

Decision Making in a Complex and Uncertain Environment

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Abstract: This paper describes decision making not only in the context of the complexities and uncertainties of the Telecoms industry (our “outside world”) but also in the context of the complexity of our own human nature (our “inside world”). It proposes some initial principles of a possible future decision framework, based on complex systems principles, that would take as a starting point the way we are as humans (complex, ever-changing and often non-rational), rather than the way we think we ought to be (simple, consistent and always rational).

1. Introduction

We make our technology and investment decisions on the basis of assumptions about what will happen in the future. History tells us that we are wrong more often than not—and sometimes dramatically so. Yet human nature is such that when planning and forecasting, we resolutely and optimistically begin all over again to make predictions and take decisions based on assumptions, even when we have been proved consistently wrong in our previous decisions and assumptions!

This paper describes initial research to scope out the problem of making technology and investment decisions when the future is highly uncertain. It identifies some avenues of research that could improve the robustness of decision making under endemic uncertainty. My hypothesis is that the road to more robust decision making in this environment lies not in making better predictions and assumptions, or better “controlling” the situation. It lies in adjusting our decision-making processes to the complexity and endemic uncertainty of the world around us and to the way we function as humans.

2. Problem Statement

2.1. Complexity and Uncertainty “Outside”

Trying to understand the dynamics and interactions of many products across several companies in a given market is already a significant challenge. But the Telecoms industry today is not a single market, nor does it even have clear boundaries. The interconnections of technological developments by different firms become exponentially more complex as they link into the wider market and cultural context. Figure 1 shows a “simplified” diagram of one portion of our industry—2G [1].

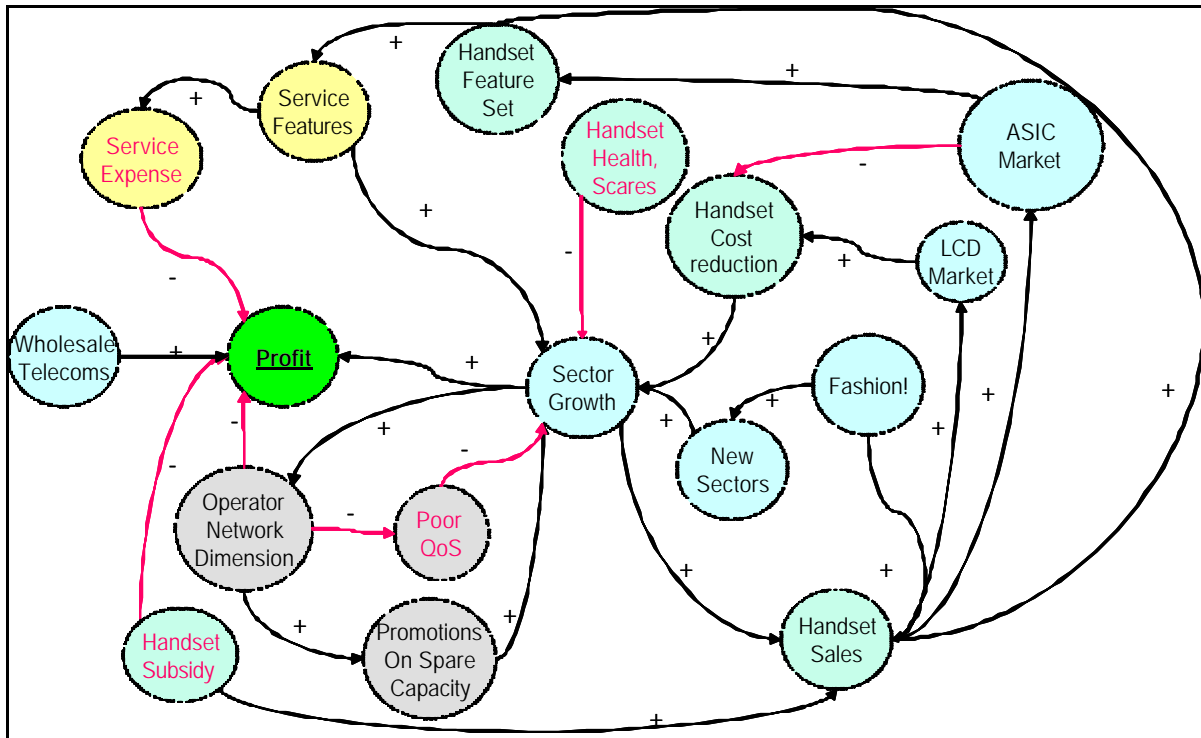


Figure 1: Interconnected dynamics of many companies, many technologies, many markets and cultures.

In this **highly interconnected** environment, it is very hard to separate out cause and effect. One can see in Figure 1, for instance, the reinforcing feedback loop between sector growth, handset sales, the LCD market and handset costs. Yet the LCD market *per se* is not Telecoms, and is influenced by factors over which we in Telecoms have little influence and of which we probably have even less understanding.

In this **dynamic** environment, the landscape can suddenly change very significantly; as it did when pre-paid subscriptions were introduced, triggering a phase transition in the number of handsets.

2.2. **Complexity and Uncertainty “Inside”**

Even in apparently simple situations, we as humans persistently behave in non-rational and unpredictable ways. Daniel McFadden, when reviewing the body of experimental studies on decision making over the last 25 years comes to the conclusion that:

When one looks at the whole body of experimental studies of cognition and choice over the past twenty-five years, what stands out is that humans fails to retrieve and process information consistently... Available salient information is too large, and beliefs are distorted because attention to new information is selective. These failures are fundamental, the results of the way human memory is wired. I conclude that perception-rationality fails, and that the failures are systematic, persistent, pervasive and large in magnitude. [2]

2.3. **Combining Inside and Outside Complexity—an Exponential Increase**

When we perceive the situation to be “too hard” to grasp (typically, in a complex and uncertain environment as outlined above) things are even worse. In experiments using computer business simulations, subjects’ decision-making performance is significantly degraded when the situation goes beyond a certain level of complexity. Key parameters are ignored because subjects incorrectly perceive the feedback provided to them; they also tend to revert to primitive decision rules “to get the decision over with”. Moreover, subjects attribute the resulting wild oscillations in the system to extraneous factors, rather than to their own behaviour. [3]

When one adds to this the social context in which a decision is made (a decision is rarely taken by one person in isolation), the complexity of the problem space again increases exponentially.

3. **Research Methodology**

A classical reductionist and deterministic approach (“if you decide in this way, this will happen”) to this kind of problem does not seem to be appropriate. I will therefore be taking an approach that, at my limited level, attempts to follow some the principles of complex systems articulated by Kauffman [4] and Prigogine [5]. I will be bringing together diverse areas of research around the common theme of decision making under uncertainty, in the hope of catalysing the emergence of qualitatively new ideas and concepts. The areas selected thus far are:

- Decision sciences.** This is to gain understanding of previous work on decision making.
- Complex dynamic systems.** This is to gain better understanding of complexity and uncertainty.
- Psychology of decision making.** This is to gain understanding of how we behave as humans in the decision situation.
- Neuroscience.** This is to gain better understanding of the neural processes that may underlie human behaviour in decision-making situations.
- Latest management and strategy theory.** This is to gain better understanding of current approaches to decision making in business.
- Reflexive research** in my own job of managing Capex investments in BT Global Services Networks. This is to bring in the concrete experience of decision making for capital investment projects BT.

As argued by Michael Lyons [6], we as humans (and the society we make up) are complex systems. I will therefore be looking for elements common to research on complex systems and the psychology of decision making, in the search for a framework for decision making that will apply the principles of complex systems in harmony with the way we behave “naturally” as complex beings.

4. Some Initial Principles

The following principles have begun to emerge from research undertaken thus far.

- ❑ In a world where landscapes can change radically in a short space of time, the power of a decision lies in its inherent adaptability, not the accuracy of the predictions on which it is based.
- ❑ Our decisions are interconnected: our own decision will influence the future decision landscape, opening up some choices, and constraining others, whilst at the same time being influenced and framed by the decisions of those in the decision chain leading up to us.
- ❑ In principle, we can never make a decision in possession of all the facts. In practice we rarely make a decision based on the facts in our possession.
- ❑ Decisions are often not what they appear to be. A decision presented as a technological decision may in fact be political, or personal.
- ❑ Nevertheless, prevalent social norms require that a decision be justified on rational grounds, even if the real reason is political or personal.
- ❑ Even “genuine” technology choices are not mainly technological, but are conditioned and framed by their environment.
- ❑ The grounds on which we make a technology decision will inevitably be partially correct at best. This is not only because of the issue of endemic misspecification, but also because of our consistent and persistent violation of rational perception. It takes some humility to accept this.
- ❑ Nothing replaces the “gut feel” of those with experience and expertise in the field. At the same time, nothing is more dangerous than the “gut feel” of those without experience.
- ❑ The danger of expertise is that of being wedded to a particular technology. The expert needs a network of people & other experts to balance his or her perspective and help frame the question.
- ❑ We are emotionally wedded to the decisions we take. It takes a certain dose of courage and maturity to accept this.
- ❑ Emotion is an intrinsic part of the way we decide as human beings. A decision framework which bans emotion is doomed to failure.
- ❑ Group dynamics are a key factor in determining the outcome and the success of implementation of a decision. They can either have a positive (e.g. strength of a coalition) or negative (game-playing, pretending to agree, etc.) impact on the decision process.

5. A Practical Problem—Telecoms Capital Investments

One key area of decision making in our industry is that of setting levels of capital investment. Those unfamiliar with the process could be forgiven for imagining that setting capital budget was a reasonably mechanical process. Based on forecasted volumes, networks specialists estimate the money required for the next financial period. The budget required is then reviewed in the light of the return on investment that the capital will engender in the form of extra revenue, and then approved or adjusted.

The actual parameters of the decisions taken are rather different.

Firstly the majority of the revenues and profits often come from legacy technology. The question can then be framed as follows: with the limited money at our disposal, should we continue to invest in the legacy technology (new features, or new geographies) or should we divert it to new and unproven technologies? Where is right balance of compromise?

Secondly, volumes forecasts are estimates based on a set of assumptions, in terms of both volumes and specific geographic location. Calculations on expected Capital spend can therefore only be based on similar assumptions, to which must be added further assumptions on costs: of network components or software development, for example. The investment recommendation is therefore based on a set of assumptions which in turn is based on a further set assumptions.

Thirdly, estimates of capital requirements are sometimes those of colleagues who want to be sure that they will obtain the money to do what they passionately believe is the right thing for the business. To ensure that the money is available even after budget cuts, they may put in a bid higher than actual requirements. Indeed, it has been common practice in all industries to add in a “comfort factor”, which is compounded at each layer of management. Those who play a “straight bat” the first time round soon learn to play this game when their “real”

budget ends up being cut below survival levels. A senior manager recently indicated to me that when he audited this process a few years ago in his former company, the budget being submitted for approval was 50% above the real requirements, after passing through only three levels of management!

In a process one would expect to be highly rational and bounded, one can see that major divergences occur with what one could rationally expect, because of both the uncertainty in the “outside world” and the way we behave as humans in the decision process.

5.1. Applying the Principles to the Problem

As BT moves into next year’s capital budget process, I will be recommending (in my area of Capex planning in Global Services Networks) that we:

- Further encourage direct and continuing dialogue on costs (begun last year) between the product lines who are customers of the product functionality and are targeted on P&L, and the project managers in the Networks organisation who are responsible for delivery of this functionality. This local interconnectedness avoids the phenomenon of “fat” being built in by stove-piped budget requests going up the line.
- Make allocation of capital budget more flexible and adaptive, possibly considering alternative ways of releasing money to build our networks, beyond a rigid one-year budgeting process.
- Take great care to avoid budget decisions that commit us to a path that unnecessarily constrains our decisions later on.
- Trust what our best technical people really believe, rather than always forcing them to rationalise and justify what they say with spreadsheets.
- Surround our best technical people with equally expert people advocating different technologies, and with worldly-wise, but benevolent business thinkers.
- Respect and manage the passion and emotion of those who do not wish to give up their projects at any cost.
- Recognise coalitions, and use or hinder them consciously to guide the dynamics of the budget process.

6. Conclusion and Way Forward

Complexity and uncertainty are properties, not only of our environment, but of our very make-up as human beings.

We do not need to throw up our hands in despair and give up the search for making genuinely good decisions, just because we cannot control or even predict our environment. We can instead use a different set of principles—based on understanding gained in particular from complexity theory and psychology—to move to a qualitatively different mode of decision making.

As my research progresses, I hope to develop a practical framework and further principles that can be used for informing our decision making under complexity and uncertainty. Rather than starting from a rationalist and reductionist viewpoint, this framework will take as its starting point the principles of complex systems and the way we work as humans. As a result, it should be easier to implement, since it will resonate with our humanity, rather than artificially constrain it.

References

- [1] Diagram (adapted) courtesy of Dr Lionel Sacks, UCL, lecture notes of module 18 of BT MSc programme.
- [2] Daniel McFadden “Rationality for Economists?” Journal of Risk and Uncertainty, Special Issue on Preference Elicitation, 1998.
- [3] John Sterman and Christian Kampmann, “Feedback complexity, bounded rationality, and market dynamics”, in Organization Behavior and Human Decision Processes Vol 62 No 2, May 1995.
- [4] Stuart Kauffman, “Investigations” Oxford University Press, 2000.
- [5] Ilya Prigogine, “The End of Certainty: Time, Chaos and the New Laws of Nature” the Free Press, 1997.
- [6] “Insights from complexity: organisational change and systems modelling”. In “Working Ideas: Insights In Systems Modelling”, Editor: M Pidd. John Wiley, Chichester (forthcoming)