Note

How the "Download Generation" will drive Electronic Charting in a New Direction.

Prepared by Mike Casey (Canada)
IIC Technologies Inc.

Abstract

Over the next decade we are about to see an amazing transformation as the generation that grew up with the internet, wireless communication and geo-location starts to take over the work force. They have far different expectations than we have or had. They are showing the energy, creativity and ingenuity to remake their world to their own liking. This will certainly change electronic charting as we know it.

Young people understand technology convergence better because they start at a different place. They have an innate sense of how something will work, they learn quickly and are fearless about trying things. This carefree approach gives them a big advantage. Often the mistakes they make are based on a false assumption that the technology is better than it currently is. Older, non-digital natives, lack this basic intuition of how things flow together. They may have a better basic understanding of how the *underlying* technology actually works but they lack the social context of how it will be used.

We examine their values and from these make several deductions about how the "Download Generation" might think about re-engineering our charting world. It starts with the collaborative knowledge, activism, customization, realism, and the search for ever increasing detail values as they apply to our mapping world.

Résumé

Au cours de la prochaine décennie nous allons assister à de fantastiques changements, lorsque la génération qui a grandi avec internet, avec les communications sans fil et avec la géolocalisation commencera à prendre la relève parmi la population active. Les attentes de cette génération sont tout-à-fait différentes de celles qui sont aujourd'hui les nôtres ou de celles que nous avons pu avoir. Elles sont à la hauteur de l'énergie, de la créativité et de l'ingéniosité déployés pour remodeler un monde à leur goût. Ceci changera certainement la face de la cartographie électronique que nous connaissons aujourd'hui.

Les jeunes comprennent mieux la convergence technologique parce que leur point de départ n'est pas le même. Ils ont un sens inné du fonctionnement des choses, ils apprennent rapidement et n'ont pas peur d'innover. Cette approche insouciante constitue un réel atout. Les erreurs qu'ils sont susceptibles de commettre proviennent souvent de la fausse supposition que la technologie est supérieure à ce qu'elle est réellement. Leurs aînés, non nés à l'ère du numérique, n'ont pas d'emblée cette intuition du flux et de l'enchaînement naturel des choses. Ils ont peut-être de meilleures connaissances de base du fonctionnement de la technologie *sous-jacente* mais il leur manque le contexte social pour savoir comment les utiliser.

Nous examinons leurs valeurs et à partir de celles-ci nous émettons plusieurs hypothèses sur la manière dont la « génération téléchargement » pourrait concevoir la réingénierie de notre monde cartographique. Cela commence par la combinaison de la connaissance, de la participation active, de la personnalisation et du réalisme, en parallèle à la recherche d'une quantité d'informations détaillées toujours plus importante en ce qui concerne notre monde cartographique.

Note

Resumen

Durante la próxima década vamos a asistir a una sorprendente transformación a medida que la generación que ha crecido con internet, la comunicación inalámbrica y la geo-localización, toma el relevo de la población activa. Esta generación tiene expectativas muy diferentes de las que tenemos hoy o podíamos tener antes. Están mostrando energía, creatividad e ingenuidad para rehacer su mundo a su propio gusto. Esto cambiará ciertamente la cartografía electrónica que conocemos hoy.

Los jóvenes comprenden mejor la convergencia tecnológica porque su punto de partida no es el mismo. Tienen un sentido innato del funcionamiento de las cosas, aprenden rápido y no les da miedo intentar las cosas. Este enfoque despreocupado les da una gran ventaja. A menudo los errores que hacen proceden de la falsa suposición que la tecnología es superior a lo que es actualmente. Las personas menos jóvenes, que no han nacido en la era digital, carecen de esta intuición natural de cómo fluyen las cosas juntas. Pueden tener un conocimiento básico mejor de cómo funciona realmente la tecnología *subyacente* pero les falta el contexto social para saber cómo se utilizará.

Examinamos sus valores y a partir de éstos emitimos varias hipótesis sobre cómo podría percibir la "Generación de Descarga" la reingeniería de nuestro mundo cartográfico. Esto empieza por la combinación del conocimiento, de la participación activa, de la personalización y del realismo, paralelamente a la búsqueda de información detallada constantemente creciente relativa a nuestro mundo cartográfico.

Introduction

Over the next decade we are about to see an amazing transformation as the generation that grew up with the internet, wireless communication and geo-location starts to take over the work force. They see things differently than we do. They don't think about the possibilities of the Internet or GPS - it is the air that they breathe. When they think about what their world could be they start at a different place. What we have lodged in our imagination they have as basic intuition. What *we* take as amazing technology *they* take for granted. Already, they are starting to drive applications of those technologies in new directions. They have far different expectations than we have or had. They are showing the energy, creativity and ingenuity to remake their world to their own liking. This will certainly change electronic charting as we know it.

Never before has a generation had such a technological leap over their parents. As technologically savvy as "Baby Boomers" perceive themselves to be, they are no match for their offspring. It is so common that parents defer to their offspring or grandchildren for technological guidance that it's no longer a cliché or point of humor; it just "Is what it is." When it is taken for granted that technology-wise we will learn from our children, then something dramatic has happened.

How did this happen? And, more importantly, *What does it mean for us?,* are the questions driving this paper.

First, What Is the "Download Generation"?

Several names have been applied to this new generation; Generation Y, Millennials and Net Generation being three. However, all three cover a slightly wider age group that the one I call the "Download Generation." More specifically I refer to a subset of Generation Y – those born in 1990 and beyond. Most are entering university now and soon will be flooding the job market. In the next ten to 15 years they will be having an enormous effect on how the mapmaking and charting world operates.
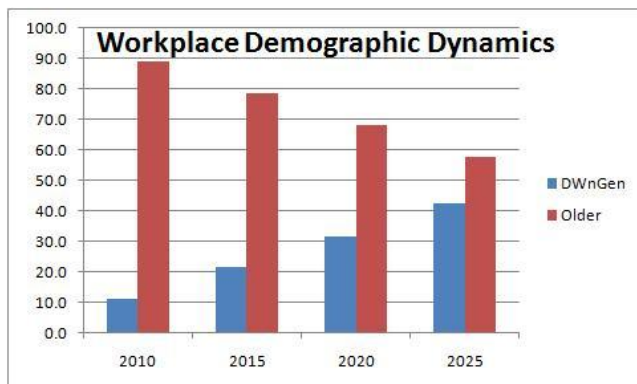

Figure 1: Expected Changes in Workplace Demographics [1]

1990 is an important year for a several reasons. For one, by that time the PC market was starting to mature. In fact Apple's flagship product was called the Mac 'Classic'. So these children grew up in a digital environment. By the time they went to kindergarten they could see their parents carrying laptop computers. The World Wide Web was the Internet and GPS became fully operational. Throughout their early years they could see that people communicated through cell phones – and soon they would have their own. They and their friends started to download ringtones to customize their own (or more likely their parent's) cell phone and the educational flip-flop began as children began to take it for granted that they had to show Mom and Dad how the cell phone really worked and all the features it had. They also developed patience as they realized that they had to explain these things several times. The same with the home PC - by now networked on broadband. In their early teens Wikipedia became the source of quick reference, Google became a verb and Mom and Dad needed help with the GPS in the car. The iPod changed music marketing forever, downloading music took off in earnest and social networking came upon us. Soon FaceBook and Twitter dominated their time, they mastered smart phones, understood 3G networks and rated and ranked the latest iPhone apps. Yet none of them have ever 'dialed' a phone. Yes, this cohort is *very* different.
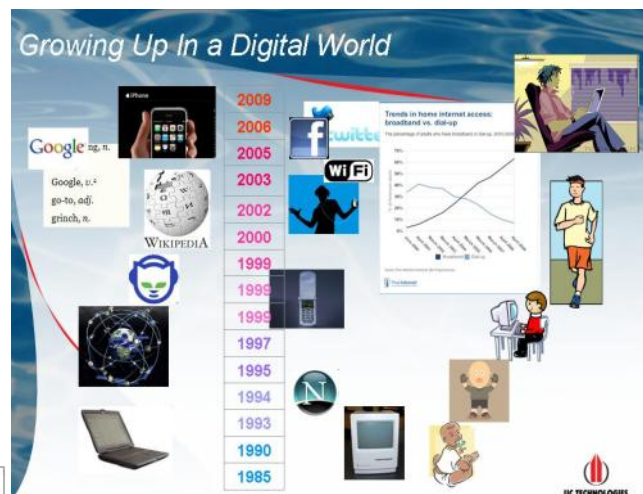
In the words of the Berkman Center for Internet & Society at Harvard University they are "Digital Natives and we, the digital immigrants.[2] The unique characteristics of this generation have been documented in several recent books such as "Born Digital"[3], "Grown Up Digital"[4], "The Emerging Millennials"[5] as well as several web communities such as www.digitalnative.org, and www.growingupdigital.com.

What's So Special About Being Technically Fluent?

When people who lack a degree of technical fluency approach a technical problem we see hesitation, apprehension and often counter-intuitive behavior as they grope for a solution. Further, this may occur seemingly at random, and all because of a basic lack of intuitive understanding about just how the technology works. They don't seem to know what actions are important and which are marginal. Neither can they articulate what the problem issue is as they lack the new language and terminology. Something just doesn't work and their frustration level can rise to a fever pitch. Having an intuitive understanding of how technologies can work together (convergence) gives you a big advantage.

Young people understand convergence better because they start at a different place. They have an innate sense of how something will work and so they frequently will ignore any documentation or training and just jump right in. They may make errors but they quickly learn and are fearless about trying things. This carefree approach gives them a big advantage. Often the mistakes they make are based on a false assumption that the technology is better than it currently is. They know something specific should happen but the technology is not there - yet. Older, non-digital natives, lack this basic intuition of how things flow together. They may have a better basic understanding of how the *underlying* technology actually works but they lack the social context of how it will be used and that is the more important of the two.

Lacking this deep level of fluency makes the terrain difficult to navigate as it is all unknown. Digital natives seem to be able to effortlessly glide - like a gifted athlete – with little hesitation, as if they were born to do this.

That's why they will make big changes in the mapmaking and charting world. We need to understand this gifted generation in order to provide some level of guidance. They may not look to us for technical assistance or training, but they will depend on us for the wisdom acquired through years of experience.

Download Generation Characteristics:
According to Don Tapscott there are eight (8) "norms" that define this generation:
1. **Freedom of choice**: free to choose media types, types of mobility, and their jobs almost like they choose their clothing
2. **Customization**: fully customize TV, Internet browsers, avatars...
3. **Scrutiny**: everything must be authenticated, everything scrutinized
4. **Integrity**: giving their time and resources to help others
5. **Collaboration**: collaboration in all areas, from jobs to information to lifestyle.
6. **Entertainment**: Products and services must invoke

enjoyment
7. **Innovation**: always looking for what is new, different, or innovative
8. **Speed**: Instant information, instant gratification.

From these characteristics, we can see where some conflicts might arise. There is always a reason (good or bad) that things "Are the way they are" As such, issues like freedom of choice, customization and the rate of innovation are issues the existing marine community will instinctively want to curb. Consequently we need to have a better understanding of this new generation since the day will come when we are dependent upon them.

From my own observations, I see the following values being particularly important to this generation:

- *Timeliness*: not as within weeks or days - but as within seconds
- *Connectedness*: always connected, always on
- *Free*: as in virtually costless
- *Choice*: multiple ways to customize what you want
- *Content*: if it isn't online it doesn't exist
- *Copyright*: new media means new rules
- *Collaborative Knowledge*: everybody adds, everybody shares
- *Spatial Awareness*: knowing where you are, where your friends are
- *Depth*: links to ever increasing detail
- *Realism*: as in photorealistic 3D models mirroring the sighted experience
- *Activism*: as in bottom up knowledge creation
- *Improvisation*: if I see it's wrong I will fix it
- *Wikis*: fellow travelers contribute the most meaningful information
- *Trust*: technology works, large institutions don't
- *Rating and Ranking*: what do other people think of this product

From these values I believe that several deductions can be made about how the "Download Generation" *might think about re-engineering our charting world. It starts with the collaborative knowledge, activism,* customization, realism, and the search for ever increasing detail values as they apply to our mapping world. But first it is important to recognize a current phenomenon occurring in the mapping world – the effect of Citizen Mapping [6,7] and, more generally, Crowdsourcing

Crowdsourcing
Jeff Howe is the author of the best selling book - Crowdsourcing - Why The Power Of The Crowd Is Driving The Future of Business"[8] and he coined the term crowdsourcing" in a article in Wired Magazine in June, 2006. According to Howe "Crowdsourcing" is defined as:
*"the act of a company or institution taking a function once performed by employees and outsourcing to an undefined (and generally large) network of people in the form of an open call" ... **wired.com***

Howe's book goes into great detail about how Crowdsourcing has changed certain markets and gives many examples showing how the phenomenon has worked spectacularly well and a few where it did not. Crowdsourcing is truly a paradigm-changing movement, the effects of which are rippling through society, the workplace, science and mapmaking.[9] This is important because the biggest development that the mapping community has to be concerned about is the *creation* of maps by the Crowd. A good example is the crowdsourced mapmaking phenomenon called *OpenStreetMap*.[10]

Open Street Map

OpenStreetMap deploys teams of volunteer amateur mapmakers into "mapping parties" on weekends to gather road network data and compile it into very useful and credible street maps free for all to use. 'OSM' (as it is known to the Crowd) has literally remapped the UK and much of Europe, and is now working its way around the world with extensive mapping going on in India and North America. One has to view the web site (openstreetmap.org) to appreciate how extensive the coverage is and the level of detail captured. As one reviewer on *OpenGeoData.org* has noted:

"OpenStreetMap maps a lot more than roads. All the things you mention: roads, paths, buildings, heights, pylons, fences ... AND... post boxes, pubs, airfields, canals, rock climbing routes, shipwrecks, lighthouses, ski runs, whitewater rapids, universities, toucan crossings, coffeeshops (the dutch kind), trees, fields, toilets, speed cameras, toll booths, recycling points and a whole lot more." ... www.opengeodata.org

OSM as of January 2009 has more than 50,000 registered users and more than 5000 mapmaking contributors each month and the number is doubling every year. That's an impressive number no matter how you view it.

These actions were primarily motivated because of the feeling among a segment of the population (many of them of the Download Generation) who felt that government mapping data should be free of charge and free of restrictive use. So they did what Tim Berners-Lee (developer of the World Wide Web) had predicted:

"If you don't make [lower-resolution mapping data] publicly available, there will be people with their cars and GPS devices driving around with their laptops .. They will be cataloging every lane, and enjoying it, driving their 4x4s behind your farm at the dead of night. There will, if necessary, be a grass-roots re-mapping"

Which is exactly what has happened and the mapping

data is provided free to anyone who wants to use it. The lesson: if you charge too much for your mapping data and put restrictive practices on how it can be accessed, used or shown, then people will simply go around you and do it themselves. Mapmaking is no longer restricted to the domain of experts.

OpenStreetMap appeals to Download Generation for a number of reasons. First it involves joining a group of activists who are focused on change. Second, acquiring and processing the data is fun and collaborative and it uses the same technology that they grew up with and know so well. Third, it allows them to stretch themselves intellectually into a new domain and learn some new skills. Additionally it allows them to acquire as much detail as they feel is necessary for their purpose and enjoyment, to build upon what others have done before them and to be judged and appreciated by their peers for their work.

If the previous 'values' are reduced down to eight (8) essentials, it becomes apparent that the OSM movement has a high degree of appeal to the "Download Generation."

	OSM
Timeliness	x
Connectedness	
Free	x
Customization	x
Content	x
Activism	x
Collaborative Knowledge	x
Trust	x

Table 1: the Appeal of OSM to the Download Generation

The "Download Generation" is perfectly suited to the Do It Yourself (DIY) movement of collaborative online information generation and OSM makes a logical extension of Wikipedia[11], Digg[12], Technorati [13] and the many other sites mushrooming up from seemingly nowhere.

"Download Generation" and Charting

This DIY mindset will surely have an effect on our charting world. We can see nascent crowdsourced seabed maps through OLEX (www.olex.no) and Piscatus (www.piscatus.co.nz) who use user-generated bathymetry to improve their seafloor images used in the fishing industry. So crowdsourced charting does exist but is focused on a narrow application at the moment.

Perhaps we can see a more likely model in the online cycling map phenomenon.

What Can Cyclists Tell Us About The Future of Charting?

First off cyclists are a well defined community. They enjoy talking to other cyclists and they love to ride to new locations. Now since cyclists must share the road with faster and heavier vehicle traffic there is a safety concern shared by all cyclists. So there is a common need to tell other cyclists how to navigate in their specific neck-of-the-woods. The cycling community is also well connected, technically savvy and environmentally active. It is no surprise then that the web is full of sites offering tips to cyclists about the best routes through a community.

The Cambridge Journey Planner (**www.camcycle.org.uk**) is a good example. The site offers preferred navigation routes through Cambridge. *Fietsrouteplanner.eu* is another such site, *cyclopath.org* another, *ridethecity.com* another, *bbbike.sourceforge.ne* yet another and on and on. As one enthusiast has noted:

"Everyone has their own reasons for enjoying OpenStreetMap, but for me, cycling is the "killer app" -in that OSM gives you the best cycling maps in the world (on the web and on your GPS), and mapping is also a great excuse to get out there and cycle." ...www.opengeodata.org

Cyclopath.org provides a mechanism for riders to update the maps after each ride. It is hard to imagine competing with that level of updating. As Jeremy Crampton [14] has noted:

"Is data created by an "trained expert" who is not familiar with an area somehow more "accurate" than data created by an "amateur" who lives in that area and has a vested interest in correct information? Especially given that the local amateur has the means (through OSM) to make corrections on the fly?"

Having a committed group of enthusiasts, eager to share new navigation information with their fellow travelers to ensure they also have a safe, enjoyable and incident-free journey - surely there is a lot to learn from this?

Sea kayakers, for example, are a likely group to strongly benefit from some community-driven wiki action. Water depth is largely irrelevant to even the most heavily laden tandem kayak – it still draws less than 25cm at best. Sea kayakers are far more interested in the effects of tidal currents in a region – an aspect that can really affect their safety.

Similar to cyclists, sea kayakers rely on their fellow travelers to provide advice based on first hand experience of sailing in an area; the nature of the currents, kelp beds to avoid, places to launch, beaches to camp on etc. A wiki-based chart would seem to be a good fit. *OpenOceanMap.org* in California provides a site with NOAA nautical charts marked with points at which sea-kayaks could be launched. EarthNC[15] has employed crowdsourcing in its merging of NOAA's raster and vector charts and Google Earth. I think there is a lot to learn from ventures like this about how users can add value to digital map and chart products without taking away their fundamental core value as navigational tools.

Crowdsourcing Navigation Publications

A clear and straightforward step forward to crowdsourcing useful navigation information would be a wiki-based Coastal Pilot or Sailing Directions. The contribution of other mariners who regularly sail within an area are those best suited to document the relevant information and to keep it up-to-date.

It is almost certain that some form of marine wiki-based navigation device will be implemented, particularly when a significant percentage of Download Generation mariners start to flood into the market.

3-D Realism

Although not a new development in electronic charting, 3-D chart models have not met with great acceptance among the marine navigation community. That will likely change when the new generation of mariners takes command. I suspect that this is exactly the kind of display detail they want.

One specific movement which I'm sure will have direct relevance to the mapping and charting world in the near future is the amazing free work being done by volunteers in developing 3-D models for display in Google Earth. While the greatest volume of work is being done by commercial organizations and municipal governments to develop 3-D models of sections of cities for their own purposes (see for example Digital Urban[16]), it is the free work being done by gifted volunteers that can be breathtaking in its complexity, realism and ultimately its usefulness. Visiting the Google SketchUp Warehouse [17] one can view amazing models of some of the most beautiful building in the world. Additionally, and of great significance to the charting community is the work being done modeling bridges over navigable waterways and waterfront detail. A beautiful example of this exists for Portland OR, [18] but there are many others.

Figure x: Angus L. MacDonald Bridge Halifax/Dartmouth NS (left) the free model by 'mapleleaf' in the 3-D Warehouse; (right) photo of daily vessel transits under the bridge

What about Connectedness?

The missing piece of technology is connectedness for the offshore user. That is both a marketing and a technical problem. The technical issues can be overcome with the use of supplemental antennae which can boost range out to beyond 20Nm[19]. Satellite phones give global coverage but continuous connectedness is not really financially viable for most shipping applications. Nor is there the same need in mid-oceanic voyages. But conventional 3G network access from 20Nm would seem to fill a growing market need. So Connectedness is doable and inevitable.

The Nautical Chart as a Paradigm

We have traditionally thought of the nautical chart as a physical entity, the end result of an intelligence gathering and filtering exercise but nonetheless boiled down to a sheet of paper covered with inked-in symbology. More recently we think of its digital equivalent as a collection of information objects displayed in a near traditional style. The Download Generation is far more likely to see it as a means to an end untied to specific hardware or display standard and fluid enough to pass from different media at different times. The introduction of electronic chart technology has from the beginning been referred to as a paradigm-changing[20] event. It is, but that paradigm has yet to be fully defined.

The Issue of Free

One of the more vexing issues will undoubtedly be the issue of fee-based licensing. The Download Generation has been raised in the era of Napster and they adopted Pirate Bay with abandon. They are notoriously unsympathetic to the entertainment industry's complaints of illegal downloading and are outraged by measures like Digital Rights Management (DRM). That didn't go so well for the entertainment industry.

A major motivation for OpenStreetMap was to get around what were perceived as excessive fees levied by the Ordnance Survey. That didn't go so well for the OS.

The Download Generation will carry that same attitude about ENC licensing when they graduate from navigation colleges and become a force to reckon with on the bridge.

One option might be to support a fee-based service in the image of Spotify[21], a streaming customizable music service which runs constantly. Should such a parallel chart service eventually come to pass it would be the culmination of one of the dreams of a Electronic Charting pioneer, Neil Anderson, who envisioned in 1984 a chart server 'in the sky' that would stream out nautical chart information in an endless stream[22]. That kind of technology didn't work 25 years ago but the times have changed.

The Entry of the Download Generation Into The Marine Navigation World

The effect on workplace demographics as shown in *Figure 2* will somehow be reproduced in the workplace of marine navigation. The effect of the Download Generation may be accelerated in places where there is a disproportionate number of deck and navigation officers approaching retirement in the next decade. If the effect seen in eastern Canada[23] is replicated elsewhere then we can expect their influence to be felt even sooner than in the population in general.
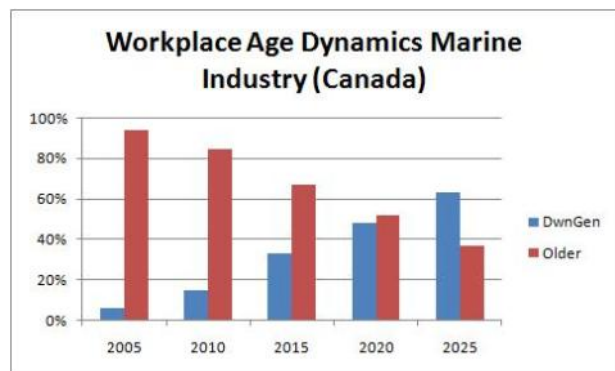

Figure 2: Expected Entry of Download Generation into Marine Navigation Community

Summary of Most Likely Changes Download Generation Will Expect (And Eventually Get)

- Openness of display options for customization
- Drill down detail
- 3-D realism
- Crowdsourced overlays
- Chart changes within minutes of the action being reported
- All content online all the time
- Ratings and feedback from fellow mariners

All of these expectations can be met, some in the near term, others requiring changes by HOs and port state regulators. Some will require changes to existing technical standards and others need international regulatory approval.

Suggested Strategies for Welcoming the Download Generation into the Navigational Charting Community

1) Prepare for the coming pressure for change
2) Use Social Networking technology to encourage debate about change
3) Support technologies that give mariners an opportunity to contribute information
4) Encourage standards to keep specific layers open for direct user input
5) Free up as much supporting data as possible
6) Pipeline new information directly to mariners tagged with quality level ratings
7) Be guided by users to incorporate photo realism and 3-D models
8) Encourage and respond to user ratings
9) Begin to employ crowdsourcing, initially on non-regulated publications, expanding later

Closing Thoughts:

As much as the world is changing one thing will remain constant - there will always be ships. Shipping will remain as the safest, most economic and most environmentally sustainable form of transportation. Shipping patterns will shift over the next 30 years - just like they have over the past 30. But like all forms of transportation, there will always be inherent risks There will always be mechanical or electronic glitches, always storms at sea, always heavy traffic, always human misunderstanding, always staff troubled by their own demons, always a chain of events leading to incidents with a loss of life, cargo and damage to the environment. So there will always be a need for vigilance assisted by some form of nautical charting technology.

What will be different is the thinking process used by the navigating officers on board: what they expect, what they know to be true and what they know that they don't know.

The "Download Generation" is perfectly suited to this environment. We need to recognize that they will influence the future.

Notes and References

[1] T8-2008. Sex and Selected Age Groups [15]; US Census Bureau factfinder.census.gov

[2] www.digitalnative.org

[3] "Born Digital", 2008, John Palfrey and Urs Gasser, Basic Books

[4] "Grown Up Digital", 2009, Don Tapscott, McGraw Hill

[5] The Emerging Millennials", 2009, Reginald W. Bibby, Project Canada

[6] "Citizen Mapping And Charting: How Crowdsourcing is Helping to Revolutionize Mapping & Charting, 2009, M.J. Casey, Hydro 2009 Conference, Norfolk, Va.

[7] "Citizen Mapping and Charting", 2009,M.J. Casey, Hydro International, Vol. 13, Number 8

[8] "Crowdsourcing - Why The Power Of The Crowd Is Driving The Future of Business", 2008, Jeff Howe, Crown Business

[9] "Volunteering Geographic Information to Authoritative Databases: Linking Contributor Motivations to Program Characteristics" David J. Coleman et al., in review; Geomatica, Journal of Geospatial Information Science, Technology and Practise,2009

[10] OpenStreetmap.org

[11] wikipedia.org

[12] digg.com

[13] technorati.com

[14] "Mapping Without a Net: Neogeography in the 21st Century", 2008, Jeremy Crampton, (http://www.wun.ac.uk/ggisa/seminars/archive/autumn08_program/index.html)

[15] earthnc.com

[16] digitalurban.blogspot.com

[17] sketchup.google.com/3dwarehouse

[18] digitalurban.blogspot.com/2009/05/portland-3d-city-model.html

[19] www.digitalantenna.com/prods/cellantenna_8.html

[20] "Exploitation of Intellectual Property by Electronic Chartmakers: Liability, Retrenchment and a Proposal for Change", 1994, Edward J. Obloy and B. Helen Sharetts-Sullivan, Defense Mapping Agency, Proceedings Conference on Law and Information Policy

[21] www.spotify.com

[22] "The Electronic Chart", Anderson, N.M., 1985. Proceedings of the Canadian Hydrographers Association and the Hydrographic Society, U.S. Branch, joint workshop, Dartmouth NS

[23] Marine Careers Opportunities in the Marine Transportation and Offshore Petroleum Industries in Eastern Canada; Government Newfoundland & Labrador; Marine Careers Secretariat: Marine *Careers Opportunities http://www.exec.gov.nl.ca/exec/wpo/publications/ index.html*

———————--

Biography of the Author

Mr. Casey is V.P. Geospatial Systems, IIC Technologies Inc. His responsibilities include exploring advances in navigation technologies, topo and bathymetric lidar developments, general trends in map and geospatial technology and business development. Formerly he worked for the Canadian Hydrographic Service and participated in several electronic charting initiatives. He was the Project Leader for the Canadian Electronic Chart Pilot Project, a project that grew to include testing electronic charting infrastructure in both Canada and the US and employing over 50 ships. He participated in and led various supporting projects such as ENC updating, at-sea testing, electronic docking charts, ENC pricing and establishing a viable ENC Distribution Chain.