Future Forecasting

a Handbook for the Designer

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Introduction

Can future forecasting be a useful tool for the design practice?
How?

Future forecasting is a tool that the designer should use in his or her practice, to envision beyond the current framework of products, services and systems.
I am convinced that future forecasting is a suitable framework for overcoming design thinking, as it pushes the design practice to consider more aspects such as the ethics and future impacts of its actions.

Historically, future forecasting is a method belonging mostly to business management, army intelligence and governments. In this dissertation, I examine the currently available techniques and tools for future forecasting, their advantages and pitfalls, and look at which techniques can be transferred to the design practice through an interdisciplinary approach, with particular regard to the effects of self-fulfilling prophecies on social prediction. I then examine the ethical implications of forecasting the future and introduce a non-essential, open-textured code of ethics for my practice.

Why a handbook? My intent is to give an overview of the future forecasting practice, summarising the various methods and techniques developed to date, prompting the reader at going more in depth and explore some topics which, due to the limitations of an MA Dissertation, were only mentioned and not explained in depth.

1

Foreword to Future Forecasting

This text is only the first step in the direction of incorporating the practice of future forecasting in design and, in a purely non-essential style, will be subject to constant revisions, extensions and enhancements.

The desire and necessity of anticipating the future are as ancient as human life. Both in the East and in the West, soothsayers, priests, magicians and astrologers have tried to predict the future by relying on atmospherical events, comets, animal's' behaviour, stone tablets, fire, crystal spheres, dreams, bones and entrails. Eva Shaw, in her comprehensive encyclopaedia *Divining the Future: Prognostication from Astrology to Zoomancy* (Shaw, 1995), lists around one thousand different divination practices, both ancient and contemporary.

In various cultures and rituals, shamans, prophets and seers, allow themselves to be possessed by the Gods to channel their divine voice and have a glimpse of what's to come. Even in the Bible prophets and prophecies are recurring subjects: in the Old Testament there are as much as 55 different prophets, both male (Abraham - *Genesis* 11-25, Balahaam - *Numbers* 22-24, Methusaleh - *Genesis* 5:21-27, *et cetera*) and female (as Miriam - *Exodus* 15:20, Huldah - *2 Kings* 22:13 and Deborah - *Book of Judges* 4-5).
Greeks and Romans are known to have used both kinds of prediction methods: augurs interpreted the god's will by observing how flocks of birds flew while both Pythias (the priestess of Apollo, in the city of Delphi) and the Sybils (in Italy, Greece, Asia Minor and Northern Africa) dispensed oracles. This God-to-man connection was usually achieved with the help of psychotropic substances, as openly stated by the Roman author Claudius Aelianus in his *De Natura Animalium*:

Is [Apis] bos praesensione valet: nec sane vel puellas, vel aniculas ad tripodem sessitane habet, neque sacra potione implet; sed pueri divino adflatu concitati supra ludentes, atque inter se ad numerum salantes, consul entibus futura praedicunt, quae vel iis, quae apud Sagram contigerunt, veriora habeantur (Jacobs, 1832).

Apis, it seems, is in effect a good prophet: he to be sure never sets girls or elderly women on tripods, never fills them with some sanctified draught, but a man prays to his god, and children without, who are playing and dancing to the music of pipes, become inspired and proclaim in time with the music the actual response of the god, so that what they say is more true than what occurred by the Sagras[1] (Scholfield, 1954).

Too bad that they all spoke in such an exquisitely cryptical way: *ibis redibis non morieris in bello*[2] - it is almost impossible to predict the future wrongly if the prediction itself is ambiguous.
With the rise of Christianity and with the ensuing fight to eradicate pagan practices, divination was slowly abandoned in the Roman Empire, both because of many imperial decrees (such as the Theodosian Decrees between 389 and 391 DC) and the massive influence of the new dominant culture.

[1] A river (not longer identifiable) in Bruttium (the current region of Calabria in Italy) which was the scene of a battle between the Locrians and the people of Croton at some date during the 6th Century B.C.

These ancestral practices, though, continued to thrive among rural masses with silent perseverance: in the following centuries neither the Inquisition, which excommunicated soothsayers, neither the Age of Enlightenment, which celebrated science over faith, managed to erase the dream of predicting the future from the world. After all, "the human condition rests on the need to be able to know what will happen tomorrow in order to act as of now", as Georges Minois wrote (Minois, 1996). As of today, "in 2012, slightly more than half of Americans said that astrology was "not at all scientific," whereas nearly two-thirds gave this response in 2010. The comparable percentage has not been this low since 1983" (National Science Foundation, 2014).

History is full of successful and failed predictions.
An obvious example is the heliocentric theory by Nicolaus Copernicus, first postulated in 1514 in the minor work *Commentariolus* and subsequently furtherly developed in 1532 with the manuscript *De Revolutionibus Orbium Coelestium*. Copernicus, using a geometric approach, proposed the spherical nature of the heavenly bodies and their circular motion, anticipating and allowing the development of the theory throughout the next 150 years, which relied on brilliant minds such as Galileo, Kepler and Newton to prove the veracity of his argument.

Figure 1: Gustave Dore (1832-1883). Prophet Isaiah.

[2] Latin sentence written by Alberic of the Trois-Fontaines, a cistercian monk and oracle which lived in the 13th Century A.D. As devoid of punctuation (or any other sign which could suggest the brake in order to read it), it lends itself to a double interpretation since if the break is positioned before or after the non, the sentence's meaning changes from "you will go, you will come back, you will not die in battle" to "you will go, you will not return, you'll die in battle".

A perhaps less explicit example of actual prediction making is a project of General John Poindexter launched in 2003, Total Information Awareness. Beyond its controversial and unethical nature, the project was extremely competent in preemptively identifying possible terrorist threats on US soil, combining a data mining system and minds of analysts.

A final example closer to the reality of the Royal College of Art is provided by the work of Dr Alberto Favaro, Professor in the Department of Physics at Imperial College, and Professor Friedrich Hehl University of Cologne. The two created in 2016 a metamaterial that demonstrates the veracity of a 1910 theory proposed by Harry Bateman, who postulated that the refraction of light could happen in sixteen different directions, which could not be proven before due to the lack of a material with the right properties (Dunning, 2017).

1.1

Predicting or Forecasting?

Besides a quick glance at the horoscope (or at someone's Palantír), a sensible, rational and possible negotiation with the future is fulfilled if the semantic difference between 'predicting' and 'forecasting' is manifested.
Predicting refers to announcing future events and making prophecies. *Forecasting* is about making calculated hypotheses and suppositions, elaborated from existing data, about what could happen in the future.

The actual discriminant is the assumption on which either of the two practices originates. The first one suggests the future is in the hands of a deity (or deities), while the latter assumes the future is guided - more or less consciously - by humanity and by the not always obvious consequences of actions and events of the past, together with chance, of course.
Even though hard data and facts fuel it, forecasting is not science *per se*, although many forecasters will not hesitate to call it so. Scott Armstrong, for example, states his Long Range Forecasting is a readable "scientific work" despite the fact that this assertion can be easily challenged, especially if approached from the perspective of social sciences (van Vught, 1987).

Future forecasting as we know it today had grown exponentially from its (not-so-humble) start in 1945 when the US Army Force Scientific Group wrote a formerly classified report for President Truman, with the aim of demonstrating how futures research could be useful for a more strategic military decision making.
The paramount importance of thinking about the future and preparing for it has grown even further in the last decades, due to the multiplication of complex yet ephemeral problems. These are issues which cannot be solved with a *miraculous solution*, simply because the solution could be far more harmful

in the long term than the initial problem. An example is the universal need for rare earth metals used to develop increasingly sophisticated computers and continue Moore's Law. Despite the need for said resources, their extraction and the subsequent refining process (which require hydro-metallurgic techniques and acid baths for extraction) are extremely harmful both for the ecosystem and the health of the people involved (Bontron, 2017).

Rittel and Weber, in 1973, called these types of issues "wicked problems", in contrast to "tame problems" which can be approached and solved using known analysis paradigms and decision-making processes.

A wicked problem is a complex and troubling situation, which refuses to be fenced and described with a unifying definition and request interdisciplinary solutions. These solutions, in Rittel and Weber's perspective, are not good or bad, right or wrong, they simply are the best that can be done at the moment with the available tools and resources. Going back to the example of Bateman's theory of light reflection mentioned in the previous Chapter, the mathematician was presented with a problem which could not be solved with the technology available in 1910. Consequently, he created a mathematical model, a.k.a. *the best he could do with the resources available*.

Figure 2: White House Photographs (1963)
Theodore Von Karman, who wrote the classified report for President Truman, standing next to President Kennedy.

Companies like IDEO, frog design and Adaptive Path, already addressed these problems in the last years, but always with the aim of creating new corporate strategies to tackle complex product-service systems.

In this context, future forecasting blends perfectly with this dissertation's opening quote - *the readiness is all*: the only way to anticipate the future is being aware of its possible declinations and agile enough to react to whatever each situation presents.

Future forecasting as presented in this dissertation relies on a series of core assumptions, derived from the work of Lee Fleming (2004) and David S. Walonick (1993), among others:

1. The ultimate aim of future forecasting is to improve the welfare of humankind, of all animals, plants and biosphere. This is achieved through *perspective thinking*, the systematic exploration of possible alternative futures: the probable (what is almost sure), the possible (what can be), the plausible (what might be) and the preferable (what ought to be). However, future forecasting is not merely about depicting possible future scenarios: it is the strategic approach on how to reach (or avoid) each one of those scenarios.

2. It is impossible to state with complete absolute certainty which will be the future of an individual wicked problem. Beyond the reliability of the methodologies used to reach a forecast, it is inevitable that a certain degree of uncertainty will persist until the predicted event horizon is surpassed.

3. Total and organic predictions are utopic: there will always be some aspects which were not thought of or deemed essential to address. As a matter of fact, it is impossible to predict new technologies and the so-called *Black Swans* (a term coined by finance professor Nicholas Nassim Taleb which indicates situations and events which appear in a random and unexpected fashion - some examples are the 2008's financial meltdown and the previous dot-com bubble in 2001).

4. Interdisciplinary teams, composed of experts in subjects with low alignment between them, such as poetry and biochemistry, astronomy and visual arts, caretaking and computer engineering, have to produce the possible solutions. In fact, Fleming demonstrated that in these conditions the outputs, although unsuccessful most of the times, will be breakthroughs (Fleming, 2004). For instance, missile guidance systems used by the United States Army in the Sixties were invented during Second World War by a team composed by Hedy Lamarr (an actress) and George Antheil (an avant-garde composer). Their technology became the precursor of modern radio standards, such as WiFi and Bluetooth.

5. Providing the forecasts to policy-makers will help them to formulate new social policies. These new laws, in turn, will change the future, nicking the forecast's accuracy. An example comes from the current events happening in the world of self-driving cars, such as the ones developed by Tesla: Elon Musk's enterprise has forecasted that by 2017 it will have commercialised a car able to self-drive from Los Angeles to New York City (a 2.789 miles drive through different road situations). By releasing to the public this forecast, besides increasing the excitement towards his company, Musk has given to policy-makers in the US - and potentially all around the globe - a clear deadline for instituting, for example, who is to blame if an accident happens. Is it the driver's fault? Alternatively, the car manufacturer's? Maybe of the person involved in the crash? Perhaps, of the computer engineer who wrote the code uploaded in the car's firmware?

2

Compasses, not Maps

[3] *Essentialism* is a philosophical conception which affirms the ontological priority of the essence with respect to things in their concrete and individual existence.

It is paramount to stress that there is not an *essential*[3] approach to forecasting the future. On the contrary, there are numerous different methods and techniques which can and should be used depending on which situation is being addressed, oftentimes hybridising them with other ones, according to the situation manifested.

Generally speaking, there are two kinds of possible forecasting methods: *qualitative* and *quantitative*. The first one is used if there are not any available data on the specific situation or if the existing data has little to no relevance to the researcher's scope. The second one is used if there are relevant numerical data drawn from the past and if it is reasonable to assume that what occurred in the past will continue to happen with little variation in the future.
I will not report all of the (seemingly) countless techniques available in both methods since they are beyond the point of this dissertation, but most of them are presented in the Appendix, in tables 1 and 2.
In the next Chapter, I will demonstrate a viable third approach to future forecasting which leverages on both quantitative and qualitative methods, integrating them with an interdisciplinary approach.

2.1

Qualitative Future Forecasting

Qualitative future forecasting is based on personal judgement of a person or, more often, of a group of experts on the issue addressed. For this reason, the techniques which are part of this method are also referred as 'judgemental methods' or 'genius forecasting'. Inevitably, these judgemental methods leverage on a range of different experts, such as sociologists, ethnographers, designers, hard scientists and, more generally, the framework implemented in the field of interdisciplinary studies.

Figure 3: Sebald Beham (1521), Genius riding a Dolphin

Qualitative forecasting is employed when it is deemed that the future will not behave in the same manner as the past. Therefore it can not be analysed using quantitative methods and techniques. A possible case scenario is the Australian's government decision in 2012 to ban all logos of cigarettes manufacturers from their packagings and enforcing them to put on the market only dark green packs of cigarettes. Evidently, it was impossible to estimate the impact of this policy decision based on existing data due to its radical nature which greatly differs from its historical precedents.

Another situation in which judgemental forecasting is helpful is when a huge amount of specific and local data are scrutinised to discern trends and pattern which will not be flagged with a quantitative approach, as they require a strictly human sensibility to be recognised. For example, when a construction company decides which kind of housing it has to build in a specific neighbourhood, it generally seeks help from an expert on the local population. He or she will be able to tell the average demographic age in the area which will, consequently, affect the topography of the houses which will be built - only one story high and with fewer bedrooms, if the neighbourhood has a prevalence of people in retirement age.

Compared to quantitative forecasting, there are two distinct advantages in using this method:

• Predictive ability - the first (and more evident) advantage is the capacity to anticipate changes in selling patterns and user behaviour, grounded on the combined forces of senior executives and external experts.

• Flexibility - this method gives the managers and policymakers the necessary flexibility to use non-numerical sources, as the intuition and judgement of experts, which possibly enhance the prediction's quality since statistical estimations can not capture all the nuances which can be evident to an expert who has years of experience on the topic.

Obviously, since this method is rooted in *informed opinions* and not hard data, there are some additional caveats, vis-a-vis to quantitative methods. A study conducted by (Lawrence et al. 2006) highlights that, usually, the information used in judgemental forecasts are partial and biased to a certain degree, since the data used as starting point for the analysis are selected without specific criteria and a fixed weighting system.
This problem can be better described by borrowing the definition of 'Garbage In, Garbage Out' from computer science: if a system's inputs are partial or wrong, the plotted output will be, inevitably, false or, in the best case scenario, partial.
Being aware of the pitfalls of this method, in Chapter 3 I will postulate a possible new methodology which keeps in consideration this limitation.

2.2

Quantitative Future Forecasting

Quantitative forecastings are often linked to specific disciplines and are developed to address a defined and focused situation but, overall, they are all commonly leveraging on Time Series data (namely, data regularly acquired at specific time intervals), Cross-Sectional data (data acquired at a specific moment in time) or Simulations.

2.2.1

Time Series Data

These series of data are used when trying to forecast something which is changing dynamically through time, such as the stock value of the market, the number of cars travelling on a specific highway during the holidays or the annual profit of a company.
The aim of the techniques grouped under this methodology is to assess how the series of observations made until a specific moment in time will continue and evolve in the future. The time series technique strictly uses information which is already known to the forecasting team, and it is not interested in any way in determining which are the factors that modify and impact the observed course. Consequently, it is possible to extrapolate trends and past seasonal cyclicalities.

2.2.2

Cross Sectional Data

With this kind of data analysis, the researchers try to forecast the value of something which has not been observed yet by using information from previously observed and studied situations. An example could be the case of a popular census: some of the variables - also called *predicting variables* - are known (birth and death rate, the number of emigrants and immigrants) and some are to forecast (number of residents of a specific State at the end of the year).
This kind of analysis is used when the variable(s) to forecast exhibit a close relationship with the other predicting ones; the technique's aim is to describe and give a numerical answer to the unknown value. As in a mathematical equation, whatever fluctuation in the known variables will generate a different solution, which will still be computable - assuming that the addressed system is governed by a predictable law.

2.2.3

Simulation

The Simulation method takes advantage of the powerful rhetorical figure of analogy.
These analogies can assume different manifestations: a *mechanical* analogy could be a crash test held to verify a car's behaviour in an accident while an equation which describes the behaviour of a flock of birds would be a *mathematical* analogy.
A *metaphorical* analogy could be using the neural system for describing a computer's mechanics and, finally, a *game* analogy is used

when the player's interactions are symbolic for the interactions inside of society (Walonick, 1993).

3

Future Forecasting for the Designer

After having a general grasp of the available methods, before being able to transfer them to the design practice, it is vital to recognise their flaws. It has to be stressed that in the context of future forecasting the only errors possible are those derived from logical fallacies, while falsity (which is the alteration or violation of truth) is not feasible since the realm addressed is one of the *possible* futures.

Many researchers have addressed the pitfalls of future forecasting, since its very beginning. Already in 1957 Khan & Mann (1957) had identified ten distinct possible shortcomings connected to the world of intelligence:

Modelism - insisting on abstracting only one part of the problem

Statistical uncertainty - the introduction of statistical analysis complicates the problem exponentially, so it is not always necessary. Sometimes it is sufficient to rely on expected value calculations.

Real uncertainty - some factors of uncertainty cannot be measured numerically; hence they are subject to personal opinion. This issue becomes apparent borrowing an example from the Cold War: how many nukes does the enemy have? How many aeroplanes? Will be there some warning before an attack?

Enemy reaction - assuming that the enemy is either inert or omnipotent

Over-concentration - overly narrow the problem addressed, disregarding seemingly unconnected factors

Phasing - not considering both past and future scenarios

Over-ambition - trying to address questions which are beyond the team's capabilities or time frame

Fanaticism - obsessing with a certain technique and/or technology

Hermetism - not communicating with a larger team or set of people

Butch - not double-checking the computational answer with a qualitative approach

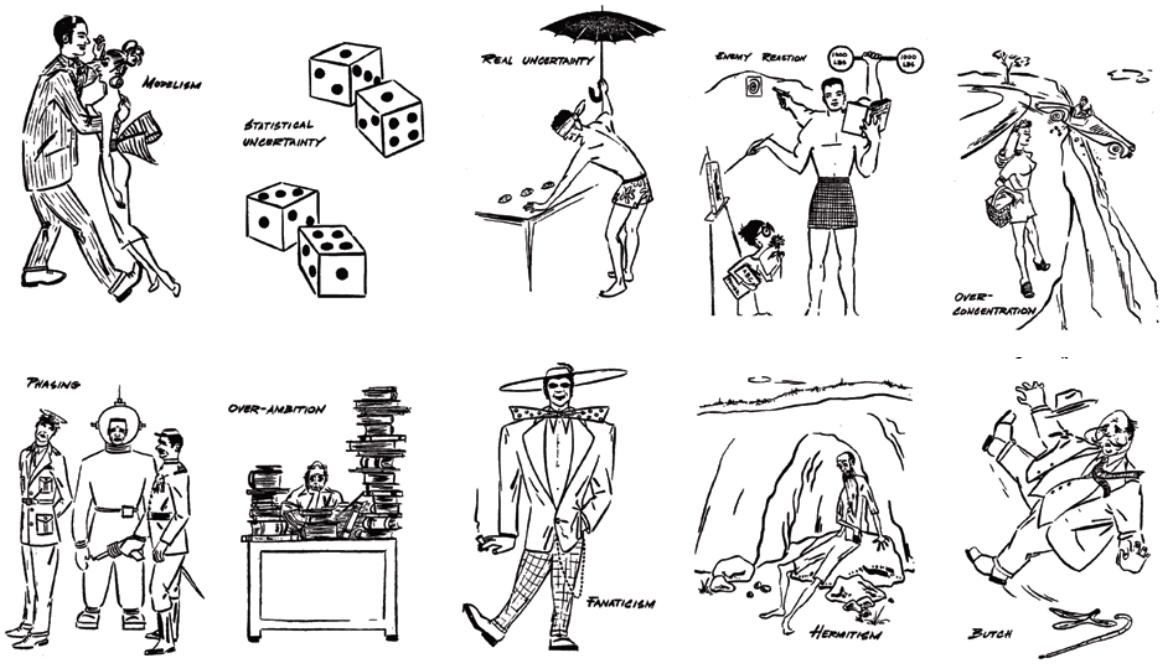

Figure 4: Khan & Mann. (1957). Ten Common Pitfalls, as drawn by the researchers.

Later on, Frans van Vught, a Dutch social scientist, summarised and abstracted these concerns, integrating them with the philosophy of science and condensing them in five "pitfalls" (van Vught, 1987):

Pitfall of false continuity - it cannot be assumed that the past will repeat itself in the future. If this assumption is used, the decision has to be logically explained.

Pitfall of ignoring theories - since social phenomena are at the heart of future forecasting, and given their undoubted complexity, dynamicity and interrelation, not using theories will lead to grave mistakes.

Pitfall of corroboration - even if a theory is available, it should not be assumed that since the theory has repeatedly been tested, its degree of corroboration is higher. Theories can be refuted.

Pitfall of intuition - most of the qualitative methods are not explicit about the processes implemented to analyse the data and formulate conclusions; hence they have no scientific base.

Pitfall of scientific determinism - scientific determinism states that if there is a large enough pool of data and theories and all of the initial conditions are met, it is possible to formulate an accurate forecast through logic. This statement is false, since every theory is a simplification of reality and, therefore, cannot express all of the nuances of the real deal.

To largely avoid these pitfalls I propose that most of the possible logical fallacies (that is, those which depend on the *human factor*) are a byproduct of an underlying fallacy, which is derived from Popper's philosophical view, called *historicism*. His arguments are grounded on the inductive reasoning, which states that if it is possible to observe a certain regularity in a limited number of situations, it is feasible to formulate a generic statement which implies the future repetition of that particular instance.

This mental framework alone is wrong, as it was postulated almost three hundred years ago by the David Hume, a Scottish empiricist, which demonstrated the complete lack of any logical argument on which is possible to base the assurance that a future experience will resemble in any way an already experienced phenomenon.
Subsequently, the British philosopher

Bertrand Russell made evident the inductivist reasoning's fallacy with the famous chicken example (which, for some reason, morphed into a turkey in most of the following citations):

We know that all these rather crude expectations of uniformity are liable to be misleading. The man who has fed the chicken every day throughout its life at last wrings its neck instead, showing that more refined views as to the uniformity of nature would have been useful to the chicken (Russell, 2001).

Undoubtedly, though, a historicist approach has its positive aspects: after all, expert's opinions are built from historical data and knowledge.

A better mental framework for the designer willing to include future forecasting in his or her practice is the parallel usage of a historical and an ahistorical approach.

Ahistoricism is based on the analytical philosophy developed by Russell, Wittgenstein's early works and the logical positivists in the Twentieth Century. In its most abstract conceptualisation, ahistoricism refers to the practice of logically reason about the future independently from its historical context, to avoid the temptation of having more preconceptions about the possible future. This fits perfectly also with Occam's Razor, which states that *pluralitas non est ponenda sine necessitate* (plurality should not be posited without necessity) (Encyclopaedia Britannica, 2015).

A productive way of combining these two approaches is given by a *gap analysis*, namely asking the same question to two groups of people, one approaching the problem through a historical lens, the other one through an ahistorical one, and comparing the gaps between the given answers.

In any case, as evident from the work of Khan, Mann and van Vught, there is not an *essentially* better method or technique to forecast the future. As designers, we can only decrease the level of uncertainty by integrating and combining multiple plotted outputs.

3.1 Combining Forecasts

In an ideal world without error in the reference models, with unlimited data samples (and without estimation errors) and with a complete and unobstructed access to the dataset which are underlying the individual forecasts, there would not be any necessity of combining forecasts. In our not-so-perfect world, which is a far cry from Plato's Hyperuranion, it is a fundamental necessity to combine different and independent forecast results to increase the final forecast accuracy.

This combinatorial process has to be done necessarily through the means of an interdisciplinary approach, which leverages

Figure 3: Jan Saenredam. (1604). Plato's Allegory of the cave.

on the porous nature of social networks and bubbles. This figure of speech is derived from an interview with former CEO of the French company Rhône-Poulenc: "*le vide* (literally, the void) has a huge function in organisations. [...] If you do not leave *le vide*, you have no unexpected things, no creation" (Stewart, 1996).
American sociologist Ronald Burt (2004) contextualised and expanded this statement saying that the higher the homogeneity of thought in a group, the more access to different points of views and perspective the people which are part of multiple groups have, empowering them to have more options to think about and synthesise. *Information arbitrage* is their advantage. They can see more broadly, select data and insights and synthesise them effectively in their practice.

3.1.1

Combining Qualitative Forecasts

Thus, it is evident that the starting point for an effective forecast is the group of people which constitute the team tackling the issue and their *social capital*.

Social capital exists when an individual has a certain advantage, be it influence, leverage or knowledge, which derives from his or her position in the fabric of society.

The 'trick' lies, therefore, in selecting the appropriate and necessary to the specific context.

It is important to stress that social capital is not a prerogative of a selected elite of people, such as lawyers, scientists or politicians: it lies in those *structural holes* in the fabric of society, ad Burt describes them. So, as an example, an indigenous person would be the perfect fit in a group debating the future of the Amazon rainforest.

After several sessions of qualitative analysis and debate, the team should use data deriving from quantitative analysis, especially if derived from time series plotting, to create an initial framing of the scenario.

Subsequently, one or more factors of the determined scenario can be variated, simulating possible future developments of the situation and observing and discussing the results achieved by enforcing or dulling the selected forces.

Through this framework, the designer is working in the setting of possible futures; therefore he or she can make decisions which will ultimately result in influencing the course of reality, nudging it towards the wanted output.

3.1.2

Combining Quantitative Forecasts

The quantitative forecasts can be based on sets of data originating from different sources, from different techniques or both. The weighting and mediation have to be done following a well-declared rule which can be replicated in other situations, such as an arithmetic average. In fact, it has been demonstrated by Robert T. Clement (1989) that the simple average performs as well as more sophisticated statistical methods, such as the linear or logarithmic combination of density.

The 'magic number' of forecasts to combine has been empirically demonstrated by Makridakis & Winkler (1983) when they calculated the error reduction of multiple forecasts combined. They noticed that the error reduction curve is exponential: already after combining five different forecasts, most of the error reduction was achieved.

Combining different quantitative forecasts has to be done necessarily by mathematical means, so to avoid further bias in the plotted output.

There are two possible ways of achieving this: arithmetic average and weighted average. The first one could seem more desirable, since it is more immediate and easy to describe (and justify), while the second has to be justified in every passage, but it can be correct if done *cum grano salis*, to not bias the result with the involved expert's opinions.

It is clear that in the process consequent the combination of different qualitative forecasting techniques, the requirement for an effective simulation is a qualitative process, in which different professional roles (ideally) sit around the same table and discuss the pros and cons of the scenarios created.

To bring all of this to numbers (therefore, to evaluate it), Lobo and Nair analysed the quarterly earnings forecasts for 96 different companies between 1973 and 1983, employing two separate qualitative methods and two quantitative extrapolations to justify their projections. By combining the two judgemental outputs, they lowered the Mean Absolute Percentage Error (MAPE) by 0.6%, compared to the average component error. When they combined the two extrapolations, the MAPE decreases of 2.1%. By furtherly combining all four of the forecasts' outcomes, the MAPE decreased of a total of 5.2% (Lobo & Nair, 1990).

Preemptively measuring the real-world impact of these future scenarios is undoubtedly difficult. However, with the (not so simple) speculative deed, certain ideas and concepts are made explicit

and, if published, enter the collective imagination, potentially being realised by the communication act.

3.2

Forecasting and the Self-Fulfilling Prophecies

It could be argued that, by transposing the Observatory Effect evident in Quantum Physics, forecasting the future would, in some ways, change it irreversibly, guiding it towards the provided forecast.

This phenomenon is called a self-fulfilling prophecy. It is a false belief which leads - paradoxically - to its fulfilment.

The process that leads to this outcome, as it has been demonstrated various times throughout history, is characterised by three distinct phases:

l) A person (the perceiver) has to have a false perception of someone else (the target).

2) The perceiver has to act towards the target accordingly to his false perception.

3) The target needs to respond to the treatment received so as to confirm the perceiver's false perception.

Figure 6: Berenice Abbott (circa l960). Circular Wave Systems.

A landmark experiment in demonstrating the existence of self-fulfilling prophecies was the one conducted in 1968 by Rosenthal & Jacobson (1968). They hypothesised that one of the reasons why disadvantaged students had a lower academic performance compared to their more advantaged counterparts were the teacher's expectations towards them, and furtherly speculated that what would happen if the teachers would expect from them to outperform every other child in academia.

To test this speculation, they lied to an elementary school, stating that Harvard (Athenaeum of which Robert Rosenthal was a professor of Psychology) had developed a new variation of the Intelligence Quotient test, developed especially to be able to precociously flag "intellectual blooming". Consequently, the researchers told the teachers which child had been spotted as a "late bloomer", namely, whom would - supposedly - undergo a substantial increment of his or her IQ during the following scholastic year.

Obviously, the existence of this test was only a figment of the researcher's imagination. The students participated in a standard IQ test, and the "late bloomers" were nothing else than randomly extracted children. Given the random nature of the selection,

the selected "late bloomers" presented no difference from the other students. If not for the teacher's perception towards them so that the gap between their current IQ and the one at the end of the year would have prejudice as only variable, effectively creating the theorised conditions for the occurrence of a self-fulfilling prophecy.

At the end of the academic year, the "late bloomer" IQ was much higher than other students', proving Rosenthal and Jacobson's thesis. The demonstrated effect was named from the two researchers "Pygmalion effect", from the mythological figure of a Greek sculptor who fell in love with one of his ivory sculptures, which tale was narrated by Ovidius in the *Metamorphōseōn librī*.

Although the Pygmalion effect can be interpreted as an inescapable proof that the world is governed by self-fulfilling prophecies, it has been shown by subsequent studies, such as the one conducted in 2005 by Jussim & Harber, that the findings of Rosenthal & Jacobson in reality only have a marginal effect.

Although it can unquestionably be argued that the teachers have an enormous self-fulfilling effect on younger students (1st and 2nd graders), the self-fulfilling effect of the students were much less evident and

significant when all the classes are taken into consideration. Through all six grades, on average, the IQ difference between the “late bloomers” and other students was only of four points.

Also, subsequent experimental, correlational and meta-analytic studies (see Jussim, Eccles & Madon (1996), even Rosenthal himself (2002) (2003)) came to the conclusion that the effects emerged from the experiment were not abnormal.

It should not be forgotten that, because only misperceptions can be self-fulfilling (Merton, 1948), the availability of valid information limits the power of self-fulfilling prophecies that naturally occurs in society (Jussim, 1991).

Rosenthal and Jacobson’s research (and the later work of Jussim & Harber) is evidently true to some extent when it comes to a micro-context, namely that of the interactions between individuals or small groups of people, as it may be the context of the workplace, school or family.

Figure 7: Étienne Maurice Falconet (1763). Pygmalion and Galatea.

3.3

Self-Fulfilling Prophecies in the macro context

However, how do the self-fulfilling prophecies work in a broader context, precisely that of wicked problems?

The literature on the issue is scarce. The sociologist Robert Merton, who first coined the term "self-fulfilling prophecy", was convinced that these prophecies were potentially able to create problems in a macro-context, like that of the United States. Merton gives the example of African-American workers in the early decades of the twentieth century who were prevented from being able to be part of trade unions, on the assumption that they were strikebreakers. This led this working class to receive fewer job proposals, forcing them to accept any offer, even those derived from strikes by white workers, furtherly strengthening and possibly realising the trade unions' wrong *a priori* assumptions.

The self-fulfilling prophecies can be exponentially magnified through a process of accumulation. Every day, every individual who is part of society (which is, everybody) interacts with a whole range of diverse people, and each one of them has some degree of bias or false assumption about the behaviour of the aforementioned individual. When these false assumptions against a person are roughly similar, the individual self-fulfilling effects could add up, exaggerating the effects of individual and smaller self-fulfilling prophecies.
This accumulation effect has some particularly severe implications in the case of stereotyped groups such as women or ethnic minorities.

There are not many studies or researches which link directly self-fulfilling prophecies with future forecasting. Therefore, in the absence of extensive empirical evidence and by what has been said before, few would argue that forecasting the future does not indeed have an influence on the forecasted future itself, even though its effect is minimal.

However, from a strategic perspective, the value self-fulfilling prophecies in the context of social change can be a fundamental tool for reaching some arguably far-fetched scenarios. The approach of using self-fulfilling prophecies to accelerate change is evident in the (more or less conscious) work of Elon Musk. In all of his ventures (such as Tesla, SpaceX and, more recently, Neuralink) the entrepreneur takes an initial step at the verge of science fiction promising miraculous products and services, projecting his vision in the collective imaginary.

This act in return creates an expectation, which leads to more funds for research and implementation of said vision, boosting it

exponentially and, eventually, leading to its fulfilment, disregarding the fact that it seemed at the edge of utopia.

It is self-evident that designing the future of anything, be it a product, a city or a political system, is an act whose repercussions can be severe. Therefore, it is of paramount importance to implement from the very beginning an ethical framework, which gives the necessary tools to the designer to think critically and justify step by step his or her choices.

Figure 8: Giovanni Battista Piranesi (1761). Carceri Immaginarie, plate XIV

4

Ethics of Future Forecasting

Ethics stem from beliefs, assumptions, principles, moral code and morality and is a highly ephemeral concept, especially in a global community driven world. However, hard questions have to be asked; there is not the luxury of time: a new technology, a new policy or economic system can not be expected to be released and self-regulate (even though Adam Smith and his Invisible Hand would beg to differ).

Oddly enough, ethics seems to be often forgotten (or, worse, ignored) in the field of forecasting the future, perhaps because it is such a treacherous subject, maybe because of its intimate nature which prevents the creation of a unified moral paradigm which can be then declined on the specific occasion. Still, ethics' importance can not be overlooked, especially regarding wicked problems.

In a quantitative analytic process, it would seem that ethics would not play a major role, anyhow, 'only' numbers (although somewhat interpreted) are involved in the process. Nevertheless, also the пятилетка (*pjatiletka in Russian*, the five-years plans for the national economy of the USSR) were 'only' numbers.

Figure 9: N.V. Tsivchinskii (1931). The Victory of the Five Year Plan is a Strike Against Capitalism.

To furtherly explicit the possible problems which lurk in using numerical data, I'll make an example: a team of researchers funded by the National Justice System, working together with the risk-assessment team of Philadelphia's Police Department, has made evident that in the US' penal system the sentences handed down vary in duration not only on the basis of the crime committed but also on the probability or likelihood that the charged subject will commit other offenses to the Criminal Code in the future. In this oddly Minority Report-esque state of the facts, who decides which are the predictor variables which will increase the sentence? Borrowing Geoffrey Barnes and Jordan Hyatt's words,"Would it ever be permissible, for example, to include an offender's racial background as a predictor variable in one of these models? If not, what about the use other predictors, such as residential location or familial circumstances, which could indirectly communicate the offender's racial identity into the forecasting model?" (Barnes & Hyatt, 2012).

Ethical implications are more glaring in the case of an expert's forecast. Who decides which expert is fit for the task? Who will guarantee that the expert will work for a 'greater good' and not for a personal benefit? These questions are magnified exponentially if the prediction is such

that it will not affect only one company or a limited number of people: who has the right to forecast which will be the future of healthcare in the United Kingdom, the future of higher education or the future of interplanetary exploration?

To reduce the future of many to the choices of a few is in sharp contrast with most of the philosophy developed from the Enlightenment onwards. Evidently, this direction goes against the principle of equality of human nature and radical freedom preached by Jean-Jacques Rousseau, John Stuart Mill and Max Weber. At the same time, it can not be disregarded that humanity lives in various societies aggregated around political constructs such as Countries which were created, among other things, to guarantee "neutrality between different conceptions of the good" (Root, 1993). This was the logical alternative "for a society whose members practised many religions, pursued many different occupations, and identified with many different customs and traditions" (ibid).

Ethics' first obstacle is given by the fact that an essential code of ethics is impossible to formulate. Moreover, following the Enlightenment diktat, ethics is approached as a solely human affair, since the basis of agency is freedom and intentionality.

This is evidently problematic in the field of future forecasting, for example when the topic addressed is the future of robots and artificial intelligence. What is the line which demarcates where a machine ends, and consciousness begins?

The morality of technology has been extensively addressed by Peter-Paul Verbeek in his book *Moralizing Technology*. In it, Verbeek articulates "an amodern, heteronomous moral subject whose actions are always closely interwoven with the material environment in which they play out" (Verbeek, 2011).
Verbeek argues that morality is a *practice* in which humans and non-humans entities are closely entwined. He does not claim that technology has a moral value *per se*, but borrows Ihde's concept of *multistability*: technology depends on its context of use. An example of technological multistability is nuclear fusion: based on its context it can either provide energy to citizens or end the lives of millions.

Verbeek contextualises multistability in the design field referring to Bruno Latour: the French philosopher understands reality as a series of connected agents, both human and non-human, which interact constantly. Specifically, non-human agents interact with human agents through "scripts", or embedded emerging behavioural nudges.

Verbeek gives the example of disposable coffee cups: it is not explicitly stated to throw away the cup after a single use, but the design and the materials of the object do not it to be washed.

Even if Verbeek succeeds in demonstrating the fundamental importance of acknowledging technology as a moral agent in society, the author does not aim to create a code of ethics.

Even more, a specific ethics code for design does not yet exist. By all means, it is impossible to create a code which is of such amplitude to cover all possible scenario and situation and, even if it were possible to write such a tome successfully, it would result unusable since it would be impossible to recall its contents distinctly.

Nevertheless, it is necessary to develop a system or framework which would be flexible and adaptive to a huge number of cases and situations. Again, being a designer means participating in projects which range from the design of a coffee mug to the digital system of the NHS, and everything in between.

4.1

Freedom and Ethics

As stated in the first Chapter, future forecasting is about social change on a macro-context. This is especially problematic - what about human freedom and agency being overridden by external agents?

First of all, a definition of freedom has to be mediated. If we follow Kant's ethical theory, freedom is understood as autonomy, devoid of external influences and pollutants. However, it is evident that humans (and technologies) do not exist in a vacuum - a person does not undergo a life-threatening surgery because it would be a fun way of spending a day, the decision is mediated by clinical tests and doctor's opinions.

Moral agency does not need as an absolute prerequisite complete and unobstructed agency. A certain degree of freedom is enough to hold a person morally accountable for his or her actions: the Nuremberg trials are an evident example.

Moreover, Foucault in his work argues that power is the underlying structure of culture and society. In the philosopher's perspective power is not a prerogative of certain specific individuals, rather it is something "at work" in everyday life and is not dependent on human agents (Foucault, 1995). As an example of *power at work* Foucault analyses Jeremy Bentham's Panopticon, a prison designed so that a single guard could observe any prisoner at any given moment, without the prisoner knowing of it.

In Bentham's Panopticon, the prisoners, the guards and the building itself are agents of power. To borrow Jim Gerrie's words: "power takes the form of self-control and does not necessarily represent a system of rules only imposed from without, but a system of rules we also self-impose in order to create and maintain a functioning community, or society" (Gerrie, 2003).

So, if every subject is immersed in such pervasive structures of power, is there any room for moral agency?

Heidegger's answer to this question is the concept of *Entschlossenheit*, of *resoluteness*: the will not to will. However, a rebellious approach towards power, paraphrasing Francis Bacon's *Novum Organum*, is merely the *pars destruens*.

Coming back to Foucault, freedom is not an *essential status*, it is a practice of dealing with power.

In this way, Foucault replaces the concept of autonomy with his definition of freedom, which is particularly relevant for the field of design and future forecasting: the forecast

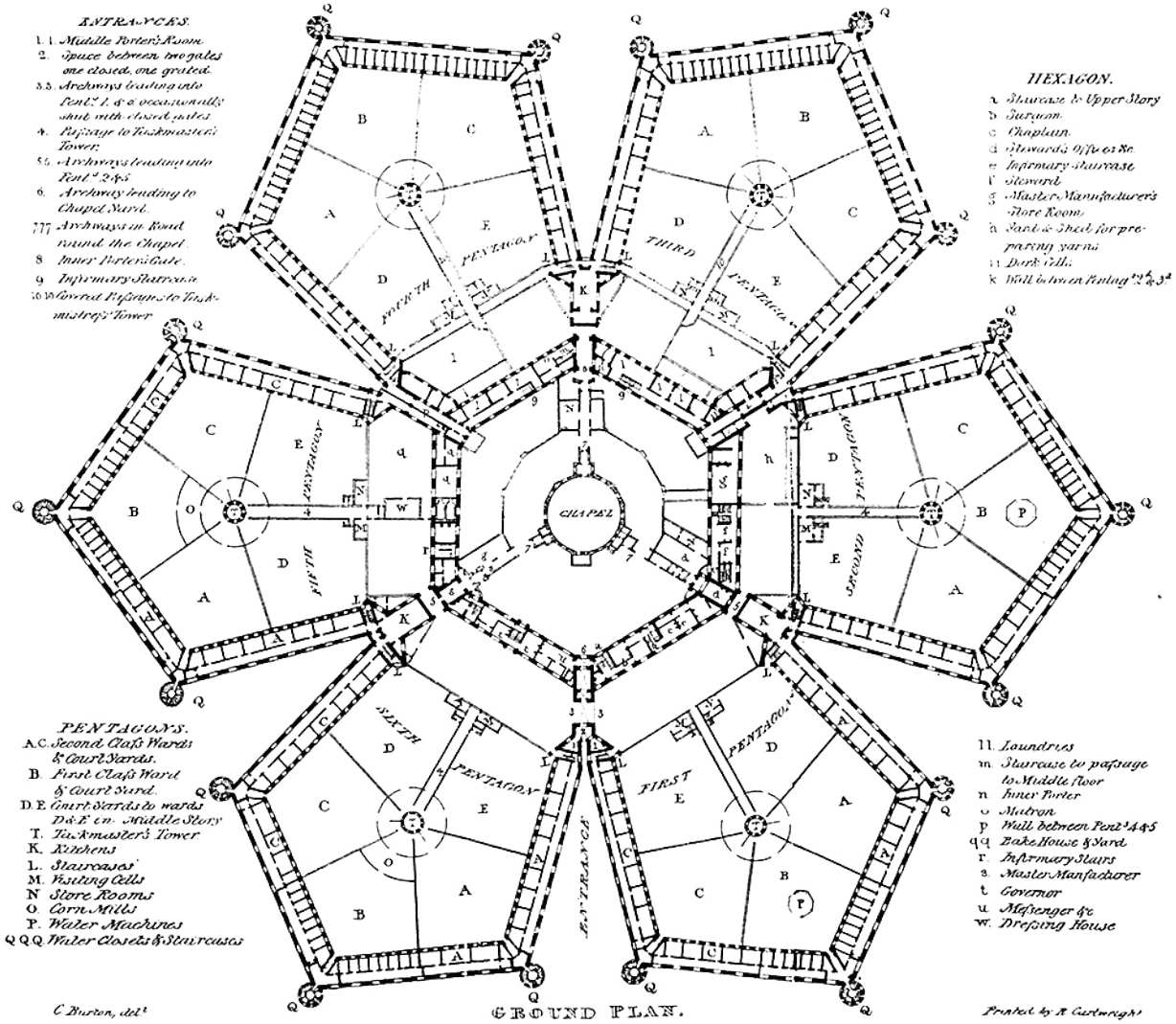

Figure 10: Jeremy Bentham (1812). Ground floor of Millbank Prison, which was built on the land purchased initially for building the Panopticon.

is an agent of power by itself, which is contextualised and located in a specific location and moment in time.

Through this lens, the act of forecasting has to be completed in a deliberate and responsible way, so that the scenario and the interactions envisioned acquire a desirable shape.

A first step to reach a desirable forecast would be to shift the paradigm and ask *what should not be designed* in the first place. An example comes from the guillotine: the horrendous device was devised by Antoine Louis and Tobias Schmidt and proposed to the French National Assembly by Joseph-Ignace Guillotin specifically to kill people. Even though it might look like this device should have never been invented, it resulted in a more 'humane' way of killing convicts. The previous method of delivering capital punishment was the breaking wheel, a device which tortured to death the individual by breaking his or her bones. In this scenario, the guillotine was an astounding piece of design.

Though, designing what should not be designed is not enough to have a fruitful conversation about the future. Thus, a useful framework for taking deliberate and responsible decisions is needed.

4.2

The Open Textured Concept

To start tackling ethics and wicked problems, I propose the use of a theoretical framework which was initially developed in philosophy for judging pieces of art, the Open Textured Concept.

Art has been historically regarded as an essential subject. Notably, Clive Bell - an English art critic - in his 1914 critical work *Art and Significant Form* begins with the assumption, derived from what he believes is common sense, which an aesthetic experience is undeniably private and personal. If this is true, then, to define art means to define that elusive something, which he calls *significant form*, which makes a work of art, well, art.

Bell cryptically states that significant form is a particular arrangement of the object's structure, so that it provokes an aesthetic, emotional response in the observer. In Bell's view, it is possible to disagree about whether an object possesses significant form, but it can still be agreed that a work of art necessarily should have significant form to be considered such. This implies that art is based on taste and the research of aesthetics is a purely empirical matter (Bell, 1914).

Moreover, Bell's work hints that art is purely a domain of aesthetics and everything which does not relate to the field cannot be considered as art.

Oddly enough, though, already sixty years before the publication of *Art*, there were artists and movements which were demonstrating the falsity of Bell's assumptions. Notably, the work of Realist painters between 1850 and 1940, influenced by Karl Marx's critique of society, rejected the aesthetic inclinations of art, focussing on depicting the beauty of the real world, much like the Impressionists, without idealising or fetishising the subjects.

An even more apparent rejection of aesthetics can be found in the work of Marcel Duchamp and, more generally speaking, Dadaists. In his controversial art piece, *Fountain* (1917), a ready-made urinal bearing the signature 'R. Mutt', art self-imposed seriousness was ridiculed, managing at the same time to spark a fierce debate about whether to consider it a work of art.

A new approach to tackle these hard questions was needed. Hence, in the mid-Sixties, the Open Textured Concept was debated and introduced in the art world.

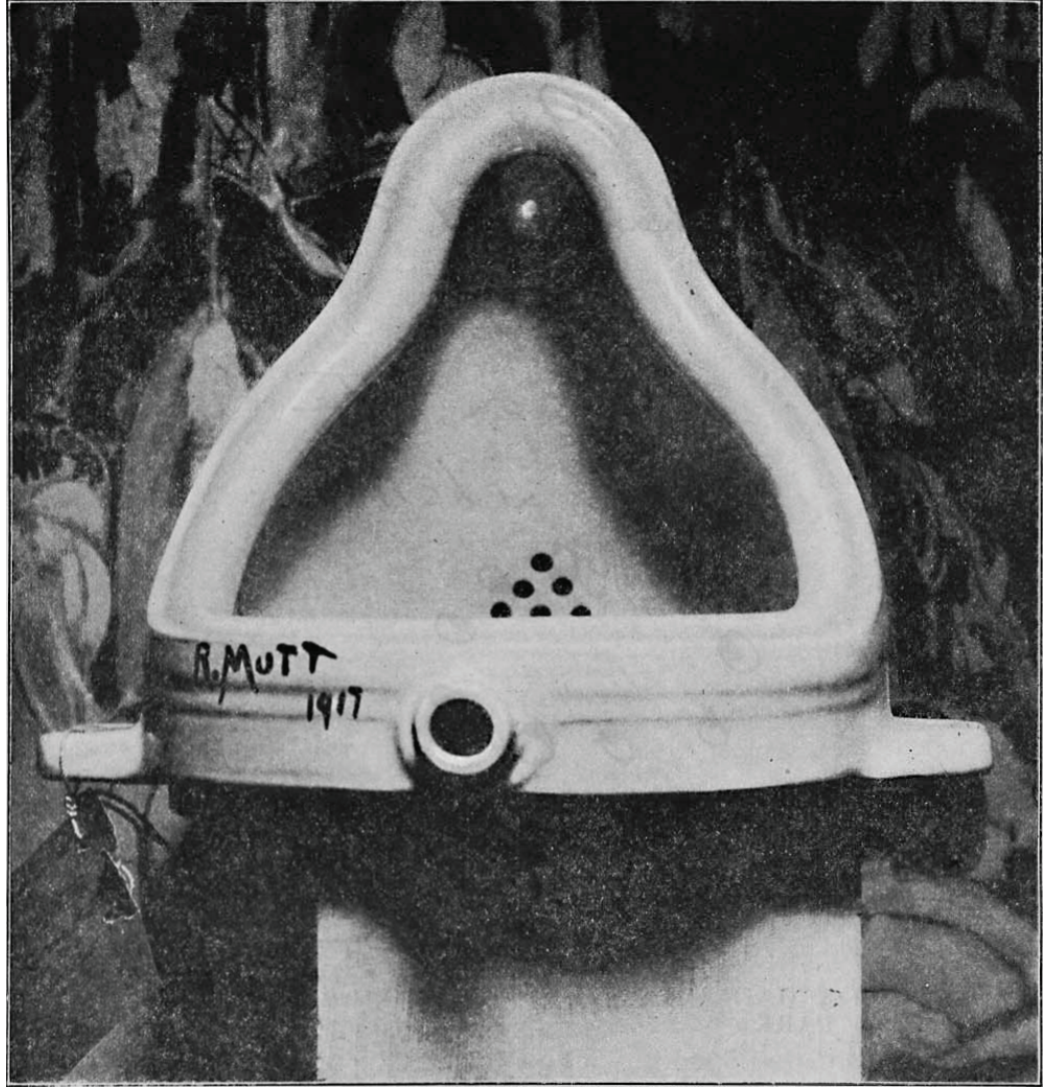

Figure 11: R. Mutt (1917). Fountain, photograph by Alfred Stieglitz.

The framework is rooted in Wittgenstein's notion of *family resemblances* (Wittgenstein, 1953) which is built on the Austrian-British philosopher analysis of games, which aim was finding their essential definition. He, however, ran into some obvious problems: some games have rules, some do not; in some games, you can lose, in others, you can only win; some games require the use of cards, dice or other objects, while others rely only on imagination.

He concluded that an essential definition of what a game is impossible.

This notion has been subsequently picked up by the American aesthetician Morris Weitz in his *The Role of Theory in Aesthetics*. He postulates that Art has a similar intrinsic behaviour to games, that is characterised by blurred edges and not bound by rigid limits, and introduced the term "open textured concept" (Weitz, 1956).
Hence, art is defined by a series of family resemblances on which experts (such as critics and historians) agree on, and these resemblances can be expanded at any given moment in time, on the basis of a valid argument.

Coming back to Duchamp's *Fountain*, can it be considered a work of art?

Following an open textured process, we can safely argue that:
- A work of art is created by an artist
- A work of art has a title, not a name
- A work of art carries the artist's signature
- A work of art is exhibited in a gallery
- ...

Clearly, Duchamp is an artist; his piece has a title (*Fountain*), it carried a signature (R. Mutt) and was exhibited for the first time in a gallery (the Grand Central Palace). However, this specific artefact has another element, which is not conceived in the classical canon of art: its subversive, ironic and political nature. Following a discussion among experts on art, it can be decided whether to include 'subversiveness' as a characteristic of what we define as 'art'.

4.3 Manifestos: the first step towards a new ethical framework

It is evident that the concept above is easily adaptable to a range of different practices dealing with complex scenarios and wicked problems, including design. To start extricating from the complexities of thousand of years of literature about ethics, I decided to focus only on texts which delivered a range of values and beliefs instantaneously. The choice fell on manifestos of avant-garde and political movements since their intent is akin to mine: point out a certain fouled behaviour from the past and provoke action and critical thinking.

I considered the following manifestos: *Fondazione e Manifesto del Futurismo, Bauhaus Manifesto and Program, Dada Manifesto, Five points towards a new Architecture, Gilbert & George X Commandments, Redstocking Manifesto, Fluxus Manifesto*.

All of the pieces of writing I chose differ widely one from another. Some are purely political, such as the feminist manifesto of the Red Stockings, some are purely technical, such as Le Corbusier's Five Points toward a new Architecture. Some are short, such as Gilbert & George's, some are lengthy, such as the Futurist manifesto.

It is clear that there is not an essential property of all manifestos. Coming back to Wittgenstein, they 'merely' share some family resemblances.

Beyond their resemblances, these manifestos can be considered, to some extent, an abstract code of ethics: even though relying on different core assumptions, every manifesto is expressed through some simple mantras, which *poetically* and *evocatively* get the point across, leaving space for interpretation.

Manifestos, though, are declarative statements of intentions, and therefore essentialist, while the open textured concept is intrinsically non-essentialist. However, manifestos can be considered under another perspective.

Umfang der Lehre.

Die Lehre im Bauhaus umfaßt alle praktischen und wissenschaftlichen Gebiete des bildnerischen Schaffens.

A. Baukunst,
B. Malerei,
C. Bildhauerei

einschließlich aller handwerklichen Zweiggebiete.

Die Studierenden werden sowol handwerklich (1) wie zeichnerisch-malerisch (2) und wissenschaftlich-theoretisch (3) ausgebildet.

1. Die handwerkliche Ausbildung — sei es in eigenen allmählich zu ergänzenden, oder fremden durch Lehrvertrag verpflichteten Werkstätten — erstreckt sich auf:

a) Bildhauer, Steinmetzen, Stukkatöre, Holzbildhauer, Keramiker, Gipsgießer,
b) Schmiede, Schlosser, Gießer, her,
c) Tischler,
d) Dekorationsmaler, Glasmaler, Mosaiker, Emaillöre,
e) Radierer, Holzschneider, Lithographen, Kunstdrucker, Ziselöre,
f) Weber.

Die handwerkliche Ausbildung bildet das Fundament der Lehre im Bauhause. Jeder Studierende soll ein Handwerk erlernen.

2. Die zeichnerische und malerische Ausbildung erstreckt sich auf:

a) Freies Skizzieren aus dem Gedächtnis und der Fantasie,
b) Zeichnen und Malen nach Köpfen, Akten und Tieren,
c) Zeichnen und Malen von Landschaften, Figuren, Pflanzen und Stilleben,
d) Komponieren,
e) Ausführen von Wandbildern, Tafelbildern und Bilderschreinen,
f) Entwerfen von Ornamenten,
g) Schriftzeichnen,
h) Konstruktions- und Projektionszeichnen,
i) Entwerfen von Außen-, Garten- und Innenarchitekturen,
k) Entwerfen von Möbeln und Gebrauchsgegenständen.

3. Die wissenschaftlich-theoretische Ausbildung erstreckt sich auf:

a) Kunstgeschichte — nicht im Sinne von Stilgeschichte vorgetragen, sondern zur lebendigen Erkenntnis historischer Arbeitsweisen und Techniken,
b) Materialkunde,
c) Anatomie — am lebenden Modell,
d) physikalische und chemische Farbenlehre,
e) rationelles Malverfahren,
f) Grundbegriffe von Buchführung, Vertragsabschlüssen, Verdingungen,
g) allgemein interessante Einzelvorträge aus allen Gebieten der Kunst und Wissenschaft.

Einteilung der Lehre.

Die Ausbildung ist in drei Lehrgänge eingeteilt:

I. Lehrgang für Lehrlinge,
II. „ „ Gesellen,
III. „ „ Jungmeister.

Die Einzelausbildung bleibt dem Ermessen der einzelnen Meister im Rahmen des allgemeinen Programms und des in jedem Semester neu aufzustellenden Arbeitsverteilungsplanes überlassen.

Um den Studierenden eine möglichst vielseitige, umfassende technische und künstlerische Ausbildung zuteil werden zu lassen, wird der Arbeitsverteilungsplan zeitlich so eingeteilt, daß jeder angehende Architekt, Maler oder Bildhauer auch an einem Teil der anderen Lehrgänge teilnehmen kann.

Aufnahme.

Aufgenommen wird jede unbescholtene Person ohne Rücksicht auf Alter und Geschlecht, deren Vorbildung vom Meisterrat des Bauhauses als ausreichend erachtet wird, und soweit es der Raum zuläßt. Das Lehrgeld beträgt jährlich 180 Mark (es soll mit steigendem Verdienst des Bauhauses allmählich ganz verschwinden). Außerdem ist eine einmalige Aufnahmegebühr von 20 Mark zu zahlen. Ausländer

Figure 12: Lyonel Feininger & Walter Gropius (1919). Programm des Staatlichen Bauhauses in Weimar.

4.3.1

Base, Superstructure and a non-essentialist manifesto

The first step is to distance ourselves from Hegel's Idealist mental framework to re-evaluate manifestos in a non-essentialist way. It asserts that ideology is directly responsible for how society works; in other words, it states that people's minds and ideas shape and mould reality itself.

Marx and Engels in their The German Ideology (1976) argue this concept, starting from the analysis of the transition from a feudal system to a capitalist one: this change has had a huge impact on society's social fabric, institutions, culture and ideology itself.

The two philosophers elaborate a new methodological approach to the study of human societies, calling it "Historical Materialism". This new conception implies that the material conditions of existence determine the very essence of society.

In this new paradigm, Marx and Engels identify - paraphrasing Foucault - two major powers at work: base and superstructure.

The base refers to all the forces and relationships of production, whether they be people, the relationships between them, the roles they play, and the materials and resources needed to produce everything that society needs.
The superstructure stems from the base and vaguely refers to all other aspects of society: ideas, values, cultures, norms, social and political institutions.

Marx and Engels argue that superstructure reflects the interest of the ruling class in controlling other social classes.

Beyond the social and political implications of The German Ideology, the relationship of power between superstructure and base is extremely relevant to the ethics of future forecasting. The manifesto is comparable to the superstructure, reflecting the ideals, values and culture of who drafted it, while the open textured code of ethics is the basis, since it has a higher level of granularity, taking into account both the people involved and the subjects (and technologies) involved.

In this perspective, the manifesto itself loses its essential nature, opening to changes, amendments and improvements, reflecting the slowly changing values of the society in which operates. The manifesto of future forecasting task is to represent the more abstract ethical beliefs, while an open textured code of ethics has to be more accurate and dependent on its specific context of use. The manifesto is the Constitution, while the open textured code of ethics is the civil law, drawing a parallel with the legislative system.

The manifesto maintains and shapes an open textured code of ethics, which in turn shapes and maintains the manifesto itself, forming a purely non-essentialist framework.

4.3.2

A Manifesto of Future Forecasting

Hence, I postulate the following manifesto for future forecasting:

1. Thou shalt have a compass, not a map
At the Media Lab, I've been working on principles that define our DNA and our world view. One of these is Compasses Over Maps. The idea is that in a world of massive complexity, speed, and diversity, the cost of mapping and planning details often exceeds the cost of just doing something–and the maps are often wrong (Ito, 2017).

2. Think what thou wilt, act what you deem of value
Do what thou wilt shall be the whole of the Law (Crowley, 1904).

3. Destroy thy idols, question thy knowledge
I will destroy your idols and your sacred stones from among you; you will no longer bow down to the work of your hands (The Holy Bible - New International Version, 1978).
Your assumptions are your windows on the world. Scrub them off every once in a while, or the light won't come in (Alda, 2009).

4. Judge thy reality by thy ideals
Ideals are not measured by whether they conform to reality; reality is judged by whether it lives up to ideals (Neiman, 2009).

5. Time washes away everything
Omnia fert aetas (Virgil, ±38 a.C.).

I opted for a brief manifesto, not to overcharge it with my personal moral assumptions and ideals. In any case, the whole aim of these five points is to be the founding stone of a manifesto which will evolve and adapt in the future, thanks not only to my contribution, but also the design community's.

5

What next?

This manifesto is a starting point for the development of an ethical and beneficial practice in the field of design and future forecasting. I am aware that the open textured concept is not perfect: given its not essential nature, it is not assertive: it does not prescribe precise rules, it does not live in black and white.
Nevertheless, coming back to the context of the wicked problems, there is no right and wrong.

Combined, design and future forecasting have the potential to approach methodically and justifiably these seemingly insurmountable problems and, moreover, an open textured ethical framework allows the openness and the amendability to have fruitful conversations about the future of a product, service, or a system.
The effectiveness of the method I propose in this thesis can only be determined with the help of time and empirical data.

Moreover, I did not develop a specific open textured code of ethics, since this thesis' aim is not to analyse a specific case study but introduce the reader to the practice of future forecasting in the context of design. Contextualising the framework I theorised in this piece of writing will be my task for the future.

As always, compasses, not maps.

Bibliography

Alda, A. (2009). *Things I overheard while talking to myself*. 1st ed. London: Arrow.

Barnes, G. C. & Hyatt, J. M. (2012) Classifying Adult Probationers by Forecasting Future Offending. *National Criminal Justice Reference Service (NCJRS)*, p.60

Bell, C. (1914). *Art*. 1st ed. London: Chatto & Windus.

Bontron, C. (2017). *Rare-earth mining in China comes at a heavy cost for local villages*. [online] the Guardian. Available at: https://www.theguardian.com/environment/2012/aug/07/china-rare-earth-village-pollution [Accessed 9 Jun. 2017].

Burt, R. S. (2004). *Structural Holes and Good Ideas*. Chicago: The University of Chicago Press, American Journal of Sociology, 110(2), pp. 349-399.

Clement, R. T. (1989). Combining Forecasts: a Review and Annotated Bibliography. *International Journal of Forecasting*. Amsterdam: Elsevier, 5(4), pp. 559-583.

Crowley, A. (1904). *The Book of the Law*. 1st ed. Cairo.

Dunning, H. (2017). *106-year-old theory of light demonstrated with metamaterial model*. [online] Imperial College. Available at: http://www3.imperial.ac.uk/newsandeventspggrp/imperialcollege/newssummary/news_22-1-2016-12-30-9 [Accessed 9 Jun. 2017].

Encyclopedia Britannica. (2015). *Occam's razor* [online] Available at: https://www.britannica.com/topic/Occams-razor [Accessed 9 Jun. 2017].

Fleming, L. (2004). *Perfecting Cross-Pollination*. September Issue. Harvard Business Review.

Foucault, M. (1995). *Discipline and punish*. 1st ed. New York: Vintage Books.

Gerrie, J. (2003). Was Foucault a Philosopher of Technology?. *Techné: Research in Philosophy and Technology*, 7(2), pp.66-73.

Ito, J. (2017). *Compasses Over Maps*. [online] MIT Media Lab Blog. Available at: http://blog.media.mit.edu/2012/07/compasses-over-maps.html [Accessed 15 Jun. 2017].

Jacobs, F. (1832). *Aeliani De Natura Animalium Lieber XI*. 1st ed. Jena: Frommann edition.

Jussim, L. (1991). Social perception and social reality: A reflection construction model. *Psychological Review*, 98(1), p.70.

Jussim, L., Eccles, J. & Madon, S. (1996). Social perception, social stereotypes, and teacher expectations: Accuracy and the quest for the powerful self-fulfilling prophecy. *Advances in Experimental Social Psychology*. San Diego, CA: Academic Press, 28, pp. 281–388.

Khan, H. & Mann, I. (1957). *Ten common Pitfalls*. United States: RAND Corporation Memorandum. July 17.

Lawrence, M. et al. (2006) Judgmental Forecasting: A review of progress over the last 25 years. *International Journal of Forecasting*. Amsterdam: Elsevier, 22.

Lobo, J. D. & Nair, R. D. (1990). Combining Judgmental and Statistical Forecasts: an application of Earnings Forecasts. *Decision Sciences*. Michigan: Michigan State University, 21, pp. 453-455

Makridakis, S. & Winkler, R. L. (1983). *Averages of Forecasts: Some Empirical Results*. Informs: Management Science 29(9), pp. 987-996

Merton, R. K. (1948). The Self-Fulfilling Prophecy. *The Antioch Review*, 8(2), p.195.

Minois, G. (1996). *Histoire de l'avenir. Des prophètes à la prospective*. 1st ed. Paris: Fayard.

National Science Foundation (2014) *Science and Technology: Public Attitudes and Understanding*. United States: Science and Engineering Indicators 2014, Chapter 7.

Neiman, S. (2009). *Moral clarity*. 2nd ed. New York: New York Times.

Root, M. (1993). *Philosophy of social science*. 1st ed. Oxford, England: Blackwell.

Rosenthal, R. (2002). Covert communication in classrooms, clinics, courtrooms, and cubicles. *American Psychologist*. United States: American Psychological Association, 57, pp. 839-849.

Rosenthal, R. (2003). Covert communication in laboratories, classrooms, and the truly real world. *Current Directions in Psychological Science*. California: Sage Publications, 12, pp. 151-154.

Rosenthal, R. & Jacobson, L. (1968). *Pygmalion in the Classroom: Teacher Expectation and Pupils' Intellectual Development*. New York, NY: Holt, Rinehart & Winston.

Russell, B. (2001). *The problems of philosophy*. 3rd ed. Oxford: Oxford University Press, pp.19-24.

Scholfield, F. A. (1954). A*elien, On the Character of Animals Books VI-XI*. 1st ed. London: William Heinemann LTD, p.371

Shakespeare, W. and Verity, A. (1931). *The tragedy of Hamlet*. 5(2). 1st ed. Cambridge: University Press, pp. 221-224

Shaw, E. (1995). *Divining the future*. 1st ed. New York, NY: Facts on File.

Stewart, T. A. (1996). *The Great Conundrum: You vs. the Team*. New York: Fortune Magazine, 134, pp.165-166.

The Holy Bible - New International Version. (1978). 1st ed. London: Hodder & Stoughton, 5:13.

van Vught, F. (1987). Pitfalls of forecasting. *Futures*, 19(2), pp.184-196.

Verbeek, P. (2011). *Moralizing technology*. 1st ed. Chicago, IL: University of Chicago Press, p.22.

Virgil (±38 a.C.). *Eclogues*. Eclogue IX

Walonick, D. (2003). *Survival statistics*. 1st ed. Minneapolis, Minn.: StatPac.

Weitz, M. (1956). The Role of Theory in Aesthetics. *The Journal of Aesthetics and Art Criticism*, 15(1), pp.27-35.

Wittgenstein, L. translation by Anscombe, G. (1953). *Philosophical Investigations*. 1st ed. Oxford: Basil Blackwell.

Appendix

Table 1 - qualitative forecasting techniques[4]

Forecasting method	Description
Environmental Scanning	Analysis of an organisation's internal and external environments for detecting early signs of opportunities and potential threats which may influence its current and future plans.
Text Mining for Technology Foresight	Tech Mining extracts useful intelligence from electronic text sources. It seeks to digest sizable amounts of raw information to identify developmental patterns and key events (breakthroughs). It is usually employed by Intelligence Agencies.
Delphi	Experts panel respond to a various rounds of questionnaires, which are usually diluted in some month's span. They have access to all information.
Real-Time Delphi	A recent variation of the Delphi technique, which requires less time to complete, because it does not include a second round of questionnaires. The answers are recorded in 'real time', hence the name.
Futures Wheel	Is a technique for graphical visualisation of direct and indirect future consequences of a particular change or development, it consists of a term describing a change that is positioned in the center of the page and the consequences following directly from the change are positioned around the change and linked to it.
Futures Polygon	A complement to the futures wheel which integrates an analysis of the likelihood of the forecast, using unanimity as the indicator of plausibility.
Cross-Impact Analysis	It analyses relationships between both historical and current events to determine how relationships will impact events, so to lower uncertainties towards the future.

[4] Glenn, J. et al. (2009). *Futures Research Methodology*. [online] Millennium-project.org. Available at: http://www.millennium-project.org/millennium/FRM-V3.html [Accessed 20 Jun. 2017].

Forecasting method	Description
Wild Cards (or Black Swans)	Is a description of an occurrence that is assumed to be improbable, but which would have large and immediate consequences for organisational stakeholders if it takes place.
Structural Analysis	Examination of the different components or elements that make up an organisation or system, to discover their interrelationships and relative importance in the realization of its goals or purpose.
Trend Impact Analysis	Uses data acquired through quantitative techniques (especially time series data) and supplements them with expert's insights about how the future could change unexpectedly.
System Perspective	Places the situation analysed in its context, forcing the forecaster to take into account all of the possible external factors which could and could not influence the forecast.
Decision Modeling	It relies on mathematical functions and distributions, such as probability distribution, cumulative distribution function, probability density function and simulations (as the Monte Carlo simulation) to forecast the future of a specific piece of technology.
Morphological Analysis	Is actually a group of techniques which share the same structure. This technique breaks down a system, product or process in essential sub-concepts, each concept representing a dimension in a multidimensional matrix. New ideas are found searching the matrix for new combination of attributes which does not exist yet. It does not provide any specific guidelines for combining the parameters.

Forecasting method	Description
Relevance Trees	Similarly to Morphological Analysis, a relevance tree is an analytic technique that subdivides a broad topic into increasingly smaller subtopics thereby showing 'all' possible paths to the objective, and provides a forecast of associated costs, durations and probabilities for each element.
Scenarios	The aim of this approach is to generate forecasts based on plausible scenarios. In contrast with other approaches where the resulting forecast is intended to be a likely outcome, here each scenario-based forecast may have a low probability of occurrence. The scenarios are generated by considering all possible factors or drivers, their relative impacts, the interactions between them, and the targets to be forecasted.
Interactive Scenarios	A hybrid between quantitative and qualitative forecasting, addressing the methodological imbalance between quantitative scenario and numerical modelling, the absence of quantification of uncertainty leading to the assumption of equiprobability of scenarios.
Robust Decisionmaking	Created by RAND, robust decision making is an analytic framework that helps identify potential robust strategies, characterize the vulnerabilities of such strategies, and evaluate trade-offs among them.
Participatory Methods	Participatory methods include a range of activities with the common thread of enabling ordinary people to play an active and influential part in decisions which could affect their lives.

Forecasting method	Description
Genius Forecasting, Intuition, and Vision	This technique is based on a combination of intuition, insight, and luck for formulating the forecast. Psychics and crystal ball readers are the most extreme case of genius forecasting and their forecasts are based exclusively on intuition.
Predictive Markets	Technique based on exchange markets. A specific market which trades on outcomes of specific events is created and the market price indicates the crowd's opinion about the probability of an event.
Normative Forecasting	The polar opposite of Genius Forecasting. It relies exclusively on a statistical (Bayesian) and mathematical (linear and dynamic programming) approach.
S&T Roadmapping	Also called Technology Roadmapping (TRM), it is a specific application of Genius Forecasting which looks at future developments of a specific technology. Its approach is to relate political and sociological challenges seen as potential outputs of R&D developments, back to the present Science and Technology policies through various technological paths.
Field Anomaly Relaxation (FAR)	FAR is a relatively transparent way to project plausible future scenarios, dealing with whole patterns instead of component variables.
Agent Based Modeling	Class of computational models which simulates the action of agents - be it a single person or a group - to assess their impact on a system.
Multiple Perspective Concept	A revision of a classical approach to system analysis. It augments the framework with organisational and personal perspectives, with particular emphasis on the problems of implementation of the envisioned scenarios.

Forecasting method	Description
Heuristics Modeling	Technique which hastens the pace of a forecast through heuristics, such as common sense, educated guess and intuitive judgement.
Causal Layered Analysis (CLA)	CLA's aim is not to forecast the future, but creating a transformative space for the creation of alternative futures. It consists of four layers: litany (the problem), social causes, worldview and myth/metaphor.
State of the Future Index (SOFI)	Technique which uses quantitative data of the last twenty years regarding a specific topic and augments them with judgements to forecast the upcoming ten years.
Historical analogy	Life cycles of similar (until a certain degree) products or services are compared. Demand pattern for each stage of life cycle is assumed to be analogous for comparable products/services.

Table 2 - Quantitative forecasting methods[5]

Forecasting Method	Subset of	Description
Simple moving average	Extrapolative methods	This technique averages the last n observations of a time series. It is appropriate only for very short or very irregular data sets, where features like trend and seasonality cannot be meaningfully determined, and where the mean changes slowly.
Exponential smoothing, such as the Holt-Winters method	Extrapolative methods	A more complex moving average technique, involving parameters reflecting the level, trend and seasonality of historical data, usually giving more weight to recent data. Widely used in general business because of its simplicity, accuracy and ease of use. This technique's robustness makes it useful even when historic data are few or volatile.
Autoregressive Moving Average (ARMA)—aka Box-Jenkins	Extrapolative methods	An even more complex class of moving average models, capable of reflecting autocorrelations inherent in data. It can outperform exponential smoothing when the historical data period is long and data are nonvolatile. But it does not perform as well when the data are statistically 'messy'.
Regression analysis	Explanatory variable methods	Fitting a curve to historical data using a formula based on independent variables (explanatory variables) and an error term. Although these techniques are relatively simple and are helpful both in analysing patterns of historical data and for correlation analysis, they are not generally recommended for forecasting.
Predictive modeling	Explanatory variable methods	An area of statistical analysis and data mining, that deals with extracting information from data and using it to predict future behaviour patterns or other results. A predictive model is made up of a number of predictors, variables that are likely to influence future behaviour.
Artificial neural networks	Explanatory variable methods	Patterned after the neural architecture of the brain, these techniques allow for nonlinear connections between input and output variables, and for learning patterns in data.
Econometric modeling	Explanatory variable methods	Systems of simultaneous equations to represent economic relationships.
Cell-based modeling	Simulation modeling methods	Modeling of individual homogeneous units (cells) over time, such as age/sex cells in pension forecasting. These models are usually deterministic, but may be stochastic. They are useful to model large systems.

[5] soa.org. (2017). Forecasting Methods. [online] Available at: https://www.soa.org/files/sections/prof-forecasting-methods.pdf [Accessed 20 Jun. 2017].

Forecasting Method	Subset of	Description
System dynamics simulation	Simulation modeling methods	Simulation of a system as a whole over time, incorporating feedback loops as well as stocks and flows. Such techniques are useful for complex systems.
Multi-agent simulation	Simulation modeling methods	A computer representation that employs multiple interacting agents and behavioural rules to mimic the behaviour of a real system. This technique is especially useful for modeling complex adaptive systems.