BIOMIMETICS OF COMMUNICATION AND MEDIA

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ABSTRACT

Biomimetics of communication and media to design complex service systems is a relatively unexplored field. System biology's recent understanding of cellular communication may provide insights to design and understand complex communication service systems. Cell membranes are one such design example; they collectively behave as a *service membrane* providing the "front-stage" for communication between environment and internal, "back stage", processes. Customer service units can evolve to service membrane architectures to provide integrated communications pan-organizationally. Such evolution may be necessary for organizational survival and growth in an environment of convergent social media where customer experience emerges from dynamic interactions across multiple shareholders, moment by moment.

Keywords – media and communication, systems biology, organizational dynamics, molecular pathways, signalling

INTRODUCTION

The biomimetics of communication and media for the design of large-scale complex service systems is a relatively unexplored field. This paper provides a foundation for such research. We consider, as one example, the cell's membranes, shown in Figure 1, which serves a host of functions including modulating communication across the whole cell, one of nature's complex service systems.

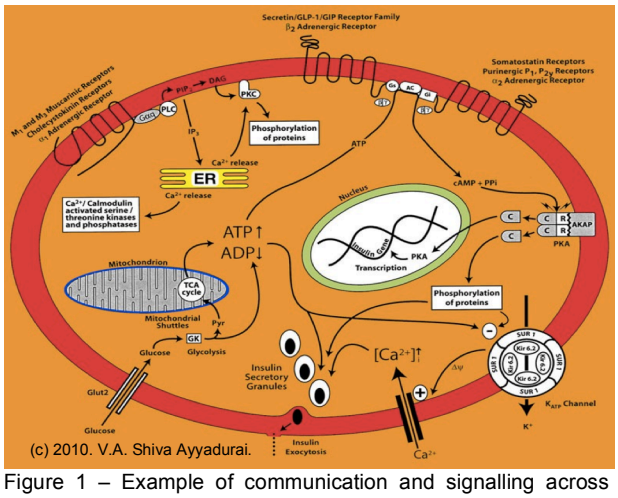

Figure 1 – Example of communication and signalling across multiple membranes of the cell.

As of 2009, nearly 80 per cent of the U.S. workforce was employed by the service industry, yet we understand very little about the design of large-scale service systems (Spohrer 2006). Such systems are pervasive in media, communications, health care, education, government, entertainment, hospitality and retail. The design principles for creating the infrastructure to support these complex systems are not well understood. Most of the emphasis in such design is primarily focused on the computing and information technology architectures (Katzan 2008). Given the complexity of these service systems, few paradigms exist to study and capture the range of complexity of such systems including the diverse stakeholders, communication models, and complex customer dynamics.

We argue that "Nature", the penultimate designer, over billions of years, has created *natural service systems*: plants, animals and ecosystems, and their many internal sub-systems. These systems are far more complex than our most complex human-made service systems. Service science may find value in the biomimetics of communication and media by understanding the core principles underlying the design of such natural service systems. The human cell, for example, is a complex interconnected system of systems that co-creates "value" moment by moment through dynamic interactions. As service science emerges and evolves, system biology's recent and on going discoveries of the organization and communication linkages across cellular sub-systems and molecular pathways may provide important insights for designing service systems.

In this paper, the service membrane, a model derived from cell membranes, is used to explore and provide an example of the biomimetics of communication and media in developing design principles for service systems. We

begin in the next section by providing a brief review of the history of biomimetics applied to the understanding of service systems. Section three presents a recurring and emergent theme, a zeitgeist of our times: the democratization of communication across multiple spatial and temporal scales, at the cellular and societal levels. Here, we present the findings of the post-genomic era as well as recent observations from the current convergent social media era. In section four, we review important features of the cell membranes, which surrounds, protects and modulates pan-cellular activity as a reflection of this zeitgeist. Section five follows with a review of customer service as an organization's "organelle" for tactical customer facing interaction, and its various challenges. Within the context of service systems, we introduce in section six the service membrane model, derived from cell membranes, as the next evolution for customer service to drive customer experience pan-organizationally.

2.0 BRIEF REVIEW OF BIOMIMETICS OF SERVICE SYSTEMS

Starting in ancient times, nearly 5,000 years ago, scientists known as Siddhars in India, observed and documented the mimicry of systems at various spatial and temporal scale. They described this phenomena "as above so below" (Rajasekaran and Narayana 2006). To the Greeks, the concept of biomimetics was not a foreign one, they attempted to build practical tools based on such concepts (Barthlott and Koch 2011). In modern times, Norbert Wiener proposed the concepts of cybernetics to create cybernetics organisms, "cyborgs", human-made systems derived from an understanding of the human body (Weiner 1948). Herbert Simon in his seminal work went on to describe how the understanding of biological life could serve to build a "sciences of the artificial" (Simon 1984). In the past two decades, biomimetics has been used to develop a range of valuable products (Bhushan 2009). These developments demonstrate the value of deriving and understanding natural design principles from observing biological phenomenon.

In the current literature, based on our understanding, there is little to no work on the biomimetics of communication and media for the design of complex service systems. At best, a few articles indirectly refer to the potential value of studying of biological systems. This paper, in this regard, appears to be the first one that directly offers a direction and motivation for the use of biomimetics in the study of complex service systems.

3.0 A NEW ZEITGEIST: BEYOND COMMAND-AND-CONTROL

Each era appears to be driven by a theme that pervades multiple aspects of observation. In our modern era, the democratization of communication, beyond a central command-and-control architecture, appears to be the zeitgeist. For the purpose of this article, two such observations across extremes of spatial and temporal organization are reviewed: at the cellular and societal levels. Recent developments in biology have yielded new understanding of cellular processes that has given way to a new field known as systems biology, which recognizes the importance of the *network of interconnections* across the cell, beyond just the DNA and nucleus. Similarly, at the societal level, a convergent social media has arisen that enables more individuals then ever before to participate in *social communication networks of dynamic interactions*, to drive new forms of relationships and value co-creation, not existent before. Across both these extremes, the central command-and-control models have become relatively diminished. What now emerges is a networked model, where interconnections give rise to new properties and functions that are poorly understood, and have little or no framework, from a socio-cultural, technology and management viewpoint to understand.

3.1 Emergence of systems biology: beyond the nucleus

In 2002, after more than a decade of research, the Human Genome Project (HGP), completed sequencing of human DNA. Two key assumptions drove the HGP:

- The difference between us and other animals was the complexity and number of genes in our DNA
- If we could map the entire human genome, then any aspect of life could be manipulated

These assumptions were based on the "central dogma" (Crick 1970), which asserted a central command-and-control model that went uni-directionally along these lines:

- DNA, within the nucleus, stores genetic information
- The genetic information provides instructions through a molecule called messenger RNA (mRNA) to create proteins
- Proteins are created outside of the nucleus of our cells
- Proteins, the molecular machines of our body, interact with each other proteins to orchestrate different molecular pathways to support function e.g. metabolism, synthesis, etc.

The irony of the HGP was it revealed a misplaced importance on DNA and the nucleus, and errors in the two key assumptions. During the early stages of the HGP, the expectation was that human DNA would have at least 500,000 to 1,000,000 genes. During the sequencing phase, the estimates changed to 100,000, then 50,000 then 30,000. Eventually it was revealed that human DNA has approximately 25,000 genes, the same number as an earthworm (International Human Genome Sequence Consortium 2004).

The HGP revealed the complexity of humans could not be explained by looking at DNA alone. The dance of proteins and molecules, known as *molecular pathways*, in the cytoplasm, elicit particular cellular functions. These cellular functions turn on and off genes, a central concept in the field of *epigenetics,* which has demonstrated that molecular pathways serve as the *epigenome* to provide *feedback* to control gene expressions (Bell, 2010). Systems biology has emerged from these post-genomic findings and aims to link all of the individual molecular pathways to understand all of life and how it interacts and interconnects. Systems biology hopes to provide a foundation of a new medicine that will be personalized, dynamic and interconnected. In this new post-genomic era, the cell is no longer visualized as the nucleus and DNA providing centralized command-and-control instructions, but they themselves are components, a part of a interconnected network of communications, where the cell's membranes may in fact be more pre-eminent.

3.2 Convergent social media: relationships as emergent networks

The theme of interconnection and network at the cellular level is mimicked in this new zeitgeist, at a much larger scale: on the societal level, in the increasing interconnection and network of human communication. The birth of the World Wide Web (WWW) in 1993 enabled masses to have access to the Internet, E-Mail and Chat. During the past nearly two decades, an explosion of new platforms, hardware and software, now enable billions to communicate with an unparalleled democratization. Where as in the pre-WWW era, where a few large communication providers could reach an audience, today the playing field has been levelled. Individuals and small organizations can now reach audiences and build relationships, one-on-one, in a mass customized manner as never before.

Central command-and-control of information, in the previous post-industrial age of broadcasting, has now given way to a world of narrowcasting, where individuals and organizations can perform targeted communication to groups across the globe. The communication paradigms have evolved to a convergent social media that includes web, e-mail, chat, social networks, "tweets", real-time video, blogs, and much more. Using this new and convergent social media, power has moved away from the center to the outer, and has become dispersed. Such power is enabling customers to become even greater participants in value co-creation, as well as empowering citizens to organize and elicit rights, as never before possible.

The zeitgeist of our times, being revealed at the cellular and societal level, is clearly beyond central command-and-control. DNA's hegemony at the cellular activity to solely determine our future, has given way to a molecular systems biology, where we are more than our DNA. A few communication networks or corporate headquarters no longer own neither the citizen nor customer. The fate and growth of organisms and organizations emerge out of the interconnections and networks, not from centralized control. This zeitgeist compels us to take a fresh look at old structures, small and large.

4.0 CELL MEMBRANES

Historically the cell membranes were considered a structure to envelop the cell and its organelles. However, systems biology, emerging form the post-genomic era, has revealed the importance of networks, and structures beyond the DNA and nucleus. Recent advances in high-throughput imaging continue to reveal detailed signalling and molecular mechanisms of intra- and inter-cellular communication. The importance of the cell membranes and their receptors represents one such revelation. The cell's membranes are not just a "bag" to hold the cell's components. They are critical to sensing events inside and outside of the cell, within the extra cellular matrix (ECM), across the cytoplasm, and performing with precision (and redundancy) signalling across a cascade of reactions spanning multiple organelles and molecular pathways to elicit specific responses.

In many ways, the membranes of the cell are like the cellular "internet" providing the connective tissue for networked communication. There is a growing recognition among systems biologists that the cell's membranes may be more important than the nuclear processes and DNA, with the latter being more of information storage, versus information control. Receptor structures, like two-sided antenna, which traverse cell membranes, from inside to outside, are the building blocks of this cellular internet. A cell's function and properties, therefore, emerges from the network of communication across all of its membranes, from ECM to cell to organelles to nucleus. No one system, including the nucleus, owns the network --- rather the playing field is levelled, and the network arising from these interconnections drives genetic expression, survival and growth.

5.0 CUSTOMER SERVICE

Customer service units of organizations were intended to manage customer contacts. This gave rise to the contact center. More recently, with the emergence of Customer Relationship Management (CRM), the attempt has been to convert contact centers to become organs for relationship management, to not only handle complaints, but to resolve them and upsell new products and services. While this intention has been based on driving customer retention and loyalty, increasing revenue per customer and higher profit, the reality of CRM has been primarily a focus in deploying hardware and software platforms that measure operational parameters, which do not holistically reflect the customer experience pan-organizationally.

Customer service units have still not moved beyond the operational focus of "closing tickets" expeditiously, relegated to receiving and rapidly handling complaints, typically isolated and treated as just a cost center guided by uni-dimensional performance measures such as units per hour (UPH) and service level agreements (SLA). While these measures are important to understanding operational performance, they appear neither to adequately capture nor to incentivize the customer experience and, moreover, fundamentally do not emphasize the importance of the Customer in the service interaction.

Most customer service units, moreover, have not evolved to the changing conditions of a convergent social media. The service aspects of most organizations, corporate or governmental, have yet to recognize that their customers and stakeholders, now hold immense power to determine the fate of their brands in real-time. The lack of recognition of this development combined with lack of demonstrable eminence given to customer service by senior executives is creating a disruptive force in customer experience globally. This disruption is creating intelligent groups of stakeholders, customers, partners, citizens and others, who are challenging directly the command-and-control of top-down driven customer service, which may no longer be tenable in a world of convergent social media

6.0 SERVICE MEMBRANE MODEL FOR CUSTOMER SERVICE

The cell's membranes provide a potential model for re-design of customer service systems, beyond just deploying technology solutions. In the emerging field of service science, some have referred to the "front-stage" and "back stage". The front stage represents the customer facing activities and the back stage represents the operational backroom activities to execute a customer's request. From this service systems perspective, the cell's membranes and its receptors serve as a *service membrane* or the "front-stage" between the external environment and the internal cellular or organelle processes, the "back stage". This service membrane provides important architectural features that customer service and contact center units may find relevant in the design of new and evolutionary *customer experiences.*

What are the relevant features of this service membrane? The service membrane exhibits the following architectural properties:

- Flexibility
- Adaptability
- Resilience
- Agility
- Omnipresence
- Intelligence
- Memory
- Networked
- Pervasive

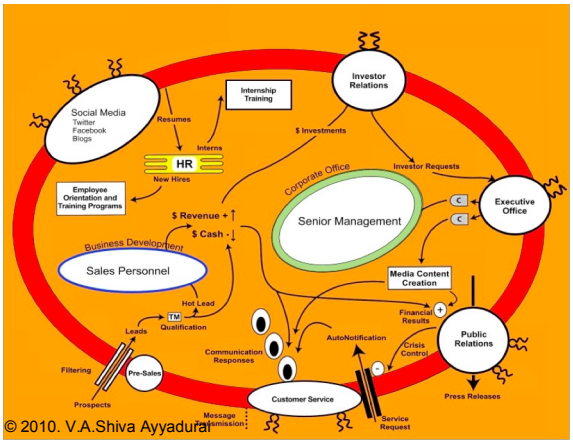

Figure 2 – Service membrane provides an interface across all organizational subsystems.

In this service membrane model, as shown in Figure 2, the intelligence and communication is pervasive across the multiple membranes of organizational communication. There are an emerging breed of organizations, currently few, which recognize that their success lies in expanding the nature of customer service *to truly include the customer* in all aspects of engagement, from sales to delivery, form design to development, from marketing to operational processes. These organizations are evolving to convert customer service contact centers at a fundamental level, beyond just deploying CRM systems. They are beginning to mimic a service membrane model incorporating many of the aforementioned features. The deployment of a growing set of such design features is providing such evolutionary organizations to co-create value in unimaginable ways. In this new model, the service membrane serves as the intelligent controller and interface that ensures enterprise-wide communication and modulates the myriad of inter and intra- organizational processes.

7.0 CONCLUSIONS

This paper has provided an initial foundation for exploring the value of biomimetics of communication and media for designing service systems. We have explored cell membranes to provide a new model for evolving customer service, in a zeitgeist of democratized and networked communication, beyond command-and-control models. We believe that the further development of this foundation will yield other promising insights for service system design.

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