. His argument is that the complex interaction of the balls, e.g., how they bounce off one another and where they end up on the table, is predictable; otherwise the system would be chaos.[87] Second Track processes' enabling leadership self-organises the system and its complex interactions. Second Track processes' enabling leadership has three critical values: symmetry, mediation, and negotiation. The emergent properties of these critical values provide spontaneous self-regulation in real time. This self-regulation establishes the system's cohesion.

Symmetry

Symmetry is lack of hierarchy or domination in participant relationships.[88] Symmetry is necessary to maximise participation, collaborative, learning and change within the group. The opposite to symmetry is asymmetry. Asymmetry refers to status inequality, which means that participants are allocated different hierarchical positions, knowledge, or formal authority.[89] In problem-solving social systems, socio-political power inequities can generate demotivation activators.[90] Individuals who are sufficiently trusted to be invited to participate in these groups are often high achievers who have worked very hard to achieve a high level of technical mastery.[91] Our natural desire is to impress others with our capability. This leads us to adopt a superiority role in the power relationships in problem-solving social groups.[92] Asymmetry causes people to disengage from the process and their knowledge and contribution is lost.

Second Track processes generate adjusting motivational activators which focus members on their contribution to the solution, not their position, in relation to the problem. This focus enables symmetry because people are motivated by how their knowledge can help the group find a solution. This motivation avoids contests over who knows more, as Second Track self-regulates a focus on collective knowledge.

Mediation

Mediation is a conflict resolution process within the group.[93] Disputes are neither good or bad, however, the way they are handled by the group can turn them into destructive events that can damage relationships and cause emotional stress, lost productivity, lost opportunities, and financial ruin.[94] Social dilemmas emerge in circumstances in which individual interests are different to the group's interests.[95] When individuals form into formal social groups to solve complex problems, conflicts emerge between individuals and the socio-political systems they represent. These systems expect individuals to behave in a certain way, e.g., to support the platforms of their constituents. This requires individuals to defend a position even if they do not personally believe in it. Conflicts may then emerge as group members disagree over words, ideas, resources, processes, or solutions. At all levels, there is potential for dysfunctional behaviour and group inefficiency.

Second Track processes generate adjusting motivational activators by ensuring the parties involved can resolve their own dispute.[96] This process enables the group itself to mediate in the act of doing, i.e., during meetings, which empowers the group as the collective owner of any disputes.

87. Johnson, 2001, p. 21
88. Puutio, Kykyri and Wahlstrom, 2008
89. Ibid.
90. Senge and Scharmer, 2001
91. Maister, Green and Galford, 2000
92. Massingham, 2014
93. Fritz, Parker and Stumm, 1998
94. Ibid., p. 137
95. Jones, 2008
96. Fritz, Parker and Stumm, 1998

This collective ownership enables mediation because people discard their constituency positions to help the group find a solution. This collective ownership avoids social dilemmas, as Second Track self-regulates quick dispute resolution.

Negotiation

Negotiation is the process of enabling agreement within the group.[97] Asymmetry generates dysfunctional behaviour because people adopt adversarial positions and make mistakes when dealing with those they perceive as adversaries in the group. This type of behaviour may be addressed by focusing people on interests not positions, and discovering mutual gain by focusing on what is wrong and what might be done.[98] Managing relationships in any social group requires ongoing negotiation.

Second Track processes generate adjusting motivational activators by changing the system connections with two ways of learning.[99] Waldrop explains the self-regulating nature of this learning by describing the economy, where individuals buy and sell without anyone being in charge or planning it, and ecosystems are formed by organisations constantly adapting to each other.[100] Problem-solving groups form ecosystems around the problem space. The first way of changing the system is done by exploitation learning, which improves what you already have.[101] Conventional thinking seeks to increase the connection's strength.[102] This thinking proposes that strong ties will build close relationships between group members and negotiation emerges as people learn more about one another and how to resolve conflicts. Second Track processes have a different approach. This approach is to build close relationships between group members and the problem, and negotiation emerges as people learn more about possible solutions. The exploitation learning of Second Track processes focuses people on their common interest in the problem. The second way of changing the system is done by exploration learning, which risks the system failing against the chance to achieve significant success.[103] This thinking changes the system structure by eliminating existing connections and inserting new ones.[104] Second Track processes encourage fluid membership, and negotiation emerges as new people quickly adapt. The exploration learning of Second Track processes focuses people on their contribution to the problem. Second Track processes expand the negotiation space and find an overlap on interests rather than positions, minimising negotiation time. Second Track's constant adaptation enables its self-regulated negotiation.

SOCIAL HORIZON

This section identifies the patterns of Second Track processes' complex social interaction and adaptation as a problem-solving emergent system. The Second Track emergent system is called the social horizon. According to Johnson, the challenge is how to push the emergent system towards the desired behaviour.[105] The unique emergent properties of Second Track processes are how it self-organises to be more adaptive in the dynamic pursuit of solving wickedly complex problems. The desired behaviour is effective and efficient knowledge flows: internally between members, and externally with first track processes.

97. Ibid.
98. Fisher and Ury, 2011
99. Waldrop, 1992, p. 11
100. Waldrop, 1992
101. Ibid.
102. Waldrop, 1992, p. 291
103. Waldrop, 1992
104. Ibid.
105. Johnson, 2001, p. 19

Second Track's social horizon is how the group establishes its own culture, motivation, and social exchange rules. There are two emergent forces which drive the desired behaviour of Second Track's social horizon: enhancing cooperation and boundary spanning.

Enhancing Cooperation

Knowledge management aims to improve knowledge sharing via increased teamwork and cooperation.[106] In conventional CoPs, this implies regular meetings, workshops, and information technology support to allow its members to interact on shared platforms. In complex social systems, cooperation requires a collective intelligence system in a state of self-organised criticality, located at the edge of chaos.[107] Second Track processes' enhancing cooperation has three critical values: social contagion, social philanthropy and reciprocity.

Social Contagion

Contagion is a social network concept that explains shared attitudes, culture, and practice through interaction.[108] It generates efficiency in knowledge flows within the group by increasing homogeneity as individuals interact and inform one another. Contagion may be explained as an emergent opportunity to increase connectedness.[109] Research in this area looks at how thoughts and emotions spread from individuals to groups. Researchers distinguish between emotional contagion, behavioural contagion and social contagion; and how communication networks inform individuals and groups about others.[110] The way contagion diffuses is complex and dynamic.[111] Second Track processes generate a social experience with the group that becomes addictive and self-generating, that accelerates contagion diffusion.

Social Philanthropy

There is increasing interest amongst researchers and practitioners about corporate social responsibility (CSR).[112] CSR is defined as a company's discretionary involvement in business practices to further economic, societal, and environmental wellbeing.[113] Most research in this area looks at macro-level of analysis and how organisations are embracing CSR.[114] Recent research provides a different focus on the micro level of analysis and individual employees' reactions to CSR.[115] These researchers look at the attributional inferences about how employees assess and respond to CSR initiatives and, more specifically, how employees' subjective interpretations of CSR-induced motives influence their feelings of job satisfaction.[116] Second Track processes generate social philanthropy which increases motivation to share knowledge with no expectation of reward.

Reciprocity

Reciprocity theory is based on the concept of social exchange.[117] In complex problem-solving groups, the desired reciprocity behaviour is that knowledge flows are two-way, from the individual to the group, and from the group to the individual. Conventional

106. Massingham, 2015, pp. 197–228
107. Borzillo and Kaminska-Labbe, 2011, p. 356
108. Borgatti and Foster, 2003
109. Schultz, 2009, pp. 77–78
110. Fox, 2016, pp. 521-545
111. Ibid.
112. Vlachos, Panagopoulos and Rapp, 2013, pp. 577–588
113. Du, Bhattacharya and Sen, 2011
114. Aguinis and Glavas, 2012
115. Vlachos, Panagopoulos and Rapp, 2013,
116. Ibid., p. 578
117. Blau, 1964

thinking argues that network cohesion is generated by interconnectedness within and between social groups.[118] Dense ties mean the group agrees on reciprocity, i.e., what the individual needs to give in order to receive.

Second Track processes make the normal rules of reciprocity redundant. In Second Track processes, relationships do not need to be dense. Second Track processes only require one-way knowledge flows from the individual to the group, increasing efficiency by negating the need for the second flow back to the individual from the group.

Boundary Spanning

Complexity theory also uses the CoP construct of boundary spanning.[119] In conventional CoPs, boundary spanning encourages interaction with individuals and groups external to one's network to bring diversity and novelty into the system.[120] In complex social systems, boundary spanning tries to adjust network structure, i.e., its shape and size, for continual learning and renewal.[121] Second Track processes' boundary spanning has one critical value: structural holes.

Structural Holes

Structural holes are locations in social networks representing the only way knowledge may flow from one network sector to another.[122] This point, sometimes referred to as a knowledge broker, has considerable power, because they are the only way others in the group can learn what others know.[123] Others depend upon the broker for access because they do not know one another, or their relationship is not sufficiently close (i.e., strong ties) to enable knowledge flow.

Diffusion explains how knowledge is shared within and between social groups.[124] Second Track processes' diffusion generates insider and outsider structural hole effects. These effects are positive social behaviour related to knowledge flows. Insider effects are generated because the problem is the structural hole. The problem plays the broker role and, in doing so, it provides members with access to one another which negates the need to develop strong ties or dependence on any one individual. External effects are generated because the group is the structural hole. The group plays the broker role and, in doing so, it provides the connection to other groups. Therefore, external effects emerge at an inter-group level.

Second Track processes' structural hole effects are efficient because the internal and external knowledge flows do not depend upon an individual who may use that power to slow knowledge flow to exploit personal advantage. Second Track processes generate positive emergent sharing behaviour, where the group allows the problem (internal) and the solution (external) to drive knowledge flow.

INTELLIGENCE HORIZON

This section identifies the outcomes of Second Track processes as a problem-solving emergent system. The Second Track emergent outcome is called the intelligence horizon. Waldrop describes the emergent outcomes of complex adaptive systems as 'groups of agents... manage to transcend themselves, acquiring collective properties such as life thought, and purpose that they might never have possessed individually'.[125] The unique emergent outcomes of Second Track processes are how

118. Galaskiewicz and Burt, 1991
119. Borzillo and Kaminska-Labbe, 2011
120. Levina and Vaast, 2005
121. Borzillo and Kaminska-Labbe, 2011, p. 356
122. Granovetter, 2005
123. Burt, 1992
124. Borgatti and Foster, 2003
125. Waldrop, 1992, p. 11

it transforms the individuals and the group. This transformation makes the individuals and the group better at solving wickedly complex problems.

Second Track's intelligence horizon is how the group transcends the combined individual knowledge to discover solutions otherwise impossible and, in doing so, builds new problem-solving capabilities. There are two emergent forces which drive the transformation Second Track's intelligence horizon: individual transformation and group transformation.

Individual Transformation

People must have the interpersonal skills and motivation to contribute to the group. Knowledge management aims to change individuals with organisational learning.[126] Whereas in traditional CoPs, individual learning is motivated by personal gain explained by behaviourism and cognitive psychology;[127] complexity thinking uses personal construct theory to examine how individuals utilise personal cognitive structures to make sense of their environment.[128] Second Track processes' individual transformation has two critical values: social identity (self-awareness, role identity, personal beliefs, and interpersonal efficacy) and personal-cognitive capacity (others awareness, learning motivation, personal construct theory).

Social Identity

Social identity theory explains motivational factors which influence social behaviours not explained by personal construct theory's cognitive focus.[129] Social identity theory explains how an individual decides whether to use their personal-cognitive capacity to help the group or not. Second Track processes allow participants to adopt a different role and identity. This is measured by changes in self-awareness, role identity, personal beliefs, and interpersonal efficacy.

Self-awareness is a process self-evaluation, self-reflection and internal state awareness.[130] Measures of self-awareness include emotional intelligence, and alignment between self-report ratings of performance with ratings ascribed by others. Individuals whose ratings align with others are seen to have high self-awareness leading to better performance outcomes than those with lower levels of self-awareness.[131] Second Track processes develop better self-awareness amongst members. Second Track processes develop better role identity for members based on collective self-esteem. Interpersonal efficacy assesses confidence to engage in a variety of interpersonal behaviours[132]. Second Track processes develop better social confidence for members based on learning new interpersonal skills.

Second Track processes transform individual social identity by enabling positive change in these four areas of measurement. The process of identity altering causes individuals to re-interpret their interests about the problem. The group is now their identity.

Personal-Cognitive Capacity

Personal-cognitive capacity is a cognitive lens through which people interpret social situations and make inferences about others.[133] CoP members that are able to form interpersonal impressions which are more extensive or differentiated are considered more cognitively complex.[134] This measures the individual's 'cognitive dimensions for interpreting

126. Massingham, 2015
127. Bruner, Goodnow and Austin, 1956
128. Kelly, 1955
129. Ellemers, De Gilder and Haslam, 2004
130. Ashley and Reiter-Palmon, 2012
131. Ibid.
132. Locke and Sadler, 2007
133. Burleson and Caplan, 1998
134. Delia, Clark and Switzer, 1974, pp. 299–308

and understanding the behaviour of others'.[135] Second Track processes increases members' cognitive complexity by expanding awareness of others' behaviour.

Second Track processes transform individual personal-cognitive capacity by enabling positive change in these three areas of measurement. The process of cognitive altering is more than realisation by the individual that the social horizon has gathered a clever group of people. Second Track processes' development of personal cognitive capacity enables the group's learning to motivate the individual to learn and to increase cognitive complexity. CoP members become increasingly aware of the learning behaviour of other members, this changes their curiosity, their learning increases, and this combines to grow the group's learning. Each individual's changing personal cognitive capacity makes them increasingly aware of the group's growing learning, which then further increases their motivation, and so the cycle continues.

Group Transformation

The ecological model of complex adaptive systems (CAS) reflects the idea that organisms and their environments evolve together.[136] For external CoPs, such as CARs, this model of CAS is measured by the group's learning. Second Track processes heighten members' sensitivity to external events and the group's flexibility to adapt in a timely manner. This sensitivity is considered a measure of CAS evolution, i.e., a key success factor.[137] Second Track processes' group transformation has two critical values: group creativity and solutions.

Group creativity: Second Track processes influence members' perception of the group's creativity in terms of their entrepreneurial orientation. Entrepreneurial orientation is perceived as the key to growth and innovation.[138] Members perceive changes in the group's capability over time, and as it moves towards the solution, there is awareness that the group itself is better in these four entrepreneurial orientation components than when it formed.

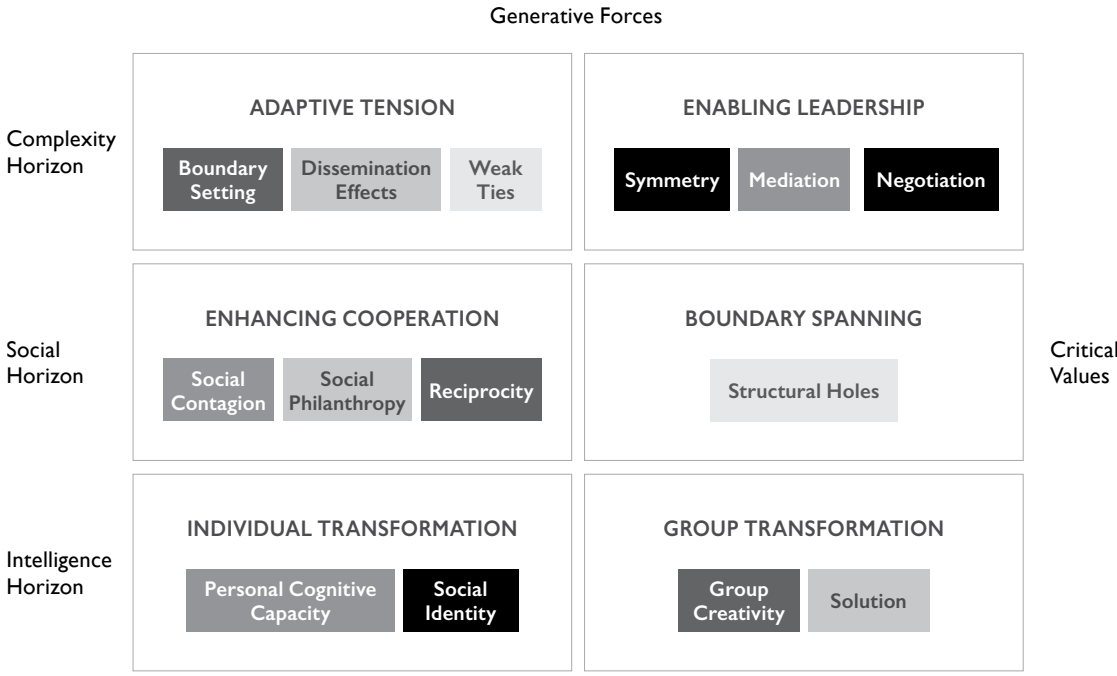
Solution: The group's transformation occurs because Second Track processes focuses on outcomes and not process. From the first meeting, the group becomes aware of the need for a solution and how this may be connected to first track and validated. As the group moves towards this validation point, it transforms, and members are increasingly sensitive to the group's creative efficacy. While every intelligence horizon has its own unique set of goals and objectives, Second Track processes have three broad guiding principles which differentiate its solutions from conventional CoP:

1. **Evaluation of the social system:** meaningful dialogue through effective Second Track process.
2. **Evaluation of the solution:** coalitions of people leading responses to common challenges.
3. **Evaluation of sustainability:** new self-resourced partnerships which continue to operate after the group has finished its work.

In this way, Second Track processes transforms the group with its solution by connecting it with key decision makers who may take the solution and implement it, and by ensuring there is a diverse and relevant range of leaders, officials and civil society partners will be interested in the solution, have the capacity to be involved, and willingness to partner the solutions into the future.

135. Delia, Clark and Switzer, 1974, p. 299–300
136. Espinosa and Porter, 2011
137. Ibid.
138. Hakala, 2013, pp. 102–118

FIGURE 1: SUMMARISES THE PAPER'S FRAMEWORK FOR UNDERSTANDING SECOND TRACK PROCESSES



The figure begins on the left with the complex adaptive system's three domains: complexity, social, and intelligence horizons. Each domain involves two generative forces (see columns) adapting two of Borzillo and Kaminska-Labbe's[139] complexity theory constructs. The third domain – the intelligence horizon – is a new domain not covered by Borzillo and Kaminska-Labbe. Finally, there are fourteen critical values which represent the CoP emergent properties. The critical values interact and combine to generate and sustain knowledge creation necessary to solve wickedly complex problems. The critical values are colour coded to indicate linkages between them. Those critical values with the same shades of grey are proposed to involve direct connections. These connections explain how the critical values represent integrating mechanisms driving the CoP knowledge creation. Figure 1 is our conceptual model of Second Track processes unique capability as an external emergent CoP.

139. Borzillo and Kaminska-Labbe, 2011

CONCLUSION

The aim of this paper was to conceptualise about the emergent driving forces in communities of practice which sustain voluntary knowledge creation necessary to solve wicked problems. Existing theory on CoP continues the long tradition of perceiving them as voluntary emergent phenomena that develop from the bottom up, i.e., self-regulating, with more limited theory on managerial guidance. This paper extends research by Borzillo and Kaminska-Labbe using complexity theory to explain CoP interactions balancing the need for control and autonomy.

The paper introduced Second Track processes as a new type of complex adaptive social system. Second Track processes sit at the edge of chaos nibbling away at the status quo by finding solutions to wickedly complex problems. The unique emergent properties of Second Track processes are revealed in the adaptive connections themselves. Second Track's dynamic properties emerge in how the system attracts and absorbs new knowledge (members) and adapts to their interaction with existing members. The adaptive properties transform the individuals and the group generating a collective intelligence that transcends the sum of Second Track's parts. This intelligence is the solution to the wickedly complex problem, and the capacity to navigate colliding social systems to ensure the solution is implemented.

Our conceptual model of CoPs developed in this current paper makes three main contributions to our understanding of CoPs. The first contribution is to introduce an external CoP, Second Track processes, which represents an opportunity to bring together teams of diverse experts to solve wickedly complex problems. The second contribution is the three CoP domains: complexity horizon, social horizon, and intelligence horizon. These domains explain CoPs as complex adaptive systems in terms of their organisation (complexity), interaction (social), and thinking (intelligence). Our model extends Borzillo and Kaminska-Labbe's theory of CoPs as complex adaptive systems in two ways. First, we develop a third domain not covered by Borzillo and Kaminska-Labbe – the intelligence horizon – which contributes understanding of cognition by CoP members and the group. Second, we explain how Second Track processes is driven by the self-directed mode, making the guided mode unnecessary (see first row in figure 1). The third contribution is fourteen critical values which represent the CoPs' emergent properties. The critical values interact and combine to generate and sustain knowledge creation necessary to solve wickedly complex problems. The critical values are organised into six quadrants representing Borzillo and Kaminska-Labbe's four complexity theory constructs, and the two new constructs which characterise the intelligence horizon.

This paper has developed a conceptual model contributing to our understanding of the different driving forces inside CoP which generate and sustain voluntary knowledge creation necessary to solve wicked problems. Further research might develop measures to empirically test the claims made in this paper, and represents an exciting opportunity for new research on CoPs.[140]

140. For practical examples of Second Track processes as CoPs, see C. Fritz-Kalish, Twenty Years on the Second Track, *Journal of Behavioural Economics and Social Systems*, 2019, vol. 1, no. 1, pp. 44-50, and B. Blackshaw, The Second Track and *talanoa*: Implementation of the *Pacific Connect* programme in the Pacific Islands, *Journal of Behavioural Economics and Social Systems*, vol. 2, no. 1, June 2020

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