

Connectivity

Inaugural lecture

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- Introductory remarks -

When I started thinking about this lecture I was guided by the Academic Vice-Principal's suggestion that I talk about my current research and area of specialisation. This encouraged me to think more deeply about the thread that has run through my research over the years and the theme that I have recently been considering in some detail. The theme is connectivity. One way of looking at our world, understanding it, perhaps even resolving some of its challenges and searching for its hidden opportunities, is to look at it through the prism of connectivity.

The idea of 'connectivity' is not new. The word was first recorded in the 1890's but it remained peripheral until an earlier iteration of technological communication, during the development of analogue telephony. It entered mainstream discourse with the dawn of the digital age, and now almost anyone with an interest in communication, and certainly digital communication, contends with the concept in some form or other.

'Connectivity' is derived from the word 'connect'. As a scientific construct it is most specific in its applications outside of communication: in medicine it refers to neurological association; in graph theory, to connections between points; and in topography, to linkages between geographical places. But today 'connectivity' is most widely used in the context of communication technology, in the linkages between electronics, computers, computer systems and the people who use them. It has a very specific association with communication technology, but I also believe that the term is an excellent proxy for the essential element within all communication that refers to the complex phenomenon of being connected, making and maintaining that connection. I want to explore the position of this construct in our theory, in the physical, psychological and sociological dimensions of communication, and I want to conclude with a brief discussion of some applications of the construct in the spheres of development and competitive advantage.

I have come to accept that the word 'connectivity' is slightly illogical. The core of the word is simple enough – 'connect' – to join together, but the double suffixes 'ive' and 'ity' make the word more complex. 'Connective' would mean 'capable of connection'; but then 'connectivity' could mean 'the condition of being capable of connection', or 'connected status', or 'the ability to connect'. Maybe I've even missed some other meanings. So, great, we have a term that can mean at least two or three things, making it about as imperfect a scientific construct as you can get. It is operationally *non-specific*. But whatever we think of its core, constitution or logic, 'connectivity' has become such a fulcrum in science, business and governance, that it doesn't need our approval, having become as concrete a concept in today's world as concepts such as 'food', 'sport', 'Nkandla' or 'tax'.

'Connectivity' is most commonly used in one of two ways: as the state of being connected; and as the ability to make or maintain a connection between two or more points. Connectivity is a Boolean construct. It follows a yes/no, binary, on/off logic. You are either connected or you are not connected. If you are 'yes', 'on', 'connected', then connectivity has qualitative and quantitative dimensions. You could have a lot or a little connectivity; the quality of that connectivity could be really good or quite poor. Connectivity can be seen from the atomistic perspective of the individual in his or her connected world; or it can be seen from the holistic perspective of the connected world – the network, community, company or country.

So let's take this word, this imperfect, multi-dimensional concept, and locate it within our discipline. We could do this from any of the fields that constitute the discipline of Communication but I want to approach it from a particular perspective because of its dual relationship with connectivity: it is the original theoretical source of technological connectivity, and it is also one way of understanding connectivity.

We need to return to Mr Boole. After the publication of his system of binary logic in 1847, George Boole's work remained largely in the theoretical realm, with few applications. But 101 years later a graduate student from MIT, employed by Bell Laboratories, made the association between Boole's work, the work of Norbert Wiener that later led to the formulation of cybernetics, and the practical world of electronic circuits. In the process he initiated the application of binary code to computation and telephony. That person was Claude Shannon, the founder of information theory and father of the information age. His 1948 paper titled 'A mathematical theory of communication' (Shannon 1948), and the subsequent book of the same title co-written with Warren Weaver, established his theory as one of the foundations of the academic discipline of Communication Science. Despite the far broader vision of communication that now exists in the discipline, Shannon's general communication system, with its information source, receiver, message and noise, has left an indelible impression on every student who has ever studied Communication. I suspect it's the only thing that most remember after graduation. The ultimate impact of Shannon's work has, however, stretched far beyond the confines of a single academic discipline. It is the foundation of the computer technology that drives and maintains so much of our society and it has also offered opportunity and research scope to academics, inventors and entrepreneurs of every hue.

The logical precondition for the mathematical theory is the existence of two or more entities in relation to each other. If there is only one party, no communication can be spoken of. If there is no relationship between parties, no communication can be spoken of, and all the electronics, fibre optics and message redundancies that are the functions of communication become irrelevant. There is no reason for the

existence of any of the theory or technology in the absence of two or more entities that are in some way related to each other.

For communication to exist, connectivity has to exist. This logical condition exists in Shannon's theory and in every mechanistic model of communication that followed, including those of Berlo (1960), Schramm (1954) and Barnlund (2008), to name a few of the most prominent. The multiplicity of actors and the essential precondition of connectivity are not, however, limited to the mechanistic view of communication.

Consider, for example, a theoretical approach to communication with an entirely different proposition. Drawing on the preceding work of Lyotard (1984), Wittgenstein (1988), Mattelart (1994), Farb (1974) and McLuhan (1969), Stephan Sonderling (2013) suggests that communication is better conceptualised as war by other means, as *agonia*, the Greek word for struggle, as fighting, or at least as competitive play. This proposition is in complete contrast to the dominant perspective of communication as alignment, collaboration, agreement, sharing of meaning or any other similes of consensus that almost entirely constitute the common definition of communication – what Sonderling describes as the hegemonic bias. However, even from this perspective communication departs from the original premise of connectivity. Reflecting on Derrida's view that 'there is war only after the opening of discourse' (Derrida 2001:145), Sonderling points to the precondition of connectivity in the manifestation of communication and ultimately in the discord inherent in communication.

Connectivity is fundamental to most communication theories, irrespective of their origins. Robert Craig of the International Communication Association conceptualises communication theory as a field of traditions, and we see that every one of these traditions has connectivity at its core (Craig 2006). Critical approaches to communication constitute the thoughts and actions that challenge assumptions which are *systemically imposed* in the interest of power. In semiology, communication is mediation *between individuals* through signs; in phenomenology, the personal experience of our *interactions*; in rhetoric it is *mediation* by discourse. The cybernetic tradition proposes the regulation and control of information within a broader system that comprises *many others*; socio-psychological and socio-cultural traditions consider communication as *interaction between individuals* in the formulation and reformulation of social order. If connectivity is extracted from the conditions of any of these theoretical traditions, their logic is entirely undermined.

You have to be connected to communicate; but once connected there is still the question of the quality and quantity of connectivity. It is in these terms that our individual, communal, spiritual and material quality of life is affected.

In order to look at connectivity atomistically, from the perspective of the individual, let me take you on a short detour into the world of stress. Poulin and his colleagues

recently found that people who have experiences of great stress have a 30% greater chance of mortality unless they simultaneously provide help to others, in which case their chances of dying are no greater than anyone else's (Poulin, Brown, Dillard & Smith 2013). In last year's landmark study by Keller and others, the researchers found that people who experience stress are more likely to die than the rest of the population, but only if they perceive their stress as harmful (Keller, Litzelman, Wisk, Maddox, Cheng, Creswell & Witt 2012). Those who experience stress, but believe that the body's stress response helps them deal with their difficulties, are no more likely to die than people with little or no stress. Physiologically they still experience symptoms like a pounding heart, but in contrast to those who believe that stress is harmful, they have far less vascular constriction and may even experience a sense of euphoria. If you believe that stress is on your side, you are more able to cope with life's difficulties, and you may even live longer than people who fear stress and avoid anything that results in stress.

I'm not telling you this to share insights into a longer life, but rather to illuminate the fascinating physiological foundation and effect of connectivity. When you experience stress the pituitary gland produces oxytocin, a hormone with interesting effects. Its neural effect is to stimulate social instincts by enhancing empathy, the willingness to help other people, and the desire for physical relationships. The effect is to motivate you to give and seek support in your social environment and to surround yourself with people who care about you. Oxytocin also has a cardiovascular effect as an anti-inflammatory agent and stimulant to those of the body's receptors that regenerate heart cells. Oxytocin is generated when social affiliation is required, but it is also generated by social affiliation – it is released, for example, when people embrace (McGonigal 2013). So we see that there is a very sound *physiological* foundation to human connectivity. Human beings are physically and neurologically primed to connect with others. Caring, contact and connectivity create resilience in life which in turn results in caring, contact and connectivity. So the decision to connect with others has a physiological foundation and physiological benefits – the human body is hot-wired for connectivity. Viktor Frankel confirms this from his psychoanalytical perspective in logotherapy: he says that '...success, like happiness... [only ensues] ...as the unintended side effect of one's personal dedication to a cause greater than oneself or as the by-product of one's surrender to a person other than oneself' (Frankel 1984: 17). Atomistically, as individual human beings we are genetically predisposed to connectivity.

And holistically? As human beings in a collective, as society, we are also hot-wired for connectivity. An open society that is connected, and well connected, is far better off than a society that is unconnected or poorly connected. We function far better in a world in which we can openly associate with others through patterns of connectivity that are known or are at least knowable, and which function well, than we are in a world of barriers and limitations, where economic, knowledge and information access is restricted, either through ignorance or exclusion. People acting in concert are

capable of far more than people acting alone, and people acting in concert can do so rather better or rather worse.

The basis for this is suggested in what we know of complex systems – of which social systems are one example. When we think of society or parts of society, we tend to circumscribe the scope of what we think about, often with a name: ‘the West’ or ‘South Africa’, the ‘PAC’, ‘Volkswagen’, ‘Unisa’, or even ‘my family’. We see these entities as wholes, separated and different in some way from everything else. And the way that we think about these social entities is crucial to their eventual course, their success and outcomes.

We can willingly or unwillingly think of these entities as closed systems, sealed off from their environments; safe in their isolation and in our ability to control them – often with the hope of achieving a greater good. In reality the closest examples of closed systems exist only in the physical world. They are governed by the second law of thermodynamics, tending towards maximum entropy, or disorder, and their natural state is one of equilibrium. Even if disturbed, they eventually return to the same state. Heat applied to water creates steam but when the temperature drops the steam turns into water again. Social systems are firstly not physical systems, and they are not closed, but in our minds we may often think of social systems as closed. When we treat them as closed systems, they tend to take on the characteristics of closed systems – they tend towards maximum disorder, eventually work cannot be done in them, their only real energy exists in their initial conditions – very often in their founders and in the circumstances of their founders – and eventually they die off. Think of social systems that no longer exist – political parties, businesses, even countries and whole societies. With many of these you will find that the cause of their demise was that they were conceptualised and governed as if they were closed systems, or rather, they were eventually conceptualised and governed as closed systems. Think of Imperial China, Lehman Brothers, Trans World Airlines, the National Party, and the empire that Shelley describes in his poem ‘Ozymandias’:

I met a traveller from an antique land
Who said: Two vast and trunkless legs of stone
Stand in the desert...

And further on Shelley continues...

And on the [statue’s] pedestal these words appear:
"My name is Ozymandias, king of kings:
Look on my works, ye Mighty, and despair!"
Nothing beside remains. Round the decay
Of that colossal wreck, boundless and bare
The lone and level sands stretch far away.

(Shelley 2014)

We can also think of social systems as open to their environments, where what goes on inside is affected by what happens outside, but where the system always retains its original form, more or less. From this perspective we think that if we manage the system's exchange with the environment we can manage its wellbeing into perpetuity. Such systems do exist, but as biological organisms, not social systems. Biological organisms are characterised by self-regulation and they can temporarily counter the effect of entropy. They differ from physical systems in that what they become is not determined by their initial conditions. A tree could become a very big tree and live very long or it could be small and short lived, depending on its soil, water and light. If we think of a social system as an open, biological, homeostatic entity, it will certainly be more able to survive, but only in a set of unchanging conditions. Inevitably the social system, if conceptualised as a homeostatic entity, will behave like a biological system and die off.

Thirdly, we can think of social systems as transformatory, able to evolve into different forms. Phylogenetic, psychological and sociocultural systems are actual examples of such systems, uniquely capable of morphogenesis, the ability to transform into something that they were not originally. Think of the evolution of species or the dramatic changes in the nature of human work over the past centuries. Nokia started off as a lumber company and transformed into a tech company. If we conceptualise our social systems as morphogenetic, we probably set a framework for thinking about and managing these systems in the best possible way.

A key characteristic of such systems is their complex holism. Famously, Hall and Fagan (1968) noted that complex systems display holistic properties that are more than the sum of their parts, and Berrien (1968) described these added properties as the 'emergent characteristics' of complex systems. An essential ingredient of morphogenetic systems is connectivity and the product of connectivity in growth, evolution and the ability to adapt to, or even thrive, through abrupt and drastic changes. Take, as an illustration of this the process of artificial intelligence in a Markovian machine. The machine maintains a steady state while searching for alternative behaviours that will take it closer to its goal state. It does so by analysing feedback from every one of its actions and selecting the best option for its initial activities; and once having established these, it searches for alternative behaviours at the next level in the operational hierarchy. This is only possible where information on the result of action is sufficient, and such information can only be conveyed through connected networks.

The Markovian machine may only be an analogy, but it is not dissimilar to what occurs at a far higher level of complexity in social systems. Through a process of learning, repetition and refinement, what initially appears difficult or complex becomes automatic and simple. Compare South Africa's logistics and transport fatalities with South Korea's, which is very similar in terms of population size, and with Switzerland's, which has high levels of efficiency and safety. In 2009/2010

transportation consumed 13.5% of GDP in South Africa, 12.5% in South Korea, and 6.5% in Switzerland (Rantsila & Ojala 2012); South Africa's fatalities per 100,000 inhabitants in 2013 reached 31.9, South Korea, 14.1, and Switzerland 4.3 (WHO 2013). Factors affecting these figures are certainly economic, but they are related more closely to the knowledge, efficiency and operational competence of road users, roads agencies, law enforcement agencies and government administrators. The connectivity of its players, and certainly the quality of connectivity with the better of its players, with the best examples of transport efficiency and safety, is the key to better and safer transport. Connectivity is a key to saving lives and costs, and is one way of looking at ways for us to improve. This is already evident in South Africa's costs of transportation – we spent as much as 15% of GDP on transport just a few years earlier, so there is evidence of improvement through the application of best practice, learning and connectivity. This is the same in all aspects of our social existence – the success of our sports teams, levels of education, economic success, social inclusion or reduction in crime.

In the real world of human endeavour, why do we find that the product of connectivity in information-rich environments is far more productive than it is in environments with little information? Why is it that the family next door to me when I grew up, with the father a doctor, had ten children of whom one became a pharmacist, one a priest, and the others all doctors? Why did this one family produce the number of doctors that were available per 100,000 people throughout sub-Saharan Africa by the time they had all graduated in the 1980's? The reason is connectivity. The information, motivation and the means; the environment, ease of access to the best possible support, and a cohort of at least nine other people in very close proximity – in other words, the perfect motivation and linkages to becoming doctors. Compare this to the conditions of any single individual in Burkino Faso during this time. Not only was there practically no support to enter the medical profession, there was hardly any professional, institutional or educational infrastructure to speak of, so in that country there were fewer than 2 physicians per 100,000 people from 1960 up to the early 1980's (Liese & Dussault 2004). Would Nigeria's Aliko Dangote have become Africa's wealthiest man if he had not been born into a family involved in commerce, and had he not had any financial and educational connections? Would Elon Musk have achieved the same level of success if he had remained in South Africa? He may have been successful but it is improbable that he would have sent rockets to space or assisted us with our online payments. And why would Google's founder, Larry Page, say that he would rather leave his money to Elon Musk than to charity? (Page 2014). Well, he believes that the collective, philanthropic results on society would be magnified by doing so, rather than being diminished by the dissipation of resources that don't increase the knowledge, capacity, individual abilities or the connectivity of its recipients. Perhaps a bit of an illusion, but certainly an interesting proposition.

Before moving on let me point to the role of connectivity in the classic case of Singapore and resource-rich Gabon, two countries that had the same GDP per capita levels in 1950. Over time first the one and then the other had higher GDP per capita until 1979, after which Singapore showed exponential growth, reaching \$35,882 GDP per capita by 2013, while Gabon languishes at \$7,261 (IHME 2014). What is the difference? Gabon has had a deeply flawed political system; oil revenue, which is in a way a free gift, accounts for over 50% of GDP and oil revenue is state controlled. Corruption is rife; there is great income inequality and high unemployment. Because of its oil resources, economic growth has been good, but it leaves the economy highly vulnerable to external shocks. At independence Gabon took the comparatively easy route of many resource-rich countries, converting income into consumption with little capital investment, following populist policies, hardly pursuing its tentative links to attract or develop human know-how, infrastructure or capital. Its affluence was driven by external demand, with little initiative to drive demand in any area other than its resources, and today it is in exactly the same position, almost entirely dependent on external demand for its resources. The country is a rent collector, collecting rent on a diminishing set of resources in the ground.

Singapore, having limited natural resources but an established foundation as a trade hub, followed a single minded policy of capital investment, human and infrastructure development, with a focus on education and industry. The result is an integrated society with high and open connectivity internally amongst its diverse indigenous and immigrant populations, and an emphasis on equal rights in a meritocratic society. This emphasis on equality was one of the reasons for its 1965 break from Malaysia, which demanded special rights for indigenous Malays. There is high international connectivity. It is one of the world's biggest financial centres with one of the world's busiest airports and a highly diversified economy. It is a global centre of trade, ranks amongst the world's highest in education, healthcare, government transparency and economic competitiveness, and it is also one of the world's least corrupt countries. There is high income inequality in Singapore, but of the kind that any country would wish for. The difference is between the one-in-five families with a millionaire and the rest of the predominantly employed and economically stable population.

If national prosperity is the measure of comparison, Singapore has done better than Gabon. The key difference between the two states is that Singapore possesses a high degree of *productive knowledge*, Gabon a lot less. Economists define productive knowledge as the knowledge that is necessary to produce the complex products and services that are most in demand in today's world. The productive knowledge of the world is now well mapped in work such as that of Hausmann, Hidalgo, Bustos, Coscia, Simoes and Yildirim (2013). It is possible to directly compare the productive knowledge of Singapore, Gabon, South Africa, Nigeria, China, Germany or any country, and to do so in immense detail. Productive knowledge is embedded in society – it is not individual knowledge – and it exists

amongst clusters of individuals who together hold the spectrum of specialised knowledge that makes it possible to source, build and sell a computer, run a nuclear power facility, invent antibiotics, ensure that water runs from your tap, or deliver bread, day after day, to the supermarket closest to you. The world's most prosperous societies are its smartest societies – and these are smart not because they have a few brilliant people in them, but because of the diversity of know-how amongst their populations and their ability to integrate their know-how in the production of the world's needs. For smart clusters to form there have to be sufficient people with know-how who constantly interact, form groups, break up and re-group until they find and create the groups, companies and organisations that can supply the things that the world wants. Productive knowledge is evolutionary; it takes time to form, and only flourishes in enabling social and political environments. That is why Silicon Valley is still the world's hotspot of digital innovation, why London remains the world's financial capital, and why it is so difficult to replicate them elsewhere in the world. The key to prosperity is connectivity; connectivity of a particular quantity, and connectivity of a particular quality.

Two points can be made from this discussion. First, connectivity is a useful construct for assessing and understanding social systems, and second, it is instrumental in social development and the generation of competitive advantage. To illustrate I'd like to give one example of the application of the metaphor of connectivity in practice. In collaboration with researchers from Saunder Business School and UCT we assess the inclusive growth potential of major African cities. Inclusive growth is important in developing societies where wealth often becomes concentrated in the hands of elites, leading to social and economic disparity. Inclusive growth leads to increased income parity and the spread of wealth more evenly through society. Cities are important because they are the nodes of development in growing economies – you will have noticed the emphasis given by China to the rapid development of integrated cities. Work, education, economic means and know-how are concentrated in cities. Utilising a metamorphic systems model of connectivity, we look at rates of urbanization, governance, economic well-being, business friendliness, inbound travel, infrastructure, digital connectivity and development. You will notice that these are variables of connectivity, the regulation of connectivity, or the enhancement of connectivity. For cities to become places of greater connectivity, they have to offer a competitive advantage over other cities and they have to be sufficiently appealing to draw know-how and investment. It is now viable for city governments to isolate the variables identified in this research as specific areas of improvement and development, and to utilise these as benchmarks for improvement.

In a highly competitive world Africa's most promising zones of inclusive growth – its cities – are collectively at a disadvantage when assessed against the connectedness of cities elsewhere in the world. It is essential that Africa's cities build connectivity, block-by-block, as its Asian counterparts have systematically done since 1945. A handful of African cities, with Accra at the fore, are slowly achieving this. Despite

their disadvantages, Africa's cities may also have advantages. Kenya's M-PESA mobile payment system would have been impossible to implement in the regulatory environments of more developed economies. Its introduction has reduced transaction costs and encouraged business amongst people who may not have been in a position to transact before. Of course M-PESA's introduction has threatened the established banking sector but on balance, its introduction has acted as an enormous stimulus to Kenya's economy. This suggests that there are radical alternatives to the accepted way of doing things in the urban markets of Africa. There is a pent-up economic and social tension in Africa that is widely held in check by constraints on connectivity. As the Kenyan example suggests there is great possibility for spontaneous, natural growth in urban regions simply by eliminating the entrenched constraints that benefit only a few, never mind the possibilities of innovation and invention. Shiue (2005) estimates that the elimination of borders, tariffs and customs in Germany between 1825 and 1855 resulted in a reduction in the cost per unit of trade equivalent to an additional 130 kilometres of transport costs. Engel and Rogers (1996) suggest that in the 1990's the border between Canada and the USA added the same volatility to prices as the inclusion of an additional 2,848 kilometers of transport in either of these countries. Imagine the effect on trade, education and social interaction in Africa if its broadband, tariff and border inefficiencies could be eliminated and its connectivity enhanced. One way of achieving this is to focus on connectivity, the elimination of bottlenecks and hurdles, and the establishment of collaboration across regions. Trevor Manuel was involved in exactly this over the past few years and I hope that the project will not be abandoned in the years ahead.

In conclusion, connectivity is an established construct in the world of digital communication. It is also a construct with great heuristic promise in the broader communication discipline. It offers a unique perspective of communication theory. It has great scope as a variable of assessment, as an instrument of social development and in the generation of competitive advantage in a range of social systems – from companies to cities to countries.

- Concluding remarks and thanks -

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