

Ubiquitous electronically mediated informing and sensemaking in organisations

by
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OPSOMMING

Hierdie studie ondersoek die impak tussen singewing soos voorgestel deur Karl Weick en sy samewerkers en alomteenwoordige elektronies-gemedieerde informering (AEGI) met ander woorde, die *aandag-effektiewe* beskikbaarheid van data, informasie en elektroniese rekenaars. Wanneer die teorie oor singewing nie die potensiële rol van AEGI in singewing heeltemal ignoreer nie, word die rol van AEGI as 'n hindernis beskou. Hierdie negatiewe siening van elektroniese rekenaartegnologie, gekenmerk as “spreadsheets on screens”, was wel aanvaarbaar in 1985, maar hierdie onveranderde posisie rakende elektroniese rekenaartegnologie se transformasie na AEGI raak al hoe meer onverdedigbaar. 'n Interpretasie gebaseer op die aandag-effektiewe aspek van Mark Weiser se visie vir alomteenwoordige informasie tegnologie, word ingespan as die fondasie om die vooruitgang vanaf 1985 na alomteenwoordige informasie tegnologie te ondersoek, en die implikasies wat dit vir singewing inhou te hersien. Alomteenwoordige informasie tegnologie (insluitend AEGI) het nog 'n lang pad om te gaan, met *akkuraatheid* van spraak-herkenning as die grootste struikelblok. Tog is die vooruitgang merkwaardig. Die studie fokus op vyf AEGI tegnologieë binne 'n *bepaalde deel van die samelewing, naamlik organisasies* om die impak op bogenoemde te evalueer: *persoonlike herinneringe, virtuele teenwoordigheid, aangevulde werklikheid, spraak-herkenning* en *organisasoriese geheue*.

Singewing verskaf *betekenis* aan ervaring. Dis 'n *sosiale* en *deurlopende* proses wat in *retrospek* uitgevoer word, *kongruensie* met 'n persoon se *identiteit* vereis, 'n *omgewing tot stand bring* wat verder singewing in staat stel, en fokus op waarneming en uitbreiding van *leidrade* tot die stadium bereik word waar die singewing wat vermag is, *geloofwaardig* genoeg is om tot aksie oor te gaan. Bo en behalwe die sewe proses eienskappe bestaan die *kern* van singewingsteorie uit *woorde, sinne, woordeskatgroepe* en hul *meganika*. Om betekenis (d.w.s. sin) te maak, moet ten minste een leidraad aan een raamwerk gekoppel word. Raamwerke het die neiging om uit woordeskatgroepe te bestaan wat ervarings van die verlede opsom, terwyl leidrade die neiging het om na vore te kom vanuit huidige ervaring.

Die studie steun op vier nuwe idees. Eerstens word *aandag* as 'n skaars bron beskou in 'n ekonomiese konteks. As 'n optrede van aandagskenking, word singewing gesien as 'n ekonomiese proses waar die *einddoel* (die sin of kennis wat gemaak word) bereik word met beperkte *middele* of hulpbronne (die tyd en die vermoë om aandag te skenk). Dus sal mense aandag skenk (d.w.s. belê) om sin te maak van iets slegs tot op 'n *punt van*

geloofwaardigheid, waar die verwagte koste om meer aandag te skenk die verwagte voordeel om dit te doen, oorskry. Soos met ander ekonomiese prosesse, mag die produktiwiteit van organisatoriese singewing vermeerder met die toepaslike organisatoriese strukture en prosedures, menslike vaardighede, ingesteldheid en van kardinale belang, *enige tegnologie wat die vereiste vir aandag wat skaars is, verminder* (d.w.s. AEGI tegnologieë). Tweedens, word die stilswe van die singewingsteorie rakende die gevolge van singewing aangespreek deur die nuwe konsep van *riskante werklikheid* – daardie situasies waar die gaping tussen die sin wat gemaak is en die werklikheid die singewer se welvaart wesenlik kan beïnvloed. Derdens, word die *kwaliteit van singewing*, naamlik dit wat die grootte van sulke gapings bepaal dan ook in hierdie studie aangespreek. Vierdens word daar geargumenteer dat *woorde met beelde aangevul kan word* as boublokke vir singewing, beide om sin te maak van “life’s pure duration” en van kommunikasie deur middel van tekeninge, foto’s, video-materiaal, animasie en aangevulde werklikheid. Daar word geargumenteer dat anders as elektroniese informasie tegnologie in 1985, die huidige en toekomstige AEGI se inherente aandag-effektiwiteit en audio-visuele vermoë, hoër kwaliteit van singewing moontlik maak, wat van groot belang is in riskante werklikheidsituasies. Bogenoemde het dan ook ’n positiewe impak op al sewe eienskappe van singewing, waarvan *geloofwaardigheid, retrospek, leidrade en deurlopenheid* die grootste is. Dit beteken dus dat die mees aandag-effektiewe alomteenwoordige elektronies-gemedieerde informasie tegnologieë die mees suksesvolle in die mark van die toekoms behoort te wees.

SUMMARY

This study investigates the impact between sensemaking as proposed by Karl Weick and his associates' school of thought, and ubiquitous electronically mediated informing (UEMI) which is the *attention-efficient* availability of data, information and electronic computing. At best, Weickian sensemaking theory ignores the potential role of UEMI in sensemaking and at worst, it regards it as more of a hindrance than a help. This dim view of electronic information technology (IT), typified as "spreadsheets on screens", had merit when first expressed in 1985, but its unchanged position notwithstanding IT's transformation towards UEMI is increasingly untenable. An interpretation based on the attention-efficiency aspect of Mark Weiser's vision of ubiquitous computing is harnessed as the foundation to review the progress since 1985 towards true ubiquitous computing and to analyse its increasing impact on sensemaking. Ubiquitous computing (which includes UEMI) still has a long way to go with the *accuracy* of speech recognition a notable obstacle. Yet, progress has been remarkable, and this thesis employs five current UEMI technologies *within a limited aspect of society, namely organisations* to evaluate this impact: *personal memories, virtual presence, augmented reality, speech recognition and organisational memories*.

Sensemaking is that which gives *meaning* to experience. It is a *social* and *on-going* process made in *retrospect*, which seeks congruence with one's *identity*, is *enactive* of an environment which enables further sensemaking, and focuses on the noticing and embellishment of *cues* to the point where the sense which has been made, is *plausible* enough to act upon. In addition to these seven process properties sensemaking theory also comprises its *substance* which involves *words, sentences, vocabularies* and their *mechanics*. To make meaning (i.e. sense) a minimum of one cue needs to be linked to one frame. Frames tend to be vocabularies that summarise past experience, whilst cues tend to emerge from current experience.

This study introduces four notions. Firstly, *attention* is viewed as a scarce resource in an economic sense. As an act of attending, sensemaking is viewed as an economic process in which *ends* (the sense or knowledge made) are achieved with limited *means* (time and attending capability). Therefore people will pay (i.e. invest) attention to make sense of something only up to a *point of plausibility* where the perceived cost of paying more attention exceeds the expected benefit of doing so. In line with other economic processes, the productivity of organisational sensemaking may be increased with appropriate organisational

structures and procedures, human skills, mindsets and most importantly, *any technology which lowers the requirements for scarce attention* (i.e. UEMI technologies). Secondly, sensemaking theory's silence on the consequences of sensemaking is addressed by introducing the notions of *risky reality*, i.e. those situations where gaps between sensemaking and reality may impact the sensemaker's welfare or survival. Thirdly, the *quality of sensemaking*, which determines the size of those gaps, is also addressed. Fourthly, this thesis proposes *augmenting* words as the building blocks of sensemaking with imagery such as drawings, photos, video footage, animation and augmented reality, both for making sense out of life's pure duration and for communication. Unlike electronic IT in 1985, current and future UEMI's inherent attention-efficiency and audio-visual capability enables a higher quality of sensemaking, which is of the essence in situations of risky reality. In addition, UEMI positively impacts all seven process properties of sensemaking, with the highest impact on the properties of *plausibility*, *retrospect*, *cues* and *on-going*. The impact of sensemaking on UEMI means that the most attention-efficient UEMI technologies will be the most successful in the market.

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Chapter 1

Introduction

1 Sensemaking and knowledge in context

Industrial revolutions are so named because they represent notable increases in both economic growth and (eventually) in people's standard of living on a mass scale. They are enabled by inventions¹ which go on to become successful commercial innovations² and which increase productivity and income per capita. Heilbroner³ puts it as follows:

- “If we are to enjoy a greater material well-being, generally speaking, we must produce more. This is particularly true when we begin at the stage of scarcely-better-than-subsistence that characterised so much of Europe before the Industrial Revolution.”

Two salient characteristics of industrial revolutions should be noted from the outset: firstly an industrial revolution refers to an impact that is *widespread across the population*, even if it takes time (years or decades), and secondly, it harnesses *suites of technologies which are embodied in so-called capital goods*, and which enables *growth in productivity*. Heilbroner defines *capital* and *productivity* as follows:

- “...capital consists of anything that can enhance a person's power to perform economically useful work. An unshaped stone is capital to the caveman who can use it as a hunting implement. A hoe is capital to a peasant; a road system is capital to the inhabitants of a modern industrial society. *Knowledge is capital too – indeed, perhaps the most precious part of society's stock of capital.* [Emphasis added]”⁴
- “Capital is, therefore, a method of raising per capita productivity, which is an *individual person's output in a given span of time* [Emphasis added]...”⁵

¹ An invention in this study is defined as a new technology. Commercial success is not implied by an invention.

² Innovation is defined as an invention that has been commercially successful.

³ Heilbroner R, Milberg W. 2008. *The making of economic society*, 71

⁴ Heilbroner R, Milberg W. 2008. *The making of economic society*, 72

⁵ Heilbroner R, Milberg W. 2008. *The making of economic society*, 72

The first industrial revolution is deemed to have occurred between 1750 and 1830 and revolved around new technologies such as steam power, railroads, the production of coal and iron, agricultural techniques, and textile machinery. The second (1870 to 1900) was based on electricity, the internal combustion engine, communications, petroleum and chemical innovations. However, the greatest increase in productivity has historically been associated with a particular class of technologies labelled as *general purpose technologies*⁶. During the first industrial revolution, the steam engine was an important general purpose technology. It could be used in a variety of new applications, from driving spinning looms in a newly mechanized factory to powering locomotives in a new transportation system. The general purpose technology that emerged during the second industrial revolution was electricity, which set off a chain of innovation in the 1890s.

It is generally accepted that we are in the midst of a Third Industrial Revolution, which is driven by digital technology (also referred to as *the computer*) as its general purpose technology. Key milestones pertaining to the development of this digital innovation include the invention of the transistor in 1947 (which enabled digital electronic computing), the launches of ARPANET in 1967, the World Wide Web in 1989, and the first internet browser in 1993, which collectively enabled access to the Internet by the public, and the launch of commercial digital mobile communications in 1991. Digital technologies, also known as Information and Communications Technologies (ICTs), are well on their way to meeting one of the key characteristics of industrial revolutions, namely widespread accessibility for, or adoption by the population. The first industrial revolution was spearheaded in the United Kingdom (UK) and the second one in the United States of America (USA). ICTs currently are being spearheaded in the “developed” world, with the most widespread ICT being mobile phones and smartphones (Figures 1 and 2 on the following page).

⁶ Brynjolfsson E. 1998. *Beyond the Productivity Paradox: Computers are the Catalyst for Bigger Changes*, 2

Figure 1: Global ICT development

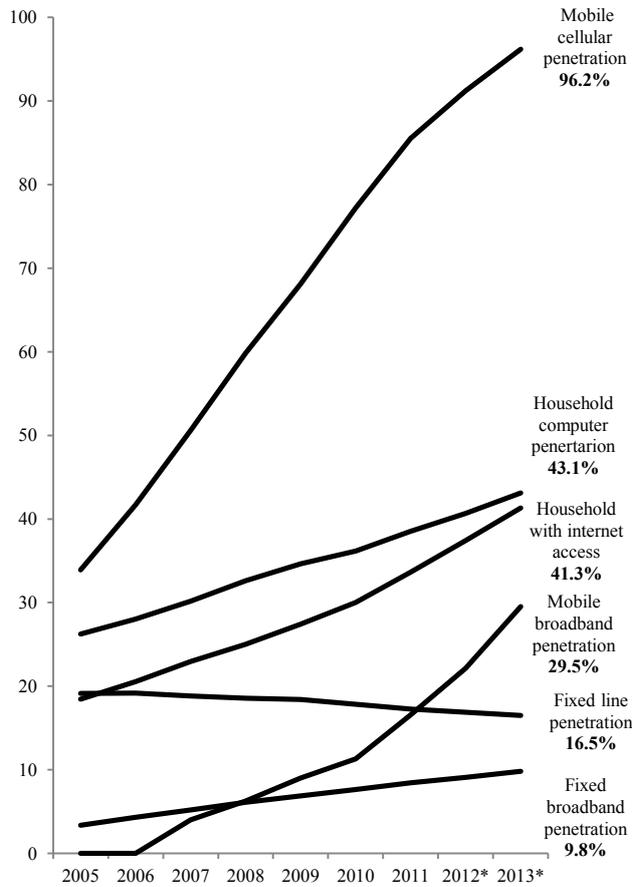
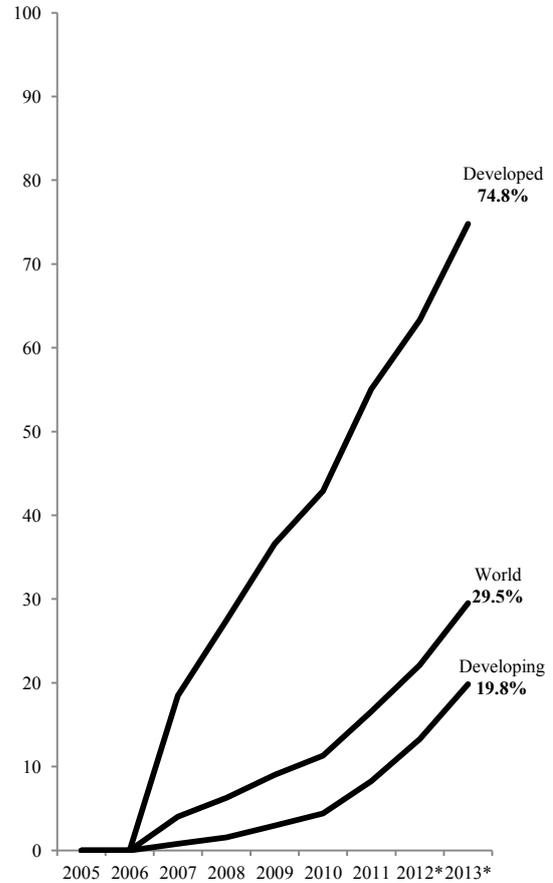


Figure 2: Mobile broadband penetration



Note: * Estimate

Source: ITU World Telecommunication/ICT Indicators database, 2013

The rapid progress of mobile broadband since 2006 is meaningful, as two characteristics of *ubiquity* are enabled. The first is ‘omnipresence’ or being available *everywhere*. As Figure 1 illustrates, the first experience of the vast majority of people on earth with telecommunications happened with mobile (as opposed to fixed line) telephony. However, *broadband* is necessary to enable the richer audio-visual channels that are necessary for rich informing⁷. Whilst the current mobile broadband penetration in the “developing world” is estimated at merely 19.8% (as opposed to nearly three quarters penetration in the “developed” world) the growth trends in both areas are significant, and indicative that much is still to happen during the current Third Industrial Revolution. However there was, and still is much contention about a second key characteristic of the Third Industrial Revolution,

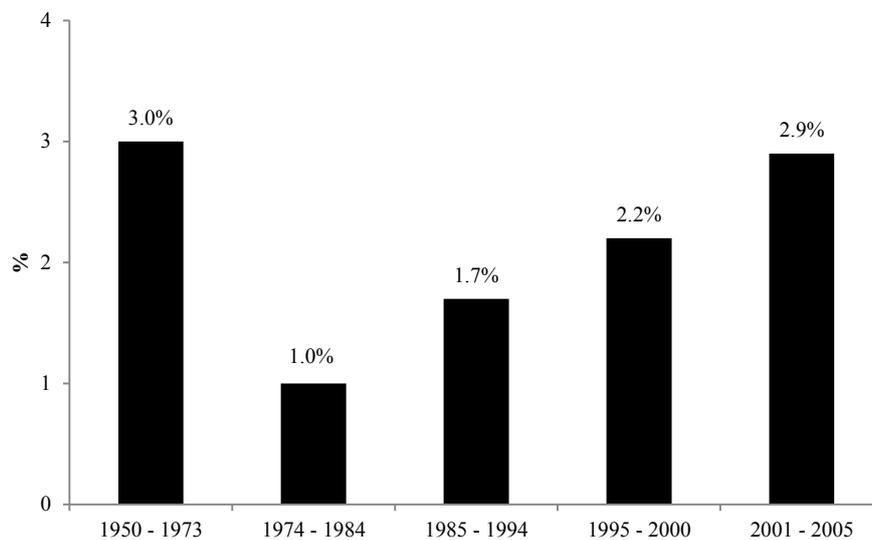
⁷The richness of an information channel refers to its ability to change understanding within a time interval

namely the impact of ICT on productivity growth. Heilbroner⁸ describes this contention as follows:

- The Nobel Prize-winning economist Robert Solow has famously remarked that ‘We see the computer age everywhere but in the productivity statistics.’ In fact, the question of economic significance of all these innovations and business investment in information and computer technology has been hotly debated by economists. It appears that Solow’s comment may have been premature. The late 1990s saw a rise in productivity and an increase in wages and per capita incomes for the first time since the Golden Age came to an end in the 1970s. Productivity growth – measured as the annual increase in output per worker – picked up in the late 1990s after a long period of stagnation that began in the 1970s, averaging 2.2 percent growth in the late 1990s and 2.9% percent from 2001 to 2005”.

The graph below shows this striking rise in productivity.

Figure 3: Annual USA productivity growth



Source: Bureau of labour statistics. Reproduced from Heilbroner R, Milberg W. 2008. *The making of economic society*.

Heilbroner states that there was consensus amongst economists that “more than half of the increase in the growth of productivity in the late 1990s was due to investment in information

⁸ Heilbroner R, Milberg W. 2008. *The making of economic society*, 198

and computer technology” and that “some [economists] have estimated the contribution as closer to two-thirds.⁹”

Being in the midst of this Third Industrial Revolution, we lack the benefit of hindsight that we have of the first and second ones, to pronounce on the scope and impact of the current one with more confidence. So it is not possible to know when the impact of ICT on productivity growth will be over. However, economist Robert Gordon¹⁰ claims that in the USA the “productivity impact of IR#3 [the Third Industrial Revolution] evaporated after only eight years [1996 to 2004], compared to the 81 years [1891 to 1972] required for the benefits of IR#2 to have their full impact on productivity and the standard of living”.

Gordon has long been a sceptic of the impact of ICT on productivity and the economy. Twelve years earlier in 2000, Gordon¹¹ stated the following about ICTs:

- “The New Economy [Gordon then refused to concede that we were in the midst of a Third Industrial Revolution] has created a dynamic explosion of productivity growth in the durable manufacturing sector, both in the manufacturing of computers and semiconductors and of other types of durables. This productivity explosion has boosted the economy’s rate of productivity growth and created enormous wealth in the stock market....However, the New Economy has meant little to the 88 percent of the economy outside of durable manufacturing; in that part of the economy, trend growth in multifactor productivity has actually *decelerated* [Emphasis added], despite a massive investment boom in computers and related equipment.”

Gordon goes on to explain that:

- “The fundamental limitation on the contribution to productivity of computers in general and the Internet in particular occurs because of the tension between rapid exponential growth in computer speed and memory on the one hand and the *fixed endowment of human time* [Emphasis added]. Most of the initial applications of mainframe and personal computers have encountered the rapid onset of

⁹ Heilbroner R, Milberg W. 2008. *The making of economic society*, 198

¹⁰ Gordon RJ. 2012. Is U.S. Economic Growth Over? Faltering innovation confronts the six headwinds. *Working Paper 18315, National Bureau of Economic Research*, 2 <http://www.nber.org/papers/w18315>. In this paper Gordon refers to the third industrial revolution which encompasses computers, the web and mobile phones.

¹¹ Gordon, R. Fall 2000. “Does the New Economy Measure Up to the Great Inventions of the Past?” *Journal of Economic Perspectives*, vol. 4, no. 14, 72

diminishing returns. Much of the use of the Internet represents a substitution from one type of entertainment or information-gathering for another.”

In essence, Gordon held a sceptical view of ICTs as a technology suite worthy of being considered the key driver (i.e. the general purpose technology) in a Third Industrial Revolution, which is deemed notably inferior to the prior one. This “faltering innovation”¹² of ICTs is deemed to have little chance in the USA of resuscitating productivity growth.

What Gordon does not consider is the *nature of innovation*, which despite becoming increasingly commercially successful over time, typically is *messy* and occurs in *fits and starts*, and spreads *unevenly* across the world. Heilbroner¹³ describes this nature well:

- “It is difficult, perhaps impossible, to exaggerate the impact of this continuing advance. Now moving rapidly, now slowly; now on a broad front, now on a narrow salient; now in the most practical of inventions, again in the purest of theoretical discoveries, the cumulative application of science and technology to the productive process was *the* [Emphasis added] great change of the nineteenth and twentieth centuries.”

It is sobering to note that electricity, deemed to have been the key General Purpose Technology of the Second Industrial Revolution is still not available in for instance, many parts of Africa, more than a century later¹⁴. This does not mean that electricity does not have *the potential* to have an impact on productivity; it merely means that for instance in Africa, it has not been harnessed optimally¹⁵, or in some places, not been harnessed at all.

What is even more problematic is Gordon’s contention that a “fundamental limitation on the contribution to productivity of computers” exists due to the “tension” between the

¹² Gordon R. 2012. Is U.S. Economic Growth Over? Faltering innovation confronts the six headwinds. *Working Paper 18315, National Bureau of Economic Research*, 18

¹³ Heilbroner R, Milberg W. 2008. *The making of economic society*, 80

¹⁴ Electrification levels in Africa are low, especially when compared with Europe and North America. South Africa and Egypt have the continent’s highest electrification levels at approximately 70 %, while the average for the Southern African Development Community region is only 20 %. This picture is changing, however, as African governments are starting to realize the importance of electrification for the well-being of the local economy.

Governments in Africa are beginning to view provision of electricity as part of their responsibility alongside basic services such as sanitation and clean water. The large number of electrification projects on the go makes Africa a continent of opportunity. South Africa’s electrification program is remarkable by most measures. Prior to 1990, less than a third of the population had access to electricity. By the end of the decade, that proportion had doubled. The South African Government aims to achieve universal access to electricity for all South Africans by 2014.

¹⁵ Many mobile communications operators run their base stations in areas in Africa that do not have electricity. They have to resort to Diesel generators to do so. It is a very expensive way to harness electricity.

exponential increase in computer speed and memory capacity and the “fixed endowment of human time”¹⁶. This makes no sense. It will be argued later in this study that the productivity of thinking is enhanced by skills, experience and richer informing, which may be aided by “computers”. Richer information cuts down on the time necessary to make sense of something, and increases the probability of the sense that was made, being less inaccurate, all else being equal. That “human time” is fixed in no way proves that the productivity of thinking cannot be increased. A possible second impact of “computers” is that they make humans redundant in some production processes and operations. In this instance limited “human time” has no impact at all on such increased productivity. Erik Brynjolfsson and Andrew McAfee explain the phenomenon as follows:

- “At least since the followers of Ned Ludd smashed mechanised looms in 1811, workers have worried about automation destroying jobs. Economists have reassured them that new jobs would be created even as old ones were eliminated. For over 200 years, the economists were right. Despite massive automation of millions of jobs, more Americans had jobs at the end of each decade up through the end of the 20th century. However, this empirical fact conceals a dirty secret. There is no economic law that says that everyone, or even the most people, automatically benefit from technological progress.”¹⁷
- “Digital technologies change rapidly, but *organizations and skills aren’t keeping pace* [Emphasis added]. As a result, millions of people are left behind. Their incomes and jobs are being destroyed, leaving them worse off in absolute purchasing power than before the digital revolution.”¹⁸

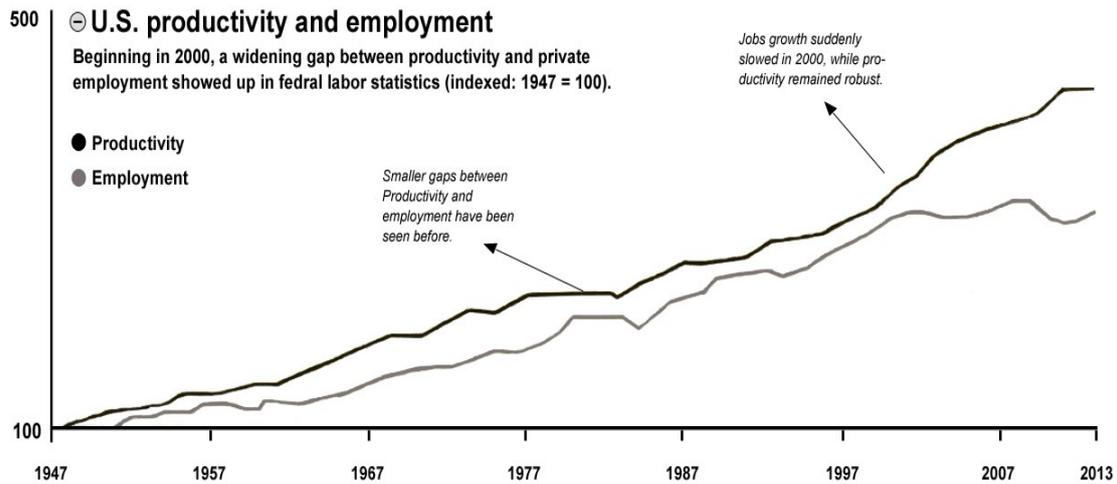
One notable aspect of the productivity growth in the USA is that from the most recent turn of the century, job growth did not keep up with productivity growth as indicated in Figure 4 on the following page.

¹⁶ Gordon, R. Fall 2000. “Does the New Economy Measure Up to the Great Inventions of the Past?” *Journal of Economic Perspectives*, vol. 4, no. 14, 72

¹⁷ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 528

¹⁸ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 444

Figure 4: Decoupling productivity and employment



Source: Reproduced from “How Technology is Destroying Jobs”, MIT Technology review, vol 116, no.4, p.30

Brynjolfsson and McAfee explain¹⁹ how to overcome this challenge of the jobless productivity growth. The one way is to improve the rate and quality of organisational innovation, whilst the other is to increase human capital, in other words ensuring that people have the skills that they need to contribute in an economy that is increasingly incorporating ICTs in its productive processes. The first way is described as:

- “...co-inventing new organizational structures, processes, and business models that leverage ever-advancing technologies and human skills. Joseph Schumpeter, the economist, described this as a process of “creative destruction” and gave entrepreneurs the central role in the development and propagation of the necessary innovations. Entrepreneurs reap rich rewards because what they sow, when they do it well, is both incredibly valuable and far too rare.”²⁰

Another way is to focus on enhancing the productivity of the education sector to increase relevant human skills. The problem is described as follows:

- “It’s not a coincidence that the educational sector also lags as an adopter of information technologies. Basic instructional methods, involving a teacher lecturing to rows of passive students, have changed little in centuries. As the old joke goes, it’s a system for transmitting information from the notes of the lecturer

¹⁹ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 810

²⁰ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 818

to the notes of the student without going through the brain of either. In many classrooms, the main instructional technology is literally a piece of yellowish limestone rock scraped across a larger black slate”²¹

The solution is envisaged as an increasingly digitised education process, in which “educators can experiment and track alternative approaches, measure and identify what works, share their findings, and replicate the best approaches in other subjects and geographies.”²² An important idea promoted by Brynjolfsson and McAfee is that the judicious combination of ICTs and humans has the ability to outperform humans in isolation or ICTs in isolation. In fact, that is the key message of their most recent work; that humans ought to “race with machines” rather than against them²³. The authors use the game of chess as an example, and describe it as follows:

- “In 1997, Gary Kasparov, humanity’s most brilliant chess master, lost to Deep Blue, a \$10 million specialized supercomputer programmed by a team from IBM. ... After head-to-head matches between humans and computers became uninteresting (because the computers always won), the action moved to “freestyle” competitions, allowing any combination of people and machines. The overall winner in a recent freestyle tournament had neither the best human players nor the most powerful computers. As Kasparov writes, it instead consisted of
 - ‘A pair of amateur American chess players using three computers at the same time. Their skill at manipulating and “coaching” their computers to look very deeply into positions effectively counteracted the superior chess understanding of their grandmaster opponents and the greater computational power of other participants. ... Weak human + machine + better process was superior to a strong computer alone and, more remarkably, superior to strong human + machine + inferior process.’

This pattern is true not only in chess but throughout the economy. In medicine, law, finance, retailing, manufacturing, and even scientific discovery, the key to winning the race is not to compete *against* the machines but to compete *with* machines.”²⁴

²¹ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 898

²² Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 904

²³ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 788

²⁴ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 802

The work of Brynjolfsson and his collaborators explore important pointers for the future impact of ICTs on productivity in all facets of life, including education and the running of innovation and innovation itself in organisations. ICTs' impact on productivity growth may be uneven and even stagnant at times, but that does not necessarily limit it to the manufacture of durable manufactured goods, as Gordon contends. Brynjolfsson and McAfee refer to two examples of ICT applications that show how relentless development of ICTs results in ICTs being capable of doing things that were previously thought to have been the exclusive preserve of human ability. This also points to a future increase of productivity as a result of ICTs.

The first example relates to an analysis in a book published in 2004 titled "The New Division of Labor" by economists Frank Levy and Richard Murnane, in which driving in traffic is given as an example of a task that is not "automatable". Brynjolfsson quotes²⁵ that book as follows:

- "The ... truck driver is processing a constant stream of [visual, aural and tactile] information from his environment. ... To program this behaviour we could begin with a video camera and other sensors to capture the sensory input. But executing a left turn against oncoming traffic involves so many factors that it is hard to imagine discovering a set of rules that can replicate a driver's behaviour. ... Articulating [human] knowledge and embedding it in software for all but highly structured situations are at present enormously difficult tasks. ... Computers cannot easily substitute for humans in [jobs like truck driving]."

Six years later, in October 2010, Google announced that it had modified a fleet of Toyota Priuses that enabled them to drive 1,000 miles on American roads without any human involvement and more than 140,000 miles with only minor inputs from the person behind the wheel, which was a legal requirement. How did they do it? Brynjolfsson describes the process as follows:

- "The Google technologists succeeded not by taking any shortcuts around challenges listed by Levy and Murnane, but instead by meeting them head-on. They used staggering amounts of data collected for Google Maps and Google Street View to provide as much information as possible about the roads their cars were travelling. Their vehicles also collected huge volumes of real-time data using

²⁵ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 208

video, radar, and LIDAR (light detection and ranging) gear mounted on the car; these data were fed into software that takes into account the rules of the road, the presence, trajectory, and likely identity of all objects in the vicinity, driving conditions, and so on. *This software controls the car and probably provides better awareness, vigilance, and reaction times than any human driver could.* [Emphasis added] The Google vehicles' only accident came when the driverless car was rear-ended by a car driven by a human driver as it stopped at a traffic light."

The second example is more relevant to the subject matter of this study. It involves ICTs being able to outperform the best human contestants in the television game called 'Jeopardy!' . In the game contestants are shown answers and must then ask questions that would yield these answers²⁶. Brynjolfsson describes the capabilities thought in the past to be limited to only humans and how IBM's Watson supercomputer executes these capabilities as follows²⁷:

- "In many cases, these questions involve puns and other types of wordplay. It can be difficult to figure out precisely what is being asked, or how an answer should be constructed. Playing Jeopardy! well, in short, requires the ability to engage in complex communication.

The way Watson plays the game also requires massive amounts of pattern matching. The supercomputer has been loaded with hundreds of millions of unconnected digital documents, including encyclopaedias and other reference works, newspaper stories, and the Bible. When it receives a question, it immediately goes to work to figure out what is being asked (using algorithms that specialize in complex communication), then starts querying all these documents to find and match patterns in search of the answer."

Given all of the above cues, one may reasonably make the following sense of them; firstly, ICTs have large potential to continue playing a leading role as the General Purpose Technology in the still unfolding Third Industrial Revolution. Secondly, of all the capital goods in society, human knowledge is the most important, as it enables the other capital goods to be formed. Thirdly, ICTs have the potential to increase the productivity of knowledge creation in all spheres of life, although this process has been spearheaded in

²⁶ "IBM's Watson Supercomputer Destroys Humans in Jeopardy" at http://www.youtube.com/watch?v=WFR3lOm_xhE 3 minutes 53 seconds

²⁷ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 249

organizations²⁸. Fourthly, the way to do so will probably involve an integrated system of human skills and ICTs.

The potential for increasing the *productivity of forming knowledge capital* is the main subject matter of this study. The making of knowledge and the associated quest to increase the productivity of knowledge making is in essence akin to invention and innovation²⁹, and is also characterised by a messy process which occurs in fits and starts, by commission, omission and happy accidents³⁰, and is known as sensemaking.

2 Sensemaking and UEMI

This section provides a concise introduction to a number of definitions and notions employed in this study. Sensemaking, UEMI, Knowledge, Technology, Productivity and Attention will be discussed.

Sensemaking is that which gives meaning to experience. Sensemaking theory holds that new meaning (i.e. new knowledge) is created when a human being links *cues*, in the form of observations, data and information, to *frames* which are the components of previously formed and remembered knowledge. All of this happens inside the human brain.

Although sensemaking occurs in all facets of life, the focus of this study is on organisational sensemaking. What sets organisational sensemaking apart from everyday sensemaking is that the act of organising is already an act of sensemaking as it orders and categorises organisational experiences. One could say that organisational sensemaking is more deliberate than everyday sensemaking in that it is organisationally and structurally mediated. Another inescapable form of mediation found in organisations is that of technology. The technological channel through which sensemaking is mediated would naturally draw the parameters for the sense that could potentially be made. (This insight was the basis for channel richness and how that influences sensemaking.³¹)

²⁸ Heilbroner R, Milberg W. 2008. *The making of economic society*, 197 reads: “One difference between computers and other post-World War II household electronics products is that computer adoption was initially and most aggressively done by business, as compared to the dishwashers and air conditioners bought en masse by American households after World War II. Business spending on information and computer technology rose from \$ 177 billion in 1990 to \$441 billion in 1999. In the latter part of the 1990s, business investment in information and computer technology constituted 36 percent of total capital expenditure by corporations.”

²⁹ Invention and innovation are subsets of sensemaking.

³⁰ One such “happy accident” was the discovery of Penicillin, which saved many lives. See American Chemical Society. *Alexander Fleming Discovery and Development of Penicillin*, <http://www.acs.org/content/acs/en/education/whatischemistry/landmarks/flemingpenicillin.html> . Accessed 3 November 2013.

³¹ Daft R., Lengel, H. 1986. Organizational Information Requirements, Media Richness and Structural Design. *Management Science*, 32(5), 284 – 295

Sensemaking theory does not hold digital technology in high esteem. Karl Weick³² said the following in 1993³³ about the *richness of information* provided by *digital technology* channels:

- “To reduce equivocality, people do not need larger quantities of information [offered by digital technologies]. Instead, they need *richer qualitative information* [Emphasis added]. Information richness is defined as the *ability of information to change understanding within a time interval* [In other words, the *productivity of sensemaking*]. Communication transactions that can overcome different frames of reference or clarify ambiguous issues to change understanding in a timely manner are considered rich. Communications that require a long time to enable understanding or that cannot overcome different perspectives are lower in richness. In a sense, richness pertains to the learning capacity of a communication.’ (Daft & Lengel, 1986, p. 560).” Information richness tends to covary with the extent of face-to-face personal interaction...”

In essence, Weick is (still) saying that the use of digital technologies causes information channels to be lean, which hampers the productivity of sensemaking. This is not a reasonable position to take anymore.

A new notion introduced by this study is that sensemaking has an *economic aspect* which means that sensemaking is a process of achieving ends (the sense that was made, i.e. new meanings, knowledge) with scarce means (time and the ability of the sensemaker to pay attention) which have alternative uses. The following quotations from Lionel Robbins³⁴ who wrote a paper on the definition of economics first published in 1932, and which is still the most widely quoted, are apt:

- “...when time and the means for achieving ends are limited and capable of alternative application, and the ends are capable of being distinguished in order of importance, then behaviour necessarily assumes the form of choice. Every act which involves time and scarce means for the achievement of one end involves

³² Weick K. 1993. *Sensemaking in organisations: Small structures with large consequences*. Reprinted in 2001 in *Making sense of the Organisation*, 10

³³ Notwithstanding improvements in digital technologies as recorded in Section 1 of this chapter and in Chapter 2, Weick maintained his low regard for the role of ICTs in organisational sensemaking. As recent as 2008

³⁴ Robbins L. 1945. *An essay on the nature and significance of economic science*, 14

the *relinquishment of their use for the achievement of another* [Emphasis added]. It has an *economic aspect* [Emphasis added].”³⁵

- “The conception we have adopted may be described as analytical. It does not attempt to pick out certain kinds of behaviour, but focuses attention on a particular aspect of behaviour, the form imposed by the influence of scarcity. It follows from this, therefore, that in so far as it presents this aspect, *any* [Emphasis added] kind of human behaviour falls within the scope of economic generalisations. *We do not say that the production of potatoes is economic activity and the production of philosophy is not* [Emphasis added]. We say rather that, in so far as either kind of activity involves the relinquishment of other desired alternatives, it has its economic aspect. There are no limitations on the subject-matter of Economic Science save this.”³⁶

It is this *economic* aspect of sensemaking that forces it to be characterised by *plausibility* rather than accuracy. A memorable quote³⁷ by Weick states that “accuracy is nice, but not necessary for sensemaking”. Once a sensemaking episode has been triggered, it continues until the sense made is plausible enough (or any relevant deadline is met), followed by the sensemaker taking action or deciding to do nothing. However, this study argues that due to human attention being another sensemaking resource, in other words a scarce³⁸ means with which to achieve the ends of sensemaking, choices have to be made as to how much of these scarce means to invest in that particular sensemaking episode, against demands for other competing instances of sensemaking, or other activities, such as sleeping, exercising or socialising, which is typical of modern (and organisational) life. This study proposes that by using attention-efficient (i.e. ubiquitous) electronically mediated informing, sensemaking productivity will be increased (all else being equal), which increases the probability to achieve a higher quality of sensemaking than would otherwise be possible in a given period of time.

The acronym UEMI stands for *ubiquitous* electronically mediated informing. The notion of ubiquity is key to understanding the ideas put forth in this study. The *Concise Oxford*

³⁵ Robbins L. 1945. *An essay on the nature and significance of economic science*, 30

³⁶ Robbins L. 1945. *An essay on the nature and significance of economic science*, 32-33

³⁷ Weick K. 1995. *Sensemaking in Organizations*, 55

³⁸ Human attention is limited by time, capability and inclination or motivation

*Dictionary*³⁹ defines the term “ubiquitous” as being an adjective that describes something that is “present, appearing, or found *everywhere* [Emphasis added]”.⁴⁰ For the purposes of this thesis, this definition is *augmented with two more facets*. The first is *simultaneity*, which acknowledges the relentlessly increasing capacity of current and expected future ICTs to process and offer data and information on demand, if not in real-time⁴¹, as opposed to the periodic “batch-processing” of older electronic computer systems. The second is *attention efficiency* which forms the foundation of one of the most important arguments offered in this study. Mark Weiser provided the initial idea of attention-efficient technology⁴². In essence, he noted that whenever people learn something sufficiently well, they *cease to be aware of it* – the use of the technology ceases to consume *active attention*. Weiser argues that this phenomenon is the result of human psychology and not of technology. However, in this study, Weiser’s notion of attention efficiency is *augmented* to include the phenomenon that some technologies are inherently easier to use (require less active attention) than others. One may reasonably infer that Weiser also considered this phenomenon when he pointed out that state-of-the art information technology in 1991 was far from ubiquitous as it was “analogous to the period when scribes had to know as much about making ink or baking clay as they did about writing”.

Whatever the case may be, the notion of the term *ubiquitous* in this study refers to electronically mediated informing that happens *everywhere*, in *real-time or at least on demand*, and which due to either familiarity or intuitive design, or both, enables its use *without the use of active attention*. One example of this is when an experienced driver changes the gears of the car with a manual gearbox without being aware of it – little or no active attention is required or used. This is the result of human psychology as Weiser explains. However, the experienced driver may never have driven a motor vehicle in his or

³⁹ Concise Oxford English Dictionary, 12th Edition

⁴⁰ The title of an earlier draft of this study was shorter: “Ubiquitous electronic mediated informing and sensemaking”. Given the standard definition of the term ubiquitous, which refers only to the geographic coverage and penetration of the population, and given that *at present* the ICTs envisaged in this study are not generally being used outside the business sector, the title was changed to limit the scope of the study to organisations. It is important to note that what is applicable for many businesses today is also applicable for sensemaking outside businesses, which this document reflects. In addition, given the nature of industrial revolutions, it is reasonable to expect that is possible with UEMI based sensemaking in organisations today and expected to occur in the (nearby) future will in the future expand, both geographically and within populations. The adoption rates illustrated in section 1 of this chapter points to this.

⁴¹ Consider real-time monitoring of the stock market, a CCTV camera of the interaction between sales staff and customers in a retail outlet, or the (somewhat macabre) live coverage on the TV in family rooms of a guided missile hitting a target.

⁴² Weiser M. The Computer for the 21st Century. *Scientific American*, September 1991

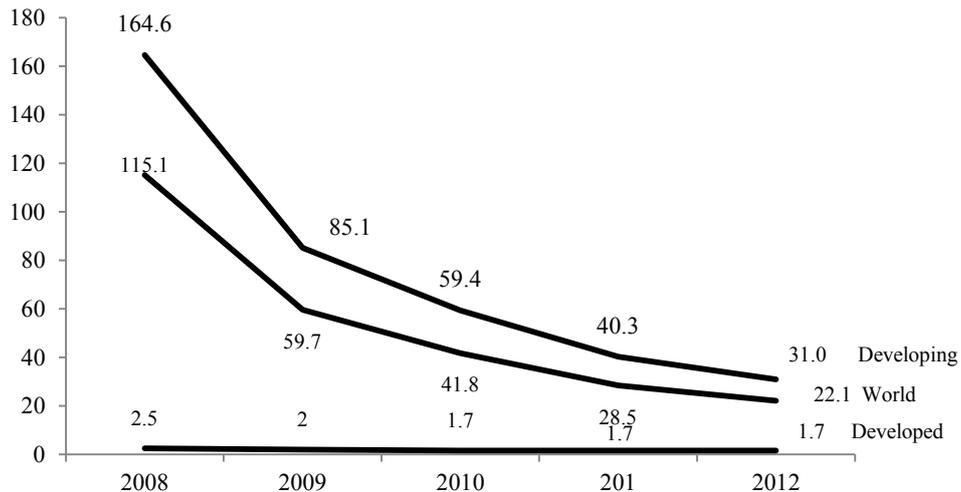
her life other than one with an automatic gearbox. The phenomenon of changing gears whilst driving “without being aware of it” in this case is the result of both human psychology and technology. It should be noted that whilst this study emphasises that the *comprehensive meaning* as defined by this thesis of the notion *ubiquitous* is something that is expected to be realised only sometime in the future, it is not an Asimovian fantasy. In fact, we are almost there. Consider the example in Section 1 Chapter 1 where the participation of Watson, IBM’s supercomputer in the game *Jeopardy!*, does not require the quiz master to interact with Watson in a more attention-demanding way than with the two human contestants⁴³. He merely verbalises a statement to Watson and the two human contestants, and the fastest contestant to respond, gets the chance to ask a question that would make the quiz master’s statement an appropriate answer. Watson not only won, but answered verbally with appropriate questions in the same way that the human contestants would, had they responded quick enough.

From a purely technical point of view, comprehensive UEMI is already possible. One challenge to its adoption is cost, and its cousin, affordability. Figure 5 below provides one explanation – the price of fixed line broadband - for the use of ICT services in the “developing” world lagging behind that of the “developed” world. Even after the notable decline in the cost of using fixed line broadband, the fact that it still costs 31% of the income per capita of people in the developing world, practically ensures that mass adoption of fixed line broadband remains a distant possibility⁴⁴.

Figure 5: Fixed-broadband prices, as a percentage of GNI p.c., 2008-2012

⁴³ “IBM’s Watson Supercomputer Destroys Humans in Jeopardy” at http://www.youtube.com/watch?v=WFR3lOm_xhE. 3 minutes 53 seconds. Sometimes, seeing is believing.

⁴⁴ It should be noted that in many places, fixed broadband is not possible, at any price. This is due to there not being any fixed line communication at all.



Note: Simple averages. Based on 144 economies for which 2008, 2009, 2010, 2011 and 2012 fixed-broadband prices were available.

Source: ITU. GNI p.c. is based on World Bank data, 2013

Another challenge to the emergence of comprehensive UEMI, from the point of view of organisational sensemaking, even in the “developed” world, is the organisational inertia of established structures, routines and mind sets, which prevents faster adoption of UEMI technologies. However, it does not make sense to postpone the study of the mutual impact between sensemaking and UEMI which is already technically possible and whose likelihood for adoption in the near future is high, given the ever-improving cost-performance ratio of ICTs. Sensemaking produces knowledge, which according to Heilbroner, is “perhaps the most precious part of society’s stock of capital”⁴⁵ Hence it behoves us to explore the productivity potential of UEMI technologies on sensemaking.

Knowledge is the next notion that needs to be defined for the purposes of this study. Unlike the generally accepted definition of knowledge given as “information and skills acquired through experience or education”⁴⁶ or “part of society’s stock of capital”⁴⁷, knowledge is taken to mean *only that which resides in a living human brain*. This narrower definition excludes information such as books in a library, or electronic information technology such as the search algorithms embedded as code on the computer servers of a search engine. In addition, knowledge is viewed as a human capacity to act⁴⁸.

⁴⁵ Heilbroner R, Milberg W. 2008. *The making of economic society*, 72

⁴⁶ Concise Oxford English Dictionary, 12th Edition.

⁴⁷ Heilbroner R, Milberg W. 2008. *The making of economic society*, 72

⁴⁸ Sveiby K. 1997. *The New Organizational Wealth: Managing and Measuring Knowledge-Based Asset*, 37

Technology can also act, and increasingly does so in more areas of life and with increasingly better results. The complete definition of technology provided by the *Concise Oxford English Dictionary*⁴⁹ reads as follows: “the application of scientific knowledge for practical purposes”, “machinery and equipment based on such knowledge” and “the branch of knowledge concerned with applied sciences”. Ignoring the animal kingdom, all technology is created by human beings. It should be noted that like knowledge, which may be viewed as a human capacity to act, *some* technology also has an independent capacity to act, if one considers automated production lines, share trading, Watson’s performance in the *Jeopardy!* quiz show or Google’s self-driven cars. Taking a cue from the second definition of technology in the dictionary, technology, which is created by human beings, is viewed in this study as a proxy for knowledge, in other words a proxy for the human capacity to act. The main hypothesis of this study can therefore be put that both knowledge and proxy knowledge (technology) have the potential to increase the productivity of sensemaking, and that a judicious combination of both will provide for the highest increase in sensemaking productivity.

The *cues* for sensemaking may comprise any combination of *information*, *data* and *observations*, which in this study, have specific meanings. Information is created by human beings with the intent of informing other human beings. When the recipient is informed, in other words, he or she notices and processes the information, the information becomes the set of cues with which to make sense and create knowledge. The key characteristics of information are *human intent* and the *human production of information to execute on this intent to inform*. *Data* is defined as observations whose *scope and timing are planned by human beings*. The key difference when compared to information is that data’s content is typically *not* created with the intent to inform. Human intent is limited to the planning of the scope and timing of observations, whatever they may be. *Observations* are entirely devoid of human intent. Sensemaking via observations is incidental to living life. The sensemaker does not intend to be informed and the observations which resulted in sensemaking were not intended to do so either.

The following examples illustrate the differences between the three types of cues; when two people are talking, that dialogue constitutes information. What a person notices from the body language of the other person are observations. When the management of an organisation puts up CCTV cameras with microphones to observe the interaction between sales staff and

⁴⁹ The Concise Oxford English Dictionary. 2011. Edition 12. *Oxford University Press*.

customers, the observations of customer reaction to for instance, a new product or service offered by the sales staff, are data. For the purposes of this study this distinction enables the following insight: sensemaking based on cues that are made available through human intent (data and information) may be provided through judicious application of ICTs, whilst observations occur without involvement of ICTs.

Another notion employed in this study is *productivity*. We have learned in Section 1.1 that the term “productivity” means an “individual person’s output in a given span of time”⁵⁰. It should be noted that this output can be anything. When the output refers to products, measurement is relatively easy, whether output is measured in units or prices. When the output is knowledge, measurement may be impossible, and proxies are used for measuring output, such as the number of research papers published in reputable journals, the number of units sold or lives saved, as a result of an enabling technology (which is nothing other than embedded or embodied knowledge). Other proxies include the level of education measured by successful attendance of formal schooling, or the years of experience in a particular role. However, the fact that some output is nigh impossible to measure should not be any reason to ignore it, if it exists and makes a real impact on people’s lives.

One such output that is impossible to measure accurately is the *quality of sensemaking*, a notion introduced in this study. The *quality* of sensemaking refers to its *fit to reality*. It could be argued that a consideration of the quality of sensemaking is superfluous, as at its highest level, sensemaking is there to create meaning. If life has meaning, whatever the meaning is for the individual, it is worth living. The problem is that some meanings may deviate from an instance of reality which carries risk in such a way as to have a negative impact on one’s well-being which one may want to avoid. For the purposes of this study this is defined as *risky reality*. It stands to reason that a high quality of sensemaking increases one’s chances of averting threats to one’s well-being or of making use of opportunities to increase one’s well-being. This holds true for either an individual or an organisation. If one has cancer and one makes sense from all of the cues obtained, that one should avoid the conventional treatment (e.g. chemotherapy) in favour of an alternative (e.g. Ozone treatment), one lives in risky reality and one’s life depends on the quality of sensemaking. Businesses constantly live in a *risky reality*; they constantly risk losing profitability and missing opportunities to become more profitable. It is not possible to accurately measure the quality of sensemaking and risky

⁵⁰ Heilbroner R, Milberg W. 2008. *The making of economic society*, 72

reality without the benefit of hindsight. Even with hindsight precise measurement may be impossible. However, that is no excuse to exclude them from consideration in sensemaking theory. One may well argue that *all* sensemaking occurs in a situation of risky reality. For example, Section 3.2 describes a sensemaking incident where Warren Bennis, then the president of the University of Cincinnati came to the realisation that he loved being a college president but hated doing college presidency, and left Cincinnati. At first it may seem that Bennis's sensemaking did not occur within risky reality, but an argument could be made that the risk was the living of an unfulfilled career life.

The most important new notion employed by this study is that of *attention*.⁵¹ Perhaps the most often quoted definition of attention is that of the psychologist William James, in 1890⁵²:

“Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness is of its essence. It implies withdrawal from some things in order to deal effectively with others, and is a condition which has a real opposite in the confused, dazed, scatter brained state which in French is called *distracted*, and *Zerstreuung* in German.”

This definition focuses on the concept of attention as a *process*; “*taking* [Emphasis added] possession of the mind”. It is thus a definition for the process of *attending*. It is important to note that according to James, and in line with the position taken by this study, the process of attending has an *economic* aspect. This may be inferred when James refers to the “withdrawal from some things *in order to deal effectively* [Emphasis added] with others”. This attending happens with *scarce means*, which is the processing capacity of the human mind.

In this study the notion of *attention* is expanded to include the *quantity* and *quality* of attention. The *quantity* of attention paid depends how much *time* one devotes to paying attention to a sensemaking process and *how much one applies oneself* during that time to make sense. For example, should a student daydream about everything except what is being said by a lecturer in a one hour class, he or she has paid zero attention; the result of a multiplication between time attending the lecture and the effort to pay attention. The quality dimension of attention paid refers to the person's (e.g. the sensemaker's) level of knowledge and skills. Attention, as opposed to attending, is the product between a quantity and a quality.

⁵¹ See Section 3 of Chapter 4 for a more comprehensive analysis of attention and its role in sensemaking.

⁵² James W. 1890. *The principles of Psychology* 1:404

The only component susceptible to direct measurement, is time. As argued in the cases of knowledge, the quality of sensemaking and risky reality above, and the fact that it is not possible to accurately measure them, is no excuse to exclude them from consideration in sensemaking theory.

In conclusion, the definitions and notions covered in this section enable the crux of the finding of this study, which may be stated as follows: whilst Weick was correct in his assessment that ICTs in 1985 were more of a hindrance than a help in sensemaking, as a result of the lean channels of communication offered by ICTs at that time, the reality⁵³ now is that ICT's afford a much richer channel for informing, which together with current processing power and software technology, enables much higher productivity in human sensemaking. ICTs enable the provision of richer audio-visual cues with precision in recall that humans cannot match. In addition, ICTs are able to take over some of the processing required to convert said rich cues to more meaningful information and technology through a process akin to human sensemaking. This conversion occurs outside the human brain, in other words, inside (digital) technology, and the resulting cues (information, data and observations) enable richer frames (meaning or knowledge) to be built inside the human brain with lesser sensemaking by the human sensemaker than would be possible without the digital technologies.

It is also argued in this study that due to the inherent attention-efficiency of UEMI technologies with its concomitant reduced load on scarce human attention, the reliance on plausibility will be reduced. This in turn should result in a better quality of sensemaking, which is valuable in the face of risky reality and which in turn should have a positive impact on one's well-being.

3 Research design

If one were to accept, as this study does, that productivity growth and the resultant raising of the standards of living of the population is valuable⁵⁴ and generally something that society at

⁵³ At least this study's interpretation of reality.

⁵⁴ Although they lie outside of the scope of this study, there are valid concerns regarding this productivity growth on the back of the increasing capability of technology. One is the ecological impact of this productivity growth. The by-products of production have and continue to pollute the earth, the water and the atmosphere. Therefore, new industries such as renewable energy are emerging in an attempt to counter this problem. A topical development in South Africa is the consideration of (and concerns relating to) allowing hydraulic fracturing (also called fracking) to extract shale gas in the Karoo area of South Africa. The following newspaper articles are relevant: <http://www.bdlive.co.za/business/energy/2013/10/20/fracking-in-the-karoo-takes-a-big-step-forward> and <http://www.bdlive.co.za/business/energy/2013/10/18/anti-fracking-protesters-march-to-shell-sas-offices>

large seeks, then one ought to accept that any study aimed at increasing productivity is also valuable⁵⁵, and something worth pursuing. We have seen in Section 1 of Chapter 1 how ICTs are considered to be the main general purpose technology and driver of productivity growth in the Third Industrial Revolution, which is currently unfolding. We have seen that knowledge⁵⁶ is “perhaps the most precious part of society’s stock of capital”⁵⁷, and a method of raising per capita productivity. It has been shown in Section 1.2 how sensemaking by humans create knowledge. Brynjolfsson and McAfee’s arguments (Section 1 Chapter 1) that ICTs have the capability of assisting, and often beating human beings at a variety of complex challenges, whether it is answering a quiz show, driving a car, participating in freestyle chess competitions, or aiding in education, is topical. The above-mentioned performance of ICTs *mimics* some human sensemaking *with superior results*⁵⁸.

One may thus reasonably expect that sensemaking theorists, like their economic counterparts, have an appreciation for the potential positive impact on sensemaking productivity of ICTs. However Karl Weick, the global thought leader on sensemaking has long held a dim view of the role of ICTs in sensemaking. This makes no sense. The writing of this thesis was prompted by this apparent anomaly.

⁵⁵ Professor Johann Kinghorn, Director of the programme in Value and Policy Studies, and Director of the Centre for Knowledge Dynamics and Decision making at the University of Stellenbosch, South Africa taught that theory without valuable application in society is not worth paying much attention to. A notable informal interaction with Professor Kinghorn, which is symptomatic of his focus on utility and value to society about matters relating to theory and learning, was when the writer of this thesis pointed out the insightful and humorous TED talk by Ken Robinson in which he talked about the need for creativity and of realising the potential in people.

As an example, Robinson went on to refer to the career of a dancer and then choreographer of Andrew Lloyd Webber’s plays (http://www.ted.com/talks/lang/eng/ken_robinson_says_schools_kill_creativity.html). Professor Kinghorn retorted that it is all good and well to foster creativity and the arts in teaching, but that what South Africa really needed, was engineers and accountants to deliver the services that South Africans need. At that time South Africa experienced service delivery protests, and still suffers from skills shortages such as those offered by engineers, artisans, and accountants.

⁵⁶ The term knowledge in this instance is broader than the narrower definition routinely used in this study. In this case Heilbroner meant it to be not only that which resides in a human brain, but also all of the information and data that has been recorded and the technology (e.g. speech recognition algorithms) and know-how that has been formed over time.

⁵⁷ Heilbroner R, Milberg W. 2008. *The making of economic society*, 72

⁵⁸“Human sensemaking” is a tautology, employed to emphasise that sensemaking is the preserve of human beings. Technology is also capable of independent action capable of producing the same or better results than those which humans achieve through sensemaking. However, sensemaking is a human endeavour. See Section 1.2.

3.1 Research question and objectives

This quote from a 1985 publication⁵⁹ sheds some light on the reasons for Weick's criticism of electronic information sensemaking:

“The growth of electronic information processing has changed organizations in profound ways. One unexpected change is that electronic processing has made it *harder, not easier* [Emphasis added], to understand events that are represented on screens.”

“Representations in the electronic world can become chaotic for at least two reasons: The data in these representations are flawed, and the people who manage those flawed data have limited processing capacity. Those two problems interact in a potentially deadly vicious circle. The data are flawed because they are incomplete; they contain only what can be collected and processed through machines. That excludes sensory information, feelings, intuitions, and context – all of which are necessary for an accurate perception of what is happening. Feelings, context, and sensory information are not soft-headed luxuries. They are ways of knowing that preserve properties of events not captured by machine-compatible information. To withhold these incompatible data is to handicap the observer. And therein lies the problem.”

In Chapter 2 a comprehensive overview of the state of information technology circa 1985 is given, which provides justification for Weick's view *then*. Since then much has changed in the world of digital technologies - in essence they have become more *ubiquitous*. These changes represent vast improvements in the presentation of information, data and observations currently offered on screens, which are now available not only on office work desks, but also anywhere else, in the form of laptop computers, tablets and smartphones. In addition, the office screens have multiplied as well and some of them offer telepresence, which for instance, allows groups of people to hold meetings and workshops in front of large screens in full high definition colour and high fidelity sound (more detail in Chapter 2). However, sensemaking theorists and writers either did not take notice of, or deemed unimportant the way in which electronically mediated informing has changed over the years. And therein lies the problem with current sensemaking theory.

The purpose of this study is to investigate to what extent the increasingly ubiquitous ICTs may assist (or hinder) the making of sense by humans in organisations. The first objective is

⁵⁹ Weick, K. 1985. Cosmos vs. chaos: Sense and nonsense in electronic contexts. *Organisational Dynamics*, Fall, 14. American Management Association, read from Weick K. Making sense of the organisation, 444

to find out what the gap is between that which this study finds and that which is accepted in Weickian sensemaking theory. In the event that such a gap is found, the second objective is to start a conversation in order to update the theory. Therefore, this study needs to answer the following research question: How does the increasingly ubiquitous nature of electronically mediated informing change organisational sensemaking?

However, when this study refers to UEMI, it does not imply that the progress of, and quest for ubiquity (in the fullest sense of the term; informing that is *simultaneously* available *everywhere* whilst requiring *minimal or no active attention* from the sensemaker) is over, but that the electronically mediated informing technology in question has an *enhanced level of ubiquity*, when compared to the reference year of 1985, which is the year that Karl Weick considered electronic information technologies to be more of a hindrance than a help in sensemaking.

The instances and future scenarios used in this study to examine the potential current *and future impact* of UEMI on sensemaking are not prevalent in equal measure throughout society. However, it is reasonable to claim that in organisations, especially in commercial businesses, much of what is analysed in this study is already occurring. In addition one may reasonably claim that what is currently technically possible as identified in this study from the perspective of sensemaking, is held back by either affordability considerations, or organisational inertia to update structures, routines, skills and mind-sets, or both.

3.2 Scope, assumptions and limitations

The study limits the scope of investigation to sensemaking in organisations, where the ubiquity (in terms of *penetration*, *performance* and *attention-efficiency*) of ICTs is the highest. In view of the rapid improvements in the performance of ICTs, the study does not limit the investigation into ICTs that are currently being used on a commercial basis, such as low definition video conferencing which is deployed on every employee's computer in some organisations. It also considers technologies that have been proven in pilot demonstrations, for example, Cisco's holographic telepresence, or augmented reality⁶⁰. In addition, it considers technologies that are envisaged for the future, and which are expected to have an impact on sensemaking. Speech recognition, which is a key technology according to this study, has not demonstrated acceptable performance even in laboratories. Acceptable performance is the achievement of human levels of speech recognition accuracies. Therefore,

⁶⁰ See Section 6.3 in Chapter 2

some analyses of this thesis are done in anticipation of such speech recognition performance having been achieved. Hence in evaluating the value and validity of the analyses offered, the reader has to consider what already exists in some instances, and what might exist in others. The assumption of eventual entry into the market of envisaged ICTs may ultimately prove to be wrong. Section 3.4 of this chapter explains why the scope includes consideration of ICTs that do not exist yet.

3.3 Strategy and structure

The study relies on three key theories. The first is sensemaking as espoused by Karl Weick⁶¹ and his associates. This theory explains how knowledge is created through the process of sensemaking. The second key theory is taken from Mark Weiser⁶², who introduced the idea of ubiquitous technologies. The crucial idea is that ubiquity as defined by him reduces the demand for *active attention*. The third key theory is taken from Lionel Robbins, who showed how *any process* which involves the reaching of means with limited resources is an *economic* one and subscribes to economic principles. Another important theory is that of the *richness of communication channels*, which refers to the capacity of a channel to transfer information per time unit.

A focused scope of detailed analysis within a broader review of both sensemaking theory and ubiquitous computing was used to draw the conclusions of this thesis. This focused area comprises sensemaking in organisations with a particular focus on the resources (section 3.3 of Chapter 3) and substance (section 3.4 of chapter 3) of sensemaking, and selected technologies which enable ubiquitous electronically mediated informing (see Section 2.6 of Chapter 2).

This study comprises five chapters. The first chapter provides a brief overview of broad developments in the world of ICTs up to now and their impact on productivity; definitions and notions pertaining to sensemaking; the research design and the following chapters. Chapter 2 describes the progress of electronic information technology (IT) since 1985, when Weick expressed a dim view of the role of electronic information technology (IT) in sensemaking⁶³. This progress in IT may be well-known to the reader and may be glanced over without missing the required train of thought leading up to the conclusion of this thesis.

⁶¹ Weick K. 1995. *Sensemaking in Organisations*

⁶² Weiser M. The Computer for the 21st Century. *Scientific American*, September 1991.

⁶³ Weick, K. 1985. Cosmos vs. chaos: Sense and nonsense in electronic contexts. *Organisational Dynamics*, Fall, 14. American Management Association, read from Weick K. Making sense of the organisation, 444

However, the reader ought to ensure that the five⁶⁴ UEMI technologies used for analyses, namely *personal memories*, *virtual presence*, *augmented reality*, *speech recognition* and *organisational memories* are taken note of and understood. What should not be missed is the vision⁶⁵ of Mark Weiser on *ubiquitous computing*. Weiser's argument that ubiquitous technologies are those that do not require *active attention* is well accepted and becomes a cornerstone of this study. This vision is also harnessed as the foundation on which current progress towards true ubiquitous computing is reviewed and its increasing impact on sensemaking is analysed. The vision of true ubiquitous computing is a work-in-progress, with the *accuracy of speech recognition technologies* in recognising speech a notable obstacle, given that words represent the bedrock of informing and sensemaking. Whilst falling outside the scope of this thesis, this chapter also briefly considers two non-technical obstacles to UEMI which may prove to be as formidable as the obstacle of achieving accurate speech recognition, namely the need for *privacy* and the value of *organisational hypocrisy*. Both may be threatened by injudicious deployment of UEMI technologies.

Chapter 3 covers sensemaking, which is that which gives meaning to experience. It differs from decision-making in that it does not involve choice between contending options. Sensemaking involves the making of meaning which guides life and its projects; once meaning is made the direction that one's life projects should take is typically self-evident and decision-making is thus largely not necessary, though it may be harnessed⁶⁶. The key value of sensemaking is that it enables the sensemaker, in other words, an individual or an organisation, to carry on with life, after a puzzling interruption which triggered the sensemaking episode.

Sensemaking involves a process which according to Weick harnesses seven resources or process properties. Sensemaking is a *social* and *ongoing* process made in *retrospect*, which requires *congruence with one's identity*, is *enactive* of an environment which enables further sensemaking, and focuses on the noticing and embellishment of *cues* to the point that the sense which has been made, is *plausible* enough to act upon.

Sense is made when we express that which we paid attention to in our lives' streams of experience (also known as the pure duration)⁶⁷. This expression is made up of words, which

⁶⁴ There are many more UEMI technologies. These five sufficed in illustrating the impact between sensemaking and UEMI. Likewise, this thesis focuses on sensemaking in organisations to illustrate this impact.

⁶⁵ Weiser M. The Computer for the 21st Century. *Scientific American*, September 1991.

⁶⁶ Weick K. 1995. *Sensemaking in Organisations*, 99

⁶⁷ Weick K. 1995. *Sensemaking in Organisations*, 43

are combined into sentences and used in conversations with others or ourselves, about our ongoing experiences. Weick refers to these words and sentences as the *substance* of sensemaking which he segmented into six vocabularies, namely *ideologies*, *third-order controls* (assumptions and definitions taken as given in organisations), *paradigms*, *theories of action* (knowledge built from trial-and-error), *tradition* and *narratives* (i.e. stories). The substance of sensemaking also refers to its *mechanics*. For meaning (i.e. sense) to be made, a minimum of one cue needs to be linked to one frame. Cues and frames are vocabularies, and tend to show certain characteristics. Frames tend to be vocabularies that summarise past experience, whilst cues tend to emerge from current experience. Therefore, frames tend to be more abstract whilst cues tend to be less so. The linking (i.e. updating) of cues within the larger context of frames is what creates meaning, in other words what makes sense.

In Chapter 4 the subject matter covered in Chapters 2 and 3 is used to investigate how sensemaking and UEMI may impact each other. In making sense of this investigation, four new ideas were developed, namely *the role of attention in sensemaking which has an economic aspect and which subscribes to economic principles*, the notion of the *quality of sensemaking* and its impact on the notion of *risky reality*, and the proposal that in sensemaking, *visual communication* ought to be considered equal in value to those of words. The chapter starts with a review of Weick's coverage of the interaction between electronic information technologies and sensemaking in the more than two decades since his 1985 verdict. His negative view of 1985 has been maintained over the years. For example, in 2008 Sutcliffe and Weick still held the view that sensemaking mitigates information overload, whilst electronic computation "often amplify overload"⁶⁸. Whilst there are some instances where this is true, this is not the whole story. By being designed to be *inherently attention-efficient*, UEMI should reduce "overload", and consequently improve the quality of sensemaking. The *quality* of sensemaking is considered in this chapter as an important new idea for sensemaking. Whilst never mentioned explicitly, the importance of quality is alluded to in current sensemaking theory, for example, when one considers the notion that *the speed of sensemaking prevents its deterioration* by preventing increased arousal (i.e. anxiety) and its subsequent narrowing of focus which results in less cues being considered for sensemaking. Sensemaking theory does not consider accuracy⁶⁹ to be necessary. Accuracy in sensemaking theory means an absolute (i.e. 100%) fit to reality. This study agrees with the

⁶⁸ Sutcliffe K, Weick K. 2008. Information overload revisited, *Handbook of Organizational decision making*, 71

⁶⁹ Accuracy in sensemaking theory means an *absolute* (i.e. 100%) fit to reality, which if not impossible, is impractical or unnecessary.

view that if 100% accuracy is not impossible, it is probably either impractical or unnecessary. Sensemaking theory goes on to state that plausible sensemaking, as judged by the sensemakers themselves, will suffice. Plausibility, as opposed to absolute accuracy is of value to sensemakers because it enables them to overcome puzzling interruptions and continue with life's projects, within a reasonable period of time.

Unfortunately this insufficient, simplistic binary⁷⁰ view held by current sensemaking theory ignores the consequences of the fit to reality of the sense that was made. Consideration of, for example, the high failure rate of organisations world-wide begs the question of how much plausible but inaccurate sensemaking contributes to these failures and whether the sensemaker (and sensemaking theorists) should not attempt to look at ways of increasing the quality of sensemaking; in other words, its fit to reality. The judge of the quality of sensemaking is not the sensemaker as is the case with plausible sensemaking, but reality itself. Reality will determine the consequences of the sense that was made, irrespective of how plausible the sensemaker found the sense that he or she made to be.

Additional nuances to be considered in the proposed idea of the quality of sensemaking include the role of the perceived consequences by the sensemaker and the scope for avoiding negative consequences. Should the level of accuracy or fit to reality result in otherwise avoidable⁷¹ negative consequences to the sensemaker, as perceived by the sensemaker, then the quality of that sensemaking should be considered inadequate. Should the same sense made not result in negative consequences it should then be viewed as having had an adequate level of accuracy or quality of sensemaking. Plausible, or "successful" sensemaking which enables resumption of life after an interruption may therefore be of adequate (no negative consequences) or inadequate quality (result in negative consequences), depending on the reality in which the consequences of sensemaking is played out and the perception of the consequences of the sensemaking by the sensemaker.

This study thus introduces the idea of *risky reality* (instances of reality whose characteristics may have an impact on the sensemaker's well-being or survival should the sense made not be accurate enough) and argues that given the existence of risky reality the notion of the *quality of sensemaking* is therefore of the essence. Weick's work often covers sensemaking in high

⁷⁰ Accuracy that is either absolute (i.e. 100% fit to reality) or plausible (in the view of the sensemaker)

⁷¹ It should be noted that negative consequences are unavoidable in some circumstances, even if 100% accurate sensemaking occurs.

reliability organisations (HROs) such as wild fire fighting teams⁷², NASA and aircraft carriers, in other words, where risky reality is prevalent. It is important for *plausible* sensemaking in these situations to be of adequate *quality*⁷³, and for sensemaking theory to pay attention to sensemaking quality.

The notion of attention is considered next. Most of the definitions and work on attention in the literature that was reviewed, starting with William James⁷⁴, tend to focus on the *process* of attending. The focus is shifted from attending as a process to attention as a *quantity* and a *quality*. Attention is defined as the product between time, concentration, and the capability (knowledge, skills, experience and thinking ability) of the sensemaker.

Weick and those whose work he builds on, namely Alfred Schutz and Edmund Husserl do refer to sensemaking as a kind of attention⁷⁵, but then seem to ignore the consequences of this idea. One consequence is that as a kind of attention, sensemaking ought to display the same characteristics as those of paying attention. The work of Lionel Robbins⁷⁶ is used to show that sensemaking has an economic aspect, with *attention being the scarce means* of achieving the ends; the sense to be made. This means that whatever reduces the amount of attention to be paid with which to make sense, will increase the productivity of sensemaking and increase the chances of a higher quality, in other words, a higher plausibility of sensemaking, which would otherwise not be possible. UEMI has the potential of increasing the returns of attention paid, because UEMI enables both *more* and *richer* data and information to be considered and computed in any given time period of sensemaking. In the parlance of economics, the inherent attention-efficiency of UEMI as defined in this study should enable both the lowering of the costs of, and increase the returns on invested attention.

This chapter also argues the case for considering augmenting the focus on words for sensemaking with audio-visual communication, which includes drawings, photos, video footage, animation and augmented reality. UEMI is designed to enable this. The remainder of the chapter illustrates how UEMI impacts all seven of the sensemaking properties. Each of

⁷² Provide info on that incident where fire fighters did not down tools in a wildfire and contrast that with real-time EDI showing, for example, the levels of heat in a building and a map provided electronically.

⁷³ It is not possible to ascertain prior to, or during the sensemaking process whether the quality of the sense being made is adequate or not. This is possible only after its consequence have become clear after they occur. Nevertheless, it should stand to reason that an increase in the level of sensemaking accuracy (i.e. quality) should result in a decrease in the probability of negative consequences.

⁷⁴ James W. 1890. The principles of Psychology 1:404

⁷⁵ Schutz A. 1967. The Phenomenology of the Social World, 72

⁷⁶ Robbins L. 1945. An essay on the nature and significance of economic science, 14,30,32-33

the seven properties benefits from UEMI as envisaged in this thesis, but the properties that benefit most are *plausibility*, *cues*, *retrospect*, and *ongoing*. Looking in the opposite direction, the key UEMI technology that will have the largest impact on sensemaking in the future is speech recognition⁷⁷. The key factor that will speed up UEMI-assisted sensemaking is the continued lowering of the cost of digital technologies.

Chapter 5 recaps the major role that ICTs play in the increased economic productivity of the Third Industrial Revolution currently in progress. It goes on to propose that current sensemaking theory has not taken proper cognisance of the nature of the development of ICTs and their current potential to increase the productivity of human sensemaking. It further concludes that sensemaking theory will benefit from considering the properties of attention. Sensemaking is a kind, or act of attention, and the properties of attention should be included in the properties of sensemaking. Sensemaking will thus benefit from both attention-efficient informing which is enabled by UEMI, as well as from a higher capability or expertise (knowledge, skills, experience and thinking ability) of the sensemaker. It also concludes that the notion of the quality of sensemaking and its impact on risky reality should be considered in the theoretical framework of sensemaking, as is perhaps alluded to by Weick's work on high reliability organisations (HROs). This study contends that UEMI will enable a higher quality of sensemaking which is valuable in the face of risky reality. Another contention of this study is the need to go beyond considering words and physical presence (e.g. management by walking around) for good sensemaking, to include drawings, animation, photos, audio-visual footage (e.g. telepresence) and augmented reality. UEMI enables all of the above.

Lastly, this thesis contends that because of its inherent attention-efficiency, UEMI has the potential to have a profound impact on sensemaking, not only where risky reality is in play, but in each of the seven properties of the sensemaking process. It contends that UEMI technology suppliers should focus on innovating around current speech recognition accuracy barriers and other attention-efficiency enhancements⁷⁸ so as to expedite the improvement of sensemaking through UEMI. The improvement in the performance/cost ratio of digital technologies will do the rest.

⁷⁷ Other key UEMI technologies include broadband and higher definition video capture, storage and display, and security and privacy.

⁷⁸ A key technology here is user interface technologies that are intuitive

3.4 Expected significance of research

It is expected that some key concepts developed during this study will be incorporated in the conversation on sensemaking. These include the *nature and role of attention in sensemaking* in view of the *economic nature* of both. Another consideration is that of the *quality of sensemaking* and its importance in instances of *risky reality*. The third consideration pertains to the role of storytelling and mediation in sensemaking which expanded from the oral tradition to written words, and over the last decade or two, to a ubiquitous digital audio-visual medium capable of being enhanced by augmented reality. In considering the *current and potential future* impact between sensemaking and UEMI technologies, this study can provide pointers to technologies with the potential to make this impact more valuable. The study should also propose additional suggestions on how to improve on the current ubiquity of ICT technologies.

Chapter 2

Ubiquity of electronically mediated informing

Yesterday, today and tomorrow

1 Introducing ubiquitous electronically mediated informing (UEMI)

The following quote from a paper⁷⁹ by Johann Kinghorn provides a good overview of recent experience as a result of the ongoing march towards *ubiquitous computing*, or as he calls it, *networked virtuality*:

- “Embedded in and driving the socio-economic transformations is (what is best described as) *the revolution of networked virtuality* [Emphasis added], popularised and vaguely embodied in the form of electronic communications technologies, systems and symbols over the last two decades. As we are really only at the beginning of the digital (and perhaps the quantum?) age, it is difficult to gauge the extent of its impact. But it cannot be denied that the foundations of our world are being reshaped in the wake of this revolution, not least through the exponential intensification of information flows and the pressures consequently exerted on knowledge capabilities, human relations and the global economy.
- Virtuality is a notion that does not fit well with the knowledge systems and human experiences on which the world’s socio-economic achievements of the past 50 years were built. The knowledge requirements and human skills of a world, which increasingly has the means for human interactions and artefacts to evolve undeterred by the limitations of sequence and location, are very different from those on which the industrial era was built. *Never before have we had to think about our world as a placeless place and about our existence in terms of timeless*

⁷⁹ Kinghorn, J. 2002. Understanding Organizational Sensemaking: A Diagnostic Tool for Strategic Leadership in Conditions of Complexity. *Strategic Management in the Knowledge Economy: New Approaches and Business Applications* by Leibold, Marius, Probst, Gilbert JB, and Gibbert, Michael, p. 317

time [Emphasis added]. Yet it is exactly what the revolution of networked virtuality is forcing us to do.”

A key issue to note is that we are only *at the beginning* of the digital age; much is still to come from digital technologies⁸⁰. Some analyses in this study will be based on technologies already widely used and others are based on future scenarios in which some technologies currently envisaged or in development phase will be successful. Kinghorn’s view is adopted by this study and aligns with that of Brynjolfsson and McAfee, who state⁸¹:

- “The third industrial revolution, which is unfolding now, is fuelled by computers and networks. Like both of the previous ones, *it will take decades to fully play out* [Emphasis added]. And like each of the first two, it will lead to sharp changes in the path of human development and history. The *twists and disruptions* will not always be easy to navigate [Emphasis added]⁸². But we are confident that most of these changes will be beneficial ones, and that our world will prosper on the digital frontier.”

Another key issue is that we stand at a significant juncture (hence Kinghorn’s references to a “*revolution of networked virtuality*” and “*exponential intensification of information*” [Emphasis added]) where our socio-economic lives of the recent industrial era are going to be rapidly augmented if not replaced in part, by the increasing ability to live in “placeless places” and in “timeless time”⁸³. This study explores the current *and future* impact on sensemaking of this ability. The concept of “networked virtuality” may at a broad level be equated with the concept of “ubiquitous computing” or it may be equated with a state which enables living in placeless places in timeless time, and which is enabled by ubiquitous computing. Ubiquitous computing covers a wide range of information and communications technologies (ICTs), which varies in complexity from something like a simple environmental sensing device (e.g. a sensor that switches on a light at sunset) through to artificial intelligence.

⁸⁰ This does not only refer to the continued more-performance-for-less-cost increases of digital processing, storage and communication, but also the emergence of new or improved digital-enabled technologies, for example, touch screens, holograms, augmented reality, etc.

⁸¹ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 1120

⁸² This section of the quote was emphasised to note the messy nature of innovation, which often happens in fits and starts and is not necessarily to the benefit of all.

⁸³ The outcome of this process is unknowable, but the impact on our lives will most probably be colossal. This thesis is an attempt at understanding this future and perhaps influence in a productive way.

The idea of ubiquitous computing is not new. Already in 1991 Mark Weiser, considered the father of ubiquitous computing and then head of the Computer Science Laboratory at the Xerox Palo Alto Research Centre, wrote the following⁸⁴:

- “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.
- Consider writing, perhaps the first information technology. The ability to represent spoken language symbolically for long-term storage freed information from the limits of individual memory. Today this technology is ubiquitous in industrialized countries. Not only do books, magazines and newspapers convey written information, but so do street signs, billboards, shop signs and even graffiti. Candy wrappers are covered in writing. The constant background presence of these products of ‘literacy technology’ does not require *active attention*, but the information to be transmitted is ready for use at a glance.” [Emphasis added⁸⁵]

Weiser went on to point out how “silicon-based information technology” was far from being ubiquitous, or as he put it, “vanish into the background”. In his estimation, state-of-the art information technology in 1991 was “analogous to the period when scribes had to know as much about making ink or baking clay as they did about writing”. An important characteristic of true ubiquity is how it enables *a more productive use of attention*, which according to the hypothesis of this study, is a fundamental human need. Weiser argues:

- “Such a disappearance is a fundamental consequence not of technology, but of human psychology. Whenever people learn something sufficiently well, they *cease to be aware of it* [Emphasis added]. When you look at a street sign, for example, you absorb its information without consciously performing the act of reading. Computer scientist, economist and Nobelist Herbert A. Simon calls this phenomenon ‘compiling’; philosopher Michael Polanyi calls it the ‘tacit dimension’; psychologist J. J. Gibson calls it ‘visual invariants’; philosophers Hans Georg Gadamer and Martin Heidegger call it the ‘horizon’ and the ‘ready-to-hand’; John Seely Brown of PARC calls it the ‘periphery’. All say, in essence,

⁸⁴ Weiser, M. The Computer for the 21st Century. *Scientific American*, September 1991.

⁸⁵ Note that the attainment of not requiring active attention – the ultimate level of attention-efficiency - is viewed as important, if not more important than the other two aspects of the concept of ubiquity as defined in this study, namely simultaneity and omnipresence.

that only when things disappear in this way are we freed to use them without thinking and so to focus beyond them on new goals.”

Ubiquitous computing enables the reduction of the *consumption of attention* thus freeing up *attention capacity*. Such reduction is enabled when either a person becomes more skilled at using the technology, or when the technology, for example computing, becomes more ubiquitous⁸⁶, in other words, more attention-efficient. For the purposes of this study, ubiquitous electronically mediated informing (UEMI) is defined as a subset of ubiquitous computing which relates to informing people, in other words, providing them with data and information in a way that meets the three requirements of ubiquity as defined in this study: presence everywhere, simultaneity (the current accepted definition⁸⁷) and attention efficiency⁸⁸, which is a third addition based on the work of Weiser.

2 A sharper look at ubiquitous computing

Stefan Poslad⁸⁹ describes ubiquitous computing as follows:

- “Ubiquitous computing, often also referred to as Pervasive Computing, is a *vision* for computer systems to infuse the physical world and human and social environments [Emphasis added]. It is concerned with making computing more physical, in the sense of developing a wider variety of computer devices that can be usefully deployed in more of the physical environment. It is concerned with developing situated and pervasive technology that is highly accessible and usable by humans that can be designed to operate in harmony in human and social environments.”

Adam Greenfield⁹⁰ gives ubiquitous computing the label of “everyware”, and goes on to describe it as follows:

⁸⁶ Recall that ubiquity as defined in this thesis refers to pervasive presence, simultaneity and attention-efficiency.

⁸⁷ The current accepted definition as provided in all of the dictionaries consulted (Oxford Concise English dictionary and various online dictionaries). In the quote from Kinghorn at the beginning of this chapter, he talks of “the means for human interactions and artefacts to evolve undeterred by the limitations of sequence and location”.

⁸⁸ Noting Mark Weiser’s ideas on ubiquitous computing, this thesis proposes that the current definition of ubiquity be expanded to include attention-efficiency (a key concept used in this thesis) and which Weiser describes as that which “does not require active attention”

⁸⁹ Poslad, S. 2009. *Ubiquitous computing: Smart devices, environments and interactions*. Preface of the book.

⁹⁰ Greenfield A. 2006. *Everyware: The dawning age of ubiquitous computing*, 9

- “Ever more pervasive, ever harder to perceive, computing has leapt off the desktop and insinuated itself into everyday life. Such ubiquitous information technology “everyware” – will appear in many different contexts and take a wide variety of forms, but it will affect almost every one of us, whether we’re aware of it or not.”

Greenfield goes on to flesh out Wieser’s vision as follows: Ubiquitous goes beyond “in every place” (as would be the case with e.g. a laptop or a smartphone being used anywhere), but to also go “in everything”. Greenfield states that “ordinary objects, from coffee cups to raincoats to the paint on the walls, would be reconsidered as sites for the sensing and processing of information, and would wind up endowed with surprising new properties. Best of all, people would fluently interact with these systems and barely notice⁹¹ the powerful informatics they were engaging in. The innumerable hassles presented by personal computing would fade into history⁹²”. This is the *vision* for ubiquitous computing, or *computerless computing*.

Weiser in effect⁹³ does envisage a point in time (it is not possible to say when), *when computing and our interaction with it will be experienced with the same, or less drain on attention as we have achieved with reading*. But it is important to note that what we have today (in 2014) does not yet meet this requirement, and that our quest for more ubiquity should continue.

3 Potential non-technical obstacles on the road to UEMI

Whilst not the central focus of this thesis it is necessary to take note of some of the characteristics of organisational life in which UEMI will play itself out. Should these characteristics not be considered and catered for on the road to full UEMI, they may become obstacles which could otherwise be prevented or at least be ameliorated. The first obstacle is that of privacy risk. Here history is repeating itself. Bell and Odofin⁹⁴ stated:

- “The debate on privacy has been a major issue as early as the 19th century, when Samuel Warren and Louis Brandeis (1890, p.193 – 220) wrote a paper titled ‘The

⁹¹ In other words, attention-efficiently

⁹² Greenfield A. 2006. *Everyware: The dawning age of ubiquitous computing*, 11

⁹³ One may infer this from his reference to reading as an activity that is done without “active attention”

⁹⁴ Bell, D. & Odofin, S. 2010. *Ubiquitous Information Systems – Understanding privacy concerns*. AIS Electronic Library, 3. Downloaded <http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1010&context=ukais2010> on 21 Jan 2011

Right to Privacy” which comprehensively explains and analyses the various rights of users to the protection of their privacy, which *was largely motivated by the advent of modern photography and the printing press* [Emphasis added]”

UEMI’s impact on privacy already is⁹⁵ and will be much larger than that of “modern photography” and the “printing press” (by 1890’s standards). Therefore, a re-looking at issues of privacy is warranted. The increased impact may be noted when looking at the current state of ubiquitous computing, as described by Bell and Odofin⁹⁶:

- “Customer loyalty smart card tracking, mobile and smart phone application, wireless MP3 players, intelligent key cards, close circuit television cameras, motion sensors, electronic passports and RFID cards are some of the frequently used ubiquitous devices that handle personal information about their owners and of which a typical average customer could own more than one of them”

A second more nuanced obstacle has to do with the notion of *organised hypocrisy*. Nils Brunsson contends that, contrary to the conventional idea that “hypocrisy is something questionable, morally dubious and to be avoided altogether”, hypocrisy should at times be “seen as a solution rather than a problem, [that] it possesses some moral advantages, and it is often impossible to avoid it”⁹⁷. Brunsson describes the “not very unusual phenomenon” of organised hypocrisy as “signifying a difference between words and deeds, the eventuality that organizations may talk in one way, decide in another and act in a third”⁹⁸. Brunsson goes on to explain⁹⁹ that:

- “Traditional administrative and decision theories have another part to play in the context of hypocrisy: *they help it work* [Emphasis added]. If organised hypocrisy is to work, people must believe that what organisations say and decide is important. It is their trust in the traditional theories that explains why so many

⁹⁵ The presence technology of Microsoft’s Lync instant messaging platform used in corporations already shows who is online and who is not. Employees are thus now potentially under more scrutiny than before as to how active they are on their computers. For example, a yellow light indicators in Lync shows user inactivity, whilst a green light indicator shows when the user is available to chat. Although there are ways of circumventing this (by not signing in to Lync, or flagging your stats as “busy” (a red light against your name / photo in the contacts list), the usefulness of this service prevents people from doing so.

⁹⁶ Bell, D. & Odofin, S. 2010. *Ubiquitous Information Systems – Understanding privacy concerns*. AIS Electronic Library. From the abstract

⁹⁷ Brunsson N. 2002. *The Organization of Hypocrisy*, xi

⁹⁸ Brunsson N. 2002. *The Organization of Hypocrisy*, xiii

⁹⁹ Brunsson N. 2002. *The Organization of Hypocrisy*, xv

people pay attention to organizational talk and decisions; ultimately many people are only interested in the organization's actions, but the traditional theories have taught them that talk and decisions pointing in a particular direction increase the likelihood of action occurring in that direction. If these people didn't believe in the traditional theories, hypocrisy wouldn't work, since they would not pay attention to talk and decisions."

As UEMI has the potential to record much of an organisation's talking, deciding and acting in rich audio-visual detail, it clearly has the potential to expose this organised hypocrisy better than ever before. Therefore, where organised hypocrisy is considered an imperative, UEMI may struggle to find application. There may be more non-technical reasons providing barriers to the adoption of UEMI.

4 Electronic information technologies since 1985

The photo¹⁰⁰ in figure 6 below of an IBM PC XT is a good representation of the notion of "electronic information technologies" in 1985 which Weick correctly identified as being more of a hindrance than a help in sensemaking.¹⁰¹

Figure 6: State of the art desktop computing in 1985



¹⁰⁰ http://www.maximumpc.com/article/features/dawn_personal_computer_altair_ibm_pc?page=0,7

Downloaded on 08 December 2010. One of the themes explored in this thesis is the concept that the process of *informing* is not limited to words, as evidenced in many academic documents. Sometimes a picture is a thousand words, and sometimes no amount of words can give justice to a picture. Therefore, this study will provide some pictures to illustrate this phenomenon.

¹⁰¹ Weick, K. 1985. Cosmos vs. chaos: Sense and nonsense in electronic contexts. *Organisational Dynamics*, Fall, 14. American Management Association, read from Weick K. Making sense of the organisation, 444

Since then substantial changes in information technology on the road to ubiquity have occurred, as described in the following sections. Key benefits enabled by these changes include *presence everywhere*, *attention-efficient technologies*, and *increased richness of information*.

4.1 Presence everywhere

Information technology (IT) is now more often described as information and communication technology (ICT), to reflect the important role that networking, enabled by telecommunications (including mobile telecommunications) technology, now plays in society. The convergence of IT and telecommunications is a key enabler of ubiquity in the vision of UEMI. In 1985 Weick did indeed anticipate the positive impact on sensemaking of one of the characteristics of ubiquity (presence everywhere) and described it as follows:

- “People who carry terminals into the field should be better problem solvers than are people who leave terminals at home, because people with terminals in the field are able to use different forms of data and test their hunches with triangulation”¹⁰².

Figure 7 below¹⁰³ represents the state-of-the-art of the ability in 1985 to “carry terminals into the field”. This terminal did not enjoy widespread adoption. This article¹⁰⁴ provides some clues as to why not: “Sometime around 1985 my father brought home our first “portable” computer (I think it was an IBM 5155). It looked like a piece of luggage, weighted something like 30 pounds, and had a 5” or 6” orange and black text screen.”

Figure 7: State of the art portable computing in 1985



¹⁰² Weick, K. 1985. Cosmos vs. chaos: Sense and nonsense in electronic contexts. *Organisational Dynamics*, Fall, 14. American Management Association, read from Weick K. Making sense of the organisation, 454

¹⁰³ This photo is from <http://oldcomputers.net/ibm5155.html> downloaded on 08 December 2010

¹⁰⁴ <http://forums.thoughtsmedia.com/f379/taking-plunge-switching-apple-world-98914.html> downloaded on 08 December 2010

It should also be noted that this portable computer may well have been networked in another building if such a building had a LAN (local area network), but the practical and pervasive mobile use of a WAN (wide area network) commonly associated with the *mobile* telecommunications of today did not exist. Contrast the above to the relatively recent emergence of large, touch screen mobile handsets (spearheaded by Apple in 2007 with the iPhone) to appreciate the giant leap towards the vision of ubiquitous computing. Smart phones and to a lesser extent tablets, netbook and notebook computers enable “presence everywhere” much better since these “terminals” may be carried “into the field”. Many people carry their handsets with them everywhere. Presence everywhere was impractical in 1985. In 2014 it is widespread.

4.2 Attention-efficient technologies

Over the last decade Apple¹⁰⁵ has proven to be leaders in developing attention-efficient products and services. Their products are easy to use, intuitive and “just work”. To use Weiser’s words, Apple’s products and services require less “active attention” than those of their competitors, though their competitors are catching up. In a video by David Pogue¹⁰⁶, the New York Times technology columnist, the issue of the attention-efficiency of digital technologies is put across well. The key message is that in an attempt to make ICT technologies easier to use, they have accomplished the opposite with technologies that drain attention and immobilise people. He also provides a demonstration of the attention-efficiency of speech recognition, a key enabler of UEMI which has not yet become widely adopted.

The expensive smartphone category of mobile phones was struggling until Apple launched the intuitive, in other words, attention-efficient touch screen interface in 2007, which provides the closest of any handset to date to offer the sensation that one is operating it in the physical world. For example, its screen is sensitive to gravity and rotates intuitively (and attention-efficiently) as would the water level in a half-filled glass bottle. To operate the computer is done by swiping with one or more fingers, and pinching the touch screens and touch pads of the iPhone, iPad and laptop computers, instead of the more attention-draining locating of the scroll bar icon to then click and hold to scroll the screen of older mobile handset technologies.

¹⁰⁵ At the time of the writing of this study, Apple is commercially one of the most successful ICT companies in the world.

¹⁰⁶ “David Pogue: When it comes to tech, simplicity sells” at <http://www.youtube.com/watch?v=NEjZt0y6OOw>. Duration: 22 minutes and six seconds. Downloaded: 3 June 2011.

The size of an iPad computer is between a laptop and a mobile phone. Up until the launch of the iPad, every computer in this size category, (and there were numerous launches of this size computer) failed in the market. As is the case with the iPhone, the intuitive (i.e. attention-efficient) touch screen user interface and its fast response to interaction of the iPad made the difference. Since the launch of these intuitive, attention-efficient handsets, the “expensive” smartphone segment is the fastest growing one for handsets, and Apple was poised at the end of 2010 to become the largest company in the world¹⁰⁷, based mainly on the success of their two touch screen products: the iPhone and the larger iPad. The characteristic of attention-efficiency of ubiquitous computing is finding wide adoption in society, because it improves people’s productivity in many aspects of their lives.

4.3 Richness of information

Weick noted that representation of events by the information technology of 1985 was “in an incomplete, cryptic form”. The representation then contained “only what can be collected and processed through machines. That excludes sensory information, feelings, intuitions, and context – all of which are necessary for an accurate perception of what is happening.” Unfortunately Weick did not expand¹⁰⁸ on what state-of-the-art in IT looked like in 1985. He only mentions a “cryptic form” of events, “symbols” and “spreadsheets”. To that one may add ‘word processing’. The only network that was online to the mainframe computer had screen images that indeed were cryptic: monochrome green or orange lettering. Laptops did not feature in organisational life. Neither did mobile phones.

Since 1985 the progress in ICT has been remarkable. Advances in processing power, memory, screen technology and networking have occasioned that by 2010, technologies such as videoconferencing were becoming cost effective for some organisations. Although ultimate ubiquitous computing¹⁰⁹ is not upon us yet, rich communication is possible with

¹⁰⁷ See: “Apple poised to become largest public company in America” at <http://www.guardian.co.uk/technology/2010/oct/18/apple-largest-us-public-company> downloaded on 08 December 2010

¹⁰⁸ Information gathered from <http://www.computerhope.com/history/198090.htm> provided the following status indicators of electronic information technology in 1985:

- Microsoft Windows 1.0 was introduced in November 1985 and initially sold for \$100.00. Until then Microsoft sold MS-DOS 3.0 for the IBM PC AT and MS-DOS 3.1 for networks.
- Intel introduced the 80386 chipset in October 1985
- Paul Brainard of Aldus Corporation introduces Pagemaker for the Macintosh, a program that lets users mix type and graphics on the same page. The combination of this software and the new Apple LaserWriter laser printer helped create the desktop publishing field.

¹⁰⁹ Defined as interaction with computing that requires no active attention

current technologies. Good examples of electronic information technology-assisted communication are provided by Hans Rosling^{110 111}. These are a far cry from the spreadsheets on computer screens in 1985. Another example is telepresence. The picture in figure 8 below shows a three-dimensional telepresence audio-visual system¹¹² already available since 2010. The people across the table may very well sit on opposite sides of the globe.

Figure 8: Three dimensional telepresence audio-visual system



Improvements of telepresence audio-visual systems over the previous generation audio-visual systems include a screen resolution that has been bumped up to high definition (HD) and the sound to high fidelity (HiFi), whilst the people on the screen are typically presented in life-size. Weick's complaint in 1985 that terminals "excludes sensory information, feelings, intuitions, and context" has been addressed to a significant extent by electronically presenting life-size people (or any other environment that may be of interest; e.g. the sales area of a company, a brainstorm session or workshop, etc.), the ability to read body language, the ability to make proper eye contact, and in meeting room format, the sensation that the person is physically there.

¹¹⁰ <http://www.youtube.com/watch?v=jbkSRLYSOjo> (4 minutes and 48 seconds, excluding your download time)

¹¹¹ <http://www.youtube.com/watch?v=BZoKfap4g4w> (9 minutes and 16 seconds, excluding your download time)

¹¹² <http://spireglobal.com/products/product-detail.asp?id=SG-3DTP4000&s=Sony-Telepresence-Integrated-Room-System>

5 Five ubiquitous computing technologies that matter

Five ICT technologies have been identified to cover the scope of this thesis in investigating how UEMI and sensemaking may impact each other. They are a subset of UEMI technologies, which in turn, are a subset of ubiquitous computing.

5.1 Encoding personal memories

Looking back at the pre-digital camera age before the 1980s, when the recording of personal memories involved cumbersome manual operations, the encoding of personal memories was indeed not a ubiquitous¹¹³ experience. Poslad¹¹⁴ describes it as follows:

- “...before the advent of the digital camera, photography would entail manually taking a light reading and then manually setting the aperture and shutter speed of the camera in relation to the light reading so that the light exposure on to a light sensitive chemical film was correct. It involved manually focusing the lens system of the camera. The camera film behaved as a sequential recording media: a new recording requires winding the film to the next empty station.
- It involved waiting for the whole film of a set of images, typically 12 to 36, to be completed before sending the recorded film to a specialist film processing company with specialist equipment to convert the film into a specialist format that could be viewed. The creation of additional copies would also require the services of a specialist film processing company”

The diagram for digital photography in figure 9 on the next page paints the present picture; it is much more ubiquitous (but still has a long way to go to achieve true ubiquity) than the above scenario. Poslad’s exact words describe the current capability best:

- “The [digital] camera can autofocus and auto-expose recorded images and video so that recordings are automatically in focus and selected parts of the scene are lit to the optimum degree. The context of the recording such as the location and date/time is also automatically captured using inbuilt location and clock systems. The camera is aware that the person making a recording is perhaps interested in capturing people in a scene, in focus [good for detecting facial expressions and body language], even if they are off-centre.

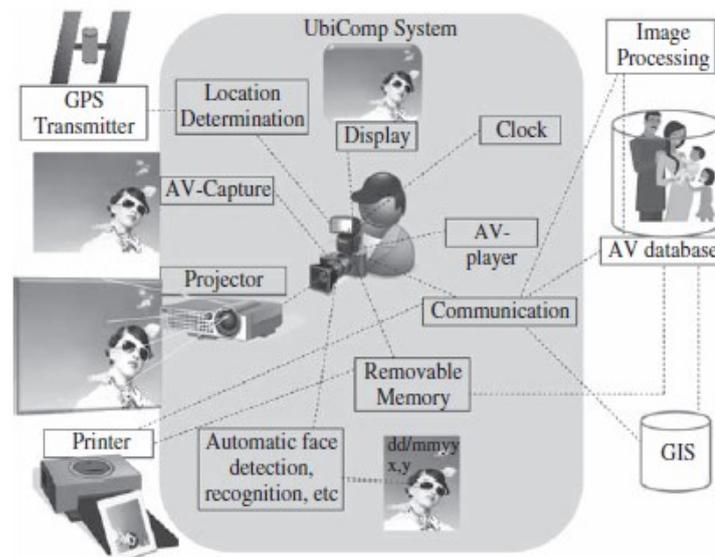
¹¹³ As defined in this thesis, ubiquitous means “everywhere”, “simultaneous” and “attention-efficient”

¹¹⁴ Poslad, S. 2009. *Ubiquitous computing: Smart devices, environments and interactions*, 3

The recorded content can be immediately viewed, printed and shared among friends and family using removable memory or exchanged across a communications network. It can be archived in an external audio-visual (AV) content database. When the AV is stored, it is tagged with the time and location (the GIS database is used to convert the position to a local context).

Image processing can be used to perform face recognition to automatically tag any people who can be recognised using the friends and family database. Through the use of micro electromechanical systems (MEMS) what previously needed to be a separate decimetre-sized device, e.g. a projector, can now be inbuilt. The camera is networked and has the capability to discover other specific types of ICT devices, e.g. printers, to allow printing to be initiated from the camera. Network access, music and video player and video camera functions could also be combined in a single device.”

Figure 9: Example of a current ubiquitous computing (UbiComp) application¹¹⁵



The AV-recording is person-aware, location-aware (via GPS), time-aware and networked to interact with other ICT devices such as printers and a family-and-friends database. Clearly something like the Looxcie shown in figure 10 on the next page is much more ubiquitous than the system shown in the diagram above. It is much more mobile, as it is worn on one's ear, but it suffers from a poorer picture quality when compared to more portable or stationary systems.

¹¹⁵ Diagram reproduced from Poslad, S. 2009. *Ubiquitous computing: Smart devices, environments and interactions*, 3

Figure 10: Looxcie increases ubiquity of personal memories¹¹⁶

Whilst this study contends that ubiquity has not yet been achieved, it also acknowledges that we are well on our way to this vision. For example, the video titled: “Deb Roy: The birth of a word”¹¹⁷ shows how a MIT researcher records his own home with an audio-visual recording system to track how his infant son learns to use the word “water”, starting at first with the word “gaga”. By analysing the footage he determined that his son learnt 512 words in two years, and as an aside, obtained the recording of when his son started to walk. But even more is possible. By analysing the spacio-temporal occurrences for any of those 512 words, he and his colleagues at MIT created wordscapes to show the prevalence of words used by his son in the house. These wordscapes are examples of augmented reality (discussed later in this chapter); they are graphically superimposed on the video of the house.

From a technical perspective (leaving aside for the moment issues such as e.g. privacy and cultural fit), a truly ubiquitous personal memory technology of the future would enable, inter alia, the following: personal audio-visual recording devices which are capable of accompanying one without one being consciously aware that they are there, like a tie pin, or even a bionic lens (covered later in this section). In other words, the recording should be as unobtrusive (i.e. as attention-efficient) as possible. In addition, all of its controls respond to (only one’s) voice command, but physical controls are also available for situations where silence is required. Audio-visual search is possible for words and images. Words should be searchable through both typing and talking. Images offered for search should be captured via cameras or fed in via photos or videos that are uploaded. Audio-visual footage recorded in

¹¹⁶ <http://www.looxcie.com/newsroom/multimedia-center/>

¹¹⁷ Video was downloaded on 10 May 2011 from: <http://www.youtube.com/watch?v=RE4ce4mexrU> It is 19 minutes and 53 seconds long

buildings such as public places, workplaces, friends' homes and one's own home will also be available for personal memories' digital archives, subject to any privacy requirements pertaining to those buildings, as CCTV footage of security cameras will not normally be available for personal memories. All of this should be affordable for mass adoption. Given the continued improvement in, for example, digital hardware performance, as per Moore's law¹¹⁸, we are getting closer to this goal.

5.2 Virtual presence

Poslad has little to say about virtual presence (telepresence): "Telepresence allows a person in one place to feel as if they are present in a remote place, to give the appearance that they are present and have an effect at a location other than their true location"¹¹⁹. For the purposes of sensemaking, virtual presence is potentially very important. It is often the case that people don't attend an important gathering or meeting because it is not practical, or cost-efficient to travel to the meeting. In an organisational setting the person not attending the meeting has to rely on the minutes of the meeting, or on the personal recollection of one or more attendants of the meeting.

Also, think of all the other arenas where sense is made in organisations, for example during teleconferences, talking on the phone between two people, or emails being sent and received. Even the AV (audio-visual) conference technology that has been used to date has often resulted in poor experiences. One sometimes struggles to recognise some of the people in the other room, let alone discern any body language. A poor visual experience during an AV conference actually drains attention, with the result that in many cases, employees have resorted back to teleconferences, without any visual communication. At least one's attention is fully focused on what has been said and what it means, and not on wondering (paying attention to determining) whether a colleague on the other side of the AV conference is grinning or grimacing. Therefore, this study contends that to gain maximum value from interacting with the meeting whilst not being physically there, virtual presence technologies need to be harnessed to replace some of the teleconferences attended, phone calls made, emails sent and missing important meetings.

¹¹⁸ Brynjolfsson E, McAfee A. 2011. *Race Against The Machine [Kindle Edition]*, 281

¹¹⁹ Poslad S. 2009. *Ubiquitous computing: Smart devices, environments and interactions*, 157

One may gain a good idea of what virtual presence may mean in the future by watching a video¹²⁰ of a glass manufacturer titled: “A Day Made of Glass... Made possible by Corning”, which illustrates their view of what virtual presence and other UEMI technologies will look like in the future; in mobile mode, at home and in the office. Note the seamless, in other words, attention-efficient transition being envisaged for communication from mobile screens to a screen in a motor vehicle, to a public kiosk screen to screens in rooms of houses and offices. The rich cues and interactivity afforded by virtual presence enables better sensemaking. Other benefits include digital archiving for later recall, a typical process of sensemaking. However, to make such recall attention-efficient, a good speech recognition system, with accuracy approaching human levels, is necessary.

Telepresence technologies have been making great strides in recent years. The main barrier to more rapid adoption is the cost of both the equipment required to enable the audio-visual interaction and the large bandwidth necessary to provide the high-definition visual and high-fidelity audio communication. Technically, much is already possible. The following video¹²¹, titled “Cisco TelePresence - On-Stage Holographic Video Conferencing”, states that hologram-based telepresence systems have already been sold in the market (28 countries at that time). What is expected to happen, as John Chambers, the Cisco CEO says in the video, is that this on-stage hologram system will be fine-tuned for business and ultimately for the home of the future.

5.3 Augmented reality

This quote from an article in *The Guardian*¹²² is instructive:

- “‘AR has been around for ages,’ says Andy Cameron, executive director of Fabrica, an interactive design studio which works with Benetton, ‘maybe going back as far as the 1970s and art installations that overlaid real spaces with something virtual.’ He mentions in particular the work of pioneering computer artist Myron Krueger. What’s changed in the past year is that AR has come within reach of all sorts of developers – and the technology powerful enough to make use of it is owned by millions of people, often in the palms of their hands.

¹²⁰ http://www.youtube.com/watch?v=6Cf7IL_eZ38. The video is 5 minutes 33 seconds long. Downloaded 25 May 2011

¹²¹ http://www.musion.co.uk/Cisco_TelePresence.html the video is 11 minutes 25 seconds long. Downloaded 25 May 2011

¹²² Arthur, A. 21 March 2010 “Augmented reality: it’s like real life, but better” downloaded on 20 March 2011 at <http://www.guardian.co.uk/technology/2010/mar/21/augmented-reality-iphone-advertising>

The arrival of powerful smartphones and computers with built-in video capabilities means that you don't have to wait for the AR effects as you do with TV. They can simply be overlaid onto real life. Step forward Apple's iPhone, and phones using Google's Android operating system, both of which are capable of overlaying information on top of a picture or video.”

One can see in the photo of an iPhone smartphone in Figure 11 below that the computer screen is now mobile and superimposed on a picture (or the view in the viewfinder) of an object (a building in this case), accompanied by information on the building, such as the history. The reality of the building is augmented by relevant information, for example, where the building is on a map.

Figure 11: Augmented reality on a smartphone¹²³



A more dramatic example of augmented reality is a video¹²⁴ titled “BMW augmented reality” in which a mechanic is taken through the necessary steps to replace a car part, using augmented reality. This formed part of BMW’s research into augmented reality. However, should one look through the lens of the requirement for attention-efficiency at this specific case of the replacement of a car part, it is doubtful whether this example of augmented reality will find application. The procedure is too simple, and humans – especially trained mechanics - should typically either remember, or work out the necessary steps without the cumbersome audio-visual glasses of the augmented reality application.

¹²³ <http://www.theguardian.com/technology/2010/mar/21/augmented-reality-iphone-advertising>

¹²⁴ “BMW augmented reality” at <http://www.youtube.com/watch?v=P9KPJIA5yds&feature=related>

Downloaded on 10 April 2011

Augmented reality has large potential, but only if it is attention-efficient. This BMW example should be viewed as the first learning steps of management figuring out how to make use of the capability of ICTs. Brynjolfsson refers to the fact that no productivity increase happened for the first 30 years after electricity replaced steam¹²⁵; roughly the time necessary for old management to retire and new management to have learned from the mistakes and missed opportunities of the previous generation of managers. Innovation indeed happens in fits and starts. Looking at the future of augmented reality technology, the following video¹²⁶, titled “Bionic lens” provides a pointer. The work being done at the University of Washington comprises the building of a computer screen into a contact lens and its linking to a computer carried on one’s person. What is interesting about this video is that it stages a quite passable alternative to the bionic lens by showing the projection of information onto the lenses of spectacles. Nothing is shown to cater for the audio technology though. Nevertheless, one gets an idea of where we are on the path to augmented reality being ubiquitous. Perhaps the best example of augmented reality is left for last. This rather exuberant video¹²⁷ shows applications already existing on the mobile smartphone, and states that we are only at the beginning of augmented reality. In summary, augmented reality may be seen as part of ubiquitous computing and it is currently undergoing rapid development.

5.4 Speech recognition technologies

Speech recognition is as difficult as it is important for UEMI-assisted sensemaking. This extract¹²⁸ puts the challenges well:

- “Speech recognition is a difficult problem, largely because of the many sources of variability associated with the signal. First, the acoustic realizations of phonemes, the smallest sound units of which words are composed, are highly dependent on the context in which they appear. These phonetic variabilities are exemplified by

¹²⁵ Erik Brynjolfsson: The key to growth? Race with the machines. Section 0:10 to 0:59 seconds of the 11:56 minute TED talk 2013. Posted April 2013

http://www.ted.com/talks/erik_brynjolfsson_the_key_to_growth_race_em_with_em_the_machines.html

¹²⁶ “Bionic lens” at <http://www.youtube.com/watch?v=-g1sjOOQYk&feature=related> Downloaded 20 May 2011

¹²⁷ “Layar - Impactful Augmented Reality in Your Everyday Life” at http://www.youtube.com/watch?v=HW9gU_4AUC 2 minutes and 15 seconds Downloaded on 29 May 2011

¹²⁸ Zue V. Cole R. Ward W. Undated. “1.2 Speech recognition” at <http://cslu.cse.ogi.edu/HLTsurvey/ch1node4.html> downloaded on 29 May 2011

the acoustic differences of the phoneme¹²⁹ /t/ in two, true, and butter in American English. At word boundaries, contextual variations can be quite dramatic---making gas shortage sound like gash shortage in American English, and *devo andare* sound like *devandare* in Italian.

Second, acoustic variabilities can result from changes in the environment as well as in the position and characteristics of the transducer. Third, within-speaker variabilities can result from changes in the speaker's physical and emotional state, speaking rate, or voice quality. Finally, differences in sociolinguistic background, dialect, and vocal tract size and shape can contribute to across-speaker variabilities.”

So where do we stand with speech recognition? A good blog on the Internet that was posted by experts provide a good picture. Titled “Rest in Peas: The Unrecognized Death of Speech Recognition”, Robert Fortner argues that *the best that speech recognition has ever achieved is 80% accuracy and that this peaked in 2001* and “flat-lined” from there, i.e. no improvement in word recognition accuracy has been experienced since then. He goes on to say:

“We have learned that speech is not just sounds. The acoustic signal doesn’t carry enough information for reliable interpretation, even when boosted by statistical analysis of terabytes of example phrases.

As the leading lights¹³⁰ of speech recognition acknowledged last May, “it is not possible to predict and collect separate data for any and all types of speech ... The approach of the last two decades has hit a dead end.”

It seems that speech recognition has a poor future seeing that humans typically have reported accuracy rates in excess of 96%; speech recognition was indeed doomed to “rest in peas”. However, it became clear that:

- It is technically correct, i.e. the accuracy of automatic speech recognition of normal conversational speech by anonymous people with a multitude of accents, linguistic abilities in general, noisy environments (as opposed to e.g. a call centre, or medical setting, etc., i.e. “snug linguistic boxes” as Fortner blogged it) will

¹²⁹ Linguistic symbols presented between slashes, e.g., /p/, /t/, /k/, refer to phonemes; the minimal sound unit, by changing it one changes the meaning of a word. The acoustic realizations of phonemes in speech are referred to as allophones, phones, or phonetic segments, and are presented in brackets, e.g., [p], [t], [k]

¹³⁰ Baker J. Et al. May 2009 at <http://research.microsoft.com/pubs/80528/SPM-MINDS-I.pdf>

probably never close the current gap on human accuracy. However, there are other ways of deriving practical value from speech recognition, as evidenced by the commercial success of e.g. Nuance¹³¹, the current global leader in speech recognition services

- When looking at e.g. dictation, accuracies approaching human accuracy have been achieved by commercial products like Nuance’s Dragon systems NaturallySpeaking. In some cases like in noisy environments, human accuracy has been exceeded. However, these high accuracies do not occur with everyone, and it does require the system to be “trained”, i.e. get to know a specific person’s particular accent, linguistic style, etc. This training requires a person to read for a few minutes to result in human-level accuracies
- One should note that humans’ accuracy is not 100%; it varies between 96% and 98%. This accuracy decreases when confronted with strangers with heavy accents, in noisy environments, in agitated emotional states, etc. But this has not precluded people from functioning well in society through this less than perfect speech recognition. The same ought to hold for speech recognition. Roberto Pieraccini¹³², who commented on the blog on 30 May 2010, put it well:
 - “Saying that speech recognition is dead because its accuracy falls far short of HAL-like levels of comprehension is like saying that aeronautical engineering is dead because commercial airplanes cannot go faster than 1,000 miles per hour, and by the way ... they cannot get people to the moon.”

Accurate-enough, attention-efficient speech recognition is *pivotal* in the vision for UEMI-based sensemaking proposed by this thesis. We need to understand what it can and can’t do. It appears that it is already practically possible to harness speech recognition in the following scenarios:

- Localities where speech is captured for recognition are the home, office and one’s personal smartphone,
- Everyone speaking at these localities is known to the system and trained the system for each voice. In an organisational setting it will involve every employee

¹³¹ See www.nuance.com

¹³² Pieracci, a speech recognition professional, elaborated on his pithy comment here: “Un-rest in Peas: The Unrecognized Life of Speech Recognition (or “Why we do not have HAL 9000 yet”)” at <http://robertopieraccini.blogspot.com/2010/05/un-rest-in-peas-unrecognized-life-of.html>

taking the 10 minutes or so to train the system. The same holds for the home setting. And the case will hold for the smartphone owner's colleagues and family. By extrapolating this idea, and ignoring for the moment potential privacy concerns, one may arrive at a situation that one's voice profile is stored on the cloud for permission-based usage in some settings, like at a conference or workshop with people outside the home and office domains

- When a group of people get together to talk, at work during a meeting or workshop, or at home, each person's voice is recorded from a unique (i.e. personal) microphone, so that the uniquely trained voice profile may be applied to the particular voice. Naturally, the transcription should be done chronologically for it to make sense

The above are some prerequisites for UEMI-assisted sensemaking, given that a foundation of UEMI processes will comprise digging back into digital archives for specific words or terms, to see in high definition audio-visual quality what people discussed in a broader context when using those words or terms and what their body language revealed. Figure 12 below shows how real-time, automated speech recognition and translation should work¹³³.

Figure 12: Real-time, automated speech recognition



Looking at the conversation between experts in the “Rest in peas” blog on page 49, it is doubtful whether this idealistic scenario will ever be possible. So we have to design UEMI around this probable constraint.

¹³³ Found at: <http://asiajin.com/blog/wp-content/uploads/2010/02/speech-translation-monitor-usage-illustration.png> Downloaded during December 2010

This video¹³⁴ demonstrating the ability of Adobe's Creative Suite 4 (the version before the version currently in the market) shows how the system has translated the speech and how it is now possible to search for the precise point in the video at which a word or phrase has been spoken. This ability provided by Adobe has helped video editors speed up their work. However, the eternal bugbear of speech recognition is visible; note how the system has mistaken almost 20% of the words spoken. For example, the first sentence of 29 words was spoken as follows, with omitted words in [] brackets and added or wrong words in <> brackets:

- “Michael thank you for joining us [could you give us] <the key to this> a little history of money and where we are today [Could] <if> you put it in a historical perspective [please].”

It appears that the system has not trained for the participants' voices, and so the poor error rates.

Turning to the current state of mobile dictation, a subset of speech recognition, the photo in figure 13 below shows the process with Nuance's Dragon software. In this case a video provides for richer, attention-efficient information as to how the service works. In the video¹³⁵ a Nuance official provides a demo of running their dictation service on a smartphone. It is sobering to see how slow the service is, notwithstanding the interviewer and Nuance official's comments to the contrary.

Figure 13: Voice recognition on a smartphone



Nevertheless, the way that this thesis envisages using UEMI in e.g. organisational sensemaking outside office buildings, speed is not that critical. That is because the key step is

¹³⁴ http://library.creativecow.net/articles/weiss_roth_david/speech_search/video-tutorial 1 minute 23 seconds
Downloaded on 25 May 2011

¹³⁵ <http://www.youtube.com/watch?v=WVUj2tfC8Hs> 11 minutes and 42 seconds. Downloaded on 25 May 2011

accurate capturing of audio-visual information or footage. What is more of a concern is the ability of a smartphone to adequately capture all of the voices and visual body language of however many employees may be talking in an open space. One possible solution is to dial into a service, like e.g. Skype video, and everyone then talks into his / her own smartphone which is then captured on a digital archive. This is rather unintuitive in view of people in such a setting being able to speak face-to-face, unless future smartphones are equipped with wide angle cameras and built-in stands so that each smartphone may be set up and then forgotten whilst carrying on with the meeting. Clearly some challenges still exist, and the mobile version will be the toughest nut to crack on the road to full UEMI-assisted sensemaking.

5.5 Encoding organisational memories

For the purposes of this thesis, the term *organisational memories* refers to the data and information¹³⁶ that is capable of being captured, stored and retrieved by ICTs. It specifically excludes what is stored in the memories of individuals, and de-facto memories embodied in organisational structures and routines. Key characteristics of such ICT-enabled organisational memories that a UEMI system should provide that stand out, include *relevance* and *speed* of recall. This speaks to attention-efficient recall; if the return on attention invested is poor (the system is slow and/or the information recalled is not relevant enough), the system will not be used¹³⁷. It also speaks to attention-efficient *digital archiving*. If it is too cumbersome, people in organisations will simply not capture organisational discourse and other memories, e.g. workshops or the sales process happening in an organisation's retail outlets. Secondly, the description points to another potential barrier to the adoption of UEMI in addition to privacy concerns and organisational hypocrisy as discussed earlier in this chapter. This is "individual's reluctance to admit mistakes and difficulties." This will be a barrier to adoption of UEMI, unless an appropriate culture is maintained in the organisation. Thirdly a good UEMI capability should counter, to some extent, the organisational memory loss due to staff leaving the organisation.

So how should UEMI feature in organisational memory in such a manner that it supports sensemaking? Simply put, it should harness the personal memories technologies; virtual presence; augmented reality and speech recognition technologies (mentioned earlier in this

¹³⁶ Section 2 in chapter 1 provides a detailed definition of *data* and *information* as used in this study

¹³⁷ The example of IBM's Watson provides an idea of what is (currently at least technically) possible in organisations. See section 1 of chapter 1

chapter) to provide rapid audio-visual archiving and recall of important parts of organisational life. Gathering places like board rooms, conference rooms, workshop rooms and other areas where employees meet ought to be equipped with high definition and high fidelity audio-visual capturing equipment. These may include various types of video cameras like wide angle and person-focused cameras and individual microphones, whether carried on one's person and/or situated at meeting tables. Large high definition screens ought to be installed on the walls of these meeting rooms so as to enable both telepresence for off-site meeting attendees, as well as the rapid playback via UEMI technologies of parts of previous meetings that may still be relevant at a current meeting. This could be used in lieu of, or in addition to written minutes and for the sake of attention efficiency be prepared by the meeting secretary prior to the current meeting. Should the discussion in e.g. a brainstorm workshop digress to material that, albeit on the agenda, had not been pre-prepared by the conveners of the meeting, a rapid (taking a maximum of a few seconds) UEMI capability to recall prior discussions in the organisation that were captured in these UEMI-equipped meeting rooms, will go a long way to assist with sensemaking by providing cues (information or data) on what is going on in the organisation, and what has been said by whom about the topic at hand. However, this only covers meeting rooms where employees gather to make sense of things. The same technologies could be used instead of phoning someone or sending an email. High quality audio-visual equipment on everyone's desk should enable and encourage people (provided other concerns like privacy, etc. are catered for) to use and capture for later use the audio-visual communication that will form part of organisational memory.

This capturing could also be expanded to people outside the organisations, to stakeholders such as customers, the government, etc. An example harnessed a lot in this thesis is that of capturing events the whole day, every day in the companies' retail stores from different camera angles. That ought to provide management with the raw material that they can recall later should they become aware that there may be a problem (or unexpected success) with a product, service or sales process. The ability to see the customers' experience on the sales arena in high quality audio-visual footage should enable the rich cues to make better sense of what is going on which may be masked by written or verbal employee reports.

Figure 14: Digitising customer interactions



An equivalent practise already in play comes from Audi (see figure 14 above), which has “digitised” part of their interaction with their vehicle repair customers. This article¹³⁸ states that “Following a successful pilot program, the German manufacturer's outfitting each Audi Centre in Britain with helmet cameras and two-way radios to let customers monitor the entire job. While this sounds fantastic from a consumer standpoint, you'll see mechanics and IT professionals in the audience sadly shaking their heads -- if you've ever had to explain a technical product to an Average Joe who thinks they know better than yourself, you'll understand there are certain disadvantages to this idea.” The article rightly warns about potential barriers to continued adoption and use of this system - unreasonable customers. However, the blade is double-edged here. Should an organisation be unfairly accused of poor or incompetent service, the organisation has the footage to show an objective picture. It should stand police forces in good stead as well. Any UEMI-captured interaction with suspected criminals should protect the honest, be they a police member or a suspect.

Conventional wisdom holds that the best way to communicate and learn is to have a face to face meeting with an expert, which enables richer cues. The only time to resort to pre-recorded audio-visual information is when the expert is not available. However there are exceptions, i.e. when it may be better to digest that which an expert has to say “off-line” in an audio-visual environment. This is because of other human factors in communication and learning such as peer and time pressures, different learning rates, etc.

¹³⁸ “Audi Cam lets you watch the entire repair from your mechanic's point of view” 7 July 2010 at <http://www.engadget.com/2010/07/07/audi-cam-lets-you-watch-the-entire-repair-from-your-mechanics-p/>. Article and photo downloaded 25 May 2011

In a video¹³⁹ titled “Salman Kahn: Let’s use video to reinvent education” Kahn, who worked in Boston, mentions tutoring his cousins who lived in New Orleans, and loading the tutoring sessions on YouTube for his cousins to refer back to. To his consternation, his cousins told him that they preferred him “on YouTube rather than in person”, i.e. they preferred the “automated version of their cousin to their cousin”. This is because in their preferred mode of learning they can “pause and repeat their cousin” without feeling that they are wasting their cousin’s time. They can review that which they should have learned a long time ago without feeling embarrassed in front of their cousin. They could now learn at their own time and at their own pace. It also took away a typical situation where when they were “trying for the very first time to get their heads around this new thing”, the last thing that they needed was for their tutor cousin to immediately ask “do you understand this?”, so as to enable him to pace his tutoring. Paying attention is not merely applying one’s mind over a time period (this is covered in more detail later in this thesis), but it also involves emotions and feelings of pressure due to consideration for others and potential embarrassment, as was the case of the Kahn’s cousins. UEMI-enabled audio-visual communication should enable similar benefits when people in organisations try to make sense of their environments. Whilst much of the success of the Kahn academy may be attributed to the personality of Kahn himself, it is also showing what can be done with electronically mediated informing (EMI). All that they need to do now is to make it truly ubiquitous.

A key part of ubiquity as defined in this thesis is attention-efficiency. It is of no use to set up a UEMI infrastructure in the work environment if people do not feel that they get an acceptable productivity from investing their attention to use the UEMI infrastructure. Leaving “soft” issues (privacy, peer pressure, legality, etc.) and cost justification aside for the moment, the technical ability to store every hour of every interaction inside the organisation and with the organisation’s stakeholders already exists. What is still doubtful from a technical point of view is whether interacting with this UEMI system will be worthwhile. The requirement of a UEMI system is to be able to capture and transcribe what was said almost instantaneously for immediate recall. It appears that that is possible. What is less certain is the accuracy of such transcription. In other words, should an employee search via voice command or by typing the search phrase for audio-visual footage that matches the search phrase, and the accuracy is so low that people need to try alternative search phrases to look

¹³⁹ “Salman Kahn: Let’s use video to reinvent education” at <http://www.youtube.com/watch?v=nTFEUsudhfs>
20 minutes 27 seconds

for something that they may not even be sure was discussed in the organisation, the service will fail. This is because people will feel that the return of such meagre benefits does not justify the investment of their attention to use the system.

Turning to augmented reality, this too is subject to cost-benefit calculations. But there is no doubt in the potential value for sensemaking. For example, the footage of events in a retail outlet may be better interpreted should it also show the outlet's sales performance over time and against other outlets.

6 Chapter summary

Weick¹⁴⁰ noted in 1985 that although “electronic information processing” changed organisations in profound ways, an unexpected change was that “electronic processing” made it “harder, not easier to understand events that are represented on screens”. In other words, as matters stood then, the information technology of the day resulted in people becoming “*increasingly* unable to make sense of the products of technology. [Emphasis added]” Since then we have progressed well on the journey towards ubiquitous computing with its capability to enable UEMI. This thesis contends that ubiquitous information technologies have the potential to remedy problems pointed out by Weick, and that they will have a positive impact on sensemaking.

Five technology bundles, collectively a sub-set of UEMI, which in turn is a sub-set of Ubiquitous computing, have been chosen to serve as a “testing ground” for the interactive impact between sensemaking and UEMI. They are personal memories, virtual presence, augmented reality, speech recognition and organisational memories. In essence, the digital audio-visual nature of these UEMI technologies ought to enable a richer and more comprehensive set of cues to be made available for sensemaking in a way that is attention-efficient and better able (than current practise) to keep up with one's train and pace of thought.

¹⁴⁰ Weick K. 1985. Cosmos vs. chaos: Sense and nonsense in electronic contexts. *Organisational Dynamics*, Fall, 14. American Management Association

Chapter 3

Sensemaking theory

The writing of a thesis consumes a lot of attention and it runs the risk of being read only by its examiners. It is hoped that at least part of this thesis will be read by other people as well, and with this in mind, the structure, content and writing style of this chapter in which sensemaking is reviewed is aimed at being informative to both the examiners and non-experts, e.g. people who have to make sense of their businesses on a daily basis.

1 Sensemaking in short and in context

Sensemaking is that which gives meaning to experience. A sensemaking episode is typically triggered when “an expectation of continuity is breached”¹⁴¹. One then focuses attention on making sense of this unexpected discontinuity. Once sense has been made one is comfortable enough to carry on living, at least in that part, or role, or project in life which suffered said discontinuity and at least until a next discontinuity triggers a next sensemaking episode.

One striking aspect of current sensemaking theory is that in principle it has little to do with accuracy – i.e. how close the sense that was made, aligns with reality¹⁴². What matters is that the sense that the individual makes enables him/her to carry on with life to an acceptable level of tranquillity. Weick (1995) puts it like this: “... the feeling of order, clarity, and rationality is an important goal of sensemaking, which means that once this feeling is achieved, further retrospective sensemaking stops”¹⁴³. Weick (1995)¹⁴⁴ also quotes from Fiske (1992) to provide another image of sensemaking, which is seen as taking “a relative approach to truth, predicting that people will believe what can account for sensory experience but what is also interesting, attractive, emotionally appealing and goal relevant”.

¹⁴¹ Organising and the Process of Sensemaking. Chapter 8 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 140

¹⁴² On first reflection when studying sensemaking one may reasonably conclude that should an instance occur when the sense that was made is perfectly aligned with reality, it is most probably by accident.

¹⁴³ Weick K. 1995. *Sensemaking in organisations*, 29

¹⁴⁴ Weick K. 1995. *Sensemaking in organisations*, 57

This position of sensemaking having little to do with accuracy has been maintained, if not strengthened, over the years. In a 2005 article¹⁴⁵ Weick states flatly¹⁴⁶:

“*Sensemaking is not about truth and getting it right* [Emphasis added]. Instead, it is about continued redrafting of an emerging story so that it becomes more comprehensive, incorporates more of the observed data, and is more resilient in the face of criticism.”

Should inaccurate sensemaking (the deviation of the sense made from reality) have practical and noted negative and puzzling consequences, these will become triggers for new iterations of sensemaking.

2 Introductory examples of individual and organisational sensemaking

Sensemaking may involve the solving of a mundane problem such as the loss of keys; e.g. pondering on why they have been lost and what led to them being lost or mislaid, and finding them, or accepting that they are lost and getting the locksmith to open the door so as to carry on with life. Or it may be more fundamental, such as depicted in the following specific example cited by Weick¹⁴⁷:

- “... Bennis gave an evening lecture at the Harvard School of Education while he was president of the University of Cincinnati. Everything came together in a superb performance. During the upbeat Q and A session after the speech, Bennis was startled when the dean, Paul Ylvisaker, asked quietly, “Warren, do you really love being president of Cincinnati?” Bennis did not have a snappy answer. In fact, he did not have any answer. After an interminable silence, in a room that quieted dramatically, Bennis finally said, “I don’t know.” Shortly thereafter, he came to

¹⁴⁵ Organising and the Process of Sensemaking. Chapter 8 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 141

¹⁴⁶ This position espoused by Weick is a major point of contention for the writer of this thesis. In short; the fact that that is how sensemaking occurs on a daily basis ought not to prevent the sensemaking theorist, if he takes seriously the notion that the creation of theory ought to be of value to society, to seek ways to enable sensemaking to be more about “truth and getting it right”. It is nonsense to ignore that especially in high-stakes cases the sensemakers involved do *attempt* to make sense in a way to “get it right” the first time. This contention is expanded upon in chapter 4 of this thesis. In essence the writer of this thesis proposes the following re-write of Weick’s statement: “For practical reasons, sensemaking seldom achieves truth or gets it right. This may have negative consequences for the sensemaker. It therefore behoves the sensemaking theorist to look for ways to reduce sensemaking inaccuracy, from the first iteration of sensemaking to the last one.”

¹⁴⁷ Leadership as the Legitimation of Doubt. Chapter 15 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 263

the realisation that he loved being a college president but hated doing college presidency, and left Cincinnati.

Why do I flag this as a moment that can carry the message of leadership for an entire century? Notice what Bennis did not say. He did not say, I can't choose between yes and no. The question of whether he loves being a president is not a problem in decision making. It is deeper than that. It is an issue of meaning, direction and sensemaking.”

Sensemaking also happens at organisational level. A criminal investigation is an example of organisational sensemaking, which starts with the discovery of a criminal act, and ends in a number of ways: a convicted criminal; a dormant, but still open file; or perhaps a wrongful conviction, which may, or may not come to light later. The unexpected loss of market share by a company or its competitor, or whether to expand business into a new country or region are all occasions, or instigations, for sensemaking.

A good example cited by Weick of an occasion that triggered sensemaking¹⁴⁸ is the receipt by the British museum in 1798 of a then unknown Australian “animal” specimen which had a mole-like body, duck's bill, otter-like feet, and a spur on the rear leg that was venomous. The naturalists at the museum found this animal so implausible that they concluded it to be a hoax and searched for the stitches on the specimen to show that it had been stitched together from different animals. Imagine seeing the animal depicted in the two photos¹⁴⁹ in figure 15 on the next page (but dead and out of its natural environment) for the first time. Found only in Tasmania and eastern Australia, the Platypus is now considered perfectly designed for its environment.

¹⁴⁸ Setting the scene – Chapter 8: Organising and the Process of Sensemaking. Making sense of the Organisation, Volume 2. 2009

¹⁴⁹ The bulk of academic material read on sensemaking is presented via only *words*. In addition, sensemaking theory holds that *words* are the building blocks of sensemaking. This thesis emphasizes (e.g. in Chapter 4) the role of visual images (static and dynamic) in sensemaking and subscribes to the notion that a picture is a thousand words, a video is a thousand pictures and the best sensemaking is made by combining words, pictures and video, if presence in person is not possible. Hence photos of the Platypus are provided in addition to the description in words.

Figure 15: The Duckbill Platypus¹⁵⁰

Another, non-humorous example of sensemaking is cited by Weick in his notable book published in 1995 “Sensemaking in organisations”¹⁵¹. Weick’s own words are best to introduce this example (also the first words of Chapter 1 of the book):

- “Sensemaking is tested to the extreme when people encounter an event whose occurrence is so implausible that they hesitate to report it for fear they will not be believed. In essence, these people think to themselves, it can’t be, therefore, it isn’t. Just such an event is the battered child syndrome.”

This sensemaking process is described by Weick as having started with a first article in 1946 by a paediatric radiologist, in which parents gave histories that were “silent” of how injuries, seen in X-ray photographs, had occurred. The author speculated that parents did not fully appreciate the seriousness of the injuries or “intentional ill treatment”. Fifteen years later in 1961 that sensemaking process resulted in a panel being formed at the American Academy of Pediatrics, titled “The Battered Child Syndrome” (BCS), and within a few years after that, all 50 states in the USA required that suspected cases of BCS had to be reported by medical staff.

3 Aspects of sensemaking

Being a pervasive part of the human condition, sensemaking has many aspects. For example, in juxtaposing sensemaking and organizing, Weick describes sensemaking as follows: “Viewed as a *significant process of organizing* [Emphasis added], sensemaking unfolds as a sequence in which people concerned with identity in the social context of others engage ongoing circumstances from which they extract cues and make plausible sense

¹⁵⁰ <http://www.creationscience.com/onlinebook/LifeSciences13.html> downloaded on 17 November 2013

¹⁵¹ The reading Weick’s 1995 book triggered the sensemaking in this thesis

retrospectively while enacting more or less order into these ongoing circumstances.”¹⁵² The meaning of this sentence will be described in detail in sections 3.1 to 3.7 below.

Another notable aspect of sensemaking is its relationship with decision-making. Whilst decision-making typically involves a choice between contending options, sensemaking involves the making of meaning which guides life and its projects. The idea is that once meaning is made the direction that one’s life projects should take is often self-evident, thus obviating the need for decision-making. However, sensemaking does not preclude decision-making. The better the sensemaking that occurs before decision-making, the better the decision(s) ought to be. Weick admits as much when he comments on the sensemaking that Warren Bennis did before leaving the University of Cincinnati:

“When he said, “I don’t know,” that was a strong act of leadership, not a weak one. It was strong because it positioned him for the sensemaking that he needed to do, not for the decision making that would come later as a *minor by-product* [Emphasis added] of sensemaking. To lead in the future is to be less in thrall of decision making- and more in thrall of sensemaking”¹⁵³

As is the case with electronic mediated informing, Weick has a somewhat dim view of decision-making. Weick essentially argues that when it comes to “deeper”¹⁵⁴ issues, issues such as leadership and strategy in organisations, the preferred making that ought to be done is sense, not decisions. One memorable example provided by Weick is that of Paul Gleason, one of “the five best wild-land fire-fighters in the world”¹⁵⁵ who stated:

“If I make a decision it is a possession, I take pride in it, I tend to defend it and not listen to those who question it. If I make sense, then this is more dynamic and I listen and I can change it. A decision is something you polish. Sensemaking is a direction for the next period”¹⁵⁶

¹⁵² Organising and the Process of Sensemaking. Chapter 8 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 131

¹⁵³ Leadership as the Legitimation of Doubt. Chapter 15 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 263

¹⁵⁴ Note the case of Warren Bennis, as described in the previous section.

¹⁵⁵ Leadership as the Legitimation of Doubt. Chapter 15 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 264

¹⁵⁶ Leadership as the Legitimation of Doubt. Chapter 15 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 266

Weick is impressed with Gleason's "commitment to sensemaking"¹⁵⁷, which is evident from the example of the practise of posting "a lookout whose job it is to monitor the relationship between the oncoming fire and the crew and to warn if the distance between the two gets too small". What is especially interesting is the ratio of resources invested in sensemaking to the resources used to actually carry out the work. On especially hazardous fires, Gleason has assigned as many as sixteen people to be lookouts, leaving only four people to actually fight the fire¹⁵⁸.

The process of sensemaking comprises many or all of seven elements that were identified by Weick (1995) and referred to as seven "properties" of the process of sensemaking. Ten years later Weick (2005)¹⁵⁹ refers to the seven properties as "resources"¹⁶⁰ for sensemaking, with a concomitant acronym: SIR COPE. This refers to the labels of those seven resources: social, identity, retrospect, cues, on-going, plausible and enactment, which are considered in more detail below:

3.1 Identity

The interaction between sensemaking and identity will be explained by using a building as a metaphor. For both an individual sensemaker and an organisation, identity provides the foundation on which sense is made (and remade, as we shall later see). Who the individual is or what the individual's organisation is (the foundation) will have an impact on what the sense being made by the individual or the organisation (the rest of the building), will look like.

How is this impact manifested? Weick (1995) harnesses the theory of cultural self-representation by Erez and Early¹⁶¹, which states that identity (sense of self) operates in service of three needs; the need for self-enhancement, self-efficacy and self-consistency. One

¹⁵⁷ Leadership as the Legitimation of Doubt. Chapter 15 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 264

¹⁵⁸ This example informs a key themes proposed in this thesis. One is that the *quality* of sensemaking (i.e. *accuracy*, or the fit to reality) matters, especially in high-risk situations, also labelled "Risky reality" in this thesis. Should Gleason not have posted (i.e. invested) 16 but only one lookout in a particularly dangerous fire, the accuracy of the sensemaking – plausible as it may have been for the one lookout – may have been inadequate to prevent loss of life. The gap between sensemaking and accuracy matters very much here and the management of the organisation is aimed at minimising this gap.

¹⁵⁹ Managing the Unexpected: Complexity as Distributed Sensemaking. Chapter 5 in Reuben R. McDaniel Jr and Dean J. Driebe (Eds.), *Uncertainty and Surprise in Complex Systems: Questions on Working with the Unexpected*, Springer-Verlag, 2005, 51 – 78

¹⁶⁰ The term "resources" is preferred in this thesis, as it indicates a measure of *quantity*, *finiteness*, and *scarcity* which is prevalent in plausible sensemaking.

¹⁶¹ Erez, M. & Early, P.C. (1993). *Culture, Self-Identity and Work*. New York: Oxford University Press.

seeks and strives to maintain 1.) a positive cognitive and emotional state; 2.) a perception of oneself as competent and 3.) a sense and experience of coherence and continuity.

The way in which we make sense will thus attempt to accommodate the above needs. However, things change in life and in sensemaking neither the foundation nor the rest of the building is static. Should things shift in that which sense has been made of, then a change in the identity of the individual or the individual's organisation is also a probability.

In this buildings model the identity is the foundation, the sense being made is the building on top of the foundation, and the three individual needs are represented as the fit between the building and the foundation.

Things in life change (the functionality demanded from the building changes) and so the building needs to be changed to accommodate these new or changed demands (new sense needs to be made); a room is changed into a toilet, a bedroom is changed into a study or a second floor is built. These may require no change to the foundation (identity).

However, some changes may well require a change to the foundation (the individual or organisation's identity). New foundations need to be built (changes to one's identity) when a new boat has to be housed next to the cars' garages, or a stronger foundation is built to accommodate additional floors above the ground floor.

The point is that whilst identity (the foundation) forms the sense being made (the building), the opposite also happens. New events may trigger new sensemaking, and some of this new sense requires an adjustment to the identity (the foundation)¹⁶².

However, all of these changes in the identity-dependent sense that is made and its correspondent sense-dependent identity being adjusted refer to only one role being played by the individual, e.g. a strategist in a multinational corporation.

People live out many roles. An individual lives as an employee, a mentor, a deacon of the church, a community committee member, a parent, a child, a mountain rescue volunteer, etc. To expand our model of buildings, there are many types of buildings (identity/identity

¹⁶² At the time of writing this section of this thesis, a drama was unfolding in Chile, where 33 trapped miners underground experienced what is described above. The sensemaking of events, i.e. the mining accident and subsequent rescue operation, have changed the individual identities of ordinary miners – as reported by the news media – from ordinary people to those of “heroes”.

The reason for being described as “heroes” is because they appeared to not have cracked under pressure and adversity (for the first 17 days after the accident they did not know whether they would ever be found). It may be so that some, or all, of the individuals may not see themselves as “heroes” but it makes sense that their identities, their sense of self, have changed since the mining accident.

needs/sense units) in which one spends part of one's life: parent's house, apartment, university buildings, one's own house, sports stadium, golf house, bar, theatre, hospital operation theatre, old age home, etc.

Whilst Weick (1995) does not explicitly refer to roles, he does say that "no individual acts like a single sensemaker" and goes on to quote Mead's words of "a parliament of selves". So, "depending who I am, my definition of what is 'out there', will also change"¹⁶³.

So who the individual is may change as a result of the sense that the individual has had to make within a role and will change according to the different roles that the individual has in life.

3.2 Retrospect

The foundation of the retrospective aspect of sensemaking is time. Weick (1969)¹⁶⁴ states that: "time exists in two distinct forms, as pure duration and as discrete segments with spatio-temporal properties." Pure duration is also described as "flow of duration" or a "stream of experience". Meaning, or sense of this flow of duration, cannot be made whilst being within this flow.

Sensemaking thus involves stepping out of this stream of experience and the chopping up of this stream of experience or flow into segments, or distinct experiences. Sense (or meaning) is then made when one pays attention to these experiences that now lie in the *past*. Sensemaking can be made only retrospectively, never in the moment.

Schutz (1967)¹⁶⁵ puts it as follows:

- "Thought is focused on the objects of the spatiotemporal world; life pertains to duration. The tension between the two is of the essence of the 'meaningfulness' of experience. It is misleading to say that experiences *have* [Emphasis added] meaning. Meaning does not lie in the experience. Rather, those experiences are meaningful which are grasped reflectively. The meaning is the *way* [Emphasis added] in which the Ego regards its experience. The meaning lies in the attitude of the Ego toward that part of the stream of consciousness which has already flowed by, toward its 'elapsed duration'."

¹⁶³ Weick K. 1995. *Sensemaking in Organization*, 18

¹⁶⁴ Weick K. 1969. *The social Psychology of Organizing*, 91

¹⁶⁵ Schutz A. (1967) *The phenomenology of the social world*, 69

This “stepping out of” and “chopping up of” a stream of experience, or the “reflective grasping of experiences” mentioned above is also referred to as an “act of attention”, which itself is part of a flow of duration - a stream of experience. One is always in a stream of experience, even when one “steps out of”, or “chops up” parts of another stream. One is always experiencing, but we can only pay attention to (make sense or make meaning of) past experiences.

3.3 Enactment

Churchill once said: “We shape our buildings, and afterwards our buildings shape us”¹⁶⁶, to which one should add that we then sometime in the future reshape the buildings, and so on, in a never ending cycle.

The above metaphor is a good one to understand for one aspect of enactment; that we shape our environment whilst simultaneously our environment shapes us and our lives. We are part of our environment, and often what we do creates limitations and opportunities that we then may, or have to respond to accordingly.

Another aspect of enactment is that one must act in order to make sense. For example, Weick often refers to the action of “saying” which makes it possible, and is also a pre-condition to “see” what one thinks. The exact phrase¹⁶⁷ that Weick uses repeatedly in his work on sensemaking is “How can I know what I think till I see what I say”¹⁶⁸?

However, one needs to entertain the possibility of making sense without expressing a single word; neither silently nor out loud. Let’s look at an example: if a soccer player suddenly

¹⁶⁶ See <http://www.winstonchurchill.org/learn/speeches/quotations>

¹⁶⁷ Weick K. 1995, 12 recounts the story of a little girl who, being told to be sure of her meaning before she spoke, uttered the phrase.

¹⁶⁸ Although the theory of sensemaking, as presented by Weick (1995) immediately made much sense to the writer of this report, this phrase was one of the toughest nuts to crack.

At face value, the phrase follows the sensemaking theory, as understood by the writer of this thesis. You think in pure duration, but you cannot know what you think until you have committed the act of attention on that which you have thought about at any time in the past, expressed what you have found about what you have thought, and then observed what you have expressed. In other words, only when one has seen (observed) what one has said (expressed), is one able to know what one has thought.

However it is not clear to the writer of this thesis whether or not Weick adopted the phrase’s term “say” literally, i.e. verbally expressing words. It makes sense that the label “say” refers not only to the verbal expression of words, but also to the mental – i.e. silent - expression of words. It should also not exclude mental expressions in images, body language or sounds for example, if such images and sounds adequately express what one has found one was thinking. Given that a common theme of Weick’s work on sensemaking is the focus on words, and possibly literally saying them – i.e. expressing them verbally, Weick’s pet phrase will still cause much sensemaking for the writer of this thesis in the future. However, the possibility should be entertained that sensemaking without using *any* words, whether silently thought or expressed in speech, is possible, and occurs frequently, perhaps evidenced as a hunch, a gut-feel; but that should be the subject matter of another study.

changes course and attacks in a new direction, and whilst doing so hears the roar of the crowd; what sense may he make? That his line of attack has real potential to score a goal? Or maybe that out of his field of sight his team member fouled an opponent which the referee is about to penalise?

Looking back at the few seconds of his immediate past whilst trying to score a goal or passing the ball to a team mate, will he verbalise the sense he is trying to make of the roar of the crowd? Maybe a facial expression (e.g. expressing joy at seeing the goal mouth open, which confirms his *feeling* that the crowd saw the opportunity as well, and roared their approval of the new direction he took) will suffice? In other words, does one *always* have to *verbally express* meaning (loudly or silently), or may you also *feel* meaning¹⁶⁹?

A third aspect of enactment in sensemaking and in a sense the external equivalent of the internal process as discussed in the second aspect is that one often has to prod, or act upon the environment to see what is in it; to see what is out there. Sometimes cues come to us. And sometimes they are found by acting on the environment.

3.4 Social

Thinking of a world of inanimate objects and people¹⁷⁰ it may be fairly easy to come up with instances where sensemaking seems devoid of people, apart from the individual sensemaker. The earlier example of someone losing his keys may be one, if that person is alone at home.

Weick's contention is that sensemaking is always social, i.e. it always involves other people, and quotes his own earlier work, and various works by others to substantiate his contention. From Resnick, Levine and Teasley¹⁷¹ he quotes as follows: "human thinking and social functioning...[are] essential aspects of one another." He takes from Walsh and Ungson¹⁷² the following on an organisation, which is "a network of intersubjectively shared meanings that are sustained through the development and use of a common language and everyday social interaction"

¹⁶⁹ Please note that this thesis will not try to prove or disprove every perceived gap in sensemaking theory that is pointed out or even briefly discussed in this thesis. Whether sensemaking is impossible to be made without expressing words aloud or in the mind has little to do with the main question of this thesis, namely the mutual impact between sensemaking and electronically mediated informing. Perhaps a reader of this thesis concurs with the writer that it is a puzzle, and proceeds to explore it, or contacts the writer and explains it to him.

¹⁷⁰ Weick K. 1995. *Sensemaking in Organisations*, 44. In this section on the "on-going" property of sensemaking, Weick talks of "Our interactions with other people and with the inanimate world."

¹⁷¹ Resnick L, Levine J and Teasley S. 1991 *Perspectives on socially shared cognition*,3

¹⁷² Walsh J, Ungson G. 1991. Organizational memory. *Academy of Management Review*, 16, 60

Weick views the social aspect of sensemaking as a “constant substrate that shapes interpretations and interpreting”¹⁷³. Conduct is contingent on the conduct of others: actual, imagined or implied. The imagined and implied presence of others forms the bulk of the argument that sensemaking is social, even if the sensemaker is alone for long periods of time.

This quote from Burns and Stalker¹⁷⁴ provides more meat to the bones of this idea:

- “In working environments decisions are made either in the presence of others or *with the knowledge that they will have to be implemented, or understood, or approved by others*. The set of considerations called into relevance on any decision-making occasion has therefore to be one shared with others or acceptable to them. [Italics added by Weick]”

So in the simple case of losing one’s keys, a decision to call in a locksmith and replace the lock and keys may require consideration for the impact on fellow occupants of the house that may share expenses or require to be given the new key to enter the house.

If a child burns his hand on a stove plate (an object) he will treat all stove plates with caution in the future, because he has made sense that stove plates may be hot and burn you. So then, is this instance of sensemaking devoid of a social aspect? Probably not; he will probably run to his mother for sympathy and treatment, or run away from his mother because she told him before to stay away from the stove. You can’t get away from people, their customs or their language¹⁷⁵, whether they are present or not.

The same holds true for other more complex cases of sensemaking. Weick says that “sensemaking is never solitary because what a person does internally is contingent on others. Even monologues and one-way communications presume an audience. And the monologue changes as the audience changes.” Presumably the same is the case when one writes a personal diary for private reflection or future reference.

Many settings exist in which sensemaking is clearly social; e.g. the settings where clear socialisation exist, such as the introduction of a stranger into a group or an apprentice to a job

¹⁷³ Weick, K. (1995). *Sensemaking in Organisations*, 39

¹⁷⁴ Burns T, Stalker G. 1961. *The management of innovation*, 118

¹⁷⁵ In Weick K. (1995). *Sensemaking in Organisations*, 41, the following quote is apt: “People who study sensemaking pay a lot of attention to talk, discourse, and conversation because that is how a lot of social contact is mediated”

which involves the need for newcomers to “learn both how to interpret and how to express themselves in the natives’ vernacular”¹⁷⁶.

Weick also notes the importance of keeping in mind that the social nature of sensemaking goes beyond shared meanings and social constructions. It also comprises instances of joint action where shared meanings are absent. The story below provides substance for the claim of Czarniawska-Joerges¹⁷⁷ that “...shared meaning is not what is crucial [but not necessarily unnecessary] for collective action, but rather it is the experience of the collective action that is shared”:

- “My two colleagues went to hear a speech given by a well-known businessman. One ‘participated in a most exciting encounter between the wisdom of practice and the curiosity of theory,’ whereas the other ‘took part in an extremely boring meeting with an elderly gentleman who told old jokes’. They are each, nevertheless, members of the same organization, and what was common for them was that they went to the same room at the same hour, sharing only the idea that their bosses expected it” ¹⁷⁸.

It is often stated that common values is the glue that holds society together. Often one hears a CEO go forth on how his organisation’s success is based on their common values, amongst other things. However, success often comes from common and co-ordinated action, whether it is based on common values or not.

This quote provided by Weick from the work of Blumer¹⁷⁹ paints this picture well:

- “The participants may fit their acts to one another in orderly joint actions on the basis of compromise, out of duress, because they may use one another in achieving their respective ends, because it is the sensible thing to do, or out of sheer necessity...In very large measure, society becomes the formation of *workable* relations. [Italics added by Weick]”

3.5 On-going

Weick appears to contradict himself on this property of sensemaking. On the one hand he states that sensemaking occurs in episodes¹⁸⁰ (e.g. it is “triggered”) whilst on the other, in the

¹⁷⁶ Weick K, 1995. *Sensemaking in Organisations*, 41

¹⁷⁷ 1992, p 188 in Chapter 8, as quoted by Weick K. 1995 *Sensemaking in organisations*, 42

¹⁷⁸ Czarniawska-Joerges. 1992. *Exploring complex organizations: A cultural perspective*, 33

¹⁷⁹ Blumer H, 1969, *Symbolic interactionism: Perspective and method*, 76.

same book, he states that “sensemaking never starts.” This implies that it never stops; which is ostensibly in line with the ‘on-going’ property of sensemaking. He goes on to say that “The reason it never starts is that pure duration never stops. People are always in the middle of things, which become things, only when those same people focus on the past from some point beyond it”¹⁸¹.

How does one make sense of this? Sense is made when we express that which was paid attention to in life. We do not make sense, i.e. “focus on the past from some point beyond it” all of the time. When we are focusing on the past, that act of sensemaking also occurs as pure duration. When we make sense of that sensemaking it also occurs in pure duration, hence Weick’s contention that “pure duration never stops” whether one is making sense or just living life.

However, what does the “on-going” property of sensemaking mean? When one has made sense one is comfortable enough to carry on living, at least in that part or project in life and at least until the next sensemaking episode is triggered. However, life is lived on many levels and through many projects simultaneously executed, all of which interact directly and indirectly with each other, and any one or more of which may be subject to sensemaking. In other words, whilst one is technically not making sense all of the time on one project, sensemaking is “on-going” both in a sense that one jumps from making sense in project to another related project, and in the sense that for a specific project, it oftentimes is a work-in-progress, and that it occurs within a “reality of continuity, thrownness, and flows”¹⁸².

A good description of this “work-in-progress” nature of sensemaking is provided by a quote highlighted by Weick¹⁸³: “there are no absolute starting points, no self-evident, self-contained certainties on which we can build, because we always find ourselves in the middle of complex situations which we try to disentangle by making, then revising, provisional assumptions.”

Those revised provisional assumptions remain provisional, and may be revised again in an iterative fashion until the sense made is satisfactory enough to enable the sensemaker to cease that particular sensemaking, and carry on with the interrupted project, or with life. However

¹⁸⁰ Weick (1995) refers to “Occasions for sensemaking” which is the title of chapter 4 of the book.

¹⁸¹ Weick K.1995. *Sensemaking in Organisations*, 43

¹⁸² Weick K.1995. *Sensemaking in Organisations*, 4.

¹⁸³ Weick quoted Burrell and Morgan, who cited Rickman, who noted from Dilthey’s adaption to social phenomena, of Heidegger’s hermeneutic circle.

the assumptions that stood when that particular sensemaking ceased, should still be considered provisional. Sensemaking is mostly a work-in-progress, it is on-going.

Risking a conflation between the on-going nature of pure duration and that of sensemaking, the label “on-going” also refers, according to Weick¹⁸⁴, to “Heidegger’s idea that people find themselves thrown into on-going situations and have to make do if they want to make sense of what is happening.”

Weick harnesses this quote from the work of Winograd and Flores to illustrate how on-going life is: “Our interactions with other people and with the inanimate world we inhabit put us into a situation of thrownness, for which the metaphor of the meeting is much more apt than the metaphor of the objective detached scientist who makes observations, forms hypothesis, and consciously chooses a rational course of action.” In other words, life is not like a laboratory. Sensemaking will therefore normally not occur like sensemaking in a laboratory. It is more like a meeting and sometimes like an accident, sometimes a deadly one¹⁸⁵. Sense will therefore be made accordingly.

An important issue raised by Weick regarding the on-going nature of life is the consequence of interruptions in life, namely emotion. An interruption of an on-going activity, or an interruption of an *expectation*, causes an arousal, a discharge in the autonomic nervous system. This arousal causes an emotion which depends on the nature of the interruption. The longer the interruption or the larger the expectation gap is, the stronger the emotion. Positive outcomes of an expectation gap will yield positive emotions; e.g. pleasure. Negative outcomes will engender negative emotions. The same holds true for interruptions. If people find that an interruption with negative consequences can be circumvented, they will experience relief.

An important issue pertaining to emotion should be noted here. Emotions impact sensemaking because people remember those events that had the same emotions as those being felt at the time of sensemaking¹⁸⁶. Weick states that “past events are reconstructed in

¹⁸⁴ Weick, K.1995. *Sensemaking in Organisations*, 43

¹⁸⁵ See e.g. Weick, K. 1993. *The collapse of sensemaking in organizations: The Mann Gulch disaster*. This involved the death of 13 men in the Mann Gulch fire disaster which occurred on 5 August in 1949, which was made famous by the book *Young Men and Fire*, written by Norman Maclean

¹⁸⁶ Weick, K.1995. *Sensemaking in Organisations*, p.49. quotes Snyder M & White P. 1982. Moods and memories: Elation, depression, and the remembering of the events in one’s life. *Journal of personality*, 50, 149 - 167

the present as explanations, not because they look the same but because they *feel* [Emphasis added] the same.”

Weick goes on to note that this may result in more “difficult” sensemaking, because “it tries to mate two very different forms of evidence”. That makes sense.

3.6 Cues

The following quote by Weick¹⁸⁷ is as good an entry to this section as any other: “We need to pay attention to ways people notice, extract cues and embellish that which they extract”. A cue is something taken from a whole which is then taken to be the equivalent of that whole. Another typical characteristic of a cue is that it enables easier sensemaking of what is going on in the whole, than trying to investigate the whole. For example, the financial figures of a company could be used as the cues to make sense of the company, which will be easier than trying to make sense to the company (the whole) itself, by spending time visiting the company and inspect all of its operations in person.

Noticing is a process by which cues are extracted for sensemaking and is therefore distinguished from the process of sensemaking. Noticing comprises filtering, classifying, and comparing, whilst sensemaking is more about interpreting, invention and then determining what the noticed cues mean.

Things noticed are things that are novel, unexpected, extreme, negative, relevant to our current goals, unpleasant, deviant, intense, unusual, sudden, brightly lit, colourful, alone or sharply drawn. Items typically noticed in the organisational world include unanticipated drains on cash flow, new taxes and regulation, disruption of routine and emergencies, public and iconoclastic executives, etc.

Weick prefers to use the term “noticing” to a term he and Daft used in 1984, i.e. “scanning”, because it “implies a more informal, more involuntary ‘beginning’ to the process of sensemaking”, whilst scanning “sounds more strategic, more conscious, more deliberate, more under the control of preconceptions, and less open to *invention* [Emphasis added] ”.

This notion of *invention* is an important one throughout the theory of sensemaking. One may recall that the difference between sensemaking and interpretation (other than interpretation being a subset of sensemaking) is that interpretation results in meaning of material that is

¹⁸⁷ Weick, K.1995. *Sensemaking in Organisations*, 49

already evident. Sensemaking goes beyond that, and also *creates*, or *invents* material that is then interpreted.

Weick adopts the work of Shotter¹⁸⁸ which likens a cue to a seed from which people develop a larger sense of what may be occurring. This seed metaphor describes the “vagueness” and “indeterminacy” of sensemaking, which is described by Shotter¹⁸⁹ as follows:

- “Just as an intention may be said to ‘contain’ or ‘point to’ its object, so an acorn may be said to ‘contain’ or ‘point to’ an oak tree. But an acorn certainly does not contain an oak tree, or anything like it, even in the miniature (pre-formation is not true). It is best seen as the structured medium or means through which, in *interaction* [Emphasis added] with its surroundings, an oak tree forms, developing itself through its own progressive self-specification. Furthermore, although an acorn specifies the production of an oak tree, and not any other kind of tree, it does not specify the tree that grows from it exactly (not the number of branches, twigs, leaves, etc.), for the tree grows in quite an unpredictable manner, sensitive to local contingencies.”

What an extracted cue will become, how it will be “embellished”, will be subject to “context”, or “frames”¹⁹⁰ or as Shotter puts it, the “local contingencies”. Context impacts both which cues will be extracted and how they will be interpreted and expanded upon.

An interesting point raised by Weick is the importance of enacting that which is enabled by the available cues. He puts it as follows: “But regardless of the cues that become salient as a consequence of context, and regardless of the way those extracted cues become embellished, the point to be retained is that faith in these cues and their sustained use as a reference point are important for sensemaking. The importance lies in the fact that these cues tie elements together cognitively. These presumed ties are then given more substance when people act as if they are real. A presumed order becomes a tangible order when faith is followed by enactment.”

¹⁸⁸ Shotter, J. 1983. “Duality of structure” and “intentionality” in an ecological psychology. *Journal for the Theory of Social Behaviour*, 13:19 – 43

¹⁸⁹ Shotter, J. 1983. “Duality of structure” and “intentionality” in an ecological psychology. *Journal for the Theory of Social Behaviour*, 13:29-30

¹⁹⁰ Sensemaking is summarised as the assignment of meaning to life, and its core building blocks a cue, a frame and the position, or link between the cue and the frame

3.7 Plausibility

As mentioned in the introduction to this thesis the following striking, if somewhat counter-intuitive quote from Weick¹⁹¹ provides the context within which the property of “plausibility” should be viewed: “A reasonable position to start from in studies of sensemaking is to argue that accuracy is nice, but not necessary.”

Eight reasons are offered by Weick to substantiate the view that “the criterion of accuracy is secondary in any analysis of sensemaking.” These are:

- If people are not to be overwhelmed, they need to “distort and filter, to separate signal from noise given their current projects.” In other words, people do not have sufficient attention to cope with all the data and information that they come across in life; it is impractical to try to do so.
- Sensemaking may involve the discovery or creation of many interpretations which require additional attention, and more importantly the postponement of action, to come up with “ ‘the’ interpretation”. Weick introduces the choice between an “accurate perception”, which given “multiple cues, multiple meanings and multiple audiences” may take so long as to seem like a “doomed intention”, and plausible sensemaking, which is more likely to happen. Again, humans just don’t have the attention to enable “accurate perceptions.” It is impractical to try to do so. Weick¹⁹² puts it like this: “Most organisational action is time-sensitive, which means that in a speed/accuracy trade-off (Fiske, 1992), managers favour speed.
- Thus a third reason why accuracy is secondary is that speed often reduces the need for accuracy in the sense that quick responses shape events before they have become crystallized into a single meaning. A fast response can be an influential response that enacts an environment.

This does not describe any lack of capability on the part of the sensemaker. In the case of enactment the goal is then clearly one of enacting a more favourable environment as soon as possible to increase the chances of success. It could be argued that with even an ability to provide absolute accuracy it will not matter since the goal has been described as the enactment of a more favourable environment.

¹⁹¹ Weick, K. 1995. *Sensemaking in Organisations*, 56

¹⁹² Weick, K. 1995. *Sensemaking in Organisations*, 57

When the opportunity of a more favourable enactment is not available, and the time constraints still exist, one may again argue that there is a lack of capability to make accurate sense and that plausible (and hence probably inaccurate) sensemaking is the only practical option.

This quote from Weick¹⁹³ (citing Bruner, 1973, p30) is a good summary: “The cost of close looks is generally too high under the conditions of speed, risk [presumably the consequences of not meeting the deadline are graver than those of being wrong], and limited capacity imposed upon organisms by their environment or their constitutions. The ability to use minimal cues quickly in categorising the events of the environment is what gives the organism its lead time in adjusting to events. Pause and close inspection inevitably cut down on this precious interval for adjustment. (Bruner, 1973, p 30.)”

The contention is thus that speed, not accuracy, is paramount for the well-being of the sensemaker; there is no time for “close looks”. And yet the timely “adjusting to events” implies a successful adjustment, i.e. the well-being of the sensemaker is promoted, which in turn relies on “the ability to use minimal cues quickly in categorising the event of the environment”. In turn this relies on “categorising” that fits conditions of speed, risk and limited capacity imposed upon organisms by their environment or their constitutions. This fit implies accuracy, whether by “close looks”, albeit much reduced due to the “minimal cues” used, or by serendipity.

- Accuracy may become paramount, but only for short periods of time and when specific questions have to be answered. The frame to understand instances where accuracy is important for sensemaking is derived from the work of Swann (1984) which talks of “global accuracy” and “circumscribed accuracy”
- Global accuracy come into play when sensemakers are concerned with forming widely generalised beliefs, whilst circumscribed accuracy is “less sweeping” and more focused on “prediction of specific encounters in a limited number of contexts and for a brief period.” So in a dynamic, on-going stream of activity, circumscribed accuracy is “the most one can hope for” if accuracy becomes a concern at all. The example of a company going bankrupt explains this issue: it will focus on debt service, cash flow and meeting the payroll, rather than on industry trends and the environment. The same holds true for companies

¹⁹³ Weick, K.1995. *Sensemaking in Organisations*, 58

experiencing rapid growth, as was the case for the global mobile communications industry in the mid-90s. Accuracy in sensemaking would be more relevant if that which is being made sense of exhibits stimulus constancy, i.e. that the targets of perceptual activity possess identities that are constant. However, what is found in organisations is “mercurial stimuli that mimic the inherent equivocality of interpersonal perception”¹⁹⁴. Sensemaking based on plausibility, rather than accuracy will be more applicable.

- The exact words of Weick¹⁹⁵ are best to explain the sixth reason: “Enactment in the pursuit of projects provides the frame within which cues are extracted and interpreted. This same frame prescribes the area within which accuracy matters. And the action repertoire that lies behind the framing itself implies what can and cannot be known. Again, people see and find sensible those things that they can do something about. Capabilities for action affect what is believed and what is rejected. What is believed as a consequence of action is what makes sense. Accuracy is not the issue.” Perhaps the following analogy could be used to illustrate this point: as one tends to live within one’s means, so one tends to sense within one’s abilities.
- The seventh reason related to a pervasive notion in sensemaking, and one that risks throwing out the baby with the bathwater when conditions of risk, speed and limited capacity to makes sense with, is in play is: action is more important than deliberation. Accurate perceptions have the power to immobilise, so people who want to get into action practice simplified, biased noticing, and make sense only for so long as it becomes plausible so as to enable action which in turn, will unearth more cues for further sensemaking, and enable enactment, since speed is of the essence in enactment. This is well-understood and valid. However, this ignores those instances where action is not the best way to proceed at some point in time. Consider the idiom: give him enough rope and he will hang himself. This talks to the wisdom of *not* taking action.
- The final reason offered by Weick is that it is almost impossible to tell, at the time of perception, whether the perceptions will prove accurate or not. Many perceptions become erroneous only in retrospect. Therefore, to worry in advance

¹⁹⁴ Weick, K.1995. *Sensemaking in Organisations*, 59

¹⁹⁵ Weick, K.1995. *Sensemaking in Organisations*, 59

about perception accuracy without being able to ascertain accuracy until after the fact is a waste of time.

So if accuracy is not necessary, what is necessary for sensemaking? In Weick's own words: "probably something that preserves plausibility and coherence, something that is reasonable and memorable, something that embodies past experience and expectations, something that resonates with other people, something that can be constructed retrospectively but also can be used prospectively, something that captures both feeling and thought [something that e.g. spreadsheets on a computer screen don't], something that allows for embellishments to fit current oddities, something that is fun to construct. In short, what is necessary in sensemaking is a good story."¹⁹⁶

4 The substance of sensemaking

Sense, or meaning, is made when we express that which was paid attention to in the pure duration of our lives. This expression is made up of words, verbal or written¹⁹⁷. Words that are combined into sentences, which typically form part of conversations (with others or with ourselves) about our on-going experiences, are the substance of sensemaking.

Most people seldom create new words. We inherit and learn about words and therefore of many meanings in life that have been formed and used by people in the past to give meaning to their experiences. When we make sense of something we could express this sense with a well-known label or sentence(s) that best describes the meaning of that specific life experience.

Once we have selected a word or phrase to describe the meaning created, it may have an impact on the future conduct of the sensemaker. Weick (1995)¹⁹⁸ describes the impact of the meaning of words as follows:

- "To label something that is novel and undesirable as a 'problem' is to imply that it is also something to be solved. But that is not the only label that is possible. If the novelty is truly open to a variety of labels, then one could also say things like, that is an issue, manage it; that is a dilemma, reframe it; that is a paradox, accept it; that is a conflict, synthesize it; that is an opportunity, take it. To label a novelty a

¹⁹⁶ However, the writer of this thesis contends that when one does not seek or let the facts get in the way of a good story, one may suffer the consequences of *Risky reality*, i.e. situations which, if made poor sense of, may adversely impact the sensemaker. This is more fully described in chapter 4 of this thesis.

¹⁹⁷ In Chapter 4 of this thesis a hypothesis is made that this expression may extend beyond words.

¹⁹⁸ Weick, K.1995. *Sensemaking in Organisations*, 90

problem, is a consequential act, just as it is consequential to call it an issue. That is the whole point of sensemaking. Once something is labelled a problem, that is when the problem starts.”

Because words or labels may share common settings and times they also may share common context, hence Weick refers to “vocabularies”. One benefit of these “ready-made” vocabularies of the past and of society is that it enables more attention-efficient sensemaking. Ready-made vocabulary speeds up the expression of meaning (which is valuable because it reduces the amount of attention required to express meaning) through both the “check-list” ability of vocabularies to find the appropriate label fast and to obviate the attention-consuming creating of a new word that precisely expresses the meaning in question.

When no known word is up to the task of expressing some new meaning, a new one will be invented, which is how vocabularies typically expand¹⁹⁹.

Current vocabularies have stood the test of time in enabling people to express meanings of their existence. The fit between the words and sentences enabled by various vocabularies and one’s experience may be good enough to obviate the need to create a new word.

People therefore draw from several different vocabularies to make sense. Weick mentions a few examples:

4.1 Vocabularies of society enable sensemaking using ideology

The Concise Oxford dictionary (9th edition) defines ideology as: 1.) the system of ideas at the basis of an economic or political theory (e.g. Marxist ideology), or perhaps more importantly for our study: 2.) the *manner of thinking* [Emphasis added] characteristic of a class or individual (e.g. bourgeois ideology). This “manner of thinking” is described by Weick(1995)²⁰⁰ by means of a quote from the work of Trice & Bayer as: “shared, relatively coherently interrelated set of emotionally charged beliefs, values, and norms that bind some people together and help them make sense of their worlds”.

Using work on various “themes in organizational theory” Weick concludes the following:

¹⁹⁹ The new profession enabled by the Internet, called “blogger”, comes from the word “blog” which is made up of the two words web and log; weblog, which was abbreviated to blog. In the past, bloggers were at best seen as informal citizen journalists. Nowadays, respectable journalists from respectable newspapers also blog, and the initial informal independence associated with the word blogger is starting to fade away.

²⁰⁰ Weick, K.1995. *Sensemaking in Organisations*, 111

- Ideologies combine beliefs about cause-effect relations, preferences for certain outcomes, and expectations of appropriate behaviours to structure how social situations are made meaningful.
- One impact of ideology on sensemaking is that in its early stages the content of organisational sensemaking consists of people trying to discover the amount of agreement that they have on cause-effect linkages and preferences for outcomes.
- Another impact of ideology on sensemaking is that it may colour the filtering that is typical of sensemaking. The example that Weick uses is that of one who believes that borrowing is risky. Such a person will use this ideological filter in his sensemaking and therefore would pay little or no attention to financial markets, loan terms and interest rates.
- Ideologies can also function as organizational structure. This is because “robust ideologies incorporating harmonious values” may elicit self-control and voluntary cooperation. Weick listed numerous examples which show that strong (centralised, exercising control over) core values allow successful decentralisation.

Sources of ideology are many. Weick lists a few to provide a flavour of which and how ideologies may impact sensemaking: transnational culture (e.g. faith in science); national cultures (e.g. Peruvian workers value superiors who act authoritatively); regional and community cultures (e.g. fatalistic acceptance of one’s own destiny in rural communities); industry ideologies (e.g. in an industry competition among distributors are discouraged, or here in South Africa, the advertising industry discourages comparative advertising); organisational ideologies (e.g. the generic recipe for survival of a Scottish manufacturer of classical knitwear) and occupational ideologies (e.g. PhDs should do research and publish).

However, it is important to note that at the individual level the meaning of ideologies and their vocabularies are internalised in a personal and unique way. Weick puts it like this: “Meanings tend to stabilize locally, which should be evident from the enormous effort required to create cross-functional teams whose members *share even a modest number of meanings* [Emphasis added].”²⁰¹

²⁰¹ From the point of view of attention-efficiency and UEMI it is clear that the more effective UEMI is deployed in organisations the less it is necessary to rely on ideology-driven sensemaking

4.2 Vocabularies of *organisations* enable sensemaking using *third order controls*

First order controls refer to control by direct supervision. Second order controls are control by programmes and routines, whilst third order controls are *assumptions* and *definitions* taken as a given.

Third order or “premise” controls are so called because they influence the premises (which consist of both factual and value content) that people use when they diagnose situations and make decisions in organisations.

In a sense third order controls are a subset of ideology limited to life in organisations. Reviewing what Herbert Simon had to say in 1957, Weick (1995)²⁰² concluded that:

- “What is interesting here is that the idea of a decision premise usually implies something that comes into play early in the sensemaking process. A premise is a supposition made so that people can get on with decision-making.”

It is interesting that the above description holds the possibility that sensemaking may precede decision making and decisions made, which is the opposite of what sensemaking theory emphasizes - namely that sensemaking is used to explain decisions already made, as was the case for the jurors as described by Garfinkel²⁰³.

Another possibility needs to be entertained. Schutz²⁰⁴ wrote:

- “All types of experiences admit of attentional modifications: experiences of the perceptual world; of the world of memory; of the world of pure phantasy and consequently of projects. As we have known since Husserl pointed it out, changes of attention can affect whether we take up a neutral or a positing [positive?] attitude toward some content of consciousness. The attentional modifications themselves show again all sorts of shadings: from *actual comprehending to merely noting to hardly noticing to leaving completely unobserved.*” [Emphasis added]

In the above quote four levels are labelled. However, one gets the impression that there may well have been more levels. Indeed, it makes sense that there exists a continuous grading of the level of attention paid from 0% to 100%.

²⁰² Weick, K. 1995. *Sensemaking in Organisations*, 115

²⁰³ Weick, K. 1995. *Sensemaking in Organisations*, 10

²⁰⁴ Schutz A. 1967. *The Phenomenology of the Social World*, 72

If so, it could also offer another alternative explanation for Garfinkel’s jurors who “did not first seem to first decide the harm and its extent”, and *then allocate blame*, and then finally choose a remedy. Instead, they *first decided* the remedy and *then decided* the “facts”, from among the alternative claims, *that justified the remedy*. Jurors essentially created a sequence that was meaningfully consistent and then *treated it as if it were the thing that actually occurred*.

It is alarming to contemplate a jury that first decides on the “remedy” and only after that is done proceeds to “allocate blame” and construct “facts” that make sense of the decision on the remedy already taken. It is alarming because this should introduce a higher level of error (e.g. judged guilty when innocent and vice versa) in American jurisprudence than what appears to be the case. An alternative explanation²⁰⁵ needs to be entertained in view of an existence of varying “shadings of attentional modification”.

This alternative explanation holds that even at the “hardly noticing shading” of “attentional modification” (which according to Husserl, Schutz and Weick creates meaning), much of the work done to first decide harm, then allocate blame and finally the remedy, was done by the jury in the courtroom in this logical order.

When the jury went out to deliberate, the easiest (briefest) and most recent item to express in the heightened shading of attention prevailing during jury deliberation is the remedy. The reverse order described by Garfinkel merely represents another iteration to strengthen the rationale behind choosing the remedy, which then proceeds in reverse order back to the harm caused.

4.3 Vocabularies of occupations and professions enable sensemaking using paradigms

Initially associated with “shared understanding” and “shared exemplars” in “scientific inquiry”, the concept of a paradigm has been extended to other occupational communities and organizations where it includes standard operating procedures, shared definitions of the environment and the agreed-upon system of power and authority.

²⁰⁵ This is offered as a hypothesis here. As this does not speak to the core of the research question of this thesis, no further work was done beyond merely describing the hypothesis. However, it is important to note this story which is a key driver behind the typically counterintuitive thinking of Weick on sensemaking, namely that sensemaking is harnessed after decisions are made, i.e. in service of explaining decisions already made and concomitant action already taken.

Paradigms capture two qualities of sensemaking in organisations: its association with conflict and its inductive origins. Conflict is inversely proportional to the level of paradigm development. The inductive quality of paradigms is evidenced in the following which was raised by Weick: “When people ‘agree’ in a paradigm, they are more likely to agree on its existence than on its rules or rationalised form”²⁰⁶.

Paradigms are preserved in their “exemplars and it reconstituted from these artefacts. These exemplars often take the form of representative anecdotes (Burke, 1969, pp. 59 – 61) from which people *induce* an on-going sense of what other events mean.” [Emphasis added]

Weick emphasizes the “gaps between exemplars in a paradigm that enables people to build consensus around it”.

4.4 Vocabularies of coping enable sensemaking using theories of action

This flavour of sensemaking builds on the stimulus-response paradigm. Knowledge (i.e. mental frames or maps) is built during responses to situations that are encountered. Quoting Hedberg, Weick²⁰⁷ elaborates on “trial-and-error sequences” during these responses which include “both the processes by which organisations adjust themselves defensively to reality and the processes by which knowledge is used offensively to improve the fits between organizations and their environments”.

It is interesting that this quote implies recognition of the importance of risky reality through Hedberg’s words; “defensively”, “reality”, “offensively” and “fits”. When it comes to Risky reality the accuracy of the fit (between mental frames and reality) is not merely “nice but not necessary”²⁰⁸. It may affect an organisation or an individual’s well-being or survival.

4.5 Vocabularies of predecessors enable sensemaking using tradition

Traditions enable people to re-accomplish actions that embody lessons that previous generations have learned.

Building on work from Shils, Weick’s²⁰⁹ words to describe tradition have a taste of legal writing: “We understand tradition to mean something that was created, was performed or believed in the past, or believed to have existed or to have been performed in the past, or that has been or is being handed down or transmitted from one generation to the next.” To

²⁰⁶ Weick, K. 1995. *Sensemaking in Organisations*, 120

²⁰⁷ Weick, K. 1995. *Sensemaking in Organisations*, 121

²⁰⁸ Weick, K. 1995. *Sensemaking in Organisations*, 56

²⁰⁹ Weick, K. 1995. *Sensemaking in Organisations*, 124

complete this formal definition Weick states that “for something to qualify as a tradition, a pattern must be transmitted at least twice, over three generations.”

In the dynamic, fast-changing world of current organisations, tradition appears to be an endangered species. This is because generations (of people) in stable organisational settings using age-old processes appear to have mostly become extinct - we may always be the “first generation”.

Nevertheless, “tradition of conduct” still seems to exist in organisations, the extent of which will depend on people’s propensity to preserve a tradition (“Individuals, groups, and organisations that work hard at articulating their evanescent actions”²¹⁰) and the means by which they attempt to do so (how it is articulated).

For tradition to be preserved, concrete human action and know-how embodied in practise needs to become symbolic or articulated so as to enable their reconstitution by either the same people at a later stage, or by subsequent generations in similar circumstances.

Weick focuses on words and stories for this articulation; “Traditions, like paradigms, have exemplars and custodians (Shils, 1981, p. 13), stories and storytellers. It may seem like we are obsessed with stories. In a way that is true, but only because of the kind of data involved. Actions are fleeting, stories about actions are not.”

This study argues that UEMI will provide the potential for stories with not only much richer information content, but also a much more accurate reconstitution of tradition.

4.6 Vocabularies of sequence and experience enable sensemaking using narratives

People like to think narratively, i.e. in the form of a tale or a story²¹¹. So stories feature strongly in sensemaking. People also think inductively, so much of sensemaking and storytelling is invention²¹².

How do people make stories? They take a set of events and if they can relate these events and sequence them, a story is born. However for people to engage with stories, i.e. require that people pay attention to them, they should be noteworthy; vivid, tellable and interesting.

²¹⁰ Weick, K. 1995. *Sensemaking in Organisations*, 126

²¹¹ *The Concise Oxford Dictionary of Current English; Seventh edition*

²¹² Weick, K. 1995. *Sensemaking in Organisations*, 128

Stories consume attention whether it is for their creation, retelling or listening to them. Looking through the lens of the notion that a positive return on attention is a fundamental human need, the value or function of stories (i.e. their return on attention) includes the following:

- Creation of meaning: a repertoire of stories is important for sensemaking because two stories in this repertoire connected in some way, will create meaning (meaning is created when elements are linked, as explained in the next section).
- Aiding comprehension: a connection between an old story and an event “raises the possibility that outcomes can be predicted, understood and possibly controlled”²¹³
- Stories are mnemonics that enable people to remember earlier complex events.
- Stories can guide action before routines are established and also enrich routines afterwards.
- Stories act as a proxy for experience: a portfolio of stories enables people to “build a database of experience from which they can infer how things work”²¹⁴.
- Stories also transmit and reinforce third-order controls by conveying shared values and meaning. This role of transmission and reinforcing is also played with ideologies, paradigms, theories of action, and traditions.
- Stories may also facilitate diagnosis and reduce the disruption produced when projects are interrupted. Hearing stories of quite implausible events may enable people to “rehearse” these implausible sequences.

4.7 Units of meaning

One may also view vocabularies used in sensemaking on another plane e.g. from less to more abstraction. We saw earlier in this chapter that sensemaking consists of placing stimuli into some kind of frame. Weick (1995)²¹⁵ states that “frames and cues can be thought of as vocabularies in which words that are more abstract (frames) include and point to other less abstract words (cues) that become sensible in the context created by the more inclusive words.”

²¹³ Weick, K. 1995. *Sensemaking in Organisations*, 129

²¹⁴ Weick, K. 1995. *Sensemaking in Organisations*, 129

²¹⁵ Weick, K. 1995. *Sensemaking in Organisations*, 110

Yet another plane noted by Weick (1995)²¹⁶ is that of the past experience and present experience. Frames typically summarise past experiences, whilst cues emanate from present experience and the ways in which these may be connected enable the number of meanings that may be made.

A key point to note is that “meaning within vocabularies is relational”. In other words, to make sense (meaning) one needs a cue, a frame and a relationship (a connection) between them. In his work Weick talks of this as a “unit of meaning”.

4.8 What do we make sense of?

Sensemaking occurs when we express that which we have paid attention to, which potentially covers almost any event in the on-going stream of life - personal, social or organisational.

Two important issues in sensemaking should be noted: firstly that it is started by some sort of shock or interruption, and secondly, that such shock is possible in anything (i.e. represented by any kind of project) in the on-going stream of life. This may be seen from the following by Weick (1995)²¹⁷:

- “...describe in detail several shocks, including how people make sense when they leave a steady job to start a new company, search for hybrid wheat varieties to solve a problem of blight, discover that a competing product is in advanced stages of development, fail while introducing a major new product in the naval systems industry, propose a risky joint venture, or face administrative turnover in response to a state budget crisis.”

We ended Section 3.1 (“Sensemaking in short”) by saying that everyone makes sense almost all of the time. Now we should elaborate this to read as follows: everyone makes sense almost all of the time about potentially anything that happens in life. It is *potentially* because one makes sense of events only in certain circumstances. Sensemaking is precipitated only by:

- Events that are unusual or novel (and which may represent an opportunity or a threat)
- Events that represent some discrepancy between, or a disruption to on-going events, and

²¹⁶ Weick, K. 1995. *Sensemaking in Organisations*, 111

²¹⁷ Weick, K. 1995. *Sensemaking in Organisations*, 84

- A request to pay attention to something, e.g. when people are asked something or asked to think about something.

Turning to organisations Weick highlights two occasions for sensemaking, namely; ambiguity and uncertainty. Briefly put, following novel, unusual, or disruptive events, or maybe a request, people make sense in situations of ambiguity because they are confused by too many plausible interpretations. In the case of uncertainty, sensemaking is necessary because people lack any interpretation.

It follows then that sensemaking in the case of uncertainty should be facilitated by the provision of more information, whilst in the case of ambiguity a richer kind of information should be helpful, e.g. information from face-to-face interaction that provides multiple varied cues. It would not be attention-efficient to provide more of the same “lean” information in the case of ambiguity.

5 Sensemaking in organisations

The impact between sensemaking and UEMI should manifest itself earliest in organisations and then spread out from there to the rest of society²¹⁸. In this thesis, future scenarios in which the impact between UEMI and sensemaking are analysed will all relate to organisational sensemaking.

It may appear strange that Weick’s (1995) book titled “Sensemaking in organizations” contains only one relatively short chapter out of a total of eight which is dedicated in full to sensemaking in organisations. Chapter 3 is titled “Sensemaking in organisations” and starts with the following sentence: “Everyday sensemaking and organizational sensemaking are not identical.” This apparent anomaly may be solved as follows: firstly, the other seven chapters also cover sensemaking in organisations, but perhaps more importantly, whilst every day and organisational sensemaking may not be identical, the extent of overlap is large.

²¹⁸ It is true that at the time of writing of this thesis, people buying or using ICT products and services outside the influence of organisations (i.e. labelled “consumers” by marketers) represent early adopters of those technologies whose future generations should enable the vision of UEMI

For example, “social” software applications (e.g. the well-known Facebook) used on smartphones (e.g. the equally known Apple iPhone) have been deemed too risky (in terms of security, safety and privacy) and perhaps too expensive for their junior staff to be adopted by companies for use in carrying on their business

But companies should start to overtake consumers in the adoption of these technologies. One reason for this is that the value of these technologies are increasingly being fully understood by companies and ways to reduce safety, security and privacy risks are being explored and implemented by them. Another reason is that whilst many technologies such as telepresence videoconferencing may well be coming down in price, they still should be too expensive to be bought by consumers for their homes. Alternatively, consumer versions of some technology products and services (e.g. audio-visual equipment and uncontested bandwidth) may not have the same capabilities of more expensive professional systems.

So what should be considered specifically for organisational sensemaking? Weick (1995)²¹⁹ employs the ideas of Wiley²²⁰ which proposes four levels of sensemaking:

5.1 Intrasubjective

Given that much of this chapter in this thesis covers intrasubjective sensemaking, i.e. sensemaking by individuals, this section will be kept brief. Nevertheless one should note that the *content* of intrasubjective sensemaking in organisations typically differ from everyday sensemaking. In Weick's words, organisational life "...is fair game for continued negotiation, controlled information processing, and mindful attention and how much needs to be reaccomplished and how pervasive is the need for accounting, justification and rationalizing."

- Weick's words suggest that organisations represent a crucible in which UEMI ("controlled information processing") and sensemaking ("continued negotiation", "accounting", "justification" and "rationalising") will meld together. In everyday life the quantity of elements and intensity of heat in the crucible is lower.
- Weick talks about "the only thing that people [in organisations] do not do, is take things for granted, which is what they spend most of their time doing everywhere else [i.e. in everyday life]". This raises the interesting possibility that the proportion of time that people in organisations spend making sense is higher than in everyday life.
- The following quote from Weick points to a higher density of sensemaking in organisations when compared to everyday life:
 "One begins to wonder when work ever gets done and whether the whole reason routines seem so characteristic of organisations is that they free up the controlled processing necessary to make sense of the dilemmas that need to be managed before people can even get at the work."

5.2 Intersubjective

Drawing from work of Linell & Markova, Wiley, and Gephardt, Weick describes the following characteristics of intersubjective sensemaking:

- Intersubjective sensemaking happens when individual thoughts, feelings, and intentions are "merged" or "synthesized" into conversations during which the self is transformed from "I" to "We".

²¹⁹ Weick, K. 1995. *Sensemaking in Organisations*, p.70.

²²⁰ Wiley, N. 1988. The micro-macro problem in social theory. *Sociological Theory*, 6: 254 – 261.

- This new self represents a “level of social reality” which consists of an “intersubject”, i.e. a joined subject, or a merged subject.
- Another way to describe this transformation is to talk of the interchange and synthesis of two or more communicating selves.

Sensemaking involves interpretation to gain meaning, but sensemaking also involves creating that which is interpreted. The interpreting of actions and events include both interpreting what is there and creating what lacks, so as to interpret it into meaning. The verbal intersubjective process is consistent with the making of intrasubjective sense and its expression, a *verbal*²²¹ process, which forms part of the cues that the party(ies) at the receiving end of this expression use to interpret and create meanings consistent with the verbal²²² expressions, and which may be accepted, or only partially accepted or rejected. In the event of the latter two, sensemaking will continue.

This process will carry on iteratively until expressed meaning is equivalent or consistent (perhaps consistent enough, when e.g. negotiation was necessary) with each of the meanings that the people in the organisation have.

Alternative outcomes for intersubjective sensemaking are also possible, for example, an agreement not to agree on the individual meanings and expressed meanings, or one or more people do not agree with the sense made as expressed and verbally agreed, but refrain from saying so or verbally accept the expressed interpretation, or, there is only partial and incomplete agreement.

5.3 Generic subjective

The intersubjective represents sensemaking at the level of interaction. The next, wider level is the generic subjective, which relates to sensemaking at the level of social structure. This social structure, at any point in time is the result of:

- Any legal requirements from the applicable legal authorities (e.g. the law of the country, labour laws, tax law, environmental laws, etc.)

²²¹ Weick quoting Gephardt in Weick, K. 1995. *Sensemaking in Organisations*, 71

²²² The term “verbal” implies the use of spoken words. It should be noted that intersubjective sensemaking also occurs when using written words in letters, reports, email, instant messaging, etc.), and when non-verbal communication (e.g. body language observed in person or over e.g. a 3D telepresence videoconference session) convey the expression that some interpretation (expressed verbally or otherwise) is shared by all. Rich cues that may be necessary to support sensemaking in situations of e.g. ambiguity pertain to, amongst other things, body language.

- That which is known to work for the kind of organisation in question, such as mathematics, mining engineering or accounting, and which is typical of extrasubjective sensemaking (described below), and
- Prior intersubjective sensemaking that worked, and thus repeatedly used to guide action, and may have constituted part of an organisation’s current “interlocking routines and habituated action sequences”²²³.

Generic subjectivity predominates in times of stability during which “intersubjectivity is largely irrelevant (unless gaps need to be filled), when artefacts such as standard plots create generic subjectivity and allow people to substitute for one another and adopt their activities and meanings”²²⁴.

However, when substitution of people happens or any other changes occur with the organisation or in its environment (new laws, new competitors, new disruptive technologies, etc.), these routines and habituated action sequences are typically reconstructed and reaffirmed intersubjectively because sensemaking and innovation is necessary.

For an organisation to meet its challenges and prosper, it needs to achieve an optimal balance, a tension between the innovation enabled by intersubjective sensemaking and the control afforded by generic subjective sensemaking. This balance will depend on the rate and extent of change the organisation encounters and enacts.

5.4 Extrasubjective

The highest level which underpins all of the sensemaking processes described above relate to “pure meanings”²²⁵ without a “knowing subject”²²⁶. It is a level of “symbolic reality” such as capitalism or mathematics. It include customs, norms, habitual behaviour, rituals, myths, metaphors and other language forms, etc., that fall under the notion of *culture*. Weick calls culture an ‘extra-subjective’ level of sensemaking which provides a reservoir of background knowledge allowing and constraining meanings at other levels.

5.5 The impermanent organisation

A part of Weick’s work is characterised by the challenging of prevailing theories of organisation, often by providing counter-intuitive alternatives, or filling in gaps, or

²²³ Weick, K. 1995. *Sensemaking in Organisations*, 74

²²⁴ Weick, K. 1995. *Sensemaking in Organisations*, 71

²²⁵ Weick, K. 1995. *Sensemaking in Organisations*, 72, referring to Karl Popper, 1972

²²⁶ Weick K. 1995, *Sensemaking in organizations*, 72

emphasizing lesser-known or lesser-occurring possibilities within conventional theories. For example, upon referring to a conventional and common process in organisations, namely that for an organisation to act, knowledge must be “textualized so that it becomes a unique representation of the otherwise multiple distributed understanding” and then be “voiced by someone who speaks on behalf of the network and its knowledge”, Weick in the very next sentence rushes to defend his enduring focus on the reverse sequence: “One has to be careful here not to presume that there is a fixed sequence in which conversing produces texts that *then* [Emphasis added] produce action. Frequently, action is the pretext for subsequent conversations and texts that interpret the enacted event.”²²⁷ Note that whilst the conventional sequence is not discarded, the counterintuitive is emphasized by arguing that it occurs “frequently”. This is perhaps true, but this heavy emphasis on the unconventional, risks blind spots in sensemaking theory pertaining to the conventional that, although incomplete, remain valid.²²⁸

Nevertheless, an emphasis on the concept of “impermanent organisation” makes much sense and flows in part from the work of Robert Chia, who stated that “Organization is a temporarily stabilized event cluster”²²⁹.

The image of impermanent organisation is one of fabrication of transient order out of the ceaseless change inherent in streaming experience. Weick²³⁰ provides this memorable quote from Chia:

“The idea that organizing could be more productively thought of as a generic existential strategy for subjugating the immanent forces of change; that organization is really a loosely coordinated but precarious ‘world-making’ attempt to regularize human exchanges and to develop a predictable pattern of interactions for the purpose of minimizing effort; that language is the quintessential organizing technology that enables us to selectively abstract from the otherwise intractable flux of raw experiences; that management is more about the taming of chance, uncertainty, and

²²⁷ Organized Impermanence: An Overview. Chapter 1 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 5

²²⁸ Refer e.g. to the opposition to accuracy whilst the praised conduct of Gleason in posting up to 80% of his human resources to ensure accuracy?

²²⁹ Organized Impermanence: An Overview. Chapter 1 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 3

²³⁰ Organized Impermanence: An Overview. Chapter 1 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 4

ambiguity than about choice; and that individuals themselves are always already effects of organizational forces; all these escape the traditional organization theorist.”

People manage this sea of ceaseless change by making sense of it. Chia captures²³¹ this process well: “Managing is firstly and fundamentally the task of becoming aware, attending to, sorting out, and prioritizing an inherently messy, fluxing, chaotic world of competing demands that are placing on a manager’s attention. It is creating order out of chaos. It is an art, not a science. Active perceptual organization and astute allocation of attention²³² is the central feature of the managerial task.”

This is in contrast, according to Weick, to organisations’ struggle to “preserve the illusion of permanence” and to keep surprise at a minimum. People create fictions of permanence by means of practices such as long-term planning, strategy, reification of temporary structures, justification, investments in buildings and technology, and acting as formal reporting relationships are stable.”²³³

This view of Weick underscores the opening statement of this section, which is essentially that Weick sometimes throws out the baby with the bathwater in his attempts²³⁴ to enhance or correct conventional theories, e.g. when he claims that strategy is a fiction of permanence. In his landmark book on strategy published in 1994, 15 years *before* Weick’s comment (in 2009) on strategy being one of the “fictions of permanence” that people create to “preserve the illusion of permanence”, Henry Mintzberg²³⁵ talks of *emergent* strategy. By first defining organisations’ plans for the future as *intended* strategy, and *realised* strategy as patterns evolved out of organisations’ past, he then poses the question: “must realized strategies always be intended?” Mintzberg’s own words cannot be improved upon:

“There is a simple way to find out: Just ask those people who happily described their (realized) strategies over the past five years what their intended strategies were five

²³¹ Organized Impermanence: An Overview. Chapter 1 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 8

²³² This thesis proposes the hypothesis, the proving or disproving of which lies outside the resources available to complete this thesis, that people pay attention the way they allocate resources. In other words, people pay attention to that which they perceive will yield the highest return on the attention invested. Chia’s statement seems to support this hypothesis. It is a pity that no research has been found by the author of this thesis, which has tested this hypothesis.

²³³ Organized Impermanence: An Overview. Chapter 1 in Weick K., *Making sense of the organization Volume Two*, John Wiley & Sons Ltd, 2009, 6

²³⁴ According to the writer of this thesis, Weick’s attempts at emphasizing the counterpoints of conventional theories are valid.

²³⁵ A leading thinker of strategy

years earlier. A few may claim that their intentions were realized perfectly. Suspect their honesty. A few others may claim that their realizations had nothing to do with their intentions. Suspect their behaviour. Most, we propose, will give an answer that falls in between these extremes. For, after all, perfect realization implies brilliant foresight, not to mention inflexibility, while no realization implies mindlessness. The real world inevitably involves *some thinking ahead of time as well as some adaption en route* [Emphasis added] ”²³⁶ .

In addition to well-known concepts such as *deliberate* strategies (which refers to intentions fully realised) and *unrealised* strategies (intentions not realised), Minzberg proposes the concept of *emergent* strategies, which refers to a realised pattern which was not *expressly* intended. Minzberg’s explanation of emergent strategy may just as well have been a description of sensemaking:

“Actions were taken, one by one, which converged in time in some sort of consistency or pattern. For example, rather than pursuing a strategy (read plan) of diversification, a company simply makes diversification decisions one by one, *in effect testing the market*. First it buys an urban hotel, next a restaurant, then a resort hotel, then another urban hotel with restaurant, and then another one of these, etc., until the strategy (pattern) of diversification into urban hotels with restaurants finally emerges. As implied earlier, few, if any, strategies can be purely deliberate, and few can be purely emergent. One suggests no learning, the other, no control. All real-world strategies need to mix these in some way – to attempt to control without stopping the learning process.”²³⁷

Even the more traditional (i.e. prior to Minzberg’s 1994 introduction of emergent strategy) concept of *intended* strategy, suggests that there is no “illusion of permanence” or any attempt to “keep surprise at a minimum”. The buying of hotels (probing the market) equates with enactment to provide further cues for retrospective sensemaking. The adjustment process is ongoing until the pattern of diversification into urban hotels with restaurants emerges. During this interplay between intended and emergent strategy (i.e. sensemaking), there was also an interplay between corporate identity and the social context (the market), e.g. the eventual focus on urban hotel with restaurants suggests a specific sub-set of the

²³⁶ Minzberg, H. 1994. *The rise and fall of Strategic Planning*, 24

²³⁷ Minzberg, H. 1994. *The rise and fall of Strategic Planning*, 25

hospitality industry, e.g. the time-pressed senior business traveller. Hence low-budget holiday package tours may not form part of their organisational identity.

And according to a key contention of this thesis, the intent of the organisation should be²³⁸ to make plausible sense (because absolutely accurate sense is typically either impossible or unnecessary or both) that is as *accurate as possible*. Any old plausible story about the impact on their organisation of the successive buying of different kinds of hotels and restaurants will simply not do.

6 Chapter summary

Sensemaking is the making of meaning of life's experiences, large and small. It may involve something as profound as making sense of one's purpose in life or as important as what a competitor's next move in the marketplace may be. Or it may busy itself with the meaning of that attractive person's faint smile in the coffee shop this morning. It differs from decision-making in that it does not involve choice between contending options; the meaning made makes the direction of? life and its projects rather self-evident and decision-making is typically not necessary.

One curious feature of sensemaking theory as espoused by Weick and his associates is how little it concerns itself with how well aligned sensemaking is with reality. The sensemaking process is inherently open to deviations from, and ignorance of reality. For example, sensemaking requires alignment with identity which may or may not be conducive to objective and dispassionate consideration of facts. It relies on fallible human memory for retrospective expression of life's experiences. Being social, it experiences pressure to be acceptable to society or be subject to groupthink. In organisations this manifests itself in all four forms of sensemaking: intrasubjective, intersubjective, generic subjective and extrasubjective sensemaking. The missing of cues is the largest contributor to ignorance of reality. Its enactment property means that it creates part of the reality it faces, which may or may not be successful. To the extent that it is not successful, the gap between sensemaking and reality is created or enlarged. Its property of plausibility means that it may not align with reality. And its on-going property points to the need for iterative updating of the sense that was made, either as a result of initial sensemaking's plausibility found to be wanting, or due to the changes in life.

²³⁸ Empirical testing of this contention lies outside the scope of this thesis.

Also note that all of the above potential deviations from, and approximations to reality are amplified by the limitations of human attention. Perhaps if there were more attention available, one may be moved to consider or seek additional facts which may get in the way of a good story.

The making of sense also harnesses the sense made by others and those who came before us – their words and vocabularies are used as (attention-efficient) short-cuts to express our personal experiences and to make sense of them. This may introduce gaps in that nuances of personal experience are masked or ignored by the pre-fabricated terminologies used instead. And last but not least, the mechanics of sensemaking may introduce distortions from reality. Sense is made when a cue is linked to a frame. If one is skilled and experienced in the field in which sense is to be made and a good thinker as well, chances are that that linking between cues and frames will be better (i.e. better align to reality) than what the case would be otherwise. Nevertheless, sensemaking is what enables us to carry on with life and its projects.

Chapter 4

Sense and nonsense in electronic contexts

The title of this chapter has been taken from part of the title of an article²³⁹ published by Weick in 1985, in which he took a dim view of the role of electronic information in sensemaking.

In this chapter we are going to:

- Pay attention to a few areas that will hopefully update Weick’s thinking with regards to electronic mediated informing,
- Explore in some depth the role of attention in sensemaking, and
- Explore the concepts of the quality of sensemaking and risky reality.

1 Setting the scene

In 1985 Weick found that an unexpected impact of “electronic processing” made it more difficult to make sense of *events represented on computer screens* because data on these events were typically incomplete and cryptic. He has continued over the years to be sensitive to the potentially negative impact of electronically mediated information on sensemaking, on the remarkably few occasions that he has taken the trouble to consider electronic information systems at all.

For example, eight years later in 1993, Weick published²⁴⁰ the following in an article:

- “To reduce equivocality, people do not need *larger quantities of information* [Emphasis added]. Instead, they need richer *qualitative information* [Emphasis added]. Information richness is defined as the ability of information to change understanding within a time interval. Communication transactions that can overcome different frames of reference or clarify ambiguous issues to change

²³⁹ Weick K. 1985. Cosmos vs. chaos: Sense and nonsense in electronic contexts. *Organisational Dynamics*, Fall, 14. American Management Association, as reprinted in 2009 in *Making Sense of the Organisation*, Vol. 2 – The Impermanent Organization.

²⁴⁰ Weick K. 1993. *Sensemaking in organisations: Small structures with large consequences*. Reprinted in 2001 in *Making sense of the Organisation*, 10

understanding in a timely manner are considered rich. Communications that require a long time to enable understanding or that cannot overcome different perspectives are lower in richness. In a sense, richness pertains to the learning capacity of a communication.’ (Daft & Lengel, 1986, p. 560). Information richness tends to covary with the extent of face-to-face personal interaction which is why map making tends to be social.”

The phrase “larger quantities of information” means information provided by electronic information systems. Two years later in 1995, Weick noted that perceptions of information technology might undermine the ability of that technology to facilitate sensemaking²⁴¹. The more advanced the technology is thought to be, the more likely people are to discredit anything that does not come through it²⁴². Weick summarises his conclusion of this phenomenon as follows: because of the fallacy of centrality, the better the information system the less sensitive it is to novel events. He also returned to the theme of a reduced ability to make sense at (and because of) “computer screens filled with generic one-way communication”. This sentence by Weick (1995)²⁴³ puts this concern across well: “The creative potential of intersubjectivity is precisely what people such as Tom Peters fear will get lost when managers shift from management by walking around (MBWA) to e-mail and management by screening around (MBSA).”

However, an alternative view needs to be considered. Sensemaking may be made from cues that are intended by human beings (data and information) and those that are incidental to living a life (observations). This study investigates and shows how UEMI technologies have the potential to increase the productivity of sensemaking through information and data cues. And whilst it is acknowledged that UEMI will not provide for observations in person, it is contended that the *shift* from management by walking around to management by screening around should rather be seen as a productive *expansion*, which results in management by walking *and* screening around (MBWASA). The productivity of management via both channels increases when the “screens” are taken along during “management walks”, e.g. with laptops, tablets and smartphones. The example of superior performance in chess games of teams of people *and* computers is apt (Section 1 in chapter 1).

²⁴¹ Weick K. 1995. *Sensemaking in Organisations*, 3

²⁴² This effect should be considered against the problem of the scarcity of attention

²⁴³ Weick K. 1995. *Sensemaking in Organisations*, 73

Thirteen years later, in an excellent article published in 2008, Sutcliffe and Weick²⁴⁴ argue that information overload is “not necessarily a case of too much data, rather it is an inability to make sense of demands, capabilities, and context as well as data” and that information overload is “a problem of interpretation as much as it is a problem of computation and information processing.” Sutcliffe and Weick argue that: “Sensemaking that is focused on interpretation and meaning mitigates overload whereas [electronic] computation and choice associated with decision making often amplify overload”²⁴⁵.

All of the above comments by Weick and Sutcliffe and those quoted by them make very good sense. With regards to information overload, too much in organisational life may well be based on “computational information processing perspectives”.

However, there is more that needs to be made sense of, which is triggered by the advances in electronic digital technologies and which enables much richer communication and informing. This study contends that this “richer qualitative information” that Weick referred to is increasingly available through UEMI, with the potential of improving sensemaking productivity.

2 The case for considering the quality of sensemaking

In reviewing sensemaking theory in Chapter 3, we have learned of seven properties and the content of sensemaking, but nowhere is it *explicitly* addressed whether one may have good or bad, or even indifferent sensemaking.

It could be argued that a consideration of the quality of sensemaking is superfluous, as at its highest level, sensemaking is there to create meaning. If life has got meaning, whatever the meaning is for the individual, it is worth living. The problem is that some meanings may deviate from reality in such a way as to have a negative impact on your well-being which one may want to avoid.

The work of Weick²⁴⁶ essentially concludes that sensemaking is about allowing the sensemaker to resume life’s projects after interruption. Though he never explicitly mentions *successful* sensemaking, one could interpret Weick’s thinking to be that sensemaking is

²⁴⁴ Sutcliffe K, Weick K. 2008. Information overload revisited, reprinted in 2009 in *Making Sense of the Organization*, Vol. 2 – The impermanent organization, 72

²⁴⁵ Sutcliffe K, Weick K. (2008) Information overload revisited, reprinted in 2009 in *Making Sense of the Organization*, Vol. 2 – The impermanent organization, 75

²⁴⁶ Weick K. 1995. *Sensemaking in organizations*.

successful once the sensemaker overcomes interruption, and resumes, modifies or retires his project(s), to carry on with life.

Sensemaking theory also *alludes* to the importance of a higher quality of sensemaking, by virtue of the role that *speed* plays when sense is made. The longer it takes to make sense the higher the level of emotional arousal, which negatively impacts the quality of continued sensemaking (e.g. the focus on cues is narrowed). This in turn prolongs the time that the sensemaker is under emotional stress - it becomes a vicious circle.

Therefore, any sense made to enable the sensemaker to resume, modify or cease projects in life signals successful sensemaking, and the quicker this is done, the better.

Weick's work and the work of others that he builds on do imply, albeit sometimes obliquely, that sensemaking has an impact on one's well-being and survival, and that it matters. This is evident from the quotes below:

- "The perception of arousal triggers a rudimentary act of sensemaking. It provides a warning that there is some stimulus to which attention must be paid in order to initiate appropriate action. This signal suggests that one's *well-being may be at stake*. [Emphasis added]"²⁴⁷. Sensemaking may thus be aimed at maintaining one's "well-being"
- "It makes good *evolutionary sense* to construct an organism that reacts significantly when the world is no longer the way it was"²⁴⁸. [Emphasis added]

Weick's reference to evolution was one inspiration behind the concept of *risky reality* that is proposed in this document. Risky reality refers to that part of reality that, if the sense one makes differs from that reality, has an impact on one's well-being.

- "...emotion is essentially a non-responsive activity, occurring between the awareness of the interrupting event and an *action alternative that will maintain or promote the individual's well-being in the face of an event*"²⁴⁹. [Emphasis added]
- "People in organisations build knowledge as they respond to the situations they encounter. These trial-and-error sequences include "both the processes by which organisations adjust themselves *defensively to reality* and the processes by which

²⁴⁷ Weick K. 1995. *Sensemaking in Organisations*, 45

²⁴⁸ Weick K. 1995. *Sensemaking in Organisations*, 46

²⁴⁹ Bercheid, Gangestad & Kulaskowski. 1983. *Emotion in close relationships: Implications for relationship counselling*. Unpublished manuscript, University of Minnesota. 396, as quoted by Weick K. 1995, *Sensemaking in organizations*, 48

knowledge is used offensively *to improve the fits between organisations and their environments*²⁵⁰ [Emphasis added]

This phrase “defensively to reality” in the above quote serves as another source of inspiration for the concept of *risky reality*.

It stands to reason that a high quality of sensemaking increases one’s chances of averting threats to one’s well-being or of making use of opportunities to increase one’s well-being. The *quality* of sensemaking denotes its *fit to reality*, mindful of the risk to one’s well-being. If one has cancer and one makes sense from all of the cues obtained, that one should avoid the conventional treatment (Chemotherapy) in favour of an alternative (e.g. Ozone treatment), one’s life depends on one’s sensemaking.

Let us use a simpler hypothetical example: if one were to believe that he or she is a reincarnation of Sir Isaac Newton (irrespective of whether one is or whether it is possible), it probably won’t affect that person’s well-being or survival as a researcher. In fact, the enactment property of sensemaking suggests that the person may well improve his or her performance as a researcher, seeing that he or she is a reincarnation of a famous scientist. However, if one makes sense that he is Superman and can fly, his life may not last long after he comes to believe that. This latter example, albeit an absurd one, illustrates the role of *quality* in sensemaking.

Sensemaking ranks plausibility over accuracy. However, if one wants to improve the *quality* of sensemaking, one has to focus on increasing accuracy, if only *in those areas and situations* that have an impact on one’s well-being and especially survival, when the reality in which sense is made is *risky*.

Weick also points to the “work-in-progress” nature of sensemaking²⁵¹: “there are no absolute starting points, no self-evident, self-contained certainties on which we can build, because *we always find ourselves in the middle of complex situations which we try to disentangle by making, then revising, provisional assumptions.*”

Hence sensemaking is *always* subject to revision in the face of a change in the environment, the emergence of new cues or interruptions *or the need to make sense of a higher quality*, in

²⁵⁰ Weick K. 1995. *Sensemaking in Organisations*, p.121, quoting Hedberg, B. 1981. How organisations learn and unlearn. In P.C. Nystrom & W. H. Starbuck (Eds.), *Handbook of organisational design* Vol. 1, 3

²⁵¹ Weick quoted Burrell and Morgan, who cited Rickman, who noted from Dilthey’s adaption to social phenomena, of Heidegger’s hermeneutic circle

order to get better results. A fairly typical interaction with health services is instructive. A sick person visits the general practitioner to find a cure for an ailment. A diagnosis (i.e. sense) is made and a treatment prescribed. After the expected recuperation period expires without an improvement, the patient visits the general practitioner again. In other words, a higher *quality* of sensemaking (a “more accurate” diagnosis and appropriate treatment) is called for. In this second round the general practitioner (or the specialist that the general practitioner referred the patient to) may fail again, succeed or succeed partially. In this story the quality (i.e. fit to risky reality) of the sensemaking is paramount. One’s well-being or life may depend on it.

A new notion introduced by this study is that the process of sensemaking has an *economic aspect*. In an essay on the nature and significance of economic science, Lionel Robbins had the following to say:

- “The conception we have adopted may be described as analytical. It does not attempt to pick out certain kinds of behaviour, but focuses attention on a particular aspect of behaviour, the form imposed by the influence of scarcity. It follows from this, therefore, that in so far as it presents this aspect, *any* kind of human behaviour falls within the scope of economic generalisations. *We do not say that the production of potatoes is economic activity and the production of philosophy is not.* We say rather that, in so far as either kind of activity involves the relinquishment of other desired alternatives, it has its economic aspect. There are no limitations on the subject-matter of Economic Science save this”²⁵². [Emphasis added]

So any human activity that is affected by scarcity “falls within the scope of economic generalisations” whether that activity is the production of potatoes, the production of philosophy, or the making of sense other than making philosophy. We have also seen that sensemaking is an act of attention²⁵³. The idea of the limited ability of the human mind and therefore the scarce nature of the means to pay attention is supported by William James’s notion of attention. He states that the paying of attention “implies withdrawal from some things *in order to deal effectively* [Emphasis added] with others, and is a condition which has a real opposite in the confused, dazed, scatter brained state which in French is called

²⁵² Robbins L. 1945. *An essay on the nature and significance of economic science*, 32-33

²⁵³ Shutz A. 1967. *The phenomenology of the social world*, 71

distraction, and Zerstreutheit in German”.²⁵⁴ The generic description of the economic aspect of human behaviour by Robbins provides an elegant description of what happens when humans pay attention to make sense:

- “...when time and the means for achieving ends are limited and capable of alternative application, and the ends are capable of being distinguished in order of importance, then behaviour necessarily assumes the form of choice. Every act which involves time and scarce means for the achievement of one end involves the *relinquishment of their use for the achievement of another*. It has an economic aspect”²⁵⁵. [Emphasis added]

It is this *economic* aspect of sensemaking that forces it to be characterised by *plausibility*, rather than accuracy. Weick says that accuracy is nice, but not necessary. This makes sense insofar as accuracy is rendered impractical as a result of the limits of human attention and energy. This is because Weick uses the term “accuracy” in a very strict sense: he literally means that if you want to work accurately, you have to consider *everything* pertaining to the issue at hand, whether it enables productive sensemaking or not. That is not only impractical, it is also unnecessary. Because of the scarcity of attention, nobody does that, nor needs to do that.

Weick states:²⁵⁶ “Accurate perceptions have the power to immobilize. People who want to get into action tend to *simplify* rather than *elaborate*”. This makes sense if one accepts that humans have an innate need to experience a positive return on their attention invested, i.e. to be productive. To pay additional attention when such investment of attention will in all probability not improve the sense to be made so as to enable action, is a waste of attention paid and it de-motivates people. Simplification enables a better return on invested attention, a higher productivity of sensemaking.

However, a lack of accuracy may have a negative impact in instances of risky reality. Hence the following slogan is more apt: *Accuracy is nice but not necessary, except when risky reality prevails*.

The quote below provides a striking description of the enactment resource in sensemaking:

²⁵⁴James W. 1890. *The principles of Psychology* 1:404

²⁵⁵Robbins L. 1945. *An essay on the nature and significance of economic science*, 30

²⁵⁶Weick K. 1995. *Sensemaking in Organisations*, 60

- “To label a novelty a problem, is a consequential act, just as it is consequential to call it an issue. That is the whole point of sensemaking. Once something is labelled a problem, that is when the problem starts.”²⁵⁷

However, consequentiality may also exist as a result of what is already out there and not subject to any enactment effect. Sensemaking in the face of risky reality is a consequential act of the latter kind. When risky reality is in play, any theory or approach that may help ameliorate risks to one’s well-being or enhance one’s chances to grasp opportunities will be of value, and thus worthy of being pursued. One can start by paying attention to the importance of the *quality* of sensemaking. This thesis contends that the quality of sensemaking may be improved by finding a way to *increase* sensemaking *accuracy* whilst paying the same or less attention than before, i.e. more attention-efficient sensemaking.

The key proposal is that required higher returns on invested attention (higher productivity) will be enabled by the deployment of UEMI, which is discussed in more detail later in this chapter.

3 What about attention?

The “elephant in the room” pertaining to the theory of sensemaking is the notion of attention. It is true that Weick and those whose work Weick builds on frequently use the label “attention”. However, when it comes to the notion of sensemaking, the notion of attention, its *properties* and its *impact on sensemaking* is, curiously, almost ignored.

We have learned that sensemaking is that which gives meaning to one’s life experiences. In the section above we argued the case for the consideration of the quality of sensemaking. This section argues that the quality of sensemaking is influenced by the *quantity* of attention, and that the quantity of attention is determined by both the *time* and *effort* invested in paying attention, as well as the *quality* of attention paid. The *quality of attention* paid depends on the knowledge, skills, experience and thinking ability of the sensemaker.

Consideration of the quotes from both Weick and Schutz below is a good starting point. First from Shutz (1967)²⁵⁸ :

- “How, above all, does it happen that the meaning of one and the same experience can change as it recedes into the past?”

²⁵⁷ Weick K. 1995. *Sensemaking in Organisations*, 90

²⁵⁸ Shutz A. 1967. *The phenomenology of the social world*, 71

We have spoken of the *Act of attention*, which brings experiences which would otherwise be simply lived through into the intentional gaze. This Act of attention itself admits of various modifications that are difficult to separate out and distinguish from one another. We shall, following Husserl, call them ‘transformations of attention’ or ‘attentional modifications.’ *It is they which are the different modes of attention, and it is they, therefore, that constitute the meaning of experiences.*” [Emphasis added]

Weick has said and quoted this from Alfred Schutz:

- “Thus ‘the meaning of a lived experience undergoes modifications depending on the particular *kind of attention* [Emphasis added] the Ego gives to that lived experience’ (Schutz, 1967, p. 73). Meaning is not ‘attached to’ the experience that is singled out. Instead, the meaning is in *the kind of attention* [Emphasis added] that is directed to this experience”²⁵⁹.

Shutz refers to *modes of attention*. Both Weick and Schutz talk about *the kind of attention*, which supports a key hypothesis of this thesis, namely that the notion of a *quantity and quality* of attention should be entertained, and that it matters. It determines the meaning or sense that is made.

Taking into account the economic aspect of the process of paying attention during sensemaking, and barring instances where one is forced to pay attention, what decides whether one pays attention or not, or how much attention one pays, depends on how one perceives the productivity of the attention paid. In other words, on what one’s *perceived* return on attention is. Indeed, a key hypothesis of this study is that the “economical” use of attention is a *fundamental human need*. This hypothesis explains the characteristic of plausibility in sensemaking: sensemaking stops when the *perceived* marginal utility of making more sense (in the hope of increasing accuracy) is exceeded by the *perceived* marginal cost of continuing to make more sense.

Below is given a list of a few (there are numerous) quotes from Weick, his associates and those whose work he builds on, that support the contention for attention as a *scarce resource*. The first one is from Chia, used by Weick:

²⁵⁹ Weick K. 1995. *Sensemaking in Organisations*, 26

- “What does it mean then to manage under conditions where what you manage is an impermanent fabrication? It means that you need to get good at *attentive action*. Managing is firstly and fundamentally the task of becoming aware, attending to, sorting out, and prioritising an inherently *messy, fluxing, chaotic world of competing demands that are placed on a manager’s attention*. It is creating order out of chaos. It is an art, not a science. Active perceptual organisation and the *astute allocation of attention* is a central feature of the managerial task. (Chia, 2005, p. 1092)”²⁶⁰. [Emphasis added]

The second quote is just a few pages later in the same book²⁶¹: “When we are confused *we pay closer attention* to what is happening in order to reduce the confusion.” In other words, the perceived benefits of investing (paying) attention (i.e. the reduction of confusion), exceeds the cost of paying (investing) “closer attention”. [Emphasis added]

The third quote is ²⁶²: “The criterion of accuracy is secondary in any analysis of sensemaking for a variety of reasons. First, people need to distort and filter, to separate signal from noise given their current projects, *if they are not to be overwhelmed by data* [Emphasis added] (Miller, 1978, chap. 5)” This speaks of the limits of human attention.

The fourth quote is²⁶³: “One begins to wonder when work ever gets done and whether the whole reason routines seem so characteristic of organisations is that *they free up the controlled processing necessary to make sense* of the dilemmas that need to be managed before people can even get at the work”. [Emphasis added]

The fifth quote is²⁶⁴: “The autonomic activity triggered by an interruption focuses attention on two things, both of which consume considerable information-processing capacity. Attention is focused on the interrupting event, and if it is not altered, on the internal autonomic activation itself. *When autonomic arousal consumes scarce information-processing capacity, this reduces the number of cues that can be processed from the activity that was under way at the time of the interruption* [Emphasis added].”

Weick then goes on to summarize: “We now see that not only does an interruption produce arousal but *arousal uses up attention* [Emphasis added], reduces the cues that can be used in

²⁶⁰ Weick K. 2009. Making sense of the organisation, Vol. 2: *The impermanent organisation*, 8

²⁶¹ Weick K. 2009. Making sense of the organisation, Vol. 2: *The impermanent organisation*, 20

²⁶² Weick K. 1995. *Sensemaking in Organisations*, 37

²⁶³ Weick K. 1995. *Sensemaking in Organisations*, 64

²⁶⁴ Weick K. 1995. *Sensemaking in Organisations*, 101

sensemaking, focuses attention on the interruption, and has the potential to escalate cognitive inefficiency.”

The sixth applicable quote is: “Problems of sensemaking should be especially severe in organisations where people work among complex interdependencies that can generate implausible outcomes (Perrow, 1984). These organisations are much more common than people, including Perrow, realize. The possibility of widespread interactive complexity is suggested by a refinement of our earlier analysis of arousal”²⁶⁵. “As pressure mounts, the first change is that loose coupling is replaced by tight coupling, and the second change is that a linear transformation system is turned into an interactively complex transformation system. Both changes are the product of a steady loss of information. And the culprit is as much *the limits on human resilience, attention and sensemaking* as it is the complexities in technology that are the focus of Perrow’s attention”²⁶⁶. [Emphasis added]

Notwithstanding these mentions of attention and the recognition (at least in his own words and those of associates’ and referents’ words) of its role in sensemaking, organising and managing, Weick “addresses it by largely ignoring”²⁶⁷ attention in his making sense of sensemaking. It is not clear why Weick does not appear to seem to value the role that attention and its characteristics play in sensemaking. Perhaps the following extract from Weick’s work provides a clue:

- “If one gains an understanding of response repertoires and the conditions under which attention is controlled by the content of these repertoires, then a more substantial theory about organizations can be built. *The theory would concentrate on attention rather than on action* [Emphasis added]. It would essentially ask the question, “how are the processes and contents of attention influenced by the conditions of task-based interdependency found in those collectives whom we conventionally designate as organisations?”
- *While I cringe at my earlier subordination of action to attention* [Emphasis added], since acting one’s way into understanding is a hallmark of [Weick’s] later

²⁶⁵ Weick K. 1995. *Sensemaking in Organisations*, 130

²⁶⁶ Weick K. 1995. *Sensemaking in Organisations*, 131

²⁶⁷ A great turn of phrase that I borrow from Weick

work, I continue to use the idea that capabilities, especially linguistic capabilities, affect what one notices.”²⁶⁸

To be fair, Weick never completely discards the importance of attention, he merely de-emphasizes the notion of the “limits of attention” in aid of focusing on the value of action in sensemaking. The following quotes from Weick make this point quite well:

- “What we try to make clear is that the traditional picture of [attention] overload as something akin to a finite container that overflows is misleading. What we propose instead is that operations of interpretation and sensemaking can alter the size of the container and the magnitude of perceived overload. This means that ‘significance’ is crucial for managing load.” Implicit here in Weick’s thinking is the viewing of attention as a *quantity*, which is a proposition of this thesis.
- “If analysts shift to an interpretive perspective on [attention] overload then so-called ‘*limits on attention*’ are less important. What is more important is that an excessive number of unrelated bits and pieces strip away context and meaning. That is why John Dewey’s imperative makes sense: so act as to increase the meaning of present experience. Action and enactment often clarify meaning within streams of experience, which means that the likelihood of overload decreases. Action can shape a pile of cues into a coherent cluster that is then easier to name and label and handle and update.” [Emphasis added].

One gets the impression that Weick often, in the aid of emphasizing a neglected, unnoticed and often counter-intuitive aspect of sensemaking (i.e. act to make sense, instead of make sense and then act), de-emphasizes well-understood notions so convincingly and to such an extent that the reader may make the incorrect conclusion that the conventional notions are not important anymore.

Attention overload is just such an instance. What Weick says is all true, but the reader needs to be wary of throwing the baby out with the bath water. Attention overload is *always* a challenge or even a problem, especially “when we are confused” or when “pressure mounts”. It is the nature of the beast. The challenge or the problem may well be ameliorated by “significance”, but judging just by the quotes that Weick uses and listed above, the challenge

²⁶⁸ Weick K. 2004 Mundane poetics: Searching for wisdom in organization studies, from Weick, K. 2009. Making sense of the organisation Vol. 2, *The Impermanent Organisation*, 16

of the *astute allocation of attention*, is pervasive in organisations and in private and social life.

Another issue about attention needs to be noted: the notion that an individual pays *attention at various, and simultaneous, levels of intensity*. Schutz states: “The attentional modifications themselves show again all sorts of shadings: from actual comprehending to merely noting to hardly noticing to leaving completely unobserved.”²⁶⁹

Weick put it like this: “...even though people are immersed in flows, they are seldom indifferent to what passes them by”²⁷⁰. We learn in chapter 2.1 of Weiser’s noting of two levels of attention: “active attention” and the performance of some tasks such as reading, which one “ceases to be aware” of doing.

Weiser and Brown²⁷¹ describe rather well these varying levels of attention as well as the simultaneous paying of different levels of attention to the same thing:

- “We use ‘periphery’ to name what we are attuned to without attending to explicitly. Ordinarily when driving our attention is centred on the road, the radio, our passenger, but not the noise of the engine. But an unusual noise is noticed immediately, showing that we were attuned to the noise in the periphery, and could come quickly to attend to it.
- It should be clear that what we mean by the periphery is anything but on the fringe or unimportant. What is on the periphery at one moment may in the next moment come to be at the centre of our attention and so be crucial. *The same physical form may even have elements in both the centre and the periphery* [Emphasis added]. The ink that communicates the central words of a text also peripherally clues [i.e. cues] us into the genre through choice of font and layout.”

The above reference to the simultaneous paying of attention to various areas in life and at various levels of intensity ties up well with an earlier contention in this section, i.e. that sensemakers have to juggle attention capacity between alternative uses (instances of sensemaking). When reality changes, the portfolio of attention investments is also changed so as to maximise opportunities or minimise threats to well-being.

²⁶⁹ Schutz A. 1967. *The Phenomenology of the Social World*, 73

²⁷⁰ Weick K. 1995. *Sensemaking in Organisations*, 45

²⁷¹ Weiser M, Brown, J. 1996. *The coming age of calm technology*, 8 – 9

Using the material in this section so far, and the idea that sensemaking creates meaning by linking cues to frames, the remaining part of this section attempts to draft a definition of attention. We start by considering William James's²⁷² definition of attention:

“Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others, and is a condition which has a real opposite in the confused, dazed, scatter brained state which in French is called distraction, and *Zerstreuung* in German.”

This definition has stood the test of time and is still widely quoted. However it, and much of the research that has been done on attention focuses on the concept of attention as a *process*: “*taking possession of the mind*” [Emphasis added]. But is it useful also to consider the *quantity* and *quality* of attention. One may think of attention as a *quantity* when one includes time in the equation. If one drives a car on a highway for an hour, a certain amount of attention was paid. If one drives the same car for two hours (on the same highway, with the same traffic density and road conditions, etc.), one may reasonably claim that twice the amount of attention has been paid. One could also reasonably claim that more attention is paid when driving a car for an hour in a traffic jam on a road full of potholes and jaywalkers than compared to driving the same car for an hour on a well-maintained highway with low traffic density.

A second aspect of the quantity of attention refers to how much one has applied oneself. For example, a student can spend a whole hour in a class daydreaming about the social event he is going to attend that evening. Although he spent an hour at class, the amount of attention paid to the lecture in this scenario is zero.

The view of attention as a quality has to do with the person's level of knowledge and skills relevant to the task at hand. It is reasonable to propose that should a 5 year old child and his father, an aeronautics engineer, spend 5 minutes watching with equal mental concentration a fighter plane doing manoeuvres in the sky, the father has paid more attention, i.e. made more sense of that 5 minute event.

Attention, as opposed to attending, is the product between a quantity and a quality. The quantity refers to time spent attending which is easily measurable and how much one has

²⁷² James W. 1890. *The principles of Psychology* 1:404

applied one's mind, which is not easy, if not impossible to measure. The quality of attention refers to the person's capability (knowledge, skills, experience, thinking ability, etc.) vis-a-vis that which is being paid attention to. This quality is also difficult to measure, but many attempts have been made, such as tests and examinations. One's qualifications and years of experience is used as an attention-efficient guide to a person's capability. The higher the person's capability, the more attention is paid for a given level of concentration (i.e. the application of one's mind) and a period of time. In short, the amount of attention paid is the product between time, concentration and capability. It is important to note that according to this proposition, the quality of attention paid (i.e. the knowledge, skills, experience and thinking capability of the sensemaker) is not necessarily related to the quality of sensemaking (i.e. its fit to reality). There are a number of reasons for this. One is that the sensemaker may not have had enough time to make good sense. Alternatively, the sensemaker may not have applied him/herself to making good sense in the ample time allowed to do so. Or the emotional state of the sensemaker may have prevented good sensemaking despite ample time taken and concentration effort made to make sense. However, given that the above are not constraints, there ought to be some correlation between the quality of the sense made and the quality of the attention paid by the sensemaker. Whilst the quality of sensemaking ought to be improved with additional time and concentration of the sensemaker, there is a point that no matter how much time and concentration is invested in making sense, the quality of the sense made will not be improved or reach a level where the sensemaker is confident in proceeding with the interrupted project, or adequately fit risky reality.

Knowledge, skills and experience refer to those frames that one has already built up, whilst one's thinking ability (knowledge, experience and skills being equal) refers to the speed and accuracy of one's sensemaking. In other words, one's thinking ability speaks of one's speed with which frames and cues are linked and how accurate the resultant frames fit reality.

Why pay all this attention to look into more detail of what attention is?

That is because attention is a key resource in sensemaking. We have seen earlier in this section that sensemaking, or the making of meaning, involves a *kind of attention* or a *mode of attention*. Therefore sensemaking will inherit the characteristics of attention, such as being a scarce resource.

Being a scarce resource, people should manage it the same way that they manage other scarce resources, i.e. *pay* (i.e. invest) attention only when the additional perceived benefit *exceeds*

the *payment*. This explains the sensemaking property of plausibility, which represents the point in sensemaking where people decide that paying more attention will bring marginal or negligible improvements in their sensemaking, not worth the additional investment of attention. Like attention, the sense made will depend on the person's skills and experience. Skills, experience and one's thinking ability will determine both how fast sense is made and how accurate it will fit reality.

This is a key proposition, one that should be considered to better understand the process of sensemaking and how to improve it. In short, *whatever may make sensemaking more attention-efficient ought to improve it*.

Sutcliffe and Weick²⁷³ address this very issue as follows in a section titled "Expertise as an antidote to overload":

- "Significance and expertise go hand in hand which suggests that overload is predominantly a phenomenon of novices and advanced beginners, less so those whose functioning is competent, and least so for those whose functioning is proficient and expert."

Another example pertains to attention-efficient cues i.e. data and information. If a picture is a thousand words then it ought to be more attention efficient to communicate in pictures. And if a video is a thousand pictures then the video should be more attention-efficient still.

However, one should not be oversimplistic about it, as nuanced or complex information may be communicated better, or only, by words. The UEMI technologies envisaged in this document comprise a mixture of all three: words, pictures and video, as enabled by e.g. audio-visual recording and augmented reality, as well as being there, in person or by telepresence.

The next section looks into more detail into the communication capability and attention-efficiency of images.

²⁷³ Sutcliffe K. & Weick K. E. Information overload revisited published originally as chapter 3 of Starbuck W.H. and Hodgekinson G. (Eds) Handbook of organisational decision making, and republished in Weick K.E. 2009 Making sense of the organisation vol 2, 75

4 Going beyond words

In this section the reader is required to invest a large amount of attention into an issue that ostensibly is a small one. However, by taking note of this issue one may have a better context within which to make sense of the potential impact of UEMI on sensemaking.

Weick (1995)²⁷⁴ argues that “the richness of one’s language is a crucial resource in sensemaking, a suggestion that directly reflects the idea of requisite variety. Rich language affords rich reflective thought - the words I say affect the thoughts I form when I see what I’ve said.”

This makes sense. But the ability to *inform* is not limited to words. We have said earlier that a picture is a thousand words. A few cases involving information presented in words and pictures are presented below to illustrate and compare the power of visual information to inform in comparison to those of words. It is not an entirely fair comparison because the words were written in a way that is mindful of the picture that it would accompany. However, the essence of the difference between the two mediums should nevertheless become clear.

Case – Vulture stalking a child

The words:

- “In March 1993, photographer Kevin Carter made a trip to southern Sudan, where he took now iconic photo of a vulture preying upon an emaciated Sudanese toddler near the village of Ayod. Carter said he waited about 20 minutes, hoping that the vulture would spread its wings. It didn’t.
- Carter snapped the haunting photograph and chased the vulture away. (The parents of the girl were busy taking food from the same UN plane Carter took to Ayod). The photograph was sold to The New York Times where it appeared for the first time on March 26, 1993 as ‘metaphor for Africa’s despair’.
- Practically overnight hundreds of people contacted the newspaper to ask whether the child had survived, leading the newspaper to run an unusual special editor’s note saying the girl had enough strength to walk away from the vulture, but that her ultimate fate was unknown. Carter came under criticism for not helping the girl.

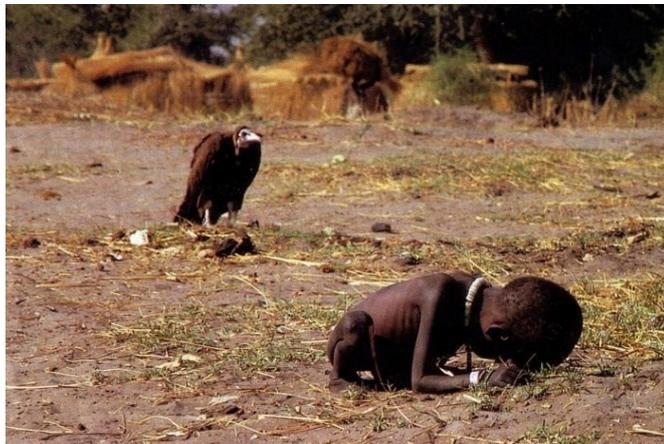
²⁷⁴ Weick K. 1995. *Sensemaking in Organisations*, 90

- "The man adjusting his lens to take just the right frame of her suffering might just as well be a predator, another vulture on the scene," read one editorial.
- Carter eventually won the Pulitzer Prize for this photo, but he couldn't enjoy it. Consumed with the violence he'd witnessed, and haunted by the questions as to the little girl's fate, he committed suicide three months later."

The picture:

See figure 16 on the next page

Figure 16: The Vulture and the Starving Child: The most iconic photograph of the century²⁷⁵



Indeed, one may see that "a picture is a thousand words". What imparts the most *accurate* impression? The words "a vulture preying upon an emaciated Sudanese toddler" or the picture? However, what is also clear is that a richer informing capability is enabled by *both* pictures and words. Words can inform in ways that pictures and video cannot. However, the inverse is also true.

Moving on to video, a case that illustrates well how words, pictures and visual footage differ in the way they inform is the notorious incident when Diego Maradona scored "the hand of god" goal during the 1986 FIFA World Cup quarter-final football match between England and Argentina.

A very good entry in Wikipedia.org²⁷⁶ and England Football online²⁷⁷ provide a few ways of receiving the cues to make sense of this event:

²⁷⁵ <http://thincquisitive.com/2012/08/22/the-vulture-and-the-starving-child-the-most-iconic-photograph-of-the-century/> downloaded 17 November 2013

²⁷⁶ [http://en.wikipedia.org/wiki/Argentina_v_England_\(1986_FIFA_World_Cup_quarter-final\)](http://en.wikipedia.org/wiki/Argentina_v_England_(1986_FIFA_World_Cup_quarter-final)), downloaded on 15 December 2010. An earlier draft of this study had more references to Wikipedia to support and illustrate its

Case: The “hand of god” goal

1 Words

Six minutes into the second half, Maradona cut inside from the left and played a diagonal low pass to the edge of the area to team-mate Jorge Valdano and continued his run in the hope of a one-two movement. Maradona's pass, however, was played slightly behind Valdano and reached England's Steve Hodge, the left midfielder who had dropped back to defend.

Hodge tried to hook the ball clear but miscued it. The ball screwed off his foot and into the penalty area, toward Maradona, who had continued his run. England goalkeeper Peter Shilton came out of his goal to punch the ball clear, with his considerable height at 6 ft 1 in (1.85 m), making him clear favourite to beat Maradona at 5 ft 5 in (1.65 m) to it. However, Maradona reached it first, with the outside of his left fist. The ball went into the goal, and the referee (Tunisian Ali Bin Nasser), not having seen the infringement, allowed the goal.

Maradona later said, "I was waiting for my teammates to embrace me, and no one came... I told them, 'Come hug me, or the referee isn't going to allow it.'"

2 The Photo

Figure 17: The photo²⁷⁸ – Infamous “Hand of God”



3 The Video (from YouTube.com)

<http://www.youtube.com/watch?v=DbbsytHDp2o>

Of course, having been there in person would (as Weick notes in his praise of the rich communication enabled by being there in person, as opposed to the lean experience which

contents, because it is attention efficient. This was not accepted by the sponsor of this thesis. In this single case of using Wikipedia, the non-academic content of the Wikipedia content is not used to argue any point, but merely serves to illustrate the richness of the different media: words, pictures and video.

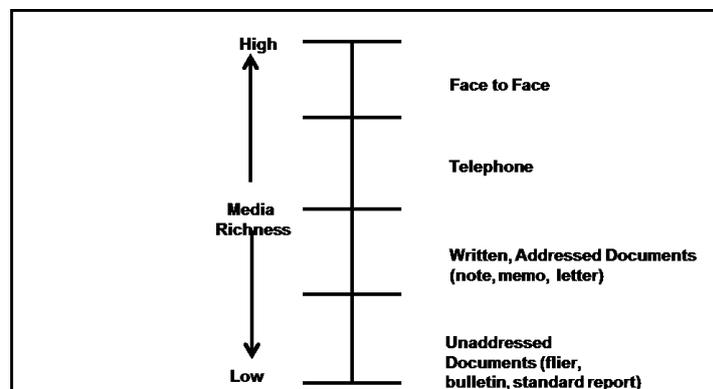
²⁷⁷ <http://www.EnglandFootballOnline.com/Seas1980-90/1985-86/M0618Arg1986Feat.html>

²⁷⁸ <http://www.EnglandFootballOnline.com/Seas1980-90/1985-86/M0618Arg1986Feat.html> downloaded on 17 December 2010

electronic information systems afford) provide a very rich experience of cues as well. The problem with being there is that it is fleeting. As Maradona handled the ball into the net, one may have missed it, as happened to the referee. Once over, the only way to look back at this is to look at the other media referred to here or listen to people describing what happened from memory. The problem with reliance on memory is that one's memory moves with time. The fish that got away becomes bigger each time the story is told. Without the written word or the video to fall back on in the future, Maradona's "Goal of the century"²⁷⁹ could have his feat enlarged from overcoming six defenders to perhaps overcoming all eleven, with its concomitant digression from reality.

The work of Daft and Lengel that Weick builds on regarding information richness appears to be limited by the technology of the times for sensemaking in organisations. It considers only four scenarios to describe the increasing level of richness (see figure 18 below): Unaddressed documents (flier, bulletin, standard report); Written, addressed documents (note, memo, letter); Telephone; and Face-to-face. The explanatory diagram below could hardly be presented more sparsely²⁸⁰:

Figure 18: Hierarchy of Media richness



Source: Daft, Lengel, and Trevino (1987)

Curiously, Daft and Lengel do not consider video conferencing. Weick continues with this omission of available, richer information technologies. The list below provides quotes that he used from the work of Daft and his colleagues:

²⁷⁹ Diego Maradona's Goal of the Century, at <http://www.youtube.com/watch?v=jk-kXwjASEE&NR=1&feature=fvwp>, length 36 seconds, downloaded on 30 May 2011

²⁸⁰ http://www.fsc.yorku.ca/york/istheory/wiki/index.php/Media_richness_theory, downloaded on 15 December 2010

- “The richness (Daft & Lengel, 1986) of face-to-face interaction, which facilitates perception of complex events and the invention of innovations to manage the complexity, is reduced *when interactions consist of computer screens filled with generic one-way communication* [Emphasis added]: A consistent standard used by Weick when considering the role of electronically mediated information in sensemaking], which relative strangers can enter and leave, using relatively mindless routines”²⁸¹
- “To resolve confusion, people need mechanisms that ‘enable debate, clarification, and enactment more than simply provide large amounts of data’ (Daft & Lengel, 1986, p 559)”²⁸²

UEMI technologies like augmented reality, virtual presence, and encoded personal and organisational memories not only approximate face-to-face interaction to a significant degree, but in some instances (e.g. the sheer ability to instantaneously and accurately recall rich cues of past events, e.g. body language), significantly surpasses the ability of most people without UEMI to do so. The video of the Kahn academy which was discussed in Chapter 2 is an example which supports the above contention. The kids preferred their cousin on YouTube than in person to make better sense of the material that they had to learn. This video²⁸³ on what motivates people at home and in the workplace shows how rich communication can be when you marry words with animation.

5 Sensemaking and UEMI: mutual impact in the organisation

This section will investigate the mutual impact between sensemaking as understood in Chapter 3 and UEMI technologies as covered in Chapter 2. This investigation will be structured largely according to the structure of the review of sensemaking in Chapter 3. Thus the first area for analysis is the seven properties for sensemaking.

5.1 Sensemaking is on-going

Intrasubjective (i.e. personal) sensemaking is on-going: one never stops making sense. A past advertisement of a major South African bank highlighting the accessibility of their banking

²⁸¹ Weick K. 1995. *Sensemaking in Organisations*, 73

²⁸² Weick K. 1995. *Sensemaking in Organisations*, 99

²⁸³ “RSA Animate – Drive: The surprising truth about what motivates us.

<http://www.youtube.com/watch?v=u6XAPnuFjJc>, 10 minutes 48 seconds Downloaded 31 May 2011

service put it well: “Great ideas don’t keep office hours”. One is always available to oneself to make sense of something.

When intrasubjective sensemaking may benefit from an immediate reference to e.g. electronically encoded personal memories or to an organisation’s database or other digital archive, etc. the *ubiquitous* property of UEMI will enable a higher *quality* of sensemaking because it will enable faster access to cues. This is because in many instances of sensemaking time is of the essence. The longer someone is not able to make sense the more stressed that individual would be, with poorer sensemaking as a result. A protracted sensemaking process may also be cut short because other things in life may demand one’s attention and so a project remains in limbo.

How will UEMI speed up sensemaking? By being better at providing cues as (information or data) and when one’s train of thought requires them. Mobile phones outside the office or home, and audio-visual equipment in the home or office together with properly tagged word content enabled by e.g. speech recognition, enables rapid access to that which is sought for sensemaking, if it exists.

It will also provide for faster and better sensemaking by enabling an individual to store in digital archives any ideas that jump to mind, scenes experienced or documents written or dictated, for future reference and sensemaking. Should such ideas not be stored as and when they pop up they will have to be re-thought or brainstormed, which slows the sensemaking process. Or they may never be re-thought again.

UEMI enables a higher quality of sensemaking because its ubiquitous property enables sensemaking that may otherwise not have occurred. Slower sensemaking builds frames relevant to the sensemaking task at hand at a slower rate and the less relevant frames there are to interpret incoming cues, the less rich sensemaking will be. Therefore, it will be less accurate and the quality of sensemaking will be lower.

Intersubjective sensemaking is also on-going but usually only during office hours. UEMI also has a role to play here, as the following case illustrates: Assume a company’s policy enables people to audiovisually record their meetings and workshops during company time. These are formal settings to enable intersubjective sensemaking that is of value to the company. To date the proceedings of meetings have been captured by a minute taker. The application of UEMI for this example is to record all organisational formal meetings in high definition video and high fidelity sound of everything that everyone said or did at the meeting.

Many obstacles to sensemaking may occur during such meetings or workshops. People sometimes talk simultaneously. Hence an individual is able to focus only on a subset of the people in the meeting or workshop and as a result misses the rich information (e.g. body language) of those attendees that are not noticed, or have been misheard. Often one forgets what one has heard, or does not appreciate the full impact of what has been said at that time.

When subsequent sensemaking (intrasubjective or intersubjective) comes up with the need for more detail on the communication and sensemaking that happened at said meeting, UEMI technologies may provide this with minimum cost (time and money). UEMI may well play a beneficial role in generic subjective sensemaking where agents may be substituted for each other in fixed roles. One way to do so is to access UEMI information of predecessors in meetings, workshops or even performing tasks. It may assist with practical training.

The number of examples of where the property of *ubiquity* may provide for a better sensemaking in terms of quality and speed is limited only by one's imagination. The conclusion may be made that the ubiquity of UEMI technologies will enable the trains of thought associated with on-going sensemaking to be disrupted less. When new cues enable new meanings to be created at any time, convenient or otherwise, UEMI will enable supporting cues to be considered immediately and the recording of new meanings to be digitally archived for further on-going sensemaking.

One note of caution should be considered. The UEMI should not *provide* cues all the time. That is not attention efficient because one's train of thought is continuously being interrupted by the continuing incoming cues. An attention-efficient UEMI service should inform only upon request.

5.2 Sensemaking is retrospective

One can make sense only of that which lies in the past, be it seconds in the past or decades. However, that which lies in the past is dependent on human memory which is known to be fallible and subject to modification, as e.g. when one's identity is modified or due to *hindsight bias*, the phenomenon where people tend to simplify past events that lead to the current situation or where these determinant histories are reconstructed according to whether the outcomes of that history are seen as good or bad.

UEMI-enabled audio-visual recording of (preferably large) parts of one's life such as important sessions at work such as meetings, workshops, spontaneous brainstorming, remote interaction with colleagues (instead of using the phone or email) may counter the above

failures. This will require attention-efficient recall of these recorded digital memories. As stated in Chapter 2, a key milestone for attention-efficient UEMI is speech recognition that is close to the speed and accuracy of human speech recognition. It appears we are almost there, if one accepts that the technology has to be trained to recognise a specific voice.

The establishment of UEMI capabilities in organisational settings will enable people to pay attention at a later stage to events that were audiovisually recorded in organisational settings. For example, provided that sufficient progress is made on speech-to-text technologies it is conceivable that a meeting minute taker will not be necessary.

One further issue needs to be considered here, and that is another of Weick's by now familiar counterintuitive notions. He acknowledges²⁸⁴ that "retrospective sensemaking does 'erase' (Starbuck & Milliken, 1988, p. 37) many of the causal sequences that made it harder to accomplish the final outcome", but also that:

- "...if people want to accomplish their projects, if effort and motivation make a difference in completing these projects, and if *the* environment is malleable, then a reading of past indeterminacy that favours order and oversimplifies causality (Reason, 1990, p. 91) may make for more effective action, even if it is lousy history." [Emphasis added]

This may well be so, but this example is more of an exception than the rule. If one wants to learn, build expertise, not to mention avoid threats to one's well-being, one should try to minimise "lousy history".

Weick goes on to ameliorate the problem of hindsight bias by pointing out that "retrospective sensemaking in everyday life" is typically done fairly quickly after events. In this case memory traces are "fresh and rich with indeterminacy" which reduce *distortions*. Weick thus effectively says that it is best to reduce "lousy history" or that "lousy history" is a necessary evil.

Weick also refers to Starbuck and Milliken's (1988, pp. 39 – 40) contention that retrospection "only makes the past clearer than the present or the future; it cannot make the past transparent" and concludes that although the "past may be subject to partial erasing, it is not obliterated."

²⁸⁴ Weick K. 1995. *Sensemaking in Organisations*, 28

A third point offered by Weick to keep the negative findings of hindsight in perspective, is that the “*feeling* of order, clarity and rationality is an important goal of sensemaking, which means that once this feeling is achieved, further retrospective sensemaking stops.” [Emphasis added]

All of this makes sense for “everyday sensemaking”, where the negative impact of *distortions* is minor, and before considering UEMI. In instances of potentially large impacts of hindsight bias in “everyday” organisational life (e.g. crafting a sales and pricing strategy in a company) costly *distortions* may be kept to a minimum with UEMI. The best approach is to reduce distortions that UEMI technologies are or will be equipped to do.

One important point made by Weick which delimits the potential role of UEMI needs to be noted here. UEMI has a strong role to play when the challenge of sensemaking is one of *ignorance* - a lack of information.

The challenge of sensemaking may also be due to “equivocality”, or confusion, because there are “too many meanings, not too few.” In this instance people do not need more information because their problem is confusion and not ignorance. What people need are “values, priorities, and clarity about preferences to help them be clear about what projects matter”²⁸⁵.

The *information* provided by UEMI may have a dual impact on sensemaking - it risks increasing information load and thus the consumption of attention on the one hand, whilst reducing attention consumption because of richer information that is not subject to the decay of human memory. In addition, UEMI also provides *data* (or planned field observations. See section 2 of chapter 1 in this thesis) from which one may infer values and preferences, should a quick chat (face-to-face or via UEMI) not do the trick.

5.3 Grounded in identity construction

People don’t know what their voices sound like. Also, people often cannot believe what they look like in a video of themselves and often correct their approach to interaction with others and themselves when they see themselves on video. In fact, sportspeople often improve their abilities by looking at feedback on their execution of a sport movement via video.

It is not implausible that an increase of watching themselves on video (for example, in a videoconference, etc.) will have an impact on their identity construction. We live most of our lives without looking at ourselves. The examples of UEMI used for this thesis (recalled from

²⁸⁵ Weick K. 1995. *Sensemaking in Organisations*, 27

audio-visual archive or live audio-visual footage of oneself) will in effect put up a mirror of ourselves to look into. Thus, we will be able to visually observe ourselves in situations that represent sensemaking in action and which may serve as cues for sensemaking at a later stage. This use of UEMI will have an impact on the sense being made which, according to the theory of cultural self-representation by Erez and Early as described above, should have an impact on one's identity.

5.4 Sensemaking that is focused on, and extracted by cues

Cues are things that are either noticed in the ordinary course of life, or scanned for, and which triggers or enables sensemaking. The treatment by Weick of cues is, by his own admission, biased to a more passive "noticing" of cues rather than a more pro-active "scanning" for cues because "noticing" implies greater scope for keeping an open mind to better enable *invention*, an important characteristic of sensemaking.

Sensemaking comprises both invention *and* discovery (i.e. interpretation), albeit according to Weick²⁸⁶, sensemaking is (in other words, should be) "less about discovery than it is about invention." This study contends that the importance depends on the circumstances in which cues are extracted for sensemaking. For example, when a company knows what to look out for to maximise the opportunities for success or minimize or manage the risk of loss, and the stakes (loss or gain) are large, scanning is the appropriate method to extract cues.

For example, a telecommunications company may be interested in scanning for cues that may help them sell more such as looking out for e.g. policy changes in companies or industries that require employees to work from home a few days a week in order to reduce costs and their carbon footprint. Such a policy change could help them sell more bandwidth and telepresence services to the homes of employees.

However, when it is not known what is being looked for, noticing is more important. In a company setting an approach such as MBWA (management by walking around) is aimed at maximising the noticing of cues.

If there is one property that UEMI should have a large impact on, it is cues. Consider a scenario of the noticing of cues through MBWA. Let us say that the product innovation manager of a company visits a retail outlet of his company to buy his son a birthday present whilst also having a face-to-face chat with his sales people on the ground and hears (i.e.

²⁸⁶ Weick K. 1995. *Sensemaking in Organisations*, 13

notices) how a customer comments on how he likes a specific new flagship product, but has heard that people have had reliability problems with a new feature of that product.

In a scenario where all the company's retail outlets are equipped with UEMI equipment that records audio-visual footage of the whole day in all of the stores he may right there and then query the company's digital archives to see whether the same sentiment had been expressed in other stores since the recent launch of the product. If so, and depending on how much is at stake he can now justify calling an immediate emergency meeting, via telepresence, with his product development team to take appropriate action. If not, he may decide to call his colleague in sales whilst on his way to his son's birthday party to tell him about his experience and e.g. ask him to investigate whether that comment was an isolated incident or not.

Sensemaking is about increased clarification due to an iterative process – in part it involves repeated exposure to past events to pick up cues then the making of sense which may point to looking for more cues to increase the plausibility (i.e. accuracy) of the sense being made.

It stands to reason that recourse to audio-visual footage enabled by UEMI will be more accurate than recourse to memory unless one has a photographic memory. As pointed out in the previous section titled “Going beyond words”, one pair of eyes cannot match the collection of cues enabled by the audio-visual recording of a number of cameras in a boardroom, retail shop, office or home, whether you have a photographic memory or not. Recall the video of the MIT researcher who filmed his home to capture his son's first speaking of the word “water” for an idea of what a UEMI room may enable in terms of the capturing of cues of a room or retail space that is recorded by more than one camera.

In short, a human being is no match for a UEMI-equipped setting (office or home space) to record cues for later sensemaking, which may involve iterative examination of captured footage to extract more cues. However, scenarios exist where one knows which cues will improve sensemaking and have an incentive to provide them, such as a manual for customers on how to use a product or service. The appropriate UEMI technology is augmented reality where explanations may be superimposed on footage of how a product should be used.

The caveat here is that people have finite amounts of attention. Therefore, in all of the above scenarios one should make sure that people are not provided with irrelevant cues. For example, in the scenario above of the director in retail, the ideal would be to instantaneously provide a list of all the footage in all of the shops where the problematic product feature was

mentioned. By spending a few minutes viewing a number of these comments the director should be in a position to take appropriate action.

5.5 Driven by plausibility rather than accuracy

Weick²⁸⁷ goes to great lengths to point out the risks associated with the expectation that accuracy is necessary in sensemaking and captures his attempts to do so in the memorable quote that “accuracy is nice, but not necessary for sensemaking.”

Hence sensemaking is made until it is plausible and then one goes over to action. For instance, one carries on with the project which was interrupted to the extent that it triggered the sensemaking in the first place.

However, this thesis argues that because *attention* is another sensemaking resource, and a scarce one at that, plausibility is necessary because of the scarce nature of human attention. Human attention is limited by time, capability and inclination or motivation.

This thesis also argues that due to the inherent attention-efficiency of UEMI technologies with its concomitant reduced load on scarce human attention the reliance on plausibility will perhaps not be eliminated, but it will be reduced. This in turn should result in a better quality of sensemaking, which is valuable in the face of risky reality and which in turn should have a positive impact on one’s well-being. The key impact of UEMI on the plausibility property of sensemaking is thus clear.

Weick offers another counterintuitive notion namely that serendipity may ameliorate the risks associated with the lack of accuracy. He says:

- “Sutcliffe (1994) raises the possibility that *inaccurate* [Emphasis added] perceptions, under some conditions, may lead to positive consequences:

Misconceptions may be beneficial if they enable managers to overcome inertial tendencies and propel them to pursue goals that might look unattainable in environments assessed in *utter objectivity* [Emphasis added]. Because environments aren’t seen accurately, managers may undertake potentially difficult courses of action with enthusiasm, effort, and self-confidence necessary to bring about success. Having an accurate environmental map may be less important than having some map that brings order to the world and prompts action.”

²⁸⁷ Weick K. 1995. *Sensemaking in Organisations*, 55

However, this line of thought begs two questions:

- Will the enthusiasm, effort and self-confidence associated with a less accurate appreciation of the difficulty always, mostly, sometimes, or by exception, result in a success?
- What would be the loss of well-being had it *not been successful*?

The many failures of small businesses that were launched with enthusiasm, effort and self-confidence, and sometimes fail with serious consequences because the would-be entrepreneur invested his/her full retrenchment package at an advanced stage of his/her working life, provides a sobering counter argument:

- At best enthusiasm, effort and self-confidence associated with a less accurate appreciation of the difficulty of launching a business will sometimes result in success.
- Often the failure amounts to the best school fees ever paid, which results in a more successful second or third attempt. Sometimes the failure is nothing short of catastrophic to people's livelihood, self-esteem, self-confidence and even life.

Of course it may be so that the value created by relying on enthusiasm, effort, and self-confidence, as opposed to accurate assessment of risks, may exceed the value destroyed when such endeavours fail.

However, it is problematic that Weick's coverage of sensemaking theory appears to completely disregard the potential risk or significant or catastrophic loss of well-being as a result of failure in some cases which I have described as when risky reality is in play.

5.6 Social

Curiously, there is not much to be said about the impact of UEMI on the social property of sensemaking. Nevertheless, when one thinks of UEMI's telepresence capabilities it is fair to say that UEMI will enable increased social contact both in terms of quantity and quality and at times when sensemaking requires it.

Sensemaking theory holds that all of sensemaking is essentially social. Even when one is making sense in the absence of anyone around (physically or digitally) one *imagines* the impact on others of what one is thinking. It stands to reason that with the increased and new capabilities of e.g. UEMI via telepresence one may rely less on one's imagination which may improve the quality of sensemaking.

One caveat needs to be considered though. Weick often mentions the value of imagination in preference to more accurate cues. Sensemaking involves both the interpretation of what is given, i.e. cues and the *making* of that which is then interpreted, i.e. the imaginative creation of new links between frames. Imagination is needed for innovation and for enactment.

It has been argued that the *quality of sensemaking* as a good fit between the sense made and risky reality, is something worth striving for. However, sometimes one needs to change (i.e. enact a new) reality and for that one must never rid sensemaking of its reliance on imagination.

5.7 Enactive of sensible environments

To appreciate how UEMI and enactment may impact each other one needs to consider the current trend of the digitisation, automation and mobilisation of our working, social and private lives. In a sense our lives are expanding into a digital world, a world that like its physical counterpart is also susceptible to enactment.

Enactment refers to the phenomenon of people creating part of their environment, that then places constraints on them or offers them opportunities. The vision of UEMI as proposed in this document will significantly increase the environment that may come back to constrain or facilitate. For example, cases abound of people putting their lives and comments on controversial themes out in the Internet which then later comes back to haunt them. The same holds true for the future UEMI in organisations. Barriers to UEMI adoption have been discussed in section 3 of chapter 2, which include privacy concerns and the threat to organisational hypocrisy, which may have value to organisations. These barriers exist because the implementation of UEMI will enact an environment in which concerns will rise about privacy and the inability or reduced ability to exercise organisational hypocrisy.

Enactment refers to that which is made to be sensed, the audio-visual recordings enabled by UEMI technologies is effectively the creation of new reality, which otherwise would not be available for sensemaking. The same holds true for augmented reality. The products of sensemaking are converted to the information contained in the augmented part of augmented reality which is then superimposed on live scenes or other video footage to serve as cues for further sensemaking. The rich set of cues in multimedia which is enabled by augmented reality enacts an environment that allows better sensemaking as the cues are now presented in a more attention-efficient way - it keeps better pace with one's train of thought.

5.8 How does sensemaking impact UEMI technologies?

A strong focus of this thesis is to counter sensemaking theory's lack of focus on the role that UEMI may play on sensemaking. This section briefly considers the impact in the other direction - the impact of sensemaking on UEMI technologies.

From the notions proposed in this thesis, it is clear that whatever affords attention-efficiency in sensemaking ought to be valuable and those UEMI technologies that enable the most attention-efficiency ought to be successful in the marketplace. This thesis has stated²⁸⁸ that the current largest stumbling block in advancing UEMI technologies is the stalling in the growth of the accuracy of speech recognition.

6 Chapter summary

When sensemaking theory considers electronically mediated informing at all, it is fairly dismissive of its value to sensemaking. Weick points to the lack of richness of information provided by computers, the effect of the fallacy of centrality (what does not come through the computer screen cannot be true) and the lack of intersubjectivity when e.g. managers choose to manage “by screening around” instead of managing “by walking around”. The organisational problem of attention overload is seemingly dismissed as a problem of a lack of interpretation and the making of meaning and the excessive focus on information processing. This thesis proposes that sensemaking theory should consider the notion of the *quality of sensemaking* which is defined as how close the sense that was made fits reality. The importance of this fit is especially notable in conditions of *risky reality*, which is defined as those situations where the welfare of the sensemaker is at stake or opportunities exist to enhance one's well-being.

And the way to improve the quality of sensemaking is to invest more attention in making sense. Attention is defined as the product between time, concentration and the quality of the attention that was paid. This *quality of attention* refers to the knowledge, skills, experience and thinking ability of the sensemaker.

Alternatively, a higher quality of sensemaking is also afforded by improving the attention-efficiency of the sensemaking process. Hence a key proposition of this thesis, one that should be considered to better understand the process of sensemaking and how to improve it, is this: whatever may make sensemaking more attention-efficient ought to improve it. What may

²⁸⁸ See chapter 2, section 6.4 of this thesis

make sensemaking more attention-efficient? It is the increasing capability of UEMI technologies, which sensemaking theory, as espoused by Weick and his associates, seemed to have missed or ignored.

UEMI technologies increasingly enable richer informing, to the point where it in some instances (e.g. multi-camera, multi-angle audio-visual recording of events) may surpass being there in person. The problem of the fallacy of centrality is ameliorated because UEMI enables informing from various sources (and points of view); one screen does not mean that cues only come from one source or one point of view. Live or recorded audio-visual footage may be enriched by augmented reality on one screen whilst a telepresence screen (or hologram) enables intersubjectivity that in this particular instance may be better than a face-to-face meeting without any UEMI.

In addition, UEMI has been shown to positively impact all seven of the sensemaking process properties, with the most beneficial impact on the properties of plausibility, retrospect, cues and on-going. Last but not least, this thesis proposes that UEMI technology providers ought to focus on that which will enable a better quality of sensemaking, namely more attention-efficient technologies. And the key ingredient to enhance attention-efficiency is improvement of speech recognition technologies.

Chapter 5

Conclusion

1 Introduction

Digital information and communications technology is considered to be the key *general purpose technology* of the current Third Industrial Revolution, which in the United States of America has been estimated to have contributed the majority of the country's growth in productivity since the mid-1980s. However there are a few dissenting voices from the community of economists questioning how important digital ICTs really are in increasing productivity, with one economist even stating that the ICT-driven Third Industrial Revolution is over.

The only way to make sense of this apparent anomaly is to accept that the dissenting economists fail to fully appreciate how messy the processes of *invention* and *innovation* are. Innovation typically occurs in fits and starts, sometimes with long periods of productivity growth stagnation, as technologies develop further, and society learns how to harness their capabilities. In addition, the costs of making use of products and services based on inventions typically decline with scale. In the case of digital ICTs, the exponential increase in performance against prices that stay constant or decline, enable productivity growth.

In view of this stellar role of ICTs in the growth of economic productivity, the equally dissenting voice of Karl Weick - the global thought leader on sensemaking – regarding the utility of ICTs in sensemaking is jarring. This is especially so given that sensemaking is the process with which knowledge is created, whilst knowledge goods are considered to be “perhaps the most precious part of society's stock of capital”²⁸⁹.

It appears that like the dissenting economists, Weick and his school of thought on sensemaking also fail to appreciate the uneven and messy nature of innovation which typically results from commission, happy accidents and omission; much like the process of sensemaking. Their negative view of the impact of ICTs on sensemaking, warranted when expressed during the embryonic stage of ICTs in the mid-1980s, has lamentably been held despite the notable increase in performance and productive capacity of ICTs since then. It has

²⁸⁹ Heilbroner R, Milberg W. 2008. *The making of economic society*, 72

become necessary to investigate the validity of this counterintuitive view. This investigation comprises the impact between Weickian sensemaking and electronically mediated informing by ICTs which are increasingly *attention-efficient* and hence labelled as *ubiquitous*.

2 Mutual impact between sensemaking and UEMI

To properly consider the mutual impact between sensemaking and UEMI (ubiquitous electronically mediated informing), it is necessary to consider four key notions not currently adequately catered for in sensemaking theory. The first notion holds that the characteristics of attention ought to be considered in sensemaking theory, as sensemaking is an *act of attention* or a *kind of attention* that is paid. The characteristics of attention which have been found in the academic literature has focused on attention as a *process*, where attention is largely viewed as the application of cognitive resources on that which informs, whilst filtering or ignoring irrelevant information or data. In this thesis the definition of attention is expanded to include new aspects, namely *quantity* and *quality*. Attention is a *scarce resource* without which sensemaking is not possible.

The study has learnt from the theory of economic science that any human activity which involves the attainment of ends with scarce means has an *economic* aspect, which means that it submits to economic theory. This holds for *any* activity, whether it is the production of potatoes or the production of philosophy²⁹⁰. As the production of philosophy is an instance of sensemaking, this study investigates in some detail the sensemaking process as the attainment of ends (the sense that was made) with scarce means (time and attending capability).

The one implication of viewing attention as a scarce resource is that attention ought to follow the laws of economics, i.e. attention will be paid only when there is an acceptable return on attention. Paying attention is an investment; it costs time and mental concentration, which explains the property of plausibility in sensemaking. The reason that sensemaking stops when *plausible* sensemaking is made is because the perceived returns on additional attention invested beyond the point of plausible sensemaking towards more accurate sensemaking are less than the perceived costs.

The *quality and quantity* of attention - and therefore the *quality* of sensemaking (the second key notion of this thesis) - relates to four factors: the *time component* of attention paid, the level of *mental concentration* of the person paying attention, the level of *experience and expertise* brought to bear on the sensemaking event or process and the *richness of data and*

²⁹⁰ Robbins L. 1945. *An essay on the nature and significance of economic science*, 32-33

information available to the sensemaker(s). In short, the longer the sensemaker(s) pay attention during a sensemaking event, the higher their mental concentration in making sense during this time period, the more knowledgeable, skilled and experienced the sensemaker(s) are, and the better their thinking ability is regarding that which needs to be made sense of and the richer and more relevant the information is that is available to the sensemaker(s), the higher the *quality* of sensemaking. In other words, the better the fit ought to be between reality and the sense that is made.

UEMI has the potential to improve sensemaking due to its superior ability when compared to human capabilities of providing richer information. Humans have to rely on having been at the event that later becomes the subject for retrospective sensemaking and on their memory to recall such an event. Alternatively the sensemaker has to rely on the memory of others or on written accounts of such an event, e.g. the minutes of a meeting.

A digital high-definition audio-visual recording of e.g. said meeting with a number of cameras recording from various angles to capture the facial expressions and other body language in addition to what has been said which is capable of being called up anywhere, at any time by any search criteria (e.g. by content, date of meeting, participants, etc.) which relates to such a meeting will provide information much faster and in a much more accurate, richer detail than any human memory or minutes of the meeting can muster. That is not only the promise of UEMI; it is already technically, if not economically possible. Sensemaking theory should consider this, as electronic computing has moved on from the state-of-the-art technologies of 1985 with their spreadsheets on stationary monochrome computer screens.

How exactly may UEMI “improve sensemaking” as claimed above? Firstly, UEMI enables the speeding up of the sensemaking process by providing both *richer* and *faster* information than human memories and the written or spoken word can. The increased speed is afforded by both the speed of digital access and the richness of information enabled by audio-visual footage that enables faster sensemaking. And faster sensemaking is better than slower sensemaking because increased anxiety with the concomitant narrowing of focus and missing of important cues for sensemaking is averted.

UEMI technology assisted sensemaking is also improved because more cues are available which afford the sensemaker(s) the opportunity of making more and more accurate (sense?), i.e. a higher quality of sense in the same time period as would be the case for sensemaking without UEMI.

Sensemaking theory holds that to make sense is to make do with what you have. It involves the interpretation and embellishment of cues that are available and where there are gaps, the making of material to interpret and to embellish. This increases the reliance on plausible sensemaking, and the chances that the sense made deviates from reality to a larger extent than would otherwise be the case, i.e. by having more cues to interpret and so rely less on making up things for interpretation.

The third key notion not adequately considered by sensemaking theory and which forms a cornerstone of this thesis, is the need to consider the quality of sensemaking in the face of *risky reality*. Sensemaking theory as described by Weick largely ignores the consequences of the sense that is made to enable one to “resume life’s projects.” In fact Weick makes the statement in reviewing the property of plausibility in sensemaking that “accuracy is nice but not necessary for sensemaking”. This may (although it probably was not Weick’s intention) leave the reader with the impression that the consequences of sensemaking do not matter, or that the fit between the sense made and reality does not matter, or both.

Whilst this thesis agrees that full accuracy, in the strictest sense as defined by Weick, is not practical because it consumes attention without a positive return on the investment of this scarce resource, it also argues that the fit (i.e. accuracy) between the sense made and a reality which has consequences pertaining to the sensemaker’s well-being or survival does matter very much. Examples include sensemaking in HROs (High reliability organisations) such as aircraft operations systems, hostage negotiation teams, wildland fire-fighting crews, or nuclear power generation plants. To these HRO organisations typically referred to in Weick’s work, one should add those that may be less life-threatening but have at stake people’s livelihoods, e.g. the strategy, operations or research functions of organisations.

The richness and speed of information that is enabled by UEMI (all else such as skills, experience and mental concentration being equal) will enable a higher quality of sensemaking that should result in better consequences (in terms of well-being and survival) of the sense that was made in the face of risky reality. An increased use of attention-efficient UEMI should reduce (though not eradicate) the level of, and reliance on plausibility in sensemaking.

This thesis contends that whilst plausibility will probably always be a property of sensemaking, its theory should go beyond viewing sensemaking as a process which ends when the sensemaker has made sense, to the point of being able to resume life’s projects, to also consider the quality and therefore the consequences of such sensemaking. The fact that

sensemaking will always have the property of plausibility does not mean that sensemaking should not strive to minimise plausibility in an effort to improve the changes of well-being and survival in the face of risky reality.

The fourth key notion expands Weick's almost exclusive focus on words as the medium to make sense to include that of the electronic audio-visual medium. Words expressed through the medium of sound (i.e. the spoken word) have served human sensemaking well. It still does so, but has since been joined by the written word over time, which has improved the *speed* and *quality* of sensemaking; it has enabled *better* sensemaking.

Communication media such as drawing, painting, and sculpture were added, but these were by and large very demanding on both attention (which includes skills) and money. Therefore, their use has been limited, and their incidence was far *less ubiquitous* than that of the spoken or written word. Later still, better sensemaking has been enabled by photography and video. This thesis has attempted to show through some examples how the best sensemaking is enabled when cues are offered as both words and visual information. It also points to the promise of augmented reality, which enables a richer channel than being there in person, in cases where the sensemaking does not rely on other human senses such as smell, taste and touch.

This thesis contends that searchable, sub-titled electronic audio-visual video (exemplified by UEMI) is superior to written text in enabling sensemaking. It should be, for it is in many ways a close proxy to being there in person and in others it is a superior experience when the aim is sensemaking (as opposed to e.g. eating a steak).

3 UEMI implications for the seven properties of sensemaking

This thesis concludes that UEMI will have an impact on each of the seven properties of sensemaking. The ubiquitous nature of UEMI will foster the *on-going* property of sensemaking. UEMI will be better positioned than what is currently the case to provide and store cues as one's train of thought requires or provides them. Intersubjective sensemaking is also enhanced by UEMI technologies such as telepresence in real-time. *Retrospective* sensemaking is enhanced by UEMI's capability to reduce the impact of poor human memory (e.g. hindsight bias) by enabling important events to be attention-efficiently recalled in rich digital audio-visual information detail. UEMI should also have an impact, albeit to a lesser extent than the case for the other properties, on how sensemaking is shaped by the *identity* of the sensemaker. This is because viewing and hearing oneself on UEMI systems will provide

independent feedback to oneself of how one comes across to others. In effect, a mirror is placed in front of sensemakers for part of the time that they are making sense with others, which will provide a motivation to promote that which one sees in this mirror and reduce that which one does not like to portray. This should result in changes to how one views oneself, which in turn will impact on how one makes sense. One of the largest impacts of UEMI on sensemaking has to do with how sensemaking is focused on, and extracted by *cues*. Sensemaking is about increased clarification due to an iterative process; some cue triggers a sensemaking event or process which then requires repeated exposure to past events to pick up more cues embedded in those events that may assist with the making of sense. Weick argues that sensemaking ought to rely more on the passive *noticing* of cues rather than a more proactive *scanning* for cues because the former way of garnering cues allows for a greater scope for invention in sensemaking. At first glance one may reasonably conclude that UEMI is better positioned to enable the scanning mode of garnering cues. But if in an organisation much of the interaction between employees and customers, and amongst employees, is digitally recorded and archived, UEMI will enable the noticing of cues as well. For example, if in addition to MBWA (managing by walking around) a manager uses a few minutes of idle time waiting at an airport to randomly browse through digital recordings or a live feed of the sales activities of a few of the company's stores, the possibility to notice (instead of scanning for) cues is increased. Whether one wants to scan or stumble upon cues, UEMI enables a superior experience in acquiring cues to trigger or complete sensemaking. Probably the biggest impact of UEMI on sensemaking relates to the property of *plausibility*. Plausibility is a necessity because of the fact that attention is a scarce resource. Being more attention efficient than the current methods and technologies enabling sensemaking, UEMI will allow for a higher quality of sensemaking, i.e. for a better fit to reality for the same investment of attention. UEMI should also have an impact on the *social* property of sensemaking. This is because UEMI will enable more frequent social contact which, whilst not as good as face to face interaction, is far richer in information than the paper letters and reports of the past, or even current digital technologies such as email, instant messaging, photos over MMS, etc. Info-snacking around virtual coffeekbreaks over telepresence will go a long way to update the organisational grapevines and so also sensemaking. And lastly, UEMI should have an impact on the property of sensemaking which is enactive of sensible environments; it will amplify this process. Ubiquitous computing is enabling the current trend of the digitisation, automation and mobilisation of the experience of our lives, be it our work, social or private lives. If an increasing part of our lives are to be *experienced digitally* and perhaps more

importantly *digitally recorded* for posterity, an increasing portion of our lives will be subject to a higher transparency, with the concomitant pressure to demonstrate consistency between current and past behaviour, as many in the public eye, e.g. politicians, will attest.

This thesis also concludes that the component of UEMI that will have the largest impact on sensemaking is that of the *accuracy of speech recognition*, because it will enable the largest leap of improvement of the attention-efficiency of UEMI technologies.

In summary, judicious application of current UEMI technologies already has the potential to significantly improve sensemaking; i.e. to increase its *quality* (not necessarily full accuracy) and the *speed* with which sense is made. An optimal improvement in sensemaking will be enabled by ubiquitous computing in the future which should be adopted with a similar ease and extent to that of storytelling and writing . This quote²⁹¹ is apt:

“Before writing was invented, people had to listen to learn anything and a good memory was an important tool. The person who could tell a good story always found an audience as well as respect, a good meal and place to sleep. People when they travelled took along their stories and shared them with others in far-away lands. When they returned home they brought back exciting tales of exotic places and people.”

Clearly storytelling then, as is still the case today, was an important way to make sense. Then came writing; “perhaps the first information technology”, according to Weiser²⁹². It is sobering to think that there are still many illiterate people today. But this is the result of economic and cultural factors rather than any incompatibility between writing and human capability and nature.

Looking forward towards the future of computing which is expected to increasingly adopt the property of ubiquity and which is more compatible with human nature, it is not unreasonable to contend that UEMI will be adopted as deeply as storytelling and writing. As was the case of the unfolding of previous Industrial Revolutions, it is expected that a period will exist during which some people are left out of this picture; hence the label *digital divide*. It should be recognised that the causes for this digital divide are the same as those for writing, namely economic and cultural causes. The lack of ubiquity of ICT technologies of the past may also have contributed, but this contribution is decreasing rapidly.

²⁹¹ http://www.suite101.com/article.cfm/the_art_of_storytelling/110011, downloaded on 15 December 2010

²⁹² Weiser, M. The Computer for the 21st Century. *Scientific American*, September 1991.

4 Implications for theory and practice

A number of recommendations are provided for inclusion in the conversation on sensemaking. Firstly, the view of Weickian sensemaking on ICTs is outdated. This warrants more attention to be paid in exploring the potential impact of UEMI technologies on sensemaking. This study is an attempt to do so.

Secondly, sensemaking has an economic aspect (or property); it is reliant on scarce means, namely attention.

Thirdly, sensemaking is a production process; it produces knowledge (meaning) of a certain quality within a certain time. This quality is determined by its fit to reality, which matters when risky reality prevails, and which unlike other spheres of life, is pervasive in business organisations and other high reliability organisations. The high proportion of fire fighters assigned to lookout posts to make sense of the progress of a fire in the wild attests to this. This does not contradict or invalidate current sensemaking theory which considers the achievement of a point of plausibility that enables action as the only measure of success, irrespective of how it fits to reality, because that reality is individually or socially constructed. In the absence of risky reality, this poses no problem, e.g. when an individual realises that an alternative career is more congruent with his or her identity and should thus contribute to a more fulfilling remainder of his or her life. Nevertheless, consideration should be given to risky reality, notwithstanding the fact that it is not measurable, if not unknowable so as to consider the welfare of those sensemakers living in it.

Fourthly, like other production processes, sensemaking is open to increases in productivity, given a supportive environment comprising appropriate organisational structures and procedures, human skills, mindsets and crucially, any technology which lowers the requirement for scarce attention. Due to their attention efficiency, UEMI technologies enable this. They do so by reducing ignorance, and if properly designed and used, by reducing equivocality. The latter is enabled by UEMI's capability for rich audio-visual communication which closely approximates that of face to face communication, but which exceeds human ability in recall to enable retrospective sensemaking, and with augmented reality. Crucially, through sophisticated algorithms embedded in software, ICTs are increasingly delivering the same results which humans produce when making sense, hence relieving humans of their sensemaking overload. The case of IBM's supercomputers winning the game of Jeopardy! and chess against a grand master, as well as the capability of Google's cars independently navigating traffic on public roads attests to that. On a less dramatic level, software costing a

few dollars is putting highly skilled people out of work, e.g. tax consultants. The macro evidence of this is provided in figure 4 in section 1 of chapter 1, which shows the decoupling between productivity growth and job growth. In order to enhance the attention efficiency of UEMI, the key challenge to still overcome is speech recognition, despite the commercial success of speech recognition on the latest smartphones and the performance of a supercomputer during a TV quiz game. The goal is attention efficient (i.e. ubiquitous) speech recognition, to the level where it compares to human speech recognition without the need for contextualised settings, which is the case in smartphones and quiz shows.

However, given that much of what is envisaged in UEMI-based sensemaking is technically possible, the most important considerations in practice include the following: firstly, governments should redouble their facilitation efforts to speed up the availability of omnipresent broadband. In certain regions of the world that means the provision of the key general purpose technology of the Second Industrial Revolution: electricity. Secondly, education systems should be overhauled to optimise the digitisation of the process. For example, the methodology harnessed by the Khan academy²⁹³, which involves extensive use of audio-visual teaching material, with teachers as moderators, provides useful pointers to what should be aimed for. Perhaps more importantly, ICT literacy and other skills which complement the productive capacity of ICTs should be increased with particular emphasis on the current and future labour force. This is necessary to reduce the unemployment caused by the substitution of ICTs for human workers.

Finally, the leaders of organisations should start paying attention to the optimum ratio between human employees and ICTs. A good example is Jeff Bezos, the founder of Amazon.com. The policy and supporting organisational culture, structure, employee skills and ICT infrastructure enables normal business to be conducted with customers without the direct involvement of a single employee. However, when problems and other exceptions arise, humans, backed by their ICTs take over to solve them. All the leading edge software is developed in-house with highly skilled employees. Amazon employs people and ICTs according to their strengths. This echoes Brynjolfsson's example given in section 1 of chapter 1 of chess teams of computers and humans outperforming teams of only humans or only computers. Organisations, whether for profit or not, can do so much worse than trying to

²⁹³ <https://www.khanacademy.org/>

learn from Amazon. (Organisations, whether for profit or not, can do well to learn from Amazon.

Appendix i

List of videos referenced

Total hours of video material – 2 hours 41 minutes and 54 seconds, excluding the download time

1. “IBM's Watson Supercomputer Destroys Humans in Jeopardy” (3 minutes 53 seconds, excluding downloading time)
http://www.youtube.com/watch?v=WFR3lOm_xhE referenced in page 11, 16
2. Ken Robinson says schools kill creativity (19 minutes and 29 seconds, excluding the download time)
http://www.ted.com/talks/lang/eng/ken_robinson_says_schools_kill_creativity.html referenced in page 21
3. David Pogue: When it comes to tech, simplicity sells” (22 minutes and 6 seconds, excluding downloading time) <http://www.youtube.com/watch?v=NEjZt0y6OOw> referenced in page 39
4. Hans Rosling's 200 Countries, 200 Years, 4 Minutes - The Joy of Stats - BBC Four (4 minutes and 48 seconds, excluding the download time)
<http://www.youtube.com/watch?v=jbkSRLYSojo> referenced in page 41
5. Hans Rosling and the magic washing machine (9 minutes and 16 seconds, excluding the download time) <http://www.youtube.com/watch?v=BZoKfap4g4w> referenced in page 41
6. Deb Roy: The birth of a word (19 minutes and 53 seconds, excluding the download time) <http://www.youtube.com/watch?v=RE4ce4mexrU> referenced in page 44
7. A Day Made of Glass... Made possible by Corning (5 minutes and 33 seconds, excluding the download time) http://www.youtube.com/watch?v=6Cf7IL_eZ38 referenced in page 46
8. Cisco TelePresence - On-Stage Holographic Video Conferencing (11 minutes and 25 seconds, excluding the download time)
http://www.musion.co.uk/Cisco_TelePresence.html referenced in page 46
9. “BMW augmented reality” (2 minutes and 38 seconds, excluding the download time)
<http://www.youtube.com/watch?v=P9KPJIA5yds&feature=related> referenced in page 47

10. Erik Brynjolfsson: The key to growth? Race with the machines. (Section 0:10 to 0:59 seconds of the 11 minute and 53 seconds TED talk 2013. Posted April 2013). http://www.ted.com/talks/erik_brynjolfsson_the_key_to_growth_race_em_with_em_the_machines.html referenced in page 48
11. “Bionic lens” (3 minutes and 38 seconds, excluding the download time) <http://www.youtube.com/watch?v=-g1sjOQU-Yk&feature=related> referenced in page 48
12. “Layar - Impactful Augmented Reality in Your Everyday Life” (2 minutes and 15 seconds, excluding the download time) http://www.youtube.com/watch?v=HW9gU_4AUCA referenced in page 48
13. Adobe Speech Search (1 minutes and 23 seconds, excluding the download time) http://library.creativecow.net/articles/weiss_roth_david/speech_search/video-tutorial referenced in page 52
14. Nuance Voice-recognition on the iPhone and Android devices at Mobile World Congress 2010 (11 minutes and 42 seconds, excluding the download time) <http://www.youtube.com/watch?v=WVUj2tfC8Hs> referenced in page 52
15. “Salman Kahn: Let’s use video to reinvent education” (20 minutes 27 seconds, excluding download time at <http://www.youtube.com/watch?v=nTFEUsudhfs> referenced in page 56
16. Maradona hand of god (11 seconds, excluding the download time) <http://www.youtube.com/watch?v=DbbsytHDp2o> referenced in page 114
17. Diego Maradona's Goal of the Century (36 seconds, excluding the download time) <http://www.youtube.com/watch?v=jk-kXwjASEE&NR=1&feature=fvwp> referenced on page 114
18. RSA animate (10 minutes and 48 seconds, excluding the download time) <http://www.youtube.com/watch?v=u6XAPnuFjJc> referenced in page 115

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