The Process for Adopting Technology in Ontario Municipalities and the Implications for Innovation in Development

Mary Rowntree Watt Bachem Riemer and Clarence Woudsma

Abstract

The purpose of this paper is to provide a stepping stone for technological innovation in the development control process. The popularity of online mapping applications, such as Google Maps and Google Earth served as an inspiration. It shows a clear interest and growing market for improved technology to do with the geography and understanding of our urban spaces both inside and outside the planning profession. Unfortunately, while these tools of planning have evolved with technology, process driven functions have remained largely unchanged. As a foundational piece of research on this topic, this paper leverages classic technology adoption theory alongside an investigation of how municipalities adopt innovation for tools of planning, such as geographic information systems. Learnings from this research as well as a quantitative investigation into their application for process innovation is discussed.

M. Riemer (Corresponding Author)
Email: maryriemer@gmail.com

C. Woudsma
School of Planning, University of Waterloo, Waterloo, Canada
Email: cwoudsma@uwaterloo.ca

1. Introduction

As technology has evolved, predicting and planning for this future has become increasingly complex. Previously, aerial photos and paper maps were tools of the trade, now replaced by Google Earth, Google Maps and Geographic Information System software. These advancements have created many opportunities for municipalities to plan in a more accurate and detailed fashion.

One of the most frequently used processes by any municipal planning department is development control. For example, the Province of Ontario, through the Planning Act, determines how the development review process is to be undertaken, how land uses may be controlled and by whom. (Quinte West, 2012)

Development control can be a time consuming process for applicants, and while the data, visualization and mapping subsets of urban planning have embraced advancement in technology, process driven functions have remained largely unchanged.

The popularity of online mapping applications, such as Google Maps and Google Earth with those both inside and outside the planning industry should serve as inspiration. There is a clear interest and growing market for improved technology to do with the geography and understanding of our urban spaces.

This growing attraction of interacting with your city in a spatial context spawned this study of the process for adopting technology in Ontario municipalities and the implications for innovation in the development control process.

2. Literature Review

2.1 Diffusion Theory

The theory of technology adoption has been widely studied, perhaps most famously by Everett M. Rogers, who developed the theory of Diffusion of Innovations and coined the term early adopter. (Singhal, 2005) For the purpose of this study, in its most elementary form, diffusion is defined as the means by which a product or innovation is taken up by a population.

(Surry, 1997; Rogers, 1995; Lieven De Marez, 2011; Onsrud and Pinto, 1993)

Rogers discussed several theories; however four of them (1) Innovation Decision Process, (2) Individual Innovativeness, (3) Rate of Adoptiveness and (4) Perceived Attributes are among those most widely used as a basis for diffusion, and are condensed in the following table. (Table 1)

Table 1. Theories of Technology Adoption

Innovation Decision Process		Individual Innovativeness	Rate of Adoptiveness	Perceived Attributes
Diffusion occurs over time		Certain individuals are predisposed to being innovative	Innovations are diffused over time in a pattern that resembles an S-shaped curve	Potential adopters judge an innovation on their perceptions of 5 attributes
5 Stages	(1) Knowledge	Innovators are risk takers, pioneers, will adopt very early	Period of slow, gradual growth	(1) Trialability
	(2) Persuasion			(2) Observability
	(3) Decision			(3) Relative Advantage
	(4) Implementation			(4) Complexity
	(5) Confirmation			(5) Compatibility
		Laggards will resist adopting until later, if ever	Followed by period of dramatic and rapid growth	An increased rate of diffusion will occur if potential adopters can:
			Followed by stabilization, and eventual decline	(a) Try the innovation on a limited basis before adoption
				(b) Realize observable results
				(c) See an advantage compared to other innovations or business as usual
				(d) Perceive the innovation as simple
				(e) Compatibility with goals and values
				(Surry, 1997; Rogers, 1995)

The speed of adoption is also influenced by a multitude of factors both inside and outside control of the innovator. "The four major factors that influence the diffusion process are the innovation itself, how information about the innovation is communicated, time, and the nature of the social system into which the innovation is being introduced." (Surry, 1997, p.1; Rogers, 1995)

2.2 Rate of Adoption

Identifying early adopters and individual innovativeness in the targeted community is crucial to achieving widespread adoption and underscores the importance of first having a solid understanding of how users and individuals view adoption philosophically as a basis for corporate or organizational adoption.

"Utopian determinists believe that technology is a positive and uplifting force that will, over time, mitigate or eliminate most or all of the ills that afflict humanity. They believe technology is leading society towards an ever more utopian existence" (Surry, 1997, p.5)

Dystopian determinists, on the other hand, root their views in the fact that technology is intrinsically evil and that the downfall of morality, intellect and society is not far behind technological innovation. George Orwell famously illustrates this dystopian determinist attitude through his fictional masterpiece, *1984*. (Surry, 1997)

Another perspective on philosophical viewpoints of technology is to separate the developer from the adopter. Developer based theories are largely determinist while adopter based theories are rooted in instrumentalism.
"The underlying assumption of developer based theories is deterministic in its belief that superior technological products and systems will, by virtue of their superiority alone, replace inferior products and systems. Developer based theories of diffusion see change as following directly from a technological revolution." (Surry, 1997, p.7)

Criticizers of this perspective point to its pro-innovation bias as a blind spot in real-world adoption of technology. This is exemplified year after year as the number of high-tech start-ups claiming superior technology grows exponentially, yet they are plagued by slowness or adoption and accompanied diffusion, then waiver and eventually fail. (Lieven del Marez, 2011; Moore, 2006; Slater & Mohr, 2006) The linearity of developer-based assumptions in adoption lack the required consideration of both circumstance of use and end-users, but just as importantly, non-users. (Lieven del Marez, 2011)

On the contrary, adopter based theories focus on the end user as the primary force of change as they are manifestation of the innovation in the real world. "All structures and machines, primitive or sophisticated, exist in a social context and, unless designed for the sake of design itself, serve a so-

cial function." (Segal, 1994, p.2) Therefore, adopter focused theories are intrinsically instrumentalist in nature as they pursue the social framework in which the improvement will be used. (Surry, 1997)

2.3 Adopters

Rogers created the first break down of adopters of technology in his diffusion theory, making the basic assumption of a symmetrical, bell-shaped pattern of five adopter segments. Innovators are assumed to be profiled as young, male, affluent, urban and open minded. On the opposite end of the spectrum, laggards are assumed to be socially and geographically isolated older persons lacking both the curiosity and monetary resources to adopt new technology. Some innovators have also found there to be a distinct issue in reaching the early majority phase of adoption, citing a "chasm". (Lieven De Marez, 2011; Parasuraman and Colby, 2001)

Figure 1. The Adoption Curve
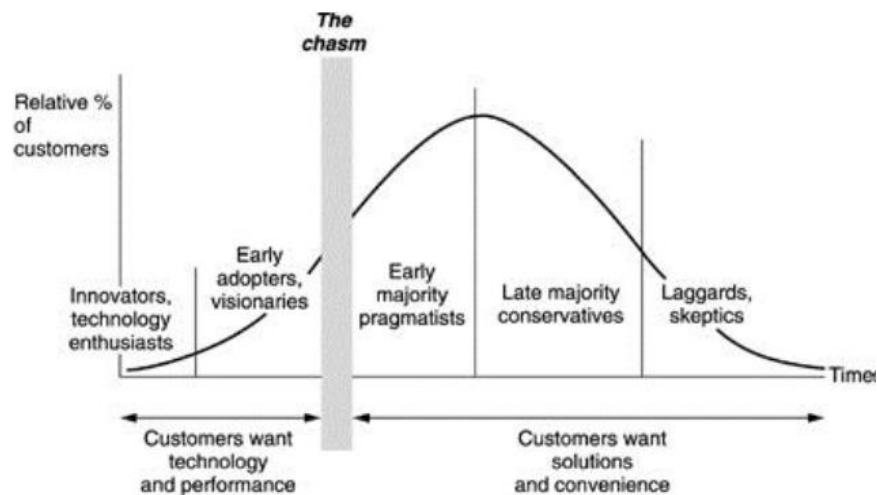
(Searls, 2003)

Rogers' diffusion theory serves as an important basis for comprehending the penetration pattern of a potential innovation and adopter based instrumentalist theory will provide insight to the real world usage and social context of adoption. (Lieven del Marez, 2011)

2.4 Paths to Adoption

The pillars of adoption; infrastructure, sustained innovation, and social support cannot stand in isolation. They are integrated and codependent, with acceleration of one often leading to acceleration of consumption as a whole.

This social aspect cannot be underscored enough. For example, Horrigan (2010) points out that Alexander Graham Bell believed that the telephone was building on the popularity of the phonograph. It soon became evident that the telephone was being used, especially by women and rural Americans, as a tool for social visiting. "For at least a generation, there was a mismatch between the uses people had for the telephone and how industry thought the telephone should be used." (Horrigan, 2010, p.6)

This mismatch is evident today in planning. There is a disparity between traditional GIS and its use as a serious, business tool that requires significant training and expense, and the desire of the public to use spatial tools to explore their city by sandboxing. Similarly, there is currently a very limited social aspect to GIS, and this latent demand is increasingly valuable as a tool for innovation in the development industry.

2.5 The Adoption of Geographic Information Systems

Though computer-based GIS is known to have been used since the late 1960s, it lacks a comprehensive formalized history. As with many innovations both before and since GIS, it is evident that there were several independent initiatives, unaware of each other and focused on separate nuances of the industry. (Coppock and Rhind, 1991)

"Like the reality (as opposed to the reporting) of scientific research, there was no strictly logical progression towards the development and implementation of GIS, but rather a mixture of failures, set-backs, diversions and successes. Inevitably, more is known about the successes than the failures which… have been numerous and often attributable to bad advice, ignorance and a determination to go it alone. This is unfortunate because failures are often as illuminating as successes, if not more so." (Coppock and Rhind, 1991, p.23)

To better understand the evolution of GIS, it can be broken down into three time periods.

(1) 1950-1970: Innovation: One of the earliest endeavors into automation of mapping was a decidedly non-digital attempt by botanist Perring, using a modified punch card technique on pre-printed paper with grid references. "His initiative also illustrates an aspect to be repeated in many later projects where the application of technology was driven by an urgent need of the users." (Coppock and Rhind, 1991, p. 26)

University of Washington geographer Garrison and transportation engineer Horwood, after developing quantitative methods in their transportation studies, noted as the earliest evidence of GIS. The developments in computer hardware during this time were paired with theoretical progression in spatial disciplines such as Garrison and Horwood's quantitative approach to analyzing spatial patterns. At roughly the same time in 1965, the US Bureau of the Census identified a need in automated data processing to address the mail-out/mail-in fundamental process of the US census. (Coppock and Rhind, 1991; Malczewski, 2004)

(2) 1980s: Integration: The transition from command-line systems requiring the user to understand basic computer language to software with graphical user interfaces (GUI) caused a significant transformation within the GIS industry. With this shift came Environmental Systems Research Institute, better known today as ESRI and released ARC/INFO.

The development of other innovations including computer assisted drafting (CAD) and global positioning systems (GPS) made GIS a feasible technology for both academic and municipal planning departments. There was a steadily increasing acceptance of GIS during this time, in part due to ESRI's ability to instill confidence through their staff's heavy involvement in their consulting projects, allowing flaws in their software to be identified internally at an early stage. (Malczewski, 2004; Coppock and Rhind, 1991)

(3) 1990-Today: Proliferation: While GIS began as software with a high barrier to use, from the 1990s on, it's outputs are more easily understood by those without professional backgrounds. The Open GIS Consortium (OGC) Project was established in 1994 and has been a key player in advancing the concept of open GIS, allowing it to intermingle with different applications more seamlessly, including non-spatial databases or graphics programs. This opens doors to integrating GIS with analysis models but also with decision making processes. (Malczewski, 2004)

2.6 Perspectives on Technology Adoption in Planning

Using GIS implementation as a benchmark for online development control applications offers a more complete picture of implementation and technology adoption procedures in planning. Göçmen and Ventura (2010) examine the use of GIS in public planning agencies and the barriers to its full potential use. While resources such as time, training and financials are cited, the pace of technology change was also noted as a significant barrier. Research surrounding technology perception in the planning industry produced well repeated issues concerning resource availability in terms of financial, training and time constraints. (Slotterback, 2011) Williamson and Parolin (2013) also point to a gap between the supply and demand of Planning Support System software, noting an implementation gap and underuse of software by planners. (Williamson and Parolin, 2013; Vonk et al, 2005)

Those without expertise not having a fulsome understanding of the issues and complexities that they are addressing has to some degree been tackled by the uptake, simplification and outputs of GIS, turning complex patterns and data into visually understandable materials. "We need to be aware of the limitations of our habitual thought process when dealing with complex subjects such as transportation and cities." (Creighton, 1970, xvii) This is true also of development planning.

It also translates into problems with software developers not providing the variety of tools that planners require, or, if they are, providing them in a complex and complicated way that doesn't take the end user's desire for simplicity into account. (Williamson and Parolin, 2013) The process is still shrouded in technical jargon and expertise with little visualization or simplification, resulting in equally complex PSS software. Unfortunately, with little uptake of PSS software, developers are not receiving the feedback needed to improve. (Vonk and Geertman, 2008)

Renewed thinking about processes such as development control are long overdue for a refresh with an open, participatory approach to the technical aspects on which they are based. Municipal planners may be open to this shift, and it is important, as users, that they are. However, there needs to be a perceived benefit, few barriers such as complicated or expensive training and retraining, and a participatory approach that allows those who are not technical experts or who are outside of the process, to be informed in an effort to narrow the existing knowledge gap. In short, the adoption of technology in planning processes is often the largest barrier.

3. Methodology

Research design focused on revealing opportunities and barriers to adoption at the individual level for three reasons. (1) To achieve an understanding of opportunities and barriers as expressed by the user, consistently identified throughout the literature review as having an overall effect on adoption. (Coppock and Rhind, 1991; Royse, 2008; Horrigan, 2010) (2) To achieve a sample comparable to assumptions made in Rogers' theories of individual innovativeness and technology adoption. (Rogers, 1995) (3) To provide a foundation for research on the topic of innovation in the development control process on which to build qualitatively outside this study that can provide increased context and nuance to findings garnered through a quantitative analysis.

Data collection methods centre on a survey of professionals in the planning and development industry, who work in Ontario, regarding their views on the potential for the adoption of online development control. Surveys were chosen for this study due to their relatively inexpensive cost, ease of use and associated high response rate, as well as the ability to be analyzed quantitatively.

Limitations in this study centre on response rates. There are a wide variety of professions that interact with the development control process, and putting surveys in the hands of those involved in all aspects at an equal rate may prove challenging. The survey is also self-selecting, and is open to a self-selection bias.

The complexity of the study is also a limitation. There is a lot to ask and certain respondents may be able to answer some things more accurately than others, posing difficulties especially when it comes to surveys. Questions revolving around the perceived benefit of an online development control process may be best understood by consulting or municipal planners in the development department; however it should be noted that questions about technology adoption procedures may have absolutely nothing to do with their department and could be controlled by the Executive, Directors or other decision makers for the municipality or firm. This is accepted as a limitation of this research as the focus lies in the adoption of an innovative development control process from the user perspective. Further research on organizational adoption is required for a more fulsome understanding. Given these limitations, an aspect of caution in the confidence of the results may be warranted.

4. Results and Findings

The online survey was distributed by the Ontario Professional Planning Institute to its 3000 members through their monthly newsletter. Additionally, leveraging of social media and networks was used through Twitter, Facebook and LinkedIn to disseminate the survey through multiple streams and to generate continued interest through the entire open survey period.

Surveys were completed by individuals who lived and worked in 22 distinct communities across Ontario. 64 participants fully completed the survey. Of those, 31 indicated they were municipal planners, 21 were consultants, 2 were planning students, 4 indicated they were a planning professional other than a municipal or consulting planner, 4 were developers, 1 was a builder and 1 indicated they were a development industry professional in another capacity. A total of 88% of respondents indicated that they were either familiar or very familiar with the development control process.

Response rates for professional categories other than municipal planners and consultant planners were unfortunately low. There are not enough responses to adequately or ethically state that the responses reflect opinions of other professional groups. However, their responses are valid, adding nuance and variety while reducing bias when taken into context of overall results. Though combining all responses other than municipal or consulting planners into a single "other" category was considered, it is not statistically relevant to draw conclusions from a mixed bag of professionals with vastly different experiences and interpret them as one voice. Therefore, this study has chosen to analyse these results in an overall picture of opinion, and to use the high response rate categories of municipal and consulting planners as a measure of differences in opinions between those inside and outside the current development control process.

4.1 Opportunities for Innovation within the Development Control Process

In an effort to tease out the potential for opportunities, survey participants were asked to respond to 2 matrix style questions. The first asked participants to describe their satisfaction with a variety of aspects of the development control process. This aimed to expose possible openings for improvement. The second question asked the opinion of participants on the

level of impact facets of the process have on the time it takes for development applications to be approved. This exposes areas where there may be opportunity for innovation.

4.1.1 Satisfaction with the Current Development Control Process

Municipal planners were much more likely to indicate their satisfaction across a number of aspects. 58% of planning consultants were somewhat or very dissatisfied with feedback received on their application, whereas 71% of municipal planners were somewhat to very satisfied with the feedback they provided. Dissatisfaction on the user end, has been historically repeated as an urgent driving factor in the application of technology. (Coppock & Rhind, 1991)

This reinforces the importance of adopter based instrumentalist theory that accounts for under-represented hurdles in adoption, such as complacency, and rejects the pro-innovation bias inherent to developer based deterministic views. (Lieven del Marez, 2011; Surry, 1997; Slater & Mohr, 2006) Keeping this in mind, it is very important to note that the aspect that received the greatest response in the very dissatisfied category (14.1%) was the 'use of paper forms / hard copy forms to submit application', a cornerstone for the adoption of online development control.

4.1.2 Impacts on Timing of Approvals

An overwhelming 90% of municipal planners indicated a moderate to strong impact of circulation time to departments and agencies on the timing of approvals, while 81% also indicated that conflicting comments had a moderate to strong impact on timing. An additional 68% indicated that the speed of responses had a strong impact as well. However, 61% of municipal planners also shifted impacts elsewhere, noting that fulfillment of conditions on the applicant side also had a strong impact in the timing of approvals.

A total of 95% of consultants indicated that circulation time between departments and agencies had a moderate to strong impact on the timing of approvals. Similarly, 76% indicated the speed of response had a strong impact on the timing of the approvals of their application. This relative level of agreement between municipal and consulting planners strengthens the correlation of improving the process with refining wait times for approval of development applications.

Municipal planners tended to answer more in line with other professionals' experiences when asked how aspects of the process that they seemed previously very satisfied with affected the timing of approval of applications.

4.2 Barriers to Innovation in the Development Control Process

Participants were asked them to rate their level of interest in various new or innovative ways to carry out aspects of the development control process. It was important to determine the individual appetite for innovation to serve as a foundation for understanding the potential for adoption over a greater population, as discussed by Rogers' theory of innovations. (Rogers, 1995) This question also aimed to gauge whether innovation of certain aspects were more or less desirable, leveraging learnings from Royse (2008) on the key to advancing the accessibility of information through innovation. Participants were also asked their opinion, based on their experiences, what level of impact various considerations such as cost have on adopting a new online process for development control.

4.2.1 Interest in Innovation of the Development Control Process

Surprisingly, given their satisfaction with paper forms, 55% of municipal planners indicated they would be very interested in the ability to submit development applications online. 6% indicated they were not interested, and were the only professional group to have answers in the not interested category. Carreira (2007) touches on the negative perceptions of technology and the costs of institutional memory. This interest in the digitization of applications may be founded in the "pragmatic shift in the mindset of municipalities…to treat information as infrastructure." (Carreira, 2007, p.52)

86% of consulting planners indicated they were very (57%) to somewhat (29%) interested in the ability to submit development applications online, while 55% indicated they would be very interested in the ability to pay online. Not surprisingly, 81% of consulting planners indicated that they would be very interested in the ability to adjust their application without reapplying, as this would allow for major financial and resource savings.

4.2.2 Considerations when Adopting Technology

74% of municipal planners indicated that the initial capital software cost would have a strong impact on the adoption of a new online process, with 58% believing that ongoing maintenance costs would continue to have a

strong impact. This was expected result as research into perspectives on technology adoption in planning repeatedly yielded issues revolving around financial, training and time resources. (Slotterback, 2010; Gocmen & Ventura, 2010)

Initial capital software cost would have a strong impact on adopting a new online process according to 57% of consultant planners, however 10% indicated it would have no impact at all. This opens up possibilities for shifting costs to the user end of the process to overcome this barrier. Only 25% responded that ongoing maintenance costs would have strong impacts. However, 60% indicated that the integration with existing processes would have a strong impact.

Barriers from the consulting side are more focused on attaining buy in from municipal planners and integrating with the existing, complex process. This validates Royse's key takeaway to advancing the accessibility of information, namely the importance of providing innovative ways of visualizing and delivering complicated and complex information and processes. (Royse, 2008)

4.3 The Role of Technology in the Development Control Process

Aspects of technology's role centered around opportunities and barriers, with more direct questions regarding views on technology following. Participants were asked to rate the importance of qualities when adopting a new technology, developed from the perceived attributes noted in Rogers' Innovation Decision Process and the 5 stages of diffusion (Surry, 1997; Rogers, 1995). This was paired with a follow up question to get a sense of their willingness and speed in adopting new technologies including whether they had ever beta tested a new technology to get a sense of willingness to innovate on top of inclination to adopt proven technology.

Overall, 75% of respondents indicated that being able to try a technology and its features before purchasing it had a strong importance in their decision. 84% indicated that the importance of the technology being very easy to use, simplistic and intuitive was strongly important to their decision to adopt, and was the quality with the greatest number of strong responses. The quality with the least strong responses was seeing the technology used all over the place, with only 40% indicating it was a strong factor in their decision to adopt.

The distribution for pace of technology adoption was relatively even and bucked the basic assumption of Rogers symmetrical bell shaped curve of five adopter segments. 24% of participants responded less than 3 months. In comparison, Rogers' "innovators" segment is assumed to be 2.5%. (Rogers, 1995; Surry, 1997) The next fastest to adopt came in at 27%, adopting in 3 to 6 months, exactly twice the assumption made by Rogers at 13.5%. Adoption then experienced a sharp drop to 16% between 6 and 12 months. Rogers assumes this category – the "early majority" – makes up 34% of adopters. (Rogers, 1995; Surry, 1997)

This is interesting and may be indicative of one of Rogers greatest criticisms, a chasm for technology adoption as explored by Searls, noting a difficulty in bridging the gap between those who want "technology and performance, and customers who want solutions and convenience." (Searls, 2003)

When cross tabulated against age, adoption rates followed interesting patterns. 25 to 34 year olds followed very closely to the standard adoption curve, although with a bias towards innovation along with a marked chasm in adoption in the 6 to 12 month timeframe, then a rebound in the 1 to 2 year adoption time.

35 to 44 year olds showed skepticism in early adoption, gaining adoption strength as time increased, the opposite of 55 to 64 year old respondents who showed a tendency towards innovation and early adoption. This later in life tendency towards innovation goes against Rogers' assumptions surrounding age. However, it is important to note that Rogers' breakdown of personal characteristics of innovators and laggards such as age, gender, education level and social circle were not necessarily meant to be separated as direct influences on the individual innovation decision process, but are being tested in this study for discussion. As well, as discussed in the survey respondent breakdown, respondents to this survey are generally very highly educated, and this, taken into account along with age, as well as other factors, may explain the discrepancy.

Exploring another of Rogers assumptions in isolation, gender was expected to have an impact on pace of adoption, as the theory of diffusions presupposes the tendency of innovators to be young males. (Lieven del Marez, 2011; Parasuraman and Colby, 2001) However, the significance of the impact was shocking. Of those who responded in the innovator catego-

ry, noting that they tend to get on board with a new technology within less than 3 months, 80% were male and only 20% were female.

Men were more than twice as likely to adopt within 3 months with 30%, and women were also almost twice as likely to indicate they wouldn't adopt until 3 years later, if ever with 9.5%, compared to 5% of men.

It is difficult to even explain these results as simply isolating one of Rogers' assumptions, as could be the case in cross tabulating against age, since this reaffirms the assumptions. The effect of gender on the results seem even more surprising when you take into account that this was a self-selecting survey about the process for adopting technology, 98.5% of which had a Bachelor's Degree or higher and work in an industry that requires moderate technological use on a daily basis. While this could be taken as a discouraging statistic, it also shows the greatest opportunity for growth in early adoption of technology is by increasing uptake by women. Women's aversion to technology adoption may be the greatest hurdle, but is also the greatest opportunity for increasing early buy in for innovation in development control.

5. Conclusion and Recommendations

Through initial research for this study, it became evident that technological innovation in planning focused on advancing tools of the trade. Research on creating more advanced mapping, databases and access to data, modelling of current and future conditions, and analyzing trends was widely available. However, little focus was paid to innovation of processes central to urban planning.

While clear breakdowns of the current development control process were found to exist, levels of satisfaction, especially from inside the process, were shockingly high. However, when confronted with aspects of innovation, interest levels from those both inside and outside the process were even higher. This points to complacency as the culprit for lack of progress rather than reluctance to innovate, and encourages the following recommendations.

5.1 Standardization

As research for this study was ongoing, various municipalities began to take notice of opportunities to update the development control process and tackle in house solutions to online submissions.

However, one of the takeaways from this research centers on the frustration from outside consulting planners who deal with multiple municipalities at different levels and are unable to have to same intimate working knowledge of the process compared to municipal planners. The quality of technology that was most strongly responded to as having an impact on the decision to adopt was ease of use, simplicity and intuitive design. While each municipality may adhere to these principles, the most easy to use, simplistic and intuitive system is one that is universal. Standardizing this process between municipalities gets at the underlying inefficiencies and frustrations of dealing with unnecessarily unique circumstances for every application.

Standardization also speaks to the user-driven instrumentalist theory, taking into account the user as the force of change and also the social structure into which an innovation is to be diffused. The mismatch between how municipalities see development control and how users see development control, much like the original discrepancy between Alexander Graham Bell's perceived versus actual use of the telephone, fails to take into account the latent demand for the social aspect of development. (Horrigan, 2010)

Providing a standardized platform across municipal boundaries opens the door to leveraging the social aspect of the pillars of adoption currently overlooked by the development control process, and more difficult to implement across differing pieces of infrastructure. This was exemplified by the eventual governmental consolidation of networks during early electricity and telephone infrastructure build outs. (Horrigan, 2010; Table 3, p.7) Competing networks led to problems with connectivity, and standardization allowed for greater social connection and "that, in turn, fostered additional investment and consumer adoption." (Horrigan, 2010, p.5)

5.2 Organizational Adoption

This research aimed to expose the opportunities and barriers for innovation in the development control process and the role of technology in address-

ing those at the individual development industry professional level. This provided, through Rogers' theory of the individual innovation decision process, a baseline understanding of the appetite for adoption in the population of users. However, an accepted limitation of this study notes that while municipal, consulting and other development industry professionals may have an appetite for innovation in the process, they are often not the same individuals that make decisions at the organizational level. Further research, likely qualitative in depth interviews, will build on this quantitative study and expose opportunities and barriers at the organizational decision making level that were not explored in this study.

References

Carrera, F. and Ferreira, Jr. (2007). The Future of Spatial Data Infrastructures: Capacity-building for the Emergence of Municipal SDIs'. International Journal of Spatial Data Research, v.2, 49-68

City of Quinte West (2012) Development Control. In City of Quinte West. Retrieved April 1, 2012, from http://www.city.quintewest.on.ca/en/cityhall/DevelopmentControl.asp.

Coppock, J.T., Rhind, D.W., 1991. The History of GIS. In: Maguire, D.J., Goodchild, M.F., Rhind, D.W. (Eds.), Geographical Information Systems: Principles and Applications, Longman Scientific and Technical, London, 21–43

Creighton, R.L., 1970. Urban Transportation Planning, University of Illinois Press, Urbana

Göçmen, Z. A., & Ventura, S. J. (2010). Barriers to GIS Use in Planning. Journal of the American Planning Association, 76(2), 172-183. doi:10.1080/01944360903585060

Horrigan, J. (2010) Adoption Paths: The social forces that shape the uptake of technology. http://ssm.com/abstract=1989632

Lieven De Marez et al. (2011) Diffusion Theory vs. Today's ICT Environment obs.obercom.pt/index.php/obs/article/download/474/446

Malczewski, J. (2004) GIS-based land-use suitability analysis: a critical overview. Progress in Planning 62 (2004) 3-65. Retrieved October 12, 2013 from: http://ced.berkeley.edu/courses/fa11/ldarch254/www11/readings/Malczewski_2004.pdf

Moore, G.A. (2006). Crossing the chasm: marketing and selling disruptive products to mainstream customers. New York: Harper Collins.

Onsrud, H.J. and J.K. Pinto, Evaluating Correlates of GIS Adoption Success and the Decision Process of GIS Acquisition. Journal of Urban and Regional Information Systems, 1993, 5(1): 18-39

Parasuraman, A, and Colby, L. (2001) Techno-Ready Marketing: How and Why Your Customers Adopt Technology. New York: The Free Press

Rogers, 1960.M Rogers Diffusion of innovations (4th ed.)Free Press, New York (1995)

Royse, K.R., Reeves, H.J., & Gibson, A.R. (2008). The modelling and visualization of digital geoscientific data as a communication aid to land-use planning in the urban environment: an example from the Thames Gateway. Geological Society, London, Special Publications, v.305, 89-106. doi: 10.1144/SP305.10

Searls, D. (2003) Closing the Chasm. Linux Journal 2003: 109 Retrieved October 12, 2013 from: http://www.linuxjournal.com/article/6629

Segal, H. P. (1994). Future imperfect: The mixed blessing of technology in America. Amherst: The University of Massachusetts Press.

Singhal, Arvind; Thomas E. Backer (2005). "FORUM: THE LIFE AND WORK OF EVERETT ROGERS—SOME PERSONAL REFLECTIONS". Journal of Health Communication 10: 285–288. doi:10.1080/10810730590949978

Slater, S.F. & Mohr, J. (2006). Successful development and commercialization of technological innovation: insights based on strategy type, Journal of Product Innovation Management, 23(1): 26-33.

Slotterback, C. S. (2011). Planners' perspectives on using technology in participatory processes. Environment and Planning.B, Planning & Design., 38, 468. doi:10.1068/b36138

Surry, D. W. (1997). Diffusion Theory and Instructional Technology. http://intro.base.org/docs/diffusion

Williamson, Wayne, and Bruno Parolin. 2013. Application of socio-technical research methods in understanding the genesis and potential sustainability of planning support systems. In Planning support systems for sustainable urban development, edited by S. Geertman, F. Toppen and J. Stillwell. Berlin: Springer-Verlag.

Vonk,G., et al (2005) Bottlenecks blocking widespread usage of planning support Systems. Environment and Planning A 2005, volume 37, pages 909 – 924 doi:10.1068/a3712

Vonk, Guido, and Stan Geertman. 2008. Improving the adoption and use of planning support systems in practice. Applied Spatial Analysis 1:153-173.