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THE 'ARTIFEX': SYNERGIES BETWEEN ENGINEERING AND THE HUMANITIES

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ABSTRACT:

Recent critical focus on the anthropogenic arguments regarding the threats to the sustainability of biosphere highlight the role of engineering in maintaining the structural integrity of the human environment. However, the discipline of engineering is not without larger contextual and methodological problems that tend to undermine the perception of its benefit to society. These include tendencies towards utilitarianism, the irreconcilability of means vs. ends rationale, and the potential for difference-blind solutions to technical problems which ignore the possible harmful effects on the environment which extend beyond in-built cost-benefit analyses. This paper intends to reconcile scientific and humanistic views through a philosophical inquiry and argues that engineering is informed by a context that requires a counter-balancing perspective which accommodates holism, environmental compatibility, lateral and longer-term thinking as well as awareness of humanity, culture and society. Inclusion of humanities subjects within the engineering curriculum positively underscores human factors in technological problems and solutions and equips engineers with a cultural vocabulary and understanding. The argument will be made that a relationship between the humanities and engineering that resembles the Renaissance concept of the 'artifex' (or the attempt to harmonise the human and the technological) is both necessary and desirable for the enhancement, understanding and development of both disciplines. Furthermore, this paper demonstrates ways in which basic philosophical principles can contribute to critical thinking within the engineering discipline. This paper uses three humanities texts, Max Frisch's *Homo Faber* (1959), Don de Lillo's *The Body Artist* (2001), and the film *Contact* (1997) based on Carl Sagan's book (1985) to problematise issues of technology and humanism and to explore the relationship of engineering to the humanities.

What is engineering? According to Florman it is the "art or science of making practical application of the knowledge of pure sciences" (1994, x). Thus the engineer uses the logic of science to achieve practical results. Another definition holds that, "Engineering is the art of directing the great sources of power in nature for the use and convenience of man" (Tredgold cited in Florman, 1994, 19). Engineering is part of the enlightenment project of ordering nature in which humans may free themselves from the 'irrationality of nature' (Hegel). It is also regarded as the 'rationalisation of work' whereby scientific principles are used to settle social conflicts. The 'golden age' of engineering is seen as post 1950. This era introduced the growth technologies of: electronics, lasers, system analysis, atomic power, and computers which acted as enablers which transform: communication and travel, energy creation, calibration and measurement, and advanced metallurgy in industrial processes and building practices. Hence these have a profound effect on the economy.

In the 1960s detrimental effects on the environment were observed by environmentalists worldwide and particularly in the USA by authors such as Rachel Carson (in her book *Silent Spring*, 1961) and attributed to the expansion of technology and growth of cities and industrialism which put increasing strain on the natural environment in the form of industrial by-products such as toxins. These critical writings and numerous scientific observations of the effects of waste products and defoliation, have brought about a questioning of the manifest 'benefits' of technology and made people look anew at the engineering profession which may been seen as largely instrumental in its approaches to technical problems. The claim is made that, "It is only human choice that makes the human world function. Technology can motivate human choice, but not replace it" (Lanier, 2010, 107). What then, is the implied criticism levelled at the profession? Whilst it is obvious that engineering has achieved 'unprecedented successes' it is also, it is claimed, complicit in triggering both local and global crises through the by-products of its usage such as the manufacture of carbon dioxide gas, non-biodegradable substances, chemical effluent and climate change. Those who are not rational optimists concerning the ability of engineering to provide technical 'fixes' to environmental issues, suggest that the unthinking application of technology may bring civilisation (which it helped build) to the brink of ruin. As Florman puts it:

> Clearly we have saved nobody – or, more precisely, those we have saved are now endangered by poisons and other hazards that we have created. Where men have been released from drudgery, they do not appear to have become superior human beings. Hardly anyone seems to think that they are more content. Hardly anybody seems to think that they are more content. Anxiety and alienation are the watchwords of the day, as if materials comforts made life worse, rather than better. Dreams of the equality, brotherhood and peace which were to follow in the wake of engineering triumphs have also proved to be vain illusions (1994, 16).

For many the solution might arise from problems which would disappear if engineers would become more moral or 'ethical' in their practice. For the most part engineers are entirely ethical within the design and applications of systems and technology themselves. Almost all descriptions of engineering practices include the ideal that they offer service to humanity. However, difficulties in assessing engineering practices, including the effect on people and environment, are caught up in accounting systems evaluating dollar costs. Funding determines which programs and projects have priority and what areas research is conducted in. Frequently these are driven ultimately by industry rather than by altruism or purely academic inquiry. Such a system may bring narrow focus-restricted thinking to a cumulative aggregation of small effects. The role of social or environmental guardian is different from role of 'creator' – often they are treated as separate and not overlapping regimes of responding to technical problems. As Florman puts it, "No engineers quarrel with the objective of being more cautious and farseeing than we have before, of establishing stricter controls, of testing as extensively as possible, and striving for perfection" (1994, 30). However, arguably global warming and climate change is upon us because of a lack of holistic (or complex systems) thinking. Chernobyl, Aswan Dam, Union Carbide, the Gulf of Mexico oil spill are the result of no single error but the result of accumulation of a multiplicity of purportedly 'error-free' decisions. However, despite the fact that the resilience of nature may be factored into the parameters of engineering designs, individual projects often do not look at the total effect of the cumulative changes they may effect on terrain or the ecosystem. Jacques Ellul (1954) in *Technological Society*, proposes that technology as a pursuit of rationalized behaviour and efficiency is 'out of control'. What was once created in technological terms out of sheer necessity is now being produced simply to produce money – the bourgeoisie has become separated from its rationale as the exponent of technology and education. The increasing wants of the capitalist economy are not applied simply to a 'needs' rationale but for the endless replication of industrial expansion – however the better sharing of resources might be in the cumulative result. From as early as the eighteenth century in Jean-Jacques Rousseau's Enlightenment tract of educational and political philosophy, *Emile* (1762), it was argued that human beings came in being as a species amidst the abundant variety of natural world. Consequently, if contact and exchange, firstly with the natural world and secondly amongst societies is not maintained, then human kind will be denatured (Florman, 1994, 53). A further argument is that the proliferation of human knowledge is exponential and thus a vision of universal global human being is impossible.

The table below shows the main arguments of the critics of engineering technology and the rebuttals to them from exponents of engineering technology.

Critics of technology	**Technological exponents**
Technology is a 'force' without human control	Technology is not independent from its creators it is merely one type of activity in people engage
Technology forces repetition and human devaluation	Technology brings us leisure time
Technology is deterministic and forces mindless consumption	Technology leads people to create new objects and ideas
Technology creates a technocratic class and	Technology and education are enablers

disenfranchises the masses	
Technology imposes an ontological division between humans and the natural world. Technology and humans are separate realities.	Technology has been employed as a process of evolution. Technology is a manifestation of humans.
Technology diverts people from existential experience of their being	Technology enables humans to explore, to create new arts, new religions, new ideas.
Technology has no morality	Technology and engineering are human benefactors

Even people who have no particular view of engineering as a positive or negative force for good in society, view engineers as people who are characterised by being practical, analytical and non-emotional. According to this stereotype, the typical engineer (while certainly at one end of the bell-curve of intelligence) strives to avoid ambiguity and although he or she gets along well enough socially, would rather deal with 'objects and concepts' than with people. The argument perhaps mistakenly reifies engineers with their roles rather than seeing them as separate from what they do. There are two-sides to this argument, an engineer who is well versed in the arts and humanities would be closer to the 'renaissance' ideal of the 'creator' rather than the more narrowly educated 'specialist' – 'man the maker' according to the twentieth century model. This is an extension of the belief that many of the technological practices of engineers are premised on procedural rationality which typically doesn't look for underlying reasons. However, by contrast there must be a reciprocal relation between engineers and society that involves comprehending and explaining what engineers do. This must involve clear communication and awareness of social and cultural issues as well as simply publicity or 'usage'. This in turn raises questions of the lack of dialogue and circulation of knowledge about engineering among non-engineers resulting in greater inequality and problems involved in the attempt to form or 'rebuild' a unity of knowledge around solutions to technical problems currently broken into fragments. This problem may be elucidated by an example from anthropology. As New Zealand-born anthropologist Michael Jackson relates, when NASA put man on the moon in 1969, this was seen in the developed world as a great technological achievement. In the developing world, news reached villages and communities belatedly with the result of 'fusing' the news of this incredible technical achievement with local and existential dilemmas. According to Jackson, two conflicting belief systems came into view:

> At the time I arrived in Sierra Leone, the country was in the grip of a conjunctivitis epidemic. I soon learned that this eye disease was known as Apollo, though several months later, when another wave of the epidemic swept the country; a distinction was made between Apollo 12 and Apollo 13. 'What was the connection?' I asked people in the town where my wife and I settled. The American moon landing had disturbed dust on the surface of the moon, I was told, and just as the sand-laden

> Harmatten blew south from the Sahara in the dry season, filling the air and irritating one's eyes, so this cosmic dust had brought its own discomforts and disease (2005, 114).

Engineers may also claim that while technology can fulfil promises, visions of beauty, truth and metaphysics can only be illusions. In some senses these abstract concepts can also be harnessed in the pursuit of material problems. Evidence of the humanities and engineering collaborating are given by NASA's project in 2003 to build a humanoid robot or 'Robonaut' for servicing missions on the Space Shuttle. One news release by journalist Jade Boyd stated, "The robot will not think for itself. It will be attached to the robotic arm of the space shuttle or space station and will be tele-operated by a trained astronaut inside the spacecraft . . . using a 3-D virtual-reality helmet and two joysticks, the astronaut inside the craft will see what Robonaut sees, feel what it feels outside the craft". Thus though anthropomorphic in design, the operation of the robonaut is by remote electronic symmetry (Boyd, 2003, para 5).

However, while technology can widen horizons and raise expectations these can create frustrations which only further access to technology can alleviate. For example, the creation of the internet has led to communication innovations such as WiFi, which speed-up access as internet use increases but which requires constant upgrading to avoid technical obsoletion. Arguably the internet has proliferated not only because it is a precise engineering solution to fractural electronic autonomy but also because it is an extremely effective communication and publishing tool. Only the other hand the adoption of technology can create imbalances in resource distribution, known, for example as the 'digital divide' between those who have access to computer technologies and those who don't. Is there a moral obligation for developed societies to provide technical assistance to developing societies which extends beyond economic interests? Whilst engineers have a responsibility to help society and empower employers, a further question becomes necessary whenever we think of engineering concepts in the abstract or indeed of the *modus vivendi* of the profession. Are existential questions a part of engineering, or can engineering projects be seen as usefully or meaningfully extending from them? The term 'imagineer' attempts to blend the imaginative use of engineering solutions. Whilst some detractors may infer that civilisation may be approaching a crisis of faith in the utopia that engineers believed that society might be able to create with the technology of the late-twentieth century, global crises such as climate change, energy and food shortages (scientific argument of causes, extent, and solutions aside) may call for adaptation and re-engineering rather than no-engineering, for example, from fossil fuels to solar energy.

Other, cultural commentators including Francis Fukuyama have argued that technologies such as biotechnology may alter human history and move us into a 'posthuman' stage of history. Why this matters is because people are created out of nature. Human exploitation of the natural environment aside, nature has provided a stable basis for the continuity to our species. Fukuyama goes further to suggest that, "technology powerful enough to reshape what we are will have possibly malign consequences for liberal democracy and the nature of politics itself" (2002, 7). Biotechnologies and cyborg technologies have significant political and ethical ramifications and re-open possibilities for social engineering that seek to alter behaviour by social planning which neo-liberal societies have historically looked upon as crude and unscientific.

As Alan Weisman has pointed out it is estimated that it would take nature in its current state 100 000 years to effectively erase the presence of human civilization – our global footprint is 0.1 million years deep, whilst the evolutionary origins of our species are far older. Weismean points to the prolific number of contemporary buildings with limited life-spans and extends the analogy by pointing to the span of the seven great wonders, which were history's exemplars of global engineering marvels:

> Nor did the proud builders of the ancient world, which had seven wonders, dream that in a span far shorter than eternity only one of them – Egypt's Khufu pyramid – would remain. Like the old-growth forest whose lofty treetops eventually collapse, Khufu has shrunk some 30 feet over the past 4 500 years. The other six were of even more mortal stuff: a huge wooden idol of Zeus plated in ivory and gold, which fell apart during an attempt to move it; a hanging garden, of which no trace remains among the ruins of its Babylonian palace 30 miles south of Baghdad; a colossal bronze statue on Rhodes that collapsed under its own weight in an earthquake and was later sold for scrap; and three marble structures – a Greek temple that crumbled in a fire, a Persian mausoleum razed by Crusaders, and a lighthouse marking Alexandria's harbour, which was felled by an earthquake as well (2007, 173).

Whilst Wesiman's argument encourages us to 'look backwards to look forwards', Nassim Taleb has pointed to the characteristics of the manifold accumulation of technology on the natural world which causes us to revise the very conditions under which we interpret our society and look for information, meaning, science and art. Taleb believes human civilization has reached a level of complexity such that we are living in a world with an increasing number of feedback loops, which generate more effects exponentially – the result perhaps of the cumulative effects of anthropomorphic bias. A summary interpretation of Taleb's findings follows in the table below:

Interpretation of effects of technology on the present environment (adapted from Nassim Taleb, 2007, 35)	
The past	**The present and future**
Status Quo	Cumulative extremism
Nonscalable	Scalable
Inocuous randomness Ignorable or controllable	Wild (even superwild) randomness Hard to see/ uncontrollable
The most typical member is mediocre	The most "typical" is either giant or dwarf,

	i.e., there is no typical member
More likely to be found in our ancestral environment	More likely to be found in our modern environment
Constraints on effects	There are potentially no physical constraints on what a number can be
Total is not determined by a single instance or observation	Total will be determined by a small number of extreme events
Easy to predict from what you see and extend what you don't see	Hard to predict from past information
Events are distributed according to the 'bell curve' (the GIF) or its variations	The distribution is either Mandelbrotian 'gray' Swans (tractable scientifically) or totally intractable Black Swans

Despite the fact that the world is in many ways too complex for a single mind or minds in series or parallel to understand, one almost universal definition of greatness of *homo sapiens* is the ability to use tools and construct with them. During the European renaissance, the concept of the multifaceted character of the engineer or architect involved knowledge of a blend of art and science. The 'artefex' (a term re-imagined by Maria Russo of the Department of Anthropology and Applied Ethics of 'Campus Bio-medico' University, Rome) was gifted with a capacity for speculative, imaginative and practical competence. This was exemplified by the architect Palladio and the engineer Leonardo da Vinci in whom theoretical and practical knowledge, scientific and humanistic learning were harmoniously combined. This gave rise to the 'technisized' person, educated by technology, "who reasons according to the logic of technology, uses technological knowledge and exercises his freedom within the bounds of technology" (Russo, n.d. 2). It is easy to see how the abstraction of technology returns us to the instrumentalist vision given above, for as Hannah Arendt puts it, each end is a means to another end: the instrumentalist economy "is condemned to a never ending chain of means and ends without ever reaching a principle that can justify the category of means and ends, that is, of utility itself. The statement for the end of has become the very content of in the name of. In other words, utility equated with meaning inevitably leads to the absence of meaning" (Russo, n. d. 15).

However, the holistic and contextual aspects of humanities may become a terminus that breaks the cycle of means and ends. As Russo suggests, the "Humanities are commonly seen as being aimed at understanding or comprehending reality as opposed to the sciences of nature which are limited to explaining phenomena. Technology and science aims at explaining facts through laws and practical goals, whilst humanistic knowledge is concerned with comprehension of meaning behind facts" (Russo, n. d. 3). So the ideal is for engineers to understand meanings behind facts and humanists to produce facts as a by-product of their understandings. Furthermore, regardless of whether engineering is seen as ethical positive and beyond critique or in context of wider societal problems, as Clinton K. Judy pointed out as early as 1944, "[University] freshman composition as an engineering tool can be and has been taught through the study of technical reports and scientific explanations, but it is not necessary to confine the method to such narrow limits" (Judy, 1944, 200). The metaphorical thinking encouraged in the Arts, Humanities and Social Sciences, and the skills of critical analysis can help engineers to conceptualise and communicate their problems, workings and solutions more clearly.

However, as Archambault et al point out, "Knowledge dissemination media and, by extension, communication media in general are more varied in the SSH (social sciences and humanities) than in the NSE (natural sciences and engineering) (2006, 333). This perhaps has as much to do with what are seen as the stricter professional boundaries of the professions than it has to do with the more limited opportunities or indeed restricted abilities of the practitioners to communicate their science. Furthermore as Archambault et al point out, there are also differences in the scope and professional 'conversations' of the two fields, "[w]hereas the problems identified in the NSE tend to be universal in nature, SSH research subjects are sometimes more local in orientation and, as a result, the target readership is more limited to a country or region" (2006, 333). This is debatable as although highly complex in detail, engineering projects tend to implement local and context-dependent solutions to problems, though they may be expressed in a 'universal language' such as mathematics. It also might imply that the theoretical concepts in humanities and social sciences may be more subtle.

According to Beder, engineers "do not require that their theories be true" but rather that they be adequate to the task – for 'design and prediction' purposes (1998, 46). Just as it is possible in the humanities and social sciences to have multiple correct 'answers' to a problem it is possible to have different models of a 'physical reality' based on multiple viewpoints. Beder points out that most engineering analysis involve three essential steps: Firstly, an idealisation of a physical system, secondly, the use of a mathematical models in a physical system, thirdly, the use of a mathematical model to solve problems and give predictions (1998, 54). A 'factor of safety' is used to minimise: variability, stresses in utility, and a 'factor of ignorance' which allows for a margin or error for poor materials and overstressing (1998, 54). Good designs take into account the environments in which they are created and used for. A simple formula is used to assess environmental impact: Number of people X resource use per person X environmental impact per unit of resource used (Bender, 1998, 197). Furthermore engineering is a social activity with political, ethical and economic dimensions. Multiple methods are recommended by Abowitz and Toole for problem solving in the engineering construction industry. A table of these multiple-methods follows:

After Abowitz & Toole (2010)	**The validity of multiple-methods to scientific problems**		
Multiple methods	Qualitative &	Surveys	Balance strengths and weaknesses

	Quantitative techniques	Participant observation Interviews Archival data	Converge on common pattern
Measurement validity	Qualitative & Quantitative techniques	Operational definitions & measures Archival data more consistent and stable than self-reported data	Indicator results stable if relevant factors unchanged
Triangulation	Convergent validation from multiple operationalism	Multiple tests of hypothesis	Empirical indicators of constructs

The humanities may only appear to be different from the technical disciplines because they are open to interpretation – they carry a message of complexity. However, there are many different ways of understanding problems with slightly different values. A 'degree of openness' is now thought to be essential to engineering programs. The fact there are no 'single' solutions in the humanities may also be applied to engineering problems. As Ruprecht argues, to understand life one must study it. Just as it is possible to live life without understanding it, it is also possible to profit from technology without understanding it (1997, 373). Understanding for the humanist and social scientist as for the engineer follows from open-mindedness. Thus the humanities, social-scientists and engineering professions are not in opposition but in tension and consequentially the curriculum of each can be enhanced by the other. As Petroski suggests, designing abridge is not dissimilar from writing a novel:

> The work of the engineer is not unlike that of the writer. How the original design for a new bridge comes to be may involve as great a leap of the imagination as the first draft of a novel. The designer may already have rejected many alternatives, perhaps he could see immediately upon the conception that they would not work for this or that reason . . . Some designs survive longer than others on paper. Eventually one evolves as the design, and it will be checked part by part for soundness, much as a writer checks his manuscript word by word. When a part is discovered that fails to perform the function it is supposed to, it is replaced with another member from the mind's catlog, much as the writer searches the thesaurus in his mind to locate a word that will not fail as he imagines the former choice has. Eventually the engineer, like the writer, will reach a version of his design that he believes to be as free of flaws as he thinks he can make it, and the design is submitted to other engineers who serve

> as editors in assessing the success or failure of any design (1969/1985, 78).

The computational model of the mind goes even further to suggest that humans can be considered as 'information systems with a shared mind', however, according to Lanier, the "cybernetic structure of a person has been refined by a very large, very long, and very deep encounter with physical reality" (Lanier, 2010, 157). The paper will now present three scenarios of the uses of the arts and technology and the interpretation that the arts bring to the interaction of the fields of technology and human society.

Max Frisch's *Homo Faber* (1959)

"I'm a technologist and accustomed to seeing things as they are" (Frisch, 22).

Max Frisch's novel Homo Faber is concerned with the 'cognitive dissonance' between technical understanding and 'real world' understanding of people, relationships, kinship ties. It also constructs a scenario in which it is possible to imagine a human being can be a technical genius but blind to emotions and feelings.

Walter Faber the engineer protagonist of Max Frisch's classic novel has a 'love affair' with the machine which borders on the obsessive and the major thrust of the novel suggests that eclipses his love for people. Faber views people as fundamentally flawed, inconsistent, harbouring weaknesses. He has a material world view which reflects not only an aesthetic void but a void of the soul. He feels 'edgy' if there is no mechanism running. He values the machine foremost:

> because the machine cannot forget anything, because it has a greater power than the human brain to grasp information and assess its probability value. Above all, however, the machine has no feelings, it feels no fear and no hope, which only disturb, it has no wishes with regard to the result it operates according to the logic of probability. For this reason I assert that the robot perceives more accurately than the man, it knows more about the future, for it calculates it, it neither speculates nor dreams, but is controlled by its own findings (the feedback) and cannot make mistakes; the robot has no need of intuition (76).

While Frisch's novel is written in the style of Faber's 'report', throughout the novel Faber is preoccupied with by the dissonance between his technological world and the world of emotions (which he tends to distrust). He cannot rely on what he feels but only on what he can calculate. Frisch's larger contention is that Faber is blinded by his lack of emotion. Faber's profession and the way his persona has become absorbed by it has made him overly preoccupied, if not fixated, in the workings of the material world, on harnessing technology - by the attempt to control nature and to make it 'stop'. As a consequence Faber's interior life is masked from his own introspection. His objectivity internalised: "I can't bear being told what I feel: although I can see the subject under discussion, I feel like a blind man" (113).

Don DeLillo's *The Body Artist*

The following analysis from Don DeLillo's The Body Artist raises questions about the unity of technology with humanist experience. Don DeLillo's The Body Artist breaks down notions of human and inhuman, strangeness and familiarity through embodiment and technology and in so doing raises questions about human and machine identity.

The novel opens with a married couple Rey Robles, a film director and his wife Lauren Harkte, a body or performance artist, in their kitchen in a rambling rented house somewhere on the east coast of America. DeLillo takes the reader through the routines of early morning largely from the perspective of Lauren Harkte and introduces us through the breakfast scene to her unusual perspective - her intimations that the two are not completely alone in the house and gradually to the strange sense of detachment she increasingly feels. After Rey takes a drive we later learn he is dead, he has committed suicide - shot himself. Lauren is left alone in the house, or so she thinks. She soon discovers there is another person present, a man who is strangely disconnected from the world around him and yet who seems to speak in Ray's voice or her own, who seems to know intimate moments of her past life and things that haven't yet happened. We follow the interactions of these people through the narrative.

The story begins with an assertion of identity: "you know more surely who you are on a strong bright day after a storm when the smallest falling leaf is stabbed with self-awareness" (DeLillo, 2001, 7) and ends, via the strange figure of Mr Tuttle with a realisation of unknowingness and dislocation. Mr Tuttle is a 'ghost-figure' almost tangible but not complete. He stands in the story for the preoccupation with technology, the medium that feels very familiar to us and yet in essence remains opaque – those continual shifts of subjectivity that we feel and experience as we work with machines. When questioned, Mr Tuttle makes only a kind of 'low grade' sense to Lauren yet he speaks as if he knows her past and future, his words are disjointed, they do not cohere syntactically. He is a barrier to Lauren's experience, he perpetuates and dissolves her grieving experience. Mr Tuttle makes Lauren confront her identity. Through his appearance, it is as if DeLillo makes Lauren ask herself questions about time: 'Why do we have to save money and time to the point where this imperative seems like the law of our lives?', highlighting the point that society has made Lauren internalise the dynamics of modernity into her very being, as if she was only program in which to behave. When she challenges him with "You have been here". He replies, "It is not able' (DeLillo, 2001, 43).

All the while though Mr Tuttle is quietly present Lauren is aware that she is not responsible for him – much like our appreciation of machines, we rely on them to function but when they break down it is not 'our fault'. Lauren reflects, "She amused herself be thinking he was from cyberspace, a man who'd emerged from her computer screen in the dead of night . . . It was always 'as if'. He did this or that 'as if'. She needed a reference elsewhere to get him placed . . . There was something elusive in his aspect, moment to moment, a thinness of physical address" (DeLillo, 2001, 45). When he talks, Mr Tuttle seems to place Lauren centrally in his words, yet maybe too he is just quantifying something much like a computer would, performing the algorithms, playing her words back to her, empty of meaning except unto herself, undermining the human sense of logocentrism.

Computer code or thought is logical a matter of electronic signals in a binary code (1 or 0); human thought on the other hand, tends to depend heavily on the use of analogy and intuition, not units of information (bits) but with hypothetical configurations of sensations, algorithms and concepts. It accepts and interprets imprecise ambiguous data that doesn't seem to be selected according to pre-established codes or readability. Analytical thought and meta-cognition is played out by the scenario of association, simile and metaphor: 'just as, so, like, as if'.

In *The Body Artist* is Mr Tuttle an unwelcome 'ghost' or a figure of good? Does he have a moral agency? He is inert and depends on our capacity for compassion yet he stretches the limits of the human. The excessive haste of technology transfer crushes event, the figural, the unharmonizable, and the press of the modern world and prevents Lauren from processing her grief. Mr Tuttle intervenes as a presence against which she can test her notions of human/ machine identity. Mr Tuttle embodies the disconnection that we experience in a world of machine processes. As DeLillo writes, "She took a bite of cereal and forgot to taste it. She lost the taste somewhere between the time she put the food in her mouth and the regretful second she swallowed it" (2001, 19). Computers do not have responsibilities or awareness of internal qualities, they have only tasks.

Technology is concerned with precision – the search for the greatest precision possible in any given set of circumstances, whereas thought by its nature instinctively resists precision and containment. Yet at the other extreme one could argue that to be worth preserving at all thought has to be more than just logical reasoning of the computer form, it has to carry the creative, experiential element that marks out human creativity that differentiates us from a world of finite machines. Technology is slaved to efficiency and to economy – a technological innovation is seen as positive when it performs better and/or expends less energy than another. Morality and difference disappears under such controls but without the capacity for difference we have lost the human.

Mr Tuttle reflects a strange kind of inhumanism, a 'not-quiteness' that is neither human nor completely other – Mr Tuttle has a corporeal body but his thought processes do not seem to come from the whole identity, it is as if he is part machine generating answers – playing back part of the questions that Lauren puts to him, inviting us to question a quality of his humanness. If technological humanism is the deliberate blurring of lines between human beings and machines - a realignment of our relationship with technology, the tension of the story, like the tension of ever-expanding technology is that it is not true that uncertainty (lack of control) decreases as accuracy goes up: uncertainty goes up as well, proving in microcosm the scenario of Taleb's 'black swans'.

Carl Sagan's *Contact*

With a scenario of alien contact, Carl Sagan's novel Contact emphasises the dual role of the sciences with the arts in aiding human understanding. The journey into outer space is *depicted as much as a journey into the human 'inner-space'.*

In the film of the Carl Sagan science-fiction book, *Contact*, scientists from SETI who are searching for extra-terrestrial communication on a US government grant, receives a signal from a star in the vicinity of Vega. The pun vega/vague soon becomes less ironic as the message deciphered contains a returned code of the first televised broadcast from earth buried within which are the engineering blueprints for a technologically advanced 'alien' device. Scientists are not sure whether this device has travel or communication purposes – blurring the semiotic fields of technological invention and extra-terrestrial contact. The devise functions via uniting a 'pilot' with worm-holes through space. The film carefully explores the ethical dilemma of a 'singularity' event which could both unite or divide the developed technological world and potentially impact on the human race, the moment when artificial intelligence becomes conscious. The film poses a set of questions on its audience. Who provided the blueprint and why? Should the device be built? Technology is presented as a powerful enabler but also a source of ethical dilemma, thus the engineering schematics become a riddle that human science and arts, technology and humanity must try to solve. At the film's ephiphanic moment, when the atheist scientist 'pilot' glimpses and extra-terrestrial star system and a planet and city it harbours, she claims 'they should have sent a poet'. The film thus locates the human and a sense of the arts as a desired quality of technological and scientific 'measurement' and 'instrumentation' which elides the tangible and intangible in a quest that is an expression of the human spirit. Sagan's concept is of the technological singularity as a future point - a creation of a super intelligence, representing the analogy between the breakdown of classical physics near gravitational regularity with a dramatic change following an exponential intelligence explosion – a world altering event that changes the course of history, altering forever the human experience of the universe.

Conclusion

Modern engineers of the late-twentieth and early twenty-first centuries were understood to be an 'ideological task force'. However, the interactivity of the human species with its environment has created large scale problems and many now question the understanding that science itself is ideologically neutral or always produces sustainable solutions. Scientific truths were for the benefit of the 'system' of humanity and were not questioned outside of the 'black-box' in which they were formed. However, environmental catastrophes such as Bhopal, Chernobyl, and the Gulf of Mexico oil spill have shown that the larger and more complex the system the larger the possible detrimental effects on the environment. Technology does not simply 'displace' the environment but rather is immersed in it. Technological innovations can transform civilisation but there may be 'black swans' associated which accumulate detrimental effects which threaten the long-term viability of the species, such as global warming. The world of modernity is in danger of becoming an object of exploitation in which both humans and nature are considered as objects instead of 'thinking and feeling environmentally enriched beings'. This would be a hindrance to human biological evolution under the mantra of progress. Like their humanist counterparts engineers need to step outside the black box of design and imagine a world in which their creations do not exist apart from them. To conclude, presented here are five scientific principles that technical disciplines have learned from humanities:

Protagoras' Relativism	Man is the measure of all things. Everything is in the process of coming to be relative to everything else
Thale's Reductionism	Reduction translates an entity or concept into a more intelligible language by dividing it into smaller components
Okham's Razor	When two concepts themselves can adequately explain a given phenomenon, the simpler is to be preferred.
Hume's Fork	Nothing proves anything but itself
Hegel's 'Dialectic'	The interpretation of experience depends on three stages: Thesis, antithesis, synthesis

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