ARCHITECTURAL SOCIABILITY AS A STRATEGY TO DRIVE TECHNOLOGY INTEGRATIONS INTO ARCHITECTURAL STRUCTURES AND SMART ENVIRONMENTS

The architectural filter to the localized Internet

STEVEN W. OCHS
Bit Lab Seattle, Washington, United States Email address: Steve@bitlabseattle.com

Abstract. Traditional architectural design fulfills the basic needs of society, but its influence as a system to facilitate personal connection has declined with the growth of telecommunications and social networks. The advance of interactive architecture is now positioning buildings to once again fulfill the role as facilitator of connections and fulfill our personal need of belonging. While current attempts to integrate social communication, technology with built environments are nominally effective; Architectural Sociability is proposed as an effective design solution. Strategy details include a purpose based social approach in which social networks, localized data streams, ubiquitous computing, pervasive networks, and smart environments are considered a traditional part of an architectural structure.

1. Introduction

Historically, traditional architecture serves many needs. These range from housing families to empowering industrial factories. Architecture's time tested delivery of function and aesthetics has performed well as a support system for society's contemporary needs. However, its influence as a system to foster personal connections has deteriorated as communication technologies and digital networks have advanced. Now, at the dawn of an era of ubiquitous technology, architecture is positioned to return to the epicenter of socialization in a digital and non-local communicative world. In order to accomplish this task, however, architects must take an unexpected path in which new systems are considered a part of physical structures.

This paper proposes architectural sociability as an approach of design for merging technology into architectural structures. It is defined as a socially focused design strategy to holistically integrate digital information and ubiquitous technology into architecture. The strategy provides for broad diffusion of technological integrations utilizing human factors, social networking and interaction design. It redirects integrated technology design toward socially based systems, which engage users simultaneously physically and digitally, and enhances society by using architecture as filter for building relationships, inspiring collaboration, and increasing cultural diversity.

Discussion is divided into the following parts: Section 2 contains the components of architectural sociability. Section 3 discusses the strategy of sociable design in architecture. Section 4 outlines the benefits of Architectural Sociability and its future applications.

2. Components of Architectural Sociability

2.1. SOCIAL NEED

Architecture serves many needs for its users, designers or sponsors. Architects have turned to a number of different models to illuminate the psychological roots of these needs. The most widely accepted, despite its limitations, is Maslow's Hierarchy of needs. According to this model, the function of contemporary architecture fulfills the basic physiological and safety needs of an individual, the 1st and 2nd levels in Maslow's model(Lang, J. & Moleski, W. 2010).

However, if we review how architecture of the distant past provided for people's needs, we find it as the primary technology to connect people and fulfill humanities need for belonging: the 3rd level of needs in Maslow's Hierarchy (see figure 1.) People used buildings and locations to find other people and social groups. This served as a Location Based Networking System (LBNS) that facilitated friendship, acceptance and exchange. When people found one another, either in an individual or group setting, they communicated face-to-face to share instant information. Structures such as city, church and political squares helped facilitate connections between people , as did smaller structures like guilds, pubs and homes. During that time, architecture was the epicenter of technologies for social connection.

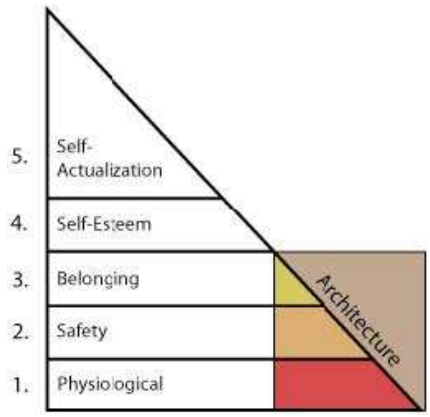

Figure 1. Architectural impact on Maslow's Hierarchy of Needs prior to the telecommunications revolution.

The change to the LBNS began in 1793, with the invention of the telegraph, one of the initial markers of the telecommunications revolution. It was a new format of communication that allowed individuals to communicate non-locally and instantly. Over the years inventors continued to develop on-local telecommunications systems such as the telephone, radio, and the television, which were widely adopted. Each new advance in communications changed the way people connected and interacted. The creation of the social network exemplifies those changes. It has shifted the communications paradigm from point-to-point, two-way conversations to many-to-many, collaborative conversations (IBM Institute of Business Value2010).

The advance of the telecommunications revolution phenomenon had a major impact on our social structures. As people adopted these systems, the need to meet face-to-face to share information was marginalized and the outcome on architecture was striking. It was no longer the primary technology to facilitate connections, collaboration and cooperation. Architecture's power to fulfill humanity's 3rd level of need in Maslow's model was usurped by telecommunications.

The change from face-to-face connection to non-local friendship is presenting societal issues. Research shows a remarkable drop in the size of core discussion groups, with shifts away from ties to the neighborhood and community contexts. From 1984 – 2004, the number of people who said that there is no one with whom they can discuss important information tripled in the United States. Both kin and non-kin confidants were lost over the past two decades. Additionally, 43% of the American population has dropped discussion partners from 3 to zero, reporting that they discuss important matters with no one or with only one other person. People who report having discussion network of 4 to 5 people have dropped to 15.3% of the population from 33% (McPherson, M. & Smith-Lovin, L. & Brashears, M. E. 2006).The study has sad implications for our social groups as it references the common American feeling of separation from others.

This presents a driving social need to help people have more meaningful social interactions. Architecture can fulfill that role again as it uses sociable strategies.

2.2. SOCIAL NETWORKS

A social network is a digital collaborative communication system that focuses on building and reflecting physical social networks or social relations among people that have similar interests. Once considered a communication fad, social networking sites are now woven into the fabric of the Internet. According to The Neilson Company, people spend more time on social networking sites and blogs than ever before, 82% more time each year (2009). In 2010, Facebook was the largest example of a social network communication solution, ranking as the 2nd most visited website online. Examples of social network communication systems include radio, podcasts, intranets, email, chat, status updates, instant messaging, sharing, forums, blogs, micro-networks, video chat, virtual reality and telephony. Each of these collaborative communication methods grows at different rates. In 1995, status updates were not prevalent on the Internet; today 110 million people update their statuses daily (McGee, M. 2010). While our desire to feel belonging sends people to social networks in search of close human connections, social networks don’t provide the fulfillment we need. However, they can be useful tool to initiate connections between people. For example, in 2010, 17% of the couples married in the United States year met online first, rather than at a social gathering. (Ringerud, T. 2010)

The digital communications ecosystem represents a cornucopia of interconnections and solutions to facilitate and initiate interactions between people. The trend continues toward diversified, amplified and collaborative communications (see figure 2.) This wide variety of options provides designers with a formidable palette for designing integrations into buildings, ultimately positioning built environments as hubs of social interaction, which can utilize digital communications as a virtual space to form introductions then transfer connections to face-to-face LBNS. This initiates a dance of communications between local and non-local space, therefore continuing to develop a deeper sense of connection between people.

2.3. STRUCTURAL INTELLIGENCE

The value of a structure's intelligence is equated to the volume of accessible data and communications flowing through a geolocation, multiplied by the square of the number of spatially situated connected users. As more accessible information flows through a building, or more users connect to that building, its potential for greater intelligence increases. This creates a network connected to an invisible and real "electronic agora"-a place within which digital information flows rapidly and freely, and can instantly be connected to the system of global digital information flows (Horan, T. 2000).

When filtered by location, a single skyscraper can produce many giga bits of data through its machines, stationary devices and mobile users. The stream of digital information produced over IP has increased eightfold over the past 5 years, and will increase fourfold up to 2015, reaching a Zetta byte of data (Cisco, 2010). The number of Internet traffic originating from TV's, tablets, smartphones and machine-to-machine modules will grow by 216%in 2012 and will continue to grow at accelerated rates (Cisco, 2010). This data provides a real-time pulse to enable contextual understanding for building users.

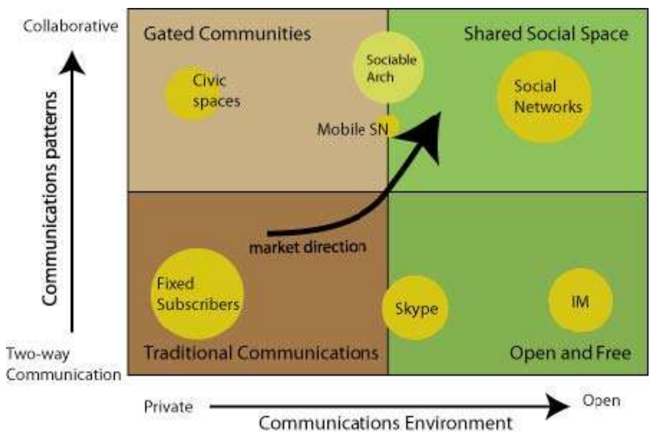

Figure 2. Communication trends and audience migration

2.4. UBIQUITOUS DEVICES AND PERVASIVE NETWORKS

The digital platform on which to implement architectural sociability structures resides in ubiquitous computing devices and embedded technology working with pervasive networks (see figure 3). A pervasive network is formed through multiple interconnected ubiquitous devices such as sensors, smart phones or tablets. As device ubiquity is on the rise, designers have a larger set of tools to incorporate into sociable structure planning. The Neilson Company reports that by the end of 2011 the United States will cross an important milestone: one in two Americans will have a smartphone (Tofel, K. 2010). Additionally, there will be more networked devices then people on the earth. Mark Weiser's 1991 ubiquitous computing statement that "services can be provided anywhere with any devices," has nearly arrived (Jin, Y. & Wang, R. & Huang, H. & Sun, L. 2010). This opportunity to connect all devices within a special orientation provides designers with a pervasive network that can function as a human factors engineering platform.

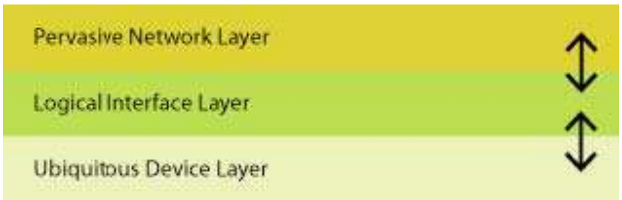

Figure 3. The digital platform for Architectural Sociability.

2.5. CLEAR PURPOSE FOR INTEGRATION

There are many terms that endeavor to describe the implementation of technology integrations into environments. Some of those include "intelligent space," "smart architecture," and "responsive environments". Mark Weiser defines these spaces as "a physical world that is richly and invisibly interwoven with sensors, actuators, displays and computational elements, embedded seamlessly in the everyday objects of our lives, and connected though a continuous network," (Diane, C. & Sajal, D. 2004).Michael Fox and Miles Kemp recent examination of the topic called the space "interactive architecture," or a new world of architecture that adapts to social, physical and environmental needs of individuals (2009).

Even though there is no term to precisely describe the explorations of technology integrations into architecture, "massive endeavors are continually ongoing to develop such prototypes." (Jin, Y. & Wang, R. & Huang, H. & Sun, L. 2010). For the purpose of Architectural Sociability we reserve the term "smart environment" as the infrastructure (sensors, actuators, structural intelligence and networks) with the potential for an individual to interact through natural interfaces.

Today's attempts to produce smart environments show signs of early exploration but little success in creating widely accepted solutions. Integrated research includes developments with smart homes, smart offices, and smart lecture halls. In many of these explorations the designer's intention is to cause the environment to react to the user or report on situations. However, lack of overall success in these designs is due to the failure to fulfill a new set of needs for people. Some attempts have focused on imbuing intelligence into the environment adding another human-to-computer layer of interaction. This is called Ambient Intelligence (Am I): "a digital environment that proactively, but sensibly, supports people in their daily lives," (Augusto, J. & Nakashima, H. & Aghajan, H. 2010). The focus of researchers and designers working with ambient intelligence is primarily to augment people's lives by enhancing security and safety, Maslow's lower levels of human needs. There are many examples of these explorations.

The assisted living smart home is one such example, which focuses on Maslow's base need for personal safety. This enhanced home is identified as a possible cost saving solution to assist disabled or elderly individuals as healthcare expenses continue to rise in some industrialized nations. The search for solutions is worldwide. The University of Ostrava in the Czech Republic have developed a smart apartment to study individual activities with infrared sensors to sounds alarms in emergencies (Cerni, M. & Penhaker M. 2008). In the UK a system has been developed that observes vital signs and activity then provides for security and response (Bonner S.2008). Some attempts purport to assist users, but don't provide many practical enhancements. Bill Gates' home was created with the capability to adjust to visitors and individual's personal preferences including temperature, music and media. This is an example of technology for technology's sake, which does not provide widely needed solutions.

Beyond the assisted smart home, attempts to integrate technologies in various structures and museums are some the most successful. The LA Museum of the Holocaust, created by Variate Labs, is an excellent experience and portrays a valuable story, yet these integrations are only used by a small percentage of the population and provide a minimum impact on worldwide livelihood.

In our current climate, most of the technology integrations attempts in interactive architecture are inadequate. This can be explained partially by the fact that industry suppliers tend to be dominated by leaders who subscribe to providing by technology-push rather than a demand-centric-pull approach, which causes user disappointment and low adoption rates. (Barlow, J. &Bayer, S. & Curry, R. 2005)

However, technology integrations in architecture can diffuse widely across the market. Architecture with purpose-based social technology integrations can accomplish this by connecting people to others around them. While the field of human factors has worked toward that goal using the physical systems of the built environment, the time has arrived to enhance those environments with technology to connect people. This is the promise of Architectural Sociability, integrating technology with a social purpose.

3. Architectural Sociability

Architectural Sociability provides a strategy to enhance society by placing architecture back at the center of socialization. It endeavors to create social change at the design level. Its primary goal is to inspire a sense of personal belonging by facilitating face-to-face social interaction and cooperation within a building or built environment using both physical and digital tools with a focused cultural goal. The bi-product of this goal provides designers with a core purpose for fluid technology integrations.

Architectural Sociability is defined as a socially focused design strategy to holistically integrate digital information and ubiquitous technology into architecture. Its components can be further broken down into these core Eco systematic parts: social need, collaborative and tele-communications, ubiquitous computing, embedded hardware, structural intelligence, pervasive networks, physical queues, human factors and smart environments. When a sociable ecosystem is properly applied, the effect increases the value of a sociable building through the networking effect.

Architectural Sociability design takes a purpose-based approach (see figure 4.), which guides the structural and digital design throughout architectural process. The following sections describe the foundation and cumulative framework to produce a successful sociable structure.

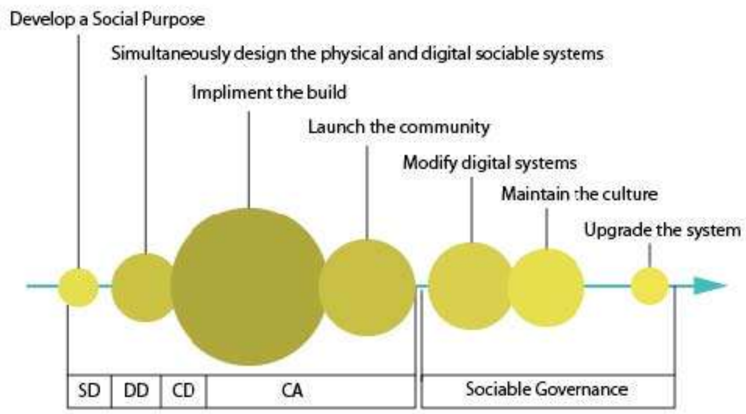

Figure 4. Path of design, build and maintenance for a sociable building.

3.1. THE SOCIABILITY MODEL

The model of sociability is based on five basic tenets to encourage the widest acceptance across the architectural field. 1. It impacts the base levels of Maslow's Hierarchy of Needs. 2. It evokes individual emotions based on emergent goals through contribution. 3. It challenges creative minds. 4. It provides an overarching purpose. 5. It provides utility for marketers.

One of the most recent successful design movements is the sustainability movement. As an example, LEED building certification has seen a growth of nearly 750% since 2008 (US Green Building Council 2010). Architectural Sociability parallels sustainability in the tenets of its success (see table 1)and is based on today's most engaging and viral systems, both in the architectural world and in the digital networking world.

3.2. ESTABLISHING THE COMPONENTS OF A SOCIABLE STRUCTURE

A sociable building is a structure that facilitates purposeful social interaction by connecting people to a pervasive network through smart environments with access to the structural intelligence. The technological taxonomy of each layer of a developing sociable structure can be outlined to provide designers with a kit-of-parts for the site development (see figure 5). Understanding these available parts create the boundaries for the spectrum of design from open residential flexibility to stringent industrial processes.

TABLE 1. Distilled tenets, Sustainability and Sociability.

Tenets	Sustainability	Sociability
Impact on Maslow's Hierarchy of Needs at base levels	Registers as a base component of Maslow's hierarchy of human needs as a way to provide safety to the civilization.	Registers on Maslow's Hierarchy of needs by facilitating social interaction through location adding to human sense of belonging.
Provide an overarching purpose	Offers a larger emergent group goal.	Offers a larger social purpose to the structure as a social lubricant.
Evoke individual emotions based on emergent goals through contribution	Provides opportunity for each individual to contribute.	Provides opportunity for each individual to interact with the others in the built environment.
Challenge creative minds	Challenges architects and designers to integrate technology.	Keeps designers focused on technology integrations for the overall purpose of the building.
Utility for marketing	Appeals to general marketing needs.	Appeals to marketing needs by creating a groundswell of communications in social media and drawing individuals to the building culture.

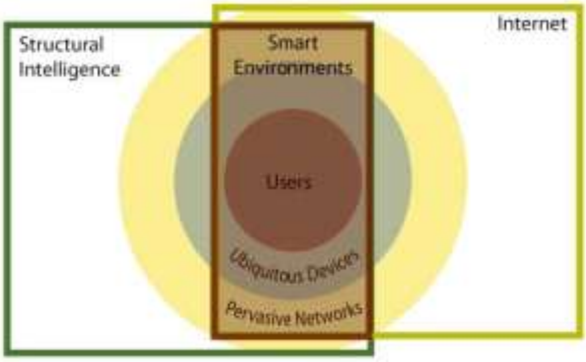

Figure 5. Layer of a sociable building.

3.3. DESIGNING WITH A SOCIABLE PURPOSE

Many cultures look differently at the same things with varying degrees of contrast. If Roman architecture is contrasted to Native American Pueblo architecture, one can see that the Romans made habitable space FIT INTO nature but the Native American Pueblo Indians saw habitable space AS nature (Benzel, K.F. 1998). The same is true with traditional architecture when contrasted to sociable architecture. Traditional architects consider the communications of the people, machines and culture to FIT INTO the building while a sociable architecture considers communications of the people, machines and culture AS the building. Hence, in sociable architecture the design process starts with the cultural and communicable purpose.

This holistic view of integrated technology design can be accomplished when not just a singular or component based approach is devised, but when a fully integrated approach seeks to solve a larger goal (Fox, M. & Kemp, M.2009). Architectural Sociability proposes to create a social purpose for each project as an overarching strategy integrated into the critical success factors of design planning. This social purpose serves as a design litmus test. The affordances of technology integrations can then be assessed to insure all sociable solutions facilitate the desired behavior toward a set of shared attitudes, values, goals, and practices that characterize an institution, organization, or group.

3.4. FACILITATING USER BEHAVIOR

The vast array of studies developed in the field of environmental psychology by scholars such as Daniel Stokols, Irwin Altman, Robert B. Bechtel, and Arzah Ts’erts’ man provide designers with models to facilitate behaviors by leveraging all the affordances the physical built environment. Architectural Sociability adds pervasive networks, structural intelligence, social networks and smart environments with embedded and ubiquitous devices to the list of "hidden dimensions" that influence psychological processes (2002) Each one of these flexible systems can be combined to create any set of solutions to be utilized to effect user behavior.

The 2009 Craigslist debacle over the erotic category is an example of how one of these sociable components can affect behavior in a location. The company was under pressure in several states to remove or change the category because it facilitated a culture of prostitution and crime in some cities. After considerable discourse, they changed the name of the category and limited the type of posts users could upload (Miller, C.C. 2010). This exemplifies how the affordance of a communication structure built into a trafficked social network can have an impact on local culture. Whether illegal or legal, Craigslist's information structure was supporting the growth of a culture. The change in the category may not have ended the social problem, but it no longer encouraged actions because Craigslist removed the opportunity to enact a certain behaviors.

The same theory can be applied to a business unit to inspire employees teat healthier. To accomplish this goal, a designer could create a widget on the office intranet-landing page listing healthy daily lunch specials in the local area. This category of information would generate a minor increase in the culture of health due to the number of employees visiting the intranet and the affordance of the presented information. Over time, this simple system might support behavioral change toward healthy foods. Additionally, if the designer chose to list location-based check-ins of those eating said food, it could facilitate communications in office around the subject, effectively enhancing a healthy food culture and affecting a broader behavioral pattern in the building. For this example to be considered an exercise of architectural sociability the designer must add a physical element to the overall experience. One could add a community kitchen inside the building and an offering for local vendors to rotate serving lunch specials at community tables. Employees could vote on the order of local vendors, thereby creating a community-programmed kitchen. This approach presents blended physical and digital physiological queues and incentives to spur shared values. This sociable system could be enhanced in a variety of ways, but the foundation is cemented for a sociocultural evolution within a business unit.

3.5. CREATING AND ENHANCING A BUILDING'S CULTURE THROUGH SOCIOCULTURAL MODELING

Sociocultural modeling is an umbrella term for theories used to describe how societies and cultures change over time (Atkinson, M. & Geddes, N.D. &Kanareykin, S. 2008). Theories such as social penetration and relational development allow designers to model, control and facilitate the path of relationship escalation and connection for building users within smart environments (Yum, Y.O. & Hara, K. 2005). Creating an ecosystem of support using all the components of Architectural Sociability combined with sociocultural modeling theories produce an integrated foundation to empower culture within a building.

Considering the path of development from a solitary individual to a group with culture requires building users to participate in a group network. In sociable structures we consider any general building user connected to or within the local smart environment a participant in the group network. Participation in the network depends on the depth of the relationship to the network and social norms. The initial instance is caused by result of the user is entering the location for a reason. This condition serves as the first basic requirement for group network growth. The probability of initial interaction of the user and the network depend on the number of spatially situated users, peers or friends interacting with the group and the relevance of building intelligence. (Backstrom, L. & Hutternlccher, D. & Xiangyang, L. & Kleinberg, J. 2006).

As users begin to network and form social groups, network growth increases. Network sustainability is a foundational aspect of developing building culture. This is dependent on a variety of social aspects, with purpose based social intelligence design as a focal point. Tom Erickson defines social intelligence as “the ways in which groups of people manage to produce coherent behavior directed towards individual or collective ends,” (Erickson, T. 2007). When choosing a culture as the final goal, strengthening the collective behavior is a primary task that can only be done through continuous connections through people. Connecting users with parallel sociable components, on common norms and values, develops an ability to magnify social intelligence and creates purpose based social groups. These focused groups with enduring patterns of social behavior can be guided in multiple ways through sociable processes which in turn lead to the net culture of a building (Mooney, L.A. & Knox, D. & Schacht, C. 2002).Ultimately, sociable building are using the triangulation of social computing to produce a unified culture.

One example of a sociable system design to enhance culture in a building would be adding music to the hallways of a residential building with a cultural purpose of developing a community around the opera. Residents would select their favorite works and podcasts and add them to a queue in the form of a digital residential jukebox. If a resident enjoyed a song or podcast, he could look on his mobile device and see the creator. He would also see an image of the resident who queued the media. The next time he saw that resident, he might comment on the composer, initiating a conversation.

The focus on the culture of opera would attract music lovers, performers and musicians. Residential buildings with a musical focus would be designed with a community space. Opportunities for small performances would be available through the building interface, including local shows dates and times. Area performers would always insure to inform the residents of the building of upcoming events due to the heavy saturation of patrons, providing tenets local contextual awareness.

These components combined with architecture build a strong identity for a building. The sociable ecosystem is a focused approach in both the digital and physical worlds. When utilizing social groups as a part of a sociable structure and considering the facilitation of communications a priority, abuilding emphasizes the network effect allowing for cumulative growth of community. This creates an extensive online social footprint for building, serving as an engine for community development. In the example of the operatic building, users who communicate in social networks would share their experiences in the building, drawing in others with the same interest. As the social group interacts face-to-face and continue to communicate through social networks, the digital footprint grows, as does the sociable network and culture (see figure 6).

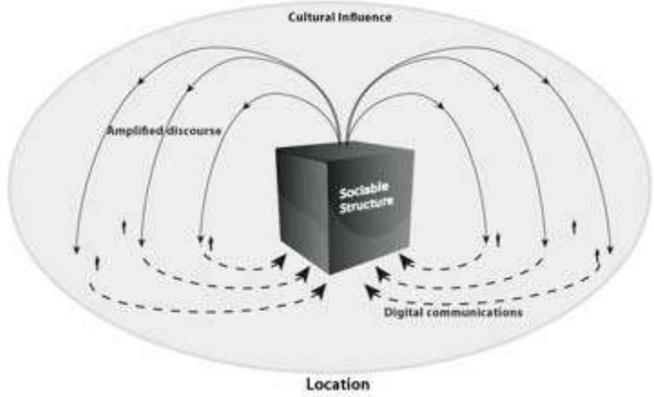

Figure 6. Communication amplification through sociable structures.

3.6. THE CREATIVE TECHNOLOGIST: ADDING A NEW MEMBER TO THE TEAM

Developing a sociable structure requires the integration of a creative technologist with specialization in sociable design. This team member should be integrated into the full cycle of the build process and work closely with the lead architect and client. The skillset required crosses a variety of disciplines with the ability to synthesize information to guide the process. Sociability can be applied to any built environment; therefore the number of solutions that can be designed by a creative technologist are equally as vast. Creative technologists should lead a team of interaction designers, interactive developers, environmental psychologists and experience designers to collaborate with architects.

4. The Impact of Architectural Sociability

The impact of a building can take many forms. It can generate traffic that has negative or positive effects on its surroundings. It can destroy the sense of space, or enhance it. The same is true for a sociable building as it extends architecture and parallels deeper into the community and culture space. It allows designers to impact behavior through its integrated communication structure. This has the potential to destroy the personality of the sociable structure or empower tithe new age of sociable architecture will require savvy designers who can understand the complete workings of social networks, manage the continuing complexity of technology and invent new interactive systems to facilitate community and culture.

4.1. BENEFITS OF ARCHITECTURAL SOCIABILITY

Architectural Sociability can benefit humanity in many ways. As current attempts to integrate technologies into new and existing architecture are slowly diffusing, architectural sociability allows a new approach to spur growth in smart environment implementation opportunities through a larger social solution to technology integrations. Socially based technology integrations will allow the general public more opportunities to experience smart environments, which increases adoption rates and understanding as new natural interface experiences arrive.

Socially, individuals in sociable buildings will see the growth of stronger relationships with the people around them based on common interests and through face-to-face interactions. This is still true in some of our contemporary remnants of physically based sociable architecture. Civic arenas, temples, theaters, shrines, libraries, and churches are all examples of spaces that facilitate belonging, but those comprise a small percentage of outbuildings. As we increase the ability for people to be social in all contexts, architecture will return to the epicenter of social connections. Sociable buildings also contribute to a user’s contextual awareness, adding to the richness of life. As sociable buildings develop focused around a variety of interests, architecture will assist the growth of worldwide diversity of culture by facilitating sociable micro-communities.

Economically, developers and firms that adopt prior to architectural sociability ubiquity will benefit from a large social media footprint and land grabs for the most valuable interests in society. One can see examples of this for real estate that is near a golf course or has a view. The same is true for fans of fashion, Ferraris or Wagner. Additionally, valuable industries such as healthcare can benefit greatly from adding sociable systems to their architecture. Sociability will act as a natural social media advertising campaign aligning with Experience Economics and drawing tenants, which will increase building value. Finally, buildings with architectural sociability will mitigate risk for developers and firms because of the flexibility of technology compared to physical expenses for developing buildings.

5. Conclusion

This paper aims to offer and encourage opportunities to develop sociable architecture by providing foundational information to assist researchers, designers and architects in the pursuit of technological integrations into structures. Ground breaking social, economic and scientific impact can be made using Architectural Sociability as an approach to create new opportunities to connect, collaborate and cooperate through architecture, social networks and technology. It is hoped that this material will inspire designers and architects to steer toward sociable buildings by adding a new kit-of-parts to their design methods and new specialists to their teams in this promising area.

References

AUGUSTO, J., NAKASHIMA, H., AGHAJAN, H., 2010. *Handbook of Ambient Intelligence and Smart Environments: Ambient Intelligence and Smart Environments: A State of the Art*, Springer US, p. 3-31.

ATKINSON, M., GEDDES, N.D., KANAREYKIN, S. 2008. *A Trade Study of Computable Social Models For Managing DIME Effects in a Population*, [Online] at: http://asinc.com/docs/MORS_Paper(1).pdf [Accessed 20 September 2011].

BACKSTROM, L., HUTTERNLUCHER, D., XIANGYANG, L., KLEINGBERG, J., 2006.Group Formation in Large Social Networks: Membership, Growth, and Evolution, IN:*KDD '06 Proceedings of the 12th ACM SIGKDD international conference on Knowledge discovery and data mining*.

BARLOW, J., BAYER, S., CURRY, R., 2005. Implementing complex innovations in fluid multi-stakeholder environments: experiences of 'telecare'. *Technovation,* 26:396–406.

BECHTEL, R.B., Ts'erts'man, A., 2002. *Handbook of Environmental Psychology*, 1st ed.,Wiley.

BENZEL, K.F., 1998. *The Room in Context: Design Beyond Boundaries*, McGraw-Hill, New York, New York.

BONNER, S., 2008 Assisted interactive dwelling house. In: *Proceedings of the 4th TIDE congress*. Finland: Helsinki.

CERNI, M, PENHAKER M., 2008. Rhythm Monitoring in Homecare Systems. In: *Proceedings of the 13th international conference on biomedical engineering*, December 3–6, Singapore p. 950-953.

CISCO, 2010a. *Visual Networking Index: Forecast and Methodology*, 2010-2015, [Online]at: http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360.pdf [Accessed 22 September 2011].

CISCO, 2010b. *Entering the Zetta byte Era*, [Online] at: http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/VNI_Hyperconnectivity_WP.pdf [Accessed 24 September 2011].

D'ESTR´EE STERK, T., 2009. Building a Better Tomorrow, In: Association for Computer Aided Design In Architecture: Acadia 09: reform.

DIANE, C. and SAJAL, D. 2004. *Smart environments: Technology, Protocols and Applications*, Wiley-Interscience.

ERICKSON, T. 2007. 'Social' systems: designing digital systems that support social intelligence, In: *Ai Society*, Volume: 23, Issue: 2, Publisher: Springer, Pages: 147-166.

FOX, M., KEMP, M., 2009. *Interactive Architecture*, New York, New York.

HORAN, T. A., 2000. *Digital Places*, *Building our city of bits*, Urban Land Institute.

IBM INSTITUTE FOR BUSINESS VALUE, 2010. *The Changing Face of Communication*, Somers, NY, [Online] at:

http://public.dhe.ibm.com/common/ssi/ecm/en/gbe03121usen/GBE03121USEN.PDF

[Accessed 30 September 2011].

JACOBUS, C. 2004. Telemedicine works. Now what? In: *Health Management Technology*,25(4):55–6.

JIN, Y., WANG, R., HUANG, H., SUN, L., 2010. *Wireless Sensor Network: Agent Oriented Architecture for ubiquitous computing in hyperspace*, p. 74-84, January 2010.

KREIR, L., 2011. The Architecture of Community, Island Press. LANG, J., AND MOLESKI, W., 2010. *Functionalism Revisited*, Ashgate, Surrey, England. MCGEE, M. 2010. By the Numbers: Twitter vs. Facebook Vs. Google Buzz. [Online] at:

http://searchengineland.com/by-the-numbers-twitter-vs-facebook-vs-google-buzz-36709 [Accessed 20 September 2011].

MCPHERSON, M., SMITH-LOVIN, L., BRASHEARS, M. E., 2006. American Sociological Review: Social Isolation in America: Changes in *Core Discussion Networks Over Two Decades*, Vol. 71, No. 3, pp. 353-375.

MILLER, C.C., 2010. *Craigslist Says It Has Shut Its Section for Sex Ads*, [Online] at: http://www.nytimes.com/2010/09/16/business/16craigslist.html [Accessed 1 November2011].

Mooney, L. A., Knox, D., & Schacht, C., *Understanding social problems* (2nd ed.)," Cincinnati, OH: Wadsworth. 2002.

NEILSEN, 2009. *Twitter Grows 1,444% Over Last Year; Time on Site Up 175%,* [Online] at:http://blog.nielsen.com/nielsenwire/nielsen-news/twitter-grows-1444-overlast-year-time¬on-site-up-175 [Accessed 30 September 2011].

RINGERUD, T., 2010. *The Truth About Online Dating*, [Online] at http://www.buzzfeed.com/awesomer/the-truth-about-online-dating/ [Accessed 25 September 2011].

TOFEL, K. C., 2010. *1 in 2 Americans will have Smartphones by Christmas 2011*. [Online]at: http://gigaom.com/2010/03/26/1-in-2-americans-will-have-a-smartphone-by¬christmas-2011/ [Accessed 19 September 2011].

U.S. GREEN BUILDING COUNCIL, 2010. *Policy Brief, Energy Performance in the LEED Rating System*, [Online] at; http://www.usgbc.org/ShowFile.aspx?DocumentID=8946[Accessed 23 September 2011].

YUM, Y.-O., and HARA, K., 2005. Computer-mediated relationship development: A cross-cultural comparison, In: *Journal of Computer-Mediated Communication*, 11(1), article 7.