

SOCIO-COGNITIVE INFLUENCES ON INNOVATION

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FINAL REPORT

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KEY MESSAGE

The process of innovation required to create, develop, adopt and use emerging technologies is both fostered and constrained by social and cognitive factors that influence the nature and extent of innovative activities. Our review of research focusing on the relationship between national and organizational dimensions of culture, organizational practices, and innovation suggests that:

- While there are significant relationships between national cultural dimensions and national measures of innovation, these relationships are not absolute, and not predictive of outcomes. Rather, they are influential in the social dynamics and logics of action employed by multiple actors, which in turn influence the innovation process, technology trajectory, and performance.
- National culture is important for organizational innovative outcomes to the extent to which it shapes organizational practices. However, organizations are able, and often do, deviate from national cultural tendencies especially in countries characterized by low levels of cultural tightness, which is the case of Canada.
- Research on cultural diversity and innovation suggest that innovation is positively influenced by cultural diversity when diversity is properly managed. More importantly, innovation is itself a cultural process, and may emerge through different processes, mechanisms, and structures, challenging the notion of one best innovation culture.
- Innovative organizations are characterized as possessing a “culture of innovation” that allows them to advance and thrive in competitive markets. However, a clear specification of what characterizes a culture of innovation remains elusive.
- Based on the literature reviewed we conceptualize a culture of innovation as a congruent and generative set of values, norms, schemas, artifacts and practices within an organization that are consistent and supportive of each other and *uniquely* positioned to address external and internal demands, resources and constraints facing the organization.
- A culture of innovation develops in an organic, causally ambiguous, and idiosyncratic way and needs to be cultivated and nourished. Accumulating the right ingredients characteristic of such a culture is necessary but not sufficient to guarantee its development. No two cultures are the same even though they might share important elements.

EXECUTIVE SUMMARY

Emerging technologies have the potential to change the way individuals interact with each other, learn, and conduct business and have the potential to bring many benefits and challenges to Canadian citizens, governments and organizations. The creation, development, adoption, and use of emerging technologies are the result of *a process of innovation*, which is both fostered and constrained by social and cognitive factors that influence the nature and extent of innovative activities. In this paper, we report on a critical interpretive synthesis of research focusing on the relationship between national and organizational dimensions of culture, organizational practices, and innovation. Our review suggests the following relationships between culture and innovation:

National culture and innovation: There are significant relationships between national cultural dimensions and national measures of innovation. However, these relationships are not absolute, and not predictive of outcomes. Rather, they are influential in the social dynamics and logics of action of multiple actors, which influence the innovation process, technology trajectory, and performance. National culture is important for organizational innovative outcomes to the extent to which it shapes organizational practices. However, organizations are able, and often do, deviate from national cultural tendencies especially in countries characterized by low levels of cultural tightness, which is the case of Canada.

Organizational culture and innovation: Research on culture and innovation is still at early stages of development and, as a result, is highly fragmented and adopt multiple perspectives drawn from multiple paradigms. Several cultural characteristics have been identified, including factors that support risk taking and knowledge sharing and facilitate interaction, coordination, and collaboration among multiple players within and across organizations. Also, a set of *orientations* has been suggested to be related to innovation, including market orientation, customer orientation, learning orientation, and entrepreneurial orientation. Innovative organizations are characterized as possessing a “culture of innovation” that allows them to advance and thrive in competitive markets.

Diversity and innovation: Research on cultural diversity and innovation suggest that innovation is positively influenced by cultural diversity when diversity is properly managed and there are practices in place to promote divergent thinking, decrease conflict and facilitate communication and understanding between different actors within the organization. In addition, innovation is itself a cultural process, may emerge through different processes, mechanisms, and structures challenging the notion of one best innovation culture.

A culture of innovation

Innovative organizations are characterized as possessing a “culture of innovation” that allows them to advance and thrive in competitive markets. However, a clear specification of what characterizes a culture of innovation remains elusive. We draw on culture, cognition and innovation literatures to elaborate on the concept of “culture of innovation”, which we conceptualize as a congruent and generative set of values, norms,

schemas, artifacts and practices within an organization that are consistent and supportive of each other, and *uniquely* positioned to address external and internal demands, resources and constraints facing the organization.

Cultural values represent culturally influenced principles and judgments about right and wrong, desirable and undesirable, such as individualism, egalitarianism, competitiveness and goal achievement. *Cultural norms* represent knowledge of behaviors that are typical and socially approved. Norms are learned by observing how others behave and through others' reactions to our own behaviors such as expectation to develop new products permanently, and an appreciation of unconventional ideas, expectations of innovative outcomes and behaviours. *Cultural schemas* are knowledge structures storing information that guide interpretations, expectancies, and responses. Cultural schemas encompass many of the cognitive components of culture which facilitate interpretation, including market and customer orientations, learning orientation, and entrepreneurial orientation. *Cultural artefacts* refer to circulated innovation stories, arrangements, rituals and language that have symbolic meaning and support innovation. *Cultural practices* refer to the actions and routines practiced by actors on a regular basis such as formal processes to collect and harvest ideas, share knowledge and foster coordination and collaboration among different actors.

Organizations are faced with internal and external demands and constraints and possess unique resources. Demands include legal compliance, social expectations, and technological factors. Resources and constraints include financial, human structural and social capital. These demands, resources, and constraints are subjectively perceived and may be acted upon in different ways, resulting in different outcomes. Further, different groups within the organization may focus on different cultural resources when interpreting situations and assembling actions, which explains why groups within an organization may perceive the innovative potential of an emerging technology differently.

Innovation is itself a cultural process and multiple assemblages of varying cultural components are possible. Innovation may emerge through different processes, mechanisms, and structures and the congruence or incongruence among cultural elements as well as how cultural elements are demarcated to address a particular problem are as important as the cultural elements themselves.

Innovation is an emergent, non-linear and dynamic discovery process that can yield unintended outcomes and characterized by high levels of technological, commercial, organizational, and social uncertainty and ambiguity. Therefore, the resulting degree of innovation often can't be decided *a priori* but is assessed *a posteriori*. It is possible and necessary to advance technology management strategies to shape the development and growth of innovative cultures. However, bringing all the right strategies and practices together does not guarantee innovative outcomes.

Implications

Navigating the innovation cycle and transforming ideas into successful outcomes in the marketplace is a complex task dependent on multiple components. While Canada is

relatively strong in idea generation and technology creation, it is weak in the capacity to commercialize those technologies on a global scale, suggesting that Canadian organizations need to foster a culture of innovation in order to support innovative practices not only in terms of new technologies but also innovative business and marketing strategies.

However, Canadian organizations need to develop a culture of innovation that is congruent with the Canadian innovative environment including internal and external demands and constraints, as well as unique resources that are available to Canadian organizations. A culture in support of innovation must address objective and subjective constraints facing the organization. Assembling the right strategies, personnel and practices alone, does not create cultures of innovation. Rather, a culture of innovation is forged through the active and engaged process of “doing”, delivering innovative outcomes repeatedly over time.

Fostering a culture of innovation and delivering innovative outcomes, from the creation or application of emerging technologies, involves processes of searching for, selecting, and committing to combinations of ingredients that are the seeds of innovation. It further involves practices to curate and cultivate the investments into creative assets, nurturing the application of those assets into productive innovations, and finally harvesting the fruits produced (innovative outcomes) through commercialization in the marketplace, or productive diffusion into the organization. Fostering a culture of innovation is a sustained process of prescient, proactive, and adroit action that both anticipates and reacts to the vagaries, uncertainties, and opportunities presented by the environment. There are no quick fixes or magic bullets to developing innovative cultures and producing innovative outcomes.

Future research

The best practices driven nature of the innovation discourse creates the illusion that any organization in any environment can become innovative if innovative practices, values, and orientations are adopted. However, there isn't enough evidence to support that claim. Research investigating the boundary conditions of these best practices is required in order to generate actionable outcomes to Canadian organizations.

Future research needs to provide insight into what constitutes a culture of innovation in the Canadian context and how the processes and practices adopted by organizations shape the development this culture over time. Research should also address how such cultures are cultivated and nourished and what may potentially be ways in which innovative cultures can be destroyed if proactive efforts are not enacted to preserve and promote them.

SOCIO-COGNITIVE INFLUENCES ON INNOVATION

Context

Emerging technologies have the potential to change the way individuals interact with each other, learn, and conduct business and have the potential to bring many benefits and challenges to Canadian citizens, governments and organizations (Tapscott & Williams, 2006). The creation, development, adoption, and use of emerging technologies, are the result of *a process of innovation* (Adams et al., 2006; Rujirawanich et al., 2011; Freeman & Engel, 2007; Gates, 2005; Bartel & Garud, 2009). Such innovation is both fostered and constrained by social and cognitive factors that influence the nature and extent of innovative activities. We follow Baregheh and colleagues' definition of innovation as "multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete, and differentiate themselves successfully in their marketplaces" (2009, p. 1334). In this report, we are particularly concerned with innovations that are related to developing and/or implementing emerging technologies to generate path-breaking changes in the market or to produce new or improved strategies, processes, capabilities, products, or services.

Innovation is an evolutionary process of technical, institutional and social change, which occurs simultaneously at three levels: the level of individual firms or research laboratories, the level of the social and institutional context, and the level of the nature and evolution of knowledge and the related technological regime (Corrocher et al., 2003). Innovation may be technological as a result of new inventions emanating from basic research, or business oriented as a result of the introduction of new business and marketing strategies (Doloreux & Lord-Tarte, 2014) which allow the utilization of emerging technologies to produce new products and services or change business processes. Innovation is a social process that not only meets a technological need but also simultaneously meets a social need that leads to new or improved capabilities and relationships and to better use of assets and resources (Krlev et al., 2014).

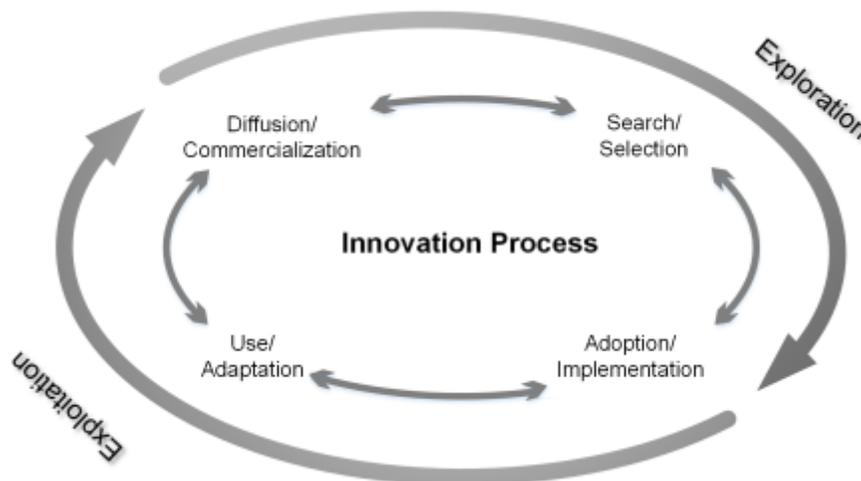
Innovative activities are not only shaped by the physical, financial, and technological resources available to organizations, but also by the social and cultural resources that influence their execution and growth processes. The management of innovation involves not only issues associated with project and knowledge management, but also issues associated with the organizational culture and social structure (Adams et al., 2006), as it is highly dependent upon social interactions (Starbuck, 2014). Innovative activities are embedded in the practices of the organization and are shaped by social and cognitive perspectives of the individuals in the organization (Bessant, et al., 2014).

In this report, we synthesize research focusing on the role of socio-cognitive influences on the process of innovation. In particular, we synthesize research focusing on the relationship between national and organizational dimensions of culture, organizational practices, and innovation in order to draw implications for Canadian organizations and policy makers interested in fostering a culture of innovation. We start by summarizing our findings regarding the relationship between culture and the innovation process.

Innovation and culture

Innovation is often characterized as comprising two distinct phases, exploration and exploitation (Tollin and Schmidt, 2012; Beverland, et al., 2015). Explorative innovation involves search, selection, and adoption routines geared to discovering, creating, and acquiring new innovations by organizations (Beverland, et al, 2015; O’Reilly and Tushman, 2013). Exploitative innovation emerges from the successful implementation, use, adaptation, refinement, and diffusion of the innovation for productive applications internally or for commercialization in external markets. Exploration and exploitation processes are often treated as two competing set of activities in firms, but scholars suggest that organizations should be “ambidextrous” and engage in both processes simultaneously (O’Reilly and Tushman, 2013). While these two types of innovation are often treated separately, there is a dynamic, iterative, and cyclical relationship between exploitation and exploration as described in Figure 1. The pursuit of new innovations develops in path-dependent ways (Bessant, et al., 2014). Future innovations emerge and develop in the context of previous explorative and exploitative processes. The outcomes of those processes may be advanced or constrained by incumbent strategies, resource endowments, and organizational histories.

Figure 1. The innovation process



The outcome of an innovation process may vary in the degree of novelty and discontinuity. At one extreme, innovations may be perceived as *radical* and depart significantly from existing products, services and approaches (Bessant, et al., 2014; Markard and Truffer, 2006; Büschgens et al., 2013). At the other, the outcome of the innovation process is less dramatic and may result in *incremental* improvements in products, services, and approaches (Edge, 2015; Beverland et al., 2015).

Incremental innovations build on current resources and processes. They tend to privilege “inside the box” thinking that favours continuity and improvements of current investments (Büschgens et al., 2013). More radical innovations, which often characterize innovations of and through emerging technologies, require “cognitive frame breaking”

that drive fundamental change in the routines and structures of organizations to embrace potentially disruptive and risky endeavours (Büschgens et al., 2013) that potentially will create new-to-the-firm or first-of-a-kind innovations. Radical innovations are characterized by higher levels of uncertainty and require more creativity and risk taking (O'Malley et al., 2014; Gatignon et al., 2002) and, unlike incremental innovations, are not facilitated by standardized innovative processes (Griffin et al., 2014; Leifer et al., 2000).

Whether firms engage in radical or incremental innovation, the real proof of its value and effectiveness is whether such innovation is translated into impacts and sustainable value to the organization or the marketplace. Some firms tend to generate innovations while others adopt innovations through a search for technologies and processes developed elsewhere that can be assimilated in their own situation (Damanpour & Wischnevsky, 2006). Firms will, therefore, differ in the strategies they pursue and the resources and capabilities they assemble to deliver on innovations. Firms that engage in innovation generation focus on developing capabilities that allow them to discover or invent first-of-a-kind type innovations that create change. Innovation adopting firms focus on building capacity to assimilate new-to-the-firm types of innovation that allow them to remain competitive (Damanpour & Wischnevsky, 2006).

Innovative firms are essential for Canadian competitiveness and economic and social wellbeing. However, a recent report from The Conference Board of Canada (2015) suggests that Canadian firms generally lag behind firms in other developed nations such as United States, Germany, Finland and Japan, in innovative capacity, despite Canada's stable fiscal climate, a competitive tax system, efficient labour markets, stable public institutions, good infrastructure, and well-educated population. While Canada is relatively strong in idea generation and technology creation, it is weak in the capacity to commercialize and market those technologies globally (Muzyka, 2015; Doloreux & Melancon, 2009). Canada's innovative initiatives have resulted in strong science faculties, a strong supply of scientific discoveries, and a number of small organizations with limited prospects in a global scale (The Conference Board of Canada, 2008). Further, organizations engaged in international collaborations tend to focus on scientific research and development and less on commercial activities (Cohn & Good, 2015) suggesting a need for fostering an innovative culture and business models in order to support path-breaking innovative practices (Muzyka, 2015) not only in terms of new technologies but also innovative business and marketing strategies (Doloreux & Lorde-Tarte, 2014). Canada needs to be a more active player in the development of emerging technologies but also find innovative ways to use emerging technologies to advance Canadian competitiveness in global markets.

Our review of research focusing on the relationship between national and organizational dimensions of culture, organizational practices, and innovation (reviewed in detail in the results section of the report) suggests:

- While there are significant relationships between national cultural dimensions and national measures of innovation, these relationships are not absolute, and not predictive of outcomes (Aten & Nardon, 2009). Rather, they are influential in the social dynamics (Ghazinoory et al., 2014) and logics of action (Nardon & Aten,

2008), which influence the innovation process, technology trajectory, and performance.

- National culture is important for organizational innovative outcomes to the extent to which it shapes organizational practices. However, organizations are able, and often do, deviate from national cultural tendencies (Nelson & Gopalan, 2003), especially in countries characterized by low levels of cultural tightness (Triandis, 2004) such as Canada.
- Research on cultural diversity and innovation suggest that innovation is positively influenced by cultural diversity when diversity is properly managed (Mueller, 2014; Parrotta et al., 2014; Reid et al., 2014; Tjosvold & Wong, 2004; Griffin et al., 2014; Peretz et al., 2015; Bartel & Garud, 2009). In addition, innovation is itself a cultural process (Elliot & Nakata, 2013; Westwood & Low, 2003), may emerge through different processes, mechanisms, and structures (Westwood & Low, 2003) challenging the notion of one best innovation culture.
- Innovative organizations are characterized as possessing a “culture of innovation” that allows them to advance and thrive in competitive markets. However, a clear specification of what characterizes a culture of innovation remains elusive.
- Building on these findings and extant literature, we conceptualize a culture of innovation as a congruent and generative set of values, norms, schemas, artifacts and practices within an organization (Stock et al., 2013; Homburg & Pflesser, 2000) that are consistent and supportive of each other (Homburg & Pflesser, 2000; Peters et al., 2016; Story et al., 2014; Baker et al., 2014; Rauch et al., 2013; Berson et al., 2008), and *uniquely* positioned to address external and internal demands, resources and constraints facing the organization (De Guinea & Markus, 2009; Leonardi & Rodriguez-Lluesma, 2012). Innovation is itself a cultural process and multiple assemblages of varying cultural components are possible (Westwood & Low, 2003; Leonardi, 2011).
- A culture of innovation develops in an organic, causally ambiguous, and idiosyncratic way and needs to be cultivated and nourished. Accumulating the right ingredients characteristic of such a culture is necessary but not sufficient to guarantee its development. No two cultures are the same even though they might share important elements.

Implications

Navigating the innovation cycle and transforming ideas into successful outcomes in the marketplace is a complex task (Tripsas & Gavetti, 2000) dependent on multiple components. While Canada is relatively strong in idea generation and technology creation, it is weak in the capacity to market those technologies (Muzyka, 2015; Doloreux & Melancon, 2009), suggesting Canadian organizations need to foster a culture of innovation in order to support innovative practices in Canada (Muzyka, 2015) not only in

terms of new technologies but also innovative business and marketing strategies (Doloreux & Lorde-Tarte, 2014).

However, Canadian organizations need to develop a culture of innovation that is congruent with the Canadian innovative environment including internal and external demands and constraints, as well as unique resources that are available to Canadian organizations. Following best practices of innovative companies in other countries, while potentially beneficial, is insufficient. For example, Google's practice of allowing employees to spend 20% of their time working in new products support innovation at Google. Mimicking Google's practice without the resources to pursue those ideas, or the ability to recognize good ideas is insufficient to produce innovative companies.

A culture in support of innovation must address objective and subjective constraints facing an organization, as well as acknowledge the way different cultural components are assembled. Assembling the right strategies, personnel, and practices alone does not create cultures of innovation. Cultures of innovation are forged through the active and engaged process of "doing", delivering innovative outcomes repeatedly over time.

Fostering a culture of innovation and delivering innovative outcomes, from the creation or application of emerging technologies, involves processes of searching for, selecting, and committing to combinations of ingredients that are the seeds of innovation. It further involves practices to curate and cultivate the investments into creative assets, nurturing the application of those assets into productive innovations, and finally harvesting the fruits produced (innovative outcomes) through commercialization in the marketplace, or productive diffusion into the organization (Grant & Collins, 2016).

This is not a one-time event or project. Fostering a culture of innovation is a sustained process of prescient, proactive, and adroit action that both anticipates and reacts to the vagaries, uncertainties, and opportunities presented by the environment. There are no quick fixes or magic bullets to developing innovative cultures and producing innovative outcomes. Managing innovation is akin to farming. Like farmers, over time, innovation managers develop the capacity to recognize potential opportunities and challenges, select and implement remedies, nurture investments, harvest the outcomes, and renew the resource-base, and deepen the capacity to consistently and sustainably deliver innovative outcomes (Grant & Collins, 2016).

Methodological Approach

We conducted a critical interpretive synthesis (Dixon-Woods et al., 2006) of the literature dealing with cultural, social and cognitive factors involved in innovation. A critical interpretive synthesis builds on meta-ethnography and grounded theory approaches (Barnett-Page & Thomas, 2009) to combine results from quantitative and qualitative research derived from multiple disciplinary traditions. We followed this approach because the status of the literature did not allow for simple aggregation of findings, rather it required a theorization of the evidence, as studies from different disciplines employed divergent assumptions about concepts and methods that needed to be uncovered in order to integrate and synthesize the literature.

We collaborated with a Carleton University librarian in order to identify the best research strategy for this systematic literature review. After a discussion of the project objectives it became evident that a traditional keyword search was not feasible as a search for the terms “culture” and “technology” resulted in over 2 million academic articles. Given the overwhelming literature on the topic, we identified 26 key articles on the field based on our familiarity with the topic, citation searches on the databases and focused keyword searches. These articles served as a basis for applying a snowball method. We followed the references cited and citation to these articles and continued following documents until no new relevant articles were identified. Our initial dataset contained 415 relevant articles published in the last sixteen years (i.e., 2001 – 2016).

We reviewed the abstracts and content of these articles and assessed their quality and relevance to our study. We selected a subset of papers that were focused on socio-cognitive underpinnings of innovation of relevance to the Canadian techno-space for deeper analysis. As we categorized, integrated and synthesized those articles, we became aware of additional relevant research and concepts, which prompted additional literature searches. The process of completing our database was ongoing and interactive. Our final review includes 113 papers, which are summarized in the results section below.

Results

Innovation is a social process influenced by the macro national cultural environment, as well as the organization in which it is embedded. We reviewed literatures on national culture and national innovation, national culture and organizational innovation, organizational culture and organizational innovation, and cultural diversity and innovation. These different streams of literature are discussed below.

National culture and national innovation

Research suggests that there is a significant relationship between national culture – conceptualized using Hofstede’s and GLOBE’s cultural dimensions and national innovation output. However, the results are somewhat inconsistent across studies. Studies show consistent support for the role of individualism (Taylor & Wilson, 2012; Rinne, et al., 2012; Gorodnichenko & Roland, 2011) low family collectivism (Kaasa & Vadi, 2010; Taylor & Wilson, 2012), and power distance (Rinne et al., 2012; Halkos & Tzeremes, 2013) in supporting innovative activities. However, other dimensions such as uncertainty avoidance are supported in some studies (e.g. Kaasa & Vadi, 2010) but not in others (Halkos & Tzeremes, 2013). National culture was also related to motivation to innovate, but culture impacts varied over time across different stages of the innovation process (Efrat, 2014).

Altogether, this stream of research suggests that while there are significant relationships between national cultural dimensions and national measures of innovation, these relationships are not absolute, and not predictive of outcomes (Aten & Nardon, 2008). Rather, they are influential in the social dynamics (Ghazinoory et al., 2014) and logics of action (Nardon & Aten, 2008), which influence the innovation process, technology trajectory, and performance.

Puia and Ofori-Dankwa (2013) suggest that in addition to culture, ethnolinguistic diversity needs to be taken into consideration as well. In an investigation of 67 countries, they found that culture (measured using Hofstede's index) and ethnolinguistic diversity are both related to national innovation, measured by number of patents and trademarks, but together account for a significantly greater effect. Zhan, Bedapudi and Hong (2015) qualified this finding by separating the effect of ethno-diversity and cultural diversity. They found that diversity arising from ethnic categorization impairs innovation, while diversity arising from cultural diversity enhances innovation. This finding is particularly relevant to the Canadian environment given the high levels of ethnic and cultural diversity in Canadian society. Research focusing on organizational diversity and innovation summarized later in this paper will further inform the mechanisms in which diversity impacts innovative activity. Studies focusing on national culture and national innovation are summarized in table 1 in Appendix 1.

National culture and organizational innovation

Innovation activities happen at the level of organizations. For this reason, several studies have focused on understanding the influences of national and organizational cultural factors on organizational innovation outcomes. Research suggests that innovation is influenced by organizational practices, which in turn, are influenced by the national cultural environment (e.g. Garret, Buisson & Yap, 2006; Ambos & Schlegelmilch, 2008; e.g. Černe, Jaklič & Škerlavaj, 2013; Vecchi & Brennan, 2009; Turró, Urbano, and Peris-Ortiz, 2014; Mueller & Thomas, 2001).

Further, research suggests that the relationship between national culture and organizational practices on innovation varies across different stages of the innovation process (Ambos & Schlegelmilch, 2008; Černe, Jaklič & Škerlavaj, 2013), but results to date have been contradictory. While some find an effect only for the exploration stage (Ambos & Schlegelmilch, 2008) others only find an effect on the exploitation stage (Rujirawanich et al., 2011; Garret et al., 2006). These contradictory findings highlight the need to consider the innovation process as a path dependent process over time.

This stream of work suggests that national culture is important in the extent to which it shapes the practices of organizations. However, organizations are able and often do, deviate from national cultural tendencies (Nelson & Gopalan, 2003), especially in countries characterized by low levels of cultural tightness (Triandis, 2004) such as Canada, which allow for a wide range of behaviors. Furthermore, organizational practices and innovative processes and technologies have the potential to influence the national cultural environment (Elgar, 2005). This research is summarized in Table 2 in appendix 1.

Organizational characteristics and organizational innovation

Research suggests that organizational characteristics such as structure (Green & Cluley, 2014; Garrett et al., 2006), size and age (Nystrom et al., 2002), resources such as human talent and technological knowledge assets (Martín-de Castro et al., 2013), practices (Garud & Rappa, 1994; De Guinea & Markus, 2009; Yusof, 2015; Cresswell et al., 2013), culture and climate (Starbuck, 2014; Fain & Wagner, 2014) influence the degree to which

organizations are able to engage in innovative activities (Story, et.al, 2014), willing to adopt innovative technologies (Nystrom et al., 2002; Yusof, 2015), and are able to successfully implement those technologies (Cresswell & Sheik, 2013).

In particular, scholars highlight the importance of an organizational culture that supports risk-taking (Nystrom et al., 2002), knowledge sharing (Martín-de Castro et al., 2013) and facilitates interaction, coordination, and collaboration among multiple players within and across organizations (Starbuck, 2014), including between other organizations and stakeholders (Egger et al., 2014; Sandberg & Aarikka-Stenroos, 2014; O'Malley et al., 2014), and internal departments (Hernandez, 2006; Workman, 1998). Several scholars have highlighted the need for organizations to develop a “culture of innovation” (Reid et al., 2014; Aarikka-Stenroos & Lehtimäki, 2014; Stock et al., 2013 Martín-de Castro et al., 2013; Stock et al., 2013; Homburg & Pflesser, 2000; Deshpande et al., 1993; Deshpande & Webster, 1989; Berson et al., 2008).

A culture of innovation is conceptualized as the degree to which cultural elements support organizational innovativeness (Stock et al., 2013) and is characterized by a set of *orientations*, including market orientation (Aarikka-Stenroos & Lehtimäki, 2014; Reid et al., 2014; Tollin, 2008; Baker & Sinkula, 2005, 2007) customer orientations (Eggers et al., 2014; Griffin et al., 2013; Sandberg & Aarikka-Stenroos, 2014; Markard & Truffer, 2006; Deshpande et al., 1993; Moorman, 1995); learning orientation (Peters et al., 2016; Reid et al., 2014; Moorman & Miner, 1997; Sinkula et al., 1997; Baker & Sinkula, 2007); and entrepreneurial orientation (Turró et al., 2014; Ghazinoory et al., 2014; Mueller & Thomas, 2001). A culture of innovation is composed of values (Turró et al., 2014; Büschgens et al., 2013; Stock et al., 2013; Markard & Truffer, 2006; Berson et al., 2008; Leonard-Barton, 1992), norms, artifacts (Stock et al., 2013; Homburg & Pflesser, 2000), behaviours (Homburg & Pflesser, 2000; Baker & Sinkula, 2005), and cognitive schemas, which refers to beliefs, frames of reference and subjective meanings which organizational members share to some degree (Tyler & Gnyawali, 2009).

Research on culture and innovation is still at early stages of development and as a result, is highly fragmented and adopt multiple perspectives drawn from multiple paradigms, emphasizing either innovation or cultural elements, and adopting cognitive or behavioural perspectives of culture (see table 3 in Appendix 1 for a summary of articles).

Organizational diversity and innovation

Among the several organizational practices linked to innovation, management of diversity is particularly prominent and relevant to the Canadian environment. Diversity is often considered a double-edged sword (Pieterse et al, 2013). Diversity has been found to have a positive effect on innovation output (Mueller, 2014; Parrotta & Pozzoli, 2014) because individuals bring different perspective, knowledge, and skills (Reid et al., 2014; Griffin et al., 2014). However, diversity may also hamper innovation due to differences in values, work practices, and communication styles (Bouncken et al., 2016; Sivakumar & Nakata, 2003). The benefits of a diverse pool of employees depends on an organizational culture that promotes divergent thinking and idea freedom (Reid et al., 2014), built on practices to leverage diversity by decreasing conflict (Tjosvold & Wong, 2004), facilitate

understandings and discussions between different actors (Griffin et al., 2014; Peretz et al., 2015), and ultimately, leveraging the multiple perspectives that people bring to the table while preventing the larger effort from fragmenting (Bartel & Garud, 2009).

Research on cultural diversity and innovation suggest that innovation not only is influenced by cultural diversity but is itself a cultural process (Elliot & Nakata, 2013; Westwood & Low, 2003). Research on creative processes across countries demonstrates that different thinking processes may support innovation (Elliot & Nakata, 2013). Further, research suggests that creativity and innovation take place within, is constituted and influenced by, and has consequences for, a social context. Thus, innovation may emerge through different processes, mechanisms, and structures (Westwood & Low, 2003) challenging the notion of one best innovation culture (see table 4 in Appendix 1 for a summary of articles).

Culture of innovation

The literature review described above suggests that innovative organizations possess a “culture of innovation” that allows them to advance and thrive in competitive markets. Such culture of innovation is particularly important in the case of innovation of and through emerging technologies, which is characterized by high levels of uncertainty and ambiguity.

We draw on culture, cognition and innovation literatures to elaborate on the concept of “culture of innovation”, which we conceptualize as a congruent set of values, norms, schemas, artifacts and practices within an organization (Stock et al., 2013; Homburg & Pflesser, 2000) that are consistent and supportive of each other (Homburg & Pflesser, 2000; Peters et al., 2016; Story et al., 2014; Baker et al., 2014; Rauch et al., 2013; Berson et al., 2008), and *uniquely* positioned to address external and internal demands, resources and constraints facing the organization (De Guinea & Markus, 2009; Leonardi & Rodriguez-Lluesma, 2012). Innovation is itself a cultural process and multiple assemblages of varying cultural components are possible (Westwood & Low, 2003; Leonardi, 2011). We start by elaborating on the characteristics of a “culture of innovation” followed by a discussion of the process in which such culture comes to exist.

Characteristics or a culture of innovation

We draw on culture research that focuses on how individuals and groups put culture to use in everyday activities (Eliasoph and Lichterman, 2003; Swidler, 1986; Weisinger & Salipante, 2000). This perspective suggests that culture is *not* a causal variable, but rather a collection of resources (e.g. values, norms, schemas, artefacts and practices) that individuals draw on to enable actions (Swidler, 1986). As such, culture is not monolithic and many subcultures coexist within an organization (Tyler & Gnyawali, 2009) as groups of individuals may share some resources but not others. In addition, innovation is itself a cultural process (Elliot & Nakata, 2013; Westwood & Low, 2003) and multiple combinations are possible. Below we summarize characteristics of a culture of innovation identified in the literature.

Cultural values represent culturally influenced principles and judgments about right and wrong, desirable and undesirable (Leung & Morris, 2014), and include national level values such as individualism (Taylor & Wilson, 2012; Rinne et al., 2012; Gorodnichenko & Roland, 2011) and egalitarianism (Rinne et al., 2012; Halkos & Tzeremes, 2013) as well as organizational level values of control or flexibility (Büschgens et al., 2013), competitiveness, and goal achievement (Deshpande et al., 1993).

Cultural norms represent knowledge of behaviors that are typical and socially approved. Norms are learned by observing how others behave and through others' reactions to our own behaviors (Leung and Morris, 2014). Cultural norms identified in the literature include expectations of unconventional ideas (Stock et al., 2013); expectations of innovative outcomes (Wang & Lin, 2012; Stock et al., 2013); expectations of un-bureaucratic organizational structures and cohesive/flexible organizational support (Stock et al., 2013; Griffin et al., 2014; Bartel & Garud, 2009); expectation of divergent thinking (Chua et al., 2014; Reid et al., 2014).

Cultural schemas are knowledge structures storing information that guide interpretations, expectancies and responses (Leung and Morris, 2014). Cultural schemas encompass many of the cognitive components of culture which facilitate interpretation, including *market and customer orientations* (Eggers et al., 2014; Baker & Sinkula, 2005, 2007; Markard & Truffer, 2006; Deshpande et al., 1993; Moorman, 1995); *learning orientation* (Peters et al., 2016; Reid et al., 2014; Moorman & Miner, 1997; Sinkula et al., 1997; Baker & Sinkula, 2007); and *entrepreneurial orientation* (Turró et al., 2014; Ghazinoory et al., 2014; Mueller & Thomas, 2001)

Cultural artefacts refer to circulated innovation stories, arrangements, rituals and language that have symbolic meaning (Smirich, 1983; Hatch, 1993). Examples of cultural artefacts include stories of the senior manager as a good or a bad example, stories about problems of market orientation, and market-oriented or non-market-oriented language (Homburg & Pflesser, 2000); circulated innovation stories, informal discussion areas, and ritualized innovation events undertaken with customers and partners (Stock et al., 2013); circulated innovation narratives that address coordination problems (Bartel & Garud, 2009).

Cultural practices refer to the actions and routines practiced by actors on a regular basis (Weisinger & Salipante, 2000) such as formal process to collect and harvest ideas and filling senior positions with outsiders (Gates, 2005), facilitate knowledge sharing (Aakhus, 2014; Abel et al., 2014; Cardinal, 2001; Moorman & Miner, 1997; Sinkula et al., 1997; Moorman, 1995), and facilitate coordination and collaboration between actors within and across organizations (Starbuck, 2014; Griffin et al., 2013; Hernandez, 2006; Jong et al., 2014; O'Malley et al., 2014; Homburg & Pflesser, 2000; Baker & Sinkula, 2005), support risk taking (Markard & Truffer, 2006; Berson et al., 2008; Nystrom et al., 2002; Tollin & Schmidt, 2012), and facilitate learning (Peters et al., 2016; Baker & Sinkula, 2005, 2007; Sinkula et al., 1997). Also, continuous and in-depth evaluations of the process-technology alignment (Yusof, 2015), consensus building activities that assist with the congruence between different perspectives (Cresswell et al., 2013), and weekly innovation (i.e., brainstorming) meetings (Edge & Maclaine, 2015).

The large number of identified cultural characteristics identified in the literature highlights the complexity (Tripsas and Gavetti, 2000) and un-foreseeability (Starbuck, 2014) of the innovation process and challenges the notion of using culture as a causal variable to explain outcomes (Swidler, 1986; Leonardi, 2011; Nardon & Aten, 2008). While the identification of cultural characteristics is a helpful first step in advancing understanding, it seems that the congruence or incongruence among cultural elements (Baker et al., 2014; Baumard, 2014; Homburg & Pflesser, 2000) as well as how cultural elements are demarcated to address a particular problem (Leonardi, 2011) is equally important. When elements are disconnected there may be a desire or expectation of innovation but an inability to capitalize on the motivation to innovate. For example, organizations with a strong market orientation but with no supporting practices for coordinating between units may be unable to convert ideas into successful products (Baker & Sinkula, 2005). Similarly, norms of behavior that are not supported by artifacts that cue in the norm may not be effective (Homburg & Pflesser, 2000).

Influences on innovation

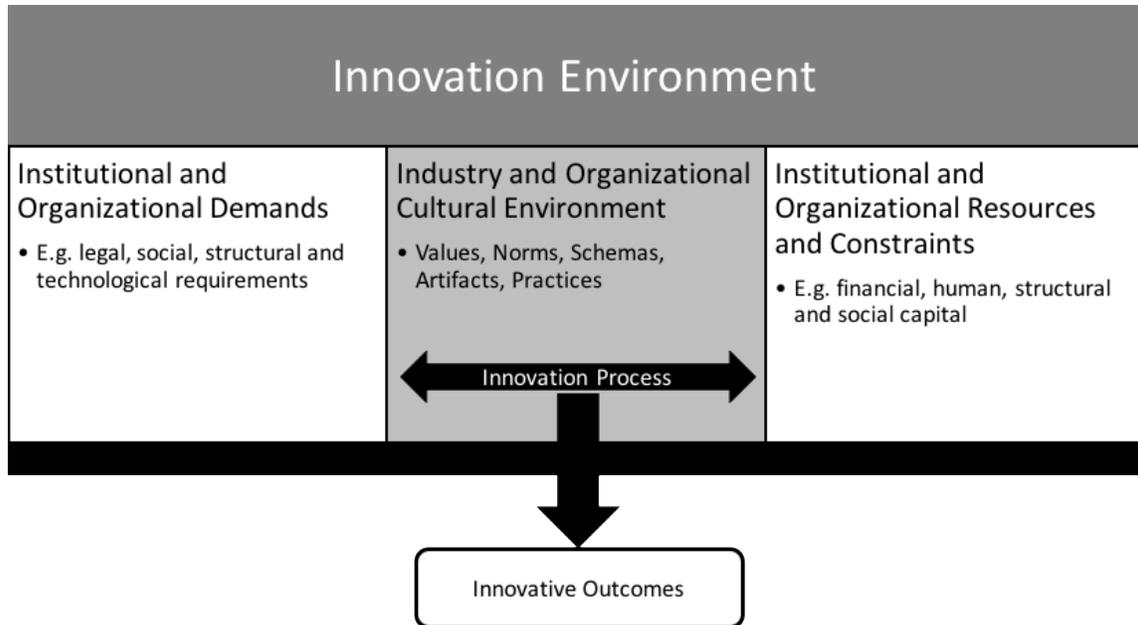
Organizations are faced with internal and external demands, resources and constraints. Demands include legal compliance, social expectations such as the extent to which the technology supports inter-professional roles and work (Cresswell & Sheikh, 2013), and technological factors (Yusof, 2015). Resources and constraints include financial capital (Cresswell & Sheikh, 2013), human capital (Martín-de Castro et al., 2013; Subramaniam & Youndt, 2005; Edvinsson & Malone, 1997), structural capital (Hodgkinson & Healey, 2014; Griffin et al., 2014; Edvinsson & Malone, 1997), and social capital (Peters et al., 2016; Ghazinoory et al., 2014; Martín-de Castro et al., 2013; Subramaniam & Youndt, 2005) as well as the extent to which the organizational architecture and support systems are aligned with the innovation process (Hodgkinson & Healey, 2014; Griffin et al., 2014).

These demands and constraints are subjectively perceived and may result in different outcomes depending on the skills, attitudes, and behaviors of organization members (Edge et al., 2015). Individuals employ cognitive schemas to filter and organize ambiguous information and facilitate decision-making and action (Walsh, 1995; Weick, 1995). Cognitive schemas are “knowledge structures that represent objects or events and provide default assumptions about their characteristics, relationships, and entailments under conditions of incomplete information” (DiMaggio, 1997, p. 269). That is, cognitive schemas organize categories of information and the relationships between them. These interpretations act as templates for action, directing attention and guiding individuals to select certain aspects of context as important (Leonardi, 2011).

The innovation process incorporates a large tacit element shaped by specific and idiosyncratic knowledge accumulated over time through either specific or improvisational learning processes (Bell & Pavitt, 1993; Dosi & Orsenigo, 1988; Zander & Kogut, 1995). The cultural environment provides the cognitive framework to interpret and address these demands and constraints, which may or may not result in innovative outcomes. As depicted in figure 2, a firm’s innovation process is embedded within an organizational

cultural environment, which filters and addresses the demands, resources, and constraints facing the organization.

Figure 2: Influences on innovation



Facing similar demands, resources, and constraints, different organizations may interpret and demarcate cultural resources differently. Further, different groups within the organization may focus on different cultural resources when interpreting situations and assembling actions, which explains why groups within an organization may perceive the innovative potential of a technology differently (Leonardi, 2011; Orlikowski & Gash, 1994).

Fostering a culture of innovation

Innovation may emerge through different processes, mechanisms, and structures (Westwood & Low, 2003) and the congruence or incongruence among cultural elements (Baker et al., 2014; Baumard, 2014; Homburg & Pflesser, 2000) as well as how cultural elements are demarcated to address a particular problem (Leonardi, 2011) are as important as the cultural elements themselves.

Innovation is an emergent, non-linear and dynamic discovery process that can yield unintended outcomes (Garud & Karnøe, 2003; Starbuck, 2014; Aarikka-Stenroos & Lehtimäki, 2014; Enright, 2001; Holmlund, 2012). It is characterized by high levels of technological, commercial, organizational, and social uncertainty and ambiguity (Hall & Martin, 2005). Therefore, the resulting degree of innovation often can't be decided a priori, but is assessed *a posteriori*. It is possible and necessary to advance technology management strategies to shape the development and growth of innovative cultures (Maine, et al., 2013). Developing capabilities to effectively identify and synthesize the affordances of new and existing technologies into innovative combinations, fostering

collaborative knowledge sharing and serendipitous discoveries, and adopting market matching strategies that reduce uncertainty are some of the ways firms create the environment that will lead to innovative outcomes (Maine, et al., 2013). However, bringing all the right strategies and practices together are not guaranteed to yield innovative outcomes. This is because innovation and the culture that support its development and growth is generative, socially complex, and causally ambiguous (Nelson & Winter, 1982). Like a farmer planting a seed faces the uncertainty of if and how the seed will germinate and grow into a productive plant, managers need to accept the uncertainty associated with a firms' efforts to develop and shape a culture of innovation (Grant & Collins, 2016).

Fostering a culture of innovation and delivering innovative outcomes, from the creation or application of emerging technologies, involves processes of searching for, selecting, and committing to combinations of ingredients that are the seeds of innovation (for example, combining biotechnology and nanotechnology in delivering radically new radiation therapies) (Maine, et al., 2013). It further involves practices to curate and cultivate the investments into creative assets, nurturing the application of those assets into productive innovations, and finally harvesting the fruits produced (innovative outcomes) through commercialization in the marketplace, or productive diffusion into the organization (Grant & Collins, 2016).

This is not a one-time event or project. Fostering a culture of innovation is a sustained process of prescient, proactive, and adroit action that both anticipates and reacts to the vagaries, uncertainties, and opportunities presented by the environment. There are no quick fixes or magic bullets to developing innovative cultures and producing innovative outcomes. This process is both cognitive and emotional. For instance, Hodkinson and Healey (2014) suggest that much of the theorizing around innovation is based on outmoded conceptions of bounded rationality and all attention to the emotional aspect of innovation and the need for organizations to engage in emotion management in order to foster innovation.

Future research

The large number of identified cultural characteristics highlights the complexity (Tripsas and Gavetti, 2000) and un-foreseeability (Starbuck, 2014) of the innovation process, and challenges the notion of using culture as a causal variable to explain outcomes (Swidler, 1986; Leonardi, 2011; Nardon & Aten, 2008). At the same time, it highlights the relevance of further exploring the relationship between culture and innovation using different methods and approaches. While extant research has identified many cultural characteristics related to innovation, further research needs to investigate the relationship between different aspects of culture, the organizational environment including demands, resources and constraints, and the mechanisms used to develop a culture of innovation that is uniquely positioned to address the needs of the organization.

The best practices driven nature of the innovation discourse creates the illusion that any organization in any environment can become innovative if innovative practices, values, and orientations are adopted. However, there isn't enough evidence to support that claim.

Research investigating the boundary conditions of these best practices are required in order to generate actionable outcomes to Canadian organizations.

Research investigating the relationship between culture and innovation tends to focus on either culture or innovation as unitary concepts. The reality is that both culture and innovation are complex constructs that need to be unpacked to produce more meaningful understanding. Future research needs to account for the dynamic inter-relationship between culture and innovation.

Additionally, simply adopting ideas and good practices from other organizations does not create a culture of innovation. Such culture develops in causally ambiguous ways over time. Future research needs to provide insight into what constitutes a culture of innovation in the Canadian context, and how the processes and practices adopted by organizations shape the development of this culture over time. Research should also address how such cultures are cultivated and nourished and what may potentially be ways in which innovative cultures can be destroyed if proactive efforts are not enacted to preserve and promote them.

Conclusions

In this report we synthesized research focusing on the role of socio-cognitive influences on the process of innovation. In particular, we synthesized research focusing on the relationship between national and organizational dimensions of culture, organizational practices, and innovation in order to draw implications for Canadian organizations and policy makers interested in fostering a culture of innovation in support of the development, adoption and use of emerging technologies.

Our review suggests that innovative organizations are characterized as possessing a “culture of innovation” that allows them to advance and thrive in competitive markets. However, a clear specification of what characterizes a culture of innovation remains elusive. We conceptualized a culture of innovation as a congruent and generative set of values, norms, schemas, artifacts and practices within an organization that are consistent and supportive of each other (Homburg & Pflesser, 2000) and uniquely positioned to address external and internal demands, resources and constraints facing the organization.

We found that “culture of innovation” is an elusive notion that can’t be articulated in a vacuum. Innovation is itself a cultural process and multiple assemblages of varying cultural components are possible (Westwood & Low, 2003; Leonardi, 2011). Rather, in order to foster a culture in support of innovation, organizations need to seek alignment between resources, constraints, demands, and cultural components. The best practices driven nature of the innovation discourse creates the illusion that any organization in any environment can become innovative if innovative practices, values, and orientations are adopted. However, there isn’t enough evidence to support that claim. Research investigating the boundary conditions of these best practices is required in order to generate actionable knowledge to Canadian organizations.

KNOWLEDGE MOBILIZATION IMPLEMENTATION

We have planned a workshop entitled “*What is a culture of innovation and how may we foster it in Canadian firms?*” The workshop is scheduled to take place on the 12th of January, 2017 at Carleton University. It will be held in one of Carleton’s creative spaces, 1125@Carleton. Expert facilitators from 1125@Carleton, applying *design thinking* principles and techniques, will guide workshop participants in generating ideas and concepts relating to the state of innovation in Canadian firms; the elements of cultures of innovation and how they impact firm competitiveness and prosperity; how innovative practices in Canadian firms are shaped by the values, norms, schemas, and artifacts that are uniquely Canadian; and how these can be fostered to enhance the innovative capacity of Canadian firms. Participants will constitute entrepreneurs, academics, policy makers drawn from a variety of organizations, including but not limited to Carleton University, University of Ottawa, National Research Council, Invest Ottawa, departments of the Federal Government of Canada, the Ontario Government, The Ottawa Hospital, corporations such as Xerox, IBM, and Mitel, and companies incubating in various innovation hubs in the Ottawa-Carleton area. Appendix 2 provides a more detailed description of the workshop.

To further disseminate the findings of our study and to engage a wider Canadian and international audience we plan to submit a paper to the annual conference of the Administrative Sciences Association of Canada (ASAC). Along with the paper, we plan to convene a panel comprising academics and practitioners to discuss further the findings of the literature review and the outcomes of the workshop. This will provide further opportunities for critical reflection.

We are submitting a journal article to a special issue of the journal *Technological Forecasting and Social Change*, an Elsevier publication. The special issue “Crossing borders: Can cultural differences predict the success of socio-technical change” is a very good match for the findings coming out of our report. Our paper is a particularly good fit with “cultural aspects as a facilitating factor for social/technological change”, an area of emphasis in the call for papers. The special issue is slated for publication in 2017.

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APPENDIX 1: LITERATURE REVIEW TABLES

Table 1: National culture and national innovation

Citation	Research question	View of innovation	Design	Key findings
Zhan et al. (2015)	What is the effect of ethno-cultural diversity on national innovation?	Process	Secondary data analysis	Ethnic diversity has a direct negative effect on innovation, while cultural diversity has a direct positive effect on innovation, but only when ethnic polarization is low.
Al-Hujran et al. (2015)	How do the social, political, and cultural constructs affect individuals' technology acceptance behavior?	Process; Adoption & Use	Survey of 413 Jordanian citizens	Citizen's attitude toward using e-government services is the most significant determinant of citizen intention to adopt and use e-government services. Citizen's attitude, in turn, is jointly determined by perceived public value and perceived ease of use, which are related to national culture (PD, UA, IC, LSO, and MF)*.
Efrat (2014)	What is the impact of national culture on the national-level innovation motivation in the age of globalization?	Performance; Measured by patents, journal articles, and high-technology exports	Secondary data analysis (35 countries)	National cultural values demonstrate strong and lasting impact on national innovation motivation: low PD, high IDV, low UA, and high MAS lead to higher rates of innovation. Dimensions which impact innovation negatively when operating individually may impact it positively when combined with other dimensions.
Ghazinoory & Bitaab (2014)	What is the impact of social capital, as a core cultural value, on the national-level innovation process and performance?	Process; Measured by entrepreneurship and knowledge development (patent application)	Secondary data analysis (34 countries)	Institutional trust and networking strongly and positively affect national innovation through their effect on entrepreneurship, and interpersonal trust and networks strongly and positively affect national innovation through their effect on knowledge development.
Halkos & Tzeremes (2013)	What is the impact of national culture on national innovation efficiency?	Process; Measured by input (innovation drivers, knowledge creation, entrepreneurship) and output (application and intellectual property)	Secondary data analysis (25 European countries)	High PD and high UA have significantly negative effects on national innovation.

* National cultural dimensions abbreviations following Hofstede (1980): PD = Power Distance, UA= Uncertainty Avoidance, IC: individualism (IDV) or collectivism (COL), LSO = Long-term Orientation or Short-term Orientation, MF= Masculinity (MAS)/ Femininity (FEM).

Citation	Research question	View of innovation	Design	Key findings
Puia & Ofori-Dankwa (2012)	What is the relationship between national culture, ethno-linguistic diversity and national innovation?	Performance; Measured by patents and trademarks	Secondary data analysis (67 countries)	National culture and ethno-linguistic diversity are independently positively associated with national innovation. When taken together, they have significantly greater influence on national innovation than measured separately.
Taylor & Wilson (2012)	What is the effect of IDV on national-level innovation?	Performance; Measured by citations-weighted technology patents and citations-weighted scientific publications	Secondary data analysis (62 countries)	IDV has a significant and positive effect on national innovation. But a certain type of collectivism (i.e. patriotism and nationalism) can also foster innovation at the national level.
Rinne et al. (2012)	What is the impact of national culture on national-level innovation?	Performance; Measured by Global Innovation Index (GII)	Secondary data analysis (66 countries)	PD has a significant and negative relationship with GII innovation scores; IDV has a significant and positive relationship with GII innovation scores; no relationship is found between UA and innovation.
Gorodnichenko & Roland (2011)	What is the impact of national culture on national-level innovation for long-run growth?	Performance; Measured by GDP per capita	Econometric analysis	Only IDV has a robust and positive effect on national innovation.
Kaasa & Vadi (2010)	What is the relationship between national culture on national-level innovation?	Performance; Measured by patent applications	Secondary data analysis (20 European countries)	PD, UA, family-related COL, and MAS have a significant and negative relationship with patenting intensity. IDV has a much weaker or non-existent relationship with patenting intensity. Culture alone does not serve as a guarantee for a high level of patenting intensity.
Nardon & Aten (2008)	What is the influence of national culture on the adoption of technological systems?	Process	Case analysis of Brazil's adoption of ethanol	A unique logic of action drove responses to events influencing the adoption of ethanol in Brazil.

Table 2. National culture and organizational innovation

Citation	Research question	View of innovation	Design	Key findings
Turró et al. (2014)	What is the effect of cultural values on organizational innovation, specifically the corporate entrepreneurship?	Process (new product introduction, production processes, and organizational methods)	Secondary data analysis (Global Entrepreneurship Monitor, 62 countries)	The impact of the environmental factors on organizational innovation is highlighted. Specifically, the national-level entrepreneurial culture has a significant positive relationship with corporate entrepreneurship, and in turn, promotes organizational innovation.
Černe et al. (2013)	What is the effect of individualism-collectivism on organizational innovation?	Process (exploration and exploitation; technological and non-technological innovation)	Secondary data analysis (Community Innovation Survey, Hofstede, GLOBE, Schwartz scores; 13 countries)	IDV is positively related to the invention phase of innovation, whereas collectivism is beneficial for the commercialization of innovative ideas. In collectivistic cultures, management innovation plays a more important stimulating role in enhancing technological innovation than it does in IDV ones.
Vecchi & Brennan (2009)	What is the effect of national cultural values on innovation performance in international manufacturing?	Performance measured by innovation inputs and process innovations, involving both technical and managerial aspects.	Survey (questionnaires in 24 countries)	Firms in high PD countries are more proactive in innovation adoption, innovation input, and innovation-related coordination; low IDV is associated with high levels of innovation inputs while high COL is associated with high levels of process innovation; MAS and UA have relatively small influence on innovation performance.
Ambos & Schlegelmilch (2008)	Does national culture impacts R&D performance differently according to different stages?	Process (augmenting –exploration - and exploitation stages)	Survey (questionnaires in 106 German industrial MNCs with foreign R&D activities)	Exploitation laboratories will perform better in environments exhibiting: high PD, high COL, high MAS, high UA, and LTO. Augmenting laboratories will perform better in environments exhibiting: low PD, high IDV, high FEM, low UA, and LTO.
Garret et al. (2006)	How does national culture affect the organization integration mechanisms in the innovation process?	Process (Specifically focus on new product development)	Comparative studies (interviews; 9 firms in New Zealand and 9 firms in Singapore)	PD, MAS, and UA affect the R&D--marketing integration practices differently in New Zealand and Singapore, in terms of the formalization, centralization, role flexibility and inter-functional climate mechanisms.
Mueller & Thomas (2001)	What is the relationship between national culture and entrepreneurship?	Process (invention, commercialization, implementation, and modification)	Survey (questionnaires; university students in 9 countries)	High IDV, low UA has a greater positive impact on entrepreneurship, which facilitates organizational innovation than COL, high UA cultures.

Table 3. Organizational characteristics and innovation

Citation	Research question	View of organizational innovation	View of organizational practice	Design	Key findings
Yusof (2015)	What affects information system adoption and use in critical care industry?	Adoption & implementation	Socio-technical fit	Case study of critical care centres in Malaysia	Technical factors, human factors, and organizational factors have positive influences on system adoption. Socio-technical factors and their fit should be considered, and requires continuous, in-depth evaluation and stakeholder understanding.
Chua et al. (2015)	How does cultural tightness affect creativity?	Creation	Culture – norms	Secondary data analysis & interviews	Individuals from tight cultures are less likely than counterparts from loose cultures to engage in and succeed at foreign creative tasks; this effect is intensified as the cultural distance between the innovator’s and the audience’s country increases. However, when working in their own or culturally close countries, cultural tightness can actually promote creativity success.
Story et al. (2014)	What are the barriers and consequences of radical innovation?	Process	Culture – schema & norm	Conceptual essay	Summarizes 12 papers included in the special issue around three themes: framing and synthesis; organizational-level barriers and enablers; and process-oriented insights.
Sandberg & Aarikka-Stenroos (2014)	What are the barriers to organizational innovation?	Process	Cultural factors; Structural factors	Systematic literature review	Six barriers are identified: restrictive mindset, a lack of important innovation competences, insufficient resources, and unsupportive organizational structure (internally); customer resistance, and macro-environment culture (externally)
O’Malley et al. (2014)	What are the barriers to collaboration as perceived by the original members? How does the change of organizational identification affect collaborative success?	Collaborative efforts in radical innovation	Organizational identity; Culture – collaboration orientation	In-depth interviews with key individuals at SSPC (solid State Pharmaceutical Cluster) in Ireland	Identification with one’s parent organization can represent a substantial barrier to collaboration within regional networks. However, collaboration is legitimized and embedded within on-going innovation activities where members exhibit dual organizational identification.
Eggers et al. (2014)	How do networking and customer responsiveness influence organizational innovativeness?	Process	Culture – Customer orientation	Surveys of 283 European manufacturing SMEs	Networking and customer responsiveness have a positive effect on radical innovativeness. Innovativeness is highest when networking and customer responsiveness are concurrently high.

Citation	Research question	View of organizational innovation	View of organizational practice	Design	Key findings
Starbuck (2014)	How do the marketing efforts and social interaction influence the success of organizational innovation?	Process	Culture – collaboration & customer orientation	Case studies of five innovation projects in the US	The networking and collaboration between innovators and internal as well as external stakeholders are beneficial for organizational radical innovation. The positive influence of social interaction depends on the nature of social interactions and the climate these interactions engender.
Hodgkinson & Healey (2014)	What is the impact of emotion on organizational innovation?	Adaptation & commercialization	Culture – cognition & emotion	Conceptual essay	Proposes prevalent cold-cognition perspective of human psychology tends to stymie attempts to foster the mindsets and behavior necessary to overcome the dynamic challenges posed by innovation. Proposes that metacognition, emotion management and self-regulation are essential for meeting the behavioral challenges of innovation.
Reid et al. (2014)	How do the individual level divergent thinking and organizational level MVC facilitate organizational innovation?	Process	Culture – market & learning orientation	Mix method: 20 interviews and 102 surveys of high-tech and innovative North American firms.	Firms could develop an effective Market Visioning Competence (MVC) – the ability to link advanced technologies to market opportunities of the future, enabling the firm to think outside existing frames of reference. Organizational level capabilities are advocated to support, encourage, and nurture the divergent thinking of individuals.
Aarikka-Stenroos & Lehtimäki (2014)	What are the challenges in the commercialization process of innovation?	Commercialization	Culture – market orientation	Six longitudinal field studies in Finland	Develops a non-linear and probing process model of the commercialization stage: strategic decision-making; marketing creation and preparation; sales creation and development activities, and suggests that the marketing creation and preparation are the major reason for innovation commercialization failures.
Baumard (2014)	What is the process of creating an organization innovation façade and how does it foster organizational innovation?	Process	Culture – Schema	Field study in Silicon Valley, California, US	Engineers have to develop their own frames and it is the interaction between managers' and engineers' frames that creates spaces for innovation to flourish. Frames have a precarious and evolving existence because it is focused on uncertain future.
Bessant et al. (2014)	How does 'reframing' challenge innovation under conditions of discontinuity?	Process	Culture – schema	Conceptual	This research argues for the importance of 'framing innovation' – transition to a new mindset or reframing – in the innovation process. Innovation is a complex and problematic process, especially for the existing incumbents who are inevitably locked into existing cognitive frames.

Citation	Research question	View of organizational innovation	View of organizational practice	Design	Key findings
Baker et al. (2014)	How does the interaction between values and norms affect new product performance?	Process	Culture – value & norm	Surveys of marketing executives of 236 firms in the US	'Innovation congruence', which is defined as the degree of correspondence between management's values and expected behaviors from lower to mid-level employees, is suggested to play an important role in innovation. There is a positive influence in the situations where norms are higher than values. Further, high radical innovation norms, far more than management values, seem to be critical determinants of new product performance.
Green & Cluley (2014)	What impact does a successful radical innovation have on an organization?	Process	Cultural factors; Structural factors	Case study of an SME digital-design agency in the UK	There is internal dynamics that emanate from the successful commercialization of an innovation. The consequences of innovation may, in fact, stifle the essence of creativity that spawned the original innovation. Divisions could occur within an organization concerning the construction of meaning between managers and employees after a radical innovation.
Büschgens et al. (2013)	What are the values that build an organizational innovation culture?	Creation	Culture – innovation orientation	Meta-analytic literature review	Based on Competing Values Framework, this research suggests two pairs of opposing values, flexibility, and control, internal and external orientation, as dimensions of organizational culture. A development culture, which emphasizes an external and a flexibility orientation, is suggested to foster innovation.
Cresswell & Sheik (2013)	How do the technical, social and organizational factors affect health information technology implementations?	Adoption& implementation	Socio-technical fit	Systematic literature review	Technical, social and organizational factors are inter-related. A close fit with organizational priorities and processes, training and support, and effective leadership and change management are important.
Martin-de Castro et al. (2013)	How does organizational culture influence knowledge-innovation relationship?	Process	Innovation culture – values	Survey of 251 high-tech manufacturing firms in Spain	Based on a knowledge-based and capability-based view, the research suggests that innovation culture moderates the relationship between human capital and product innovation.

Citation	Research question	View of organizational innovation	View of organizational practice	Design	Key findings
Stock et al. (2013)	How do different layers of innovation-oriented culture affect product program innovativeness?	Process	Culture – value	Survey of companies in 5 industries (electronics, machinery, services, software/IT, and utilities)	This research suggests that cultural artifacts fully mediate the effects of innovation-oriented value and norms on innovativeness. Therefore, values and norms need to transform into specific artifacts before they can influence innovation outcomes. Moreover, this research reveals that a company’s innovation-oriented corporate culture is less crucial in markets in which customer preferences change dynamically, but it prevails in technologically turbulent settings.
Westwood & Low (2013)	What is the impact of culture on cognitive style and personality, and in turn, on creativity and innovation?	Creation	Culture – schema	Conceptual	There is insufficient evidence to enable definitive statements to be made about systematic differences across cultures in personality or cognitive style with respect to creativity. Creativity and innovation are complex psychosocial processes involving numerous salient factors of which culture is but one.
Wang & Lin (2012)	What are the employees’ factors that drive innovation performance?	Process	Culture – schema	Survey of high-tech firms in Taiwan	Innovation self-efficacy, role conflict, and role ambiguity influence innovation performance directly and indirectly via the mediation of customer knowledge development and innovation outcome expectation.
Leonardi & Barley (2010)	What is the relationship between social action and technological change in organizations?	Implementation	Culture – schema	Conceptual	This research clusters the research on the social construction of implementation into five coherent perspectives: perception, interpretation, appropriation, enactment, and alignment. It suggests that organizational culture provides frames for interpreting technologies; technologies serve symbolic and instrumental purposes, and interpretations of a technology are potentially limitless and can only be understood in situations
Bartel & Garud (2009)	What is the role of narratives in sustaining organizational innovation?	Process	Culture – cultural artifacts	Conceptual	Innovation narratives can promote coordinated action and facilitate innovation because narratives can symbolize the boundaries of acceptable behavior in organizations, provide a means of information sharing and inspire new ideas.

Citation	Research question	View of organizational innovation	View of organizational practice	Design	Key findings
Berson et al. (2008)	How does CEO's self-directive values influence innovation-oriented cultures, and in turn, influence organizational outcomes?	Process	Culture – value	Surveys of 26 Israeli companies that represent multiple industries	Self-directive values positively impact on innovation-oriented culture. Innovation organizational cultures positively associate with sales growth. Innovation, as a key dimension of organizational culture typologies, emphasizes an entrepreneurial orientation, creativity, and a risk-taking work environment.
Kaplan & Tripsas (2008)	How does a cognitive lens explain technical change?	Process	Culture – schemas	Conceptual	Cognition may change the expected technological outcome predicted by purely economic or organizational models under certain conditions. Interactions of producers, users, and institutions shape the development of collective frames around the meaning of new technologies.
Baker & Sinkula (2007)	How does market orientation influence the organizational priorities placed on incremental and radical innovation?	Process	Culture – value	Cross-sectional survey of 243 marketing executives	A strong market orientation helps facilitate a balance between customer-led incremental and lead-the-customer radical innovation by shifting firms' innovation priority more toward radical innovation activities. A cultural factor –learning orientation—mediates the relationship between market orientation and organizational innovation type.
Hernandez (2006)	What are the consequences and barriers of integrating R&D and Marketing for innovativeness and commercial success?	Commercialization	Culture – collaboration orientation	Literature review	A stronger link between R&D and Marketing is an effective solution for improving organizational innovativeness and commercial success. However, there are numerous barriers to creating this link, including organizational difficulties and cultural differences.
Markard & Truffer (2006)	How does market liberalization alter the way innovations are handled in the electricity supply system?	Process	Culture – value	Survey of 8 firms (3 countries) in electricity supply system	liberalization induced a shift from incremental, technology-oriented innovation to more radical, customer-oriented product innovations and organizational innovations. The authors identify an organizational environment for innovation managers, which is more creative and risk oriented with regard to unconventional ideas and solutions.

Citation	Research question	View of organizational innovation	View of organizational practice	Design	Key findings
Baker & Sinkula (2005)	What is the effect of market orientation on firm performance, specifically on the new product success?	Process	Culture – value	Cross-sectional survey of 243 marketing executives	This research finds a strong positive relationship between market orientation and new product success. But implies barriers to market orientation's effectiveness. The need for firms to coordinate a strong market orientation with resources and capabilities that increase the effectiveness of the marketing function is underscored.
Garud & Karnoe (2003)	What is the process of technological path creation? How does culture influence the technological path creation?	Process	Culture – Values & schema	Comparative case studies of wind turbine development in Denmark and the US	The development of technologies entails not just an act of discovery by alert individuals or speculation on the future, but also the creation of a new path through the distributed efforts of many. Path creation results in a steady accumulation of artifacts, tools, practices, rules and knowledge that begin shaping actors in the domains of design, production, use, evaluation, and regulation. The paths are different in Denmark (Bricolage) and US (Breakthrough).
Nystrom et al. (2002)	What are the effects of organizational climate on organizational innovativeness?	Adoption	Cultural factors; Structural factors	Surveys of the medical imaging technology adoptions in 70 hospitals in the US	Organizational size and slack (organizational contextual factors) are positively related with innovativeness. The climate measures of risk orientation and external orientation interact significantly with the context dimensions of organizational size and organizational age.
Cardinal (2001)	What is the impact of organization-wide controls (input, output, behavior) on innovativeness at the firm level?	Process	Organizational control	Archival and questionnaire are used in 57 pharmaceutical firms in the US	Contrary to existing theory and hypotheses that emphasize the different managing styles for incremental and radical innovation projects, this research suggests that the management of R&D activities may be considered more similar than previously thought: input controls and output controls are important to incremental innovation; all three classes of control are found to be important for radical innovation.

Citation	Research question	View of organizational innovation	View of organizational practice	Design	Key findings
Homburg & Pflesser (2000)	How do different layers of market-oriented organizational culture affect innovation? What are the structural relationships among the layers?	Process	Culture – value	Mixed (content analysis of 50 reports on cultural change processes, field interviews, and surveys of 173 respondents in Germany)	There are positive causal relationships from values, norm, artifacts, behavior, and performance. This research argues that organizational culture consists of four distinguishable but interrelated components. They include shared basic values, behavioral norms, different types of artifacts, and behaviors. Specifically, artifacts include stories, arrangements, rituals, and language that are created by an organization and have a strong symbolic meaning (Schein, 1992; Trice & Beyer, 1993).
Garud & Rappa (1994)	How do individual and collective cognitive processes influence technological change?	Creation	Culture – schemas	Secondary data analysis of Cochlear Implants industry in the US	The micro- and macro-level processes that shape individual and shared realities place paradoxical demands on researchers in their efforts to develop a new technology. How well this paradox is managed can profoundly influence the technological change in organizations.
Orlikowski & Gash (1994)	How are the nature, value, and use of a groupware technology interpreted by various organizational stakeholders? What are the consequences?	Process	Culture – Individual value & schema	Field study (interview, observations, and document analysis) in the US	Difficulties and conflicts around the development, use, and change of technology may result from the significantly different technological frames of key groups in organizations (managers, technologists, users).

Table 4: Cultural diversity and organizational innovation

Citation	View of diversity	Design	Key findings
Bouncken et al. (2016)	Diversity as a resource and inhibitor of innovation	Semi-structured interviews in one a large global consumer goods company.	Cultural diversity has both positive and negative effects on innovation: cultural diversity may bring informational advantages that enhance creativity and innovation; cultural diversity can increase a climate of helping and explaining; cultural diversity may be harmful to the quality of teamwork and thus for creativity and innovation, such as the innovation process can be hindered in the beginning by cultural differences within teams.
Peretz et al. (2015)	Organizational diversity programs	Surveys of over 5000 organizations in 22 countries	National cultural values have an impact on the adoption and operation of organizational diversity programs: organizations in low institutional and in-group COL, low PD, low UA, high LTO, high gender egalitarianism, high humane orientation, and high-performance orientation are more likely to adopt diversity programs. Cultural practices that are supportive of diversity, are found to positively moderate the relationship between diversity programs and organizational performance.
Parrotta & Pozzoli (2014)	Diversity as a resource to facilitate innovation	Secondary data analysis (Denmark)	This research estimates the contribution of workers' diversity in cultural background, education, and demographic characteristics to firm's innovation activity. The authors find evidence supporting the hypothesis that ethnic diversity may facilitate firms' patenting activity in several ways by increasing the propensity to apply for a patent, by increasing the overall number of patent applications, and by enlarging the breadth of patenting technological fields.
Mueller (2014)	Diversity as a resource to facilitate innovation	Secondary data analysis of knowledge-intensive companies in Germany	There is a positive relationship between cultural diversity in the highly skilled workforce and R&D activity, and between cultural diversity of employees and the start-up rate of technology-oriented companies. However, their results do not show a positive influence of the ethnic diversity of mixed immigrant-native ownership on innovation.
Reid et al. (2014)	Diversity as a resource to facilitate innovation	Surveys of 198 high-tech firms in the North American nanotechnology sector	Diversity is an antecedent of organizational divergent thinking: diversity captures management's mindset about open communication and free access across functions and departments, as well as diversity in hiring practices. These two organization-level approaches to the encouragement of divergent thinking have a clear role to play in setting the stage for individuals' behaviors that are associated with networking and idea driving, as well as for the organizational orientation towards the use of market learning tools and the proactive market orientation.
Elliot & Nakata (2013)	-Diversity as a group- or team-level factor & individual and group-level creativity;	Case studies of innovation practices and paths in Japan and US	The authors use Japan and the US as examples to illustrate how the two paths (Spontaneous and Divergent route) influence their distinctive innovation practices in terms of their new product development strategy, structure, systems, and shared values and leadership style. They suggest that not only the individual creativity but also group level or team level factors such as demographic diversity could have an effect on cross-cultural creativity.

Citation	View of diversity	Design	Key findings
Bartel & Garud (2009)	Diversity as a resource to and inhibitor of innovation	Conceptual	The authors argue that dysfunctional confrontation can arise as people with diverse backgrounds and expertise interact, thereby undermining innovation, and unproductive stress can be generated as different people with diverse ideas and perspectives come together, and conflict and misunderstandings could be activated. The authors propose that organizational culture could create a connective thread among diverse people that promotes real-time problem solving among diverse actors, and a coordination mechanism through the use of boundary objects (e.g., narratives) to increase the coherence and flexibility in the innovation process.
Tjosvold & Wong (2004)	Organizational diversity programs	Conceptual	Diversity of people and perspectives can contribute to the ability of teams to develop and implement innovation in organizations. However, teams of diverse composition are expected to confront a great deal of conflict and the solution alternatives. This research proposes that culturally diverse team can use the theory of cooperation and competition as a basis to develop common values, norms, and procedures that are accessible and effective for all cultural groups. Particularly, “Cultural Tuning” and “cooperative conflict” provide guidance for developing a “third culture” to managing conflict among culturally diverse people (including a holistic rule, synergistic rule, and learning rule).
Sivakumar & Nakata (2003)	Diversity as a resource to and inhibitor of innovation	Econometric analysis	Global new product teams’ composition is affected by national values, and depends on the innovation stage (i.e., initiation and implementation). Cultural diversity can have both positive (e.g., strong idea generation, creativity) and negative (e.g., conflict, inefficient work styles) effect on innovation.
Westwood & Low (2003)	-Diversity as a resource to facilitate innovation; -Innovative and creative process is itself a cultural process	Conceptual	Propose a contingent view suggesting that there are different processes, mechanisms, and structures through which creativity and innovation emerge across cultures, and the particular social systems and personality traits should be incorporated in understanding certain creativity and innovation type. Diversity-related factors such as demographic heterogeneity within top management teams may have a positive relationship with organizational innovativeness.
Cardinal (2001)	Organizational diversity programs	Archival data analysis and surveys of 57 pharmaceutical firms in the US	Input control can be considered as a form of resource allocation to create the type of “knowledge environment” desired by firms by manipulating the degree and variety of core knowledge, skills, experiences, and attitudes. Input control through scientific diversity offers several advantages in the pharmaceutical industry. Scientific diversity aids in general creativity and brainstorming processes. Diversity of perspectives, backgrounds, and training facilitate the generation of new ideas.

APPENDIX 2: WORKSHOP

What is a culture of innovation and how may we foster it in Canadian firms?

Workshop

1125@Carleton
Carleton University
Ottawa, Ontario

January 12, 2016

Background:

Innovation is said to be central to sustainable economic growth, prosperity, social development, and global competitiveness. Canadian firms are credited with being quite inventive but, according to The Conference Board of Canada (2015), lags behind other developed countries such as the United States, Germany, Finland, and Japan in innovative capacity. Canadian firms are good at developing new technologies but are less able to commercialize that technology on a global scale. Moving technologies from the labs to the market require a strong capacity for exploitative innovation, which involves bringing new inventions and discoveries into sustainable commercial use.

Research on innovation has suggested that firms that are able to compete and prosper on a global scale have strong cultures of innovation. A culture of innovation constitutes a congruent set of values, norms, schemas, artifacts, and practices that are consistent and mutually supportive (Homburg and Pflesser, 2000). Cultures of innovation are context-dependent and are shaped by national, environmental, and societal influences. What constitutes a culture of innovation in practice in Japan may not be the same as what would constitute a culture of innovation in Canada. Though the essential elements may be the same at a high level, they may vary significantly and the detail level. Innovation cultures are not homogenous and their development idiosyncratic and difficult to explicate.

Canada, a country shaped by the diversity of its people, geography, and history may have a culture of innovation that is not well understood. We seek, in this workshop, to better understand what constitutes Canada's culture of innovation and how this may be fostered to increase the innovative capacity of Canadian firms, particularly as it relates to exploitative innovation.

Objectives of the Workshop:

The main objectives of the workshop are to gain insights into

- a. The state of innovation in Canadian firms.
- b. What constitutes cultures of innovation and what the key elements.
- c. How cultural characteristics shape the innovative practices of Canadian firms.
- d. How Canadian firms can enhance the development and growth of cultures of innovation, individually and collectively.

Workshop Approach:

The workshop will apply a “*design thinking*” approach using facilitators from Carleton University’s 1125@Carleton who are familiar with the facilitation process and techniques. Participants will apply design thinking principles and techniques to generate ideas and concepts characteristic of innovative cultures in Canadian firms. Through expert facilitation by design thinking practitioners from Carleton University’s 1125@Carleton collaborative incubator workshop leaders will guide participants in exploring the state of innovation in Canadian firms; the elements of cultures of innovation and how they impact firm competitiveness and prosperity; how innovative practices in Canadian firms are shaped by the values, norms, schemas, and artifacts that are uniquely Canadian; and how these can be fostered to enhance the innovative capacity of Canadian firms.

Workshop Setting:

The workshop will be held at 1125@Carleton, a collaborative creative space developed to facilitate *design thinking* activities and workshops. The facility is outfitted with interactive tools (both physical and electronic) and furniture that allow for individual reflection, group interaction, and the generative display and collection of ideas and thoughts of participants.

Participants:

Participants in the workshop will constitute entrepreneurs, academics, policy makers drawn from a variety of organizations, including but not limited to Carleton University, University of Ottawa, National Research Council, Invest Ottawa, departments of the Federal Government of Canada, the Ontario Government, The Ottawa Hospital, corporations such as Xerox, IBM, and Mitel, and companies incubating in various innovation hubs in the Ottawa-Carleton area.

Schedule:

The workshop will take place on the 12th of January, 2017. It will run for 5-6 hours.

Program Outline:

Breakfast

Keynote (TBA)

Workshop Part 1: What constitutes a Culture of innovation?

Workshop Part 2: Culture of Innovation in Canadian Firms?

Workshop Part 3: Enhancing the innovative capacity of Canadian Firms?

Recommendations and feedback

Lunch

Closing