

Using Systems Thinking to Deepen Scenarios

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Abstract

This paper outlines a way of using systems thinking in scenario planning to deepen understanding of the distinctions between scenarios in a scenario set. Deeper structural contrast between scenarios helps to get more value out of the scenario impact phase in strategy work. As well as outlining basic principles the paper will use an application as a case illustration. The case is the use of this method in the construction of a set of four scenarios for the UK Government Foresight project on “Intelligent Infrastructure – the Next 50 Years”. The way in which causal loops made clear distinctions between the scenarios will be described and then how the systems models were used to create anecdotal narratives which connected the systemic structure with possible experiences of different people living in that world. The paper will conclude with some reflections on the scope for further development and research of the linking of systems thinking to scenario planning, and the use of system archetypes in technology forecasting. ♣

Key words: Scenario planning, causal loops, cognitive task, structure, narratives

A Challenge in Scenario Thinking

One way executives and policy makers can challenge their prospective decisions is to “wind tunnel”¹ their options in a scenario set. A scenario set contains two or more images of the future that, between them, cover a range of uncertainties facing the decision maker. The essential exercise is to ask “what if we pursue this option in this world; what are the likely consequences?” For example, in a given scenario the opportunities and threats of that context are examined and the relative strengths and weaknesses of the organisation in that context are estimated. This may lead to modifications in the option or even the generation of new options.

There must, of course be more than one scenario to distinguish different possible outcomes of the fundamental uncertainties that led to the need for the scenarios in the first place. Good “wind-tunnelling” begins from treating all scenarios in the set as equally plausible and equally deserving of careful consideration.

However, this places a cognitive burden on the decision maker. It is hard enough to grasp the implications of one unknown future, let alone, a typical scenario set of four unknown futures. What tends to happen is that, as the work proceeds, the multiple scenarios tend to blur together in the mind

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and their distinguishing features get overtaken by their similarities and so the benefit of the impact is diluted.

This is where systems thinking can help. The author and others, including Kees van der Heijden, have made experiments in deepening scenarios structure by introducing causal loop modelling as a way of bringing out the structural differences between scenarios in a way that helps sustain mental clarity in the face of the complexity.

The Cognitive Task of Distinguishing One Scenario from Another

The essence of scenario impact thinking is the ability to entertain, mentally and emotionally, more than one 'reality'. Cognitive science calls this 'memory of the future' in which we visualise some, as yet non-existent, possible future situation. With this mental image we can see what we can learn about the likelihood of our intentions and plans working out. It is a simulation or rehearsal in the mind. So for effective thinking with scenarios, each scenario of a set needs to be 'loaded up' into the mind and visualised clearly. Holding this visualisation in mind, experiments can be made to see 'what would happen if?' Without practice, this is quite hard. Of course, movie makers, dramatists and novelists do this but they are usually exploring only one scenario or story line at a time. In scenario thinking we must do this with at least two different but parallel stories neither of which is our current reality.

Good scenario practice typically makes holding multiple scenarios in mind without confusion somewhat easier by means of several devices. They include:

- Narrative – telling a verbal story of how we got from today to that future situation
- Descriptive – portraying the future situation by reviewing what would be seen and heard by someone residing in that future time and place
- Illustrative graphics – taking key parameters of interest and displaying them as, for example, bar charts of values consistent with that scenario
- Evocative images – these may be 'pockets of the future in the present' or imaginative illustrations
- Causal logics – showing how different combinations of drivers result in the scenario's state of affairs
- Dilemmas – indicating how different scenarios tend to stabilise around a particular resolution point between polarised forces or values

Framing Scenario Sets

A typical way of initially distinguishing scenarios in a set is shown in Figure 1 below taken from the Foresight project on Intelligent Infrastructure (Curry, Hodgson, Kelnar and Wilson 2006).²

Figure 1: The axes of uncertainty and the four scenarios defined by combinations of those axes

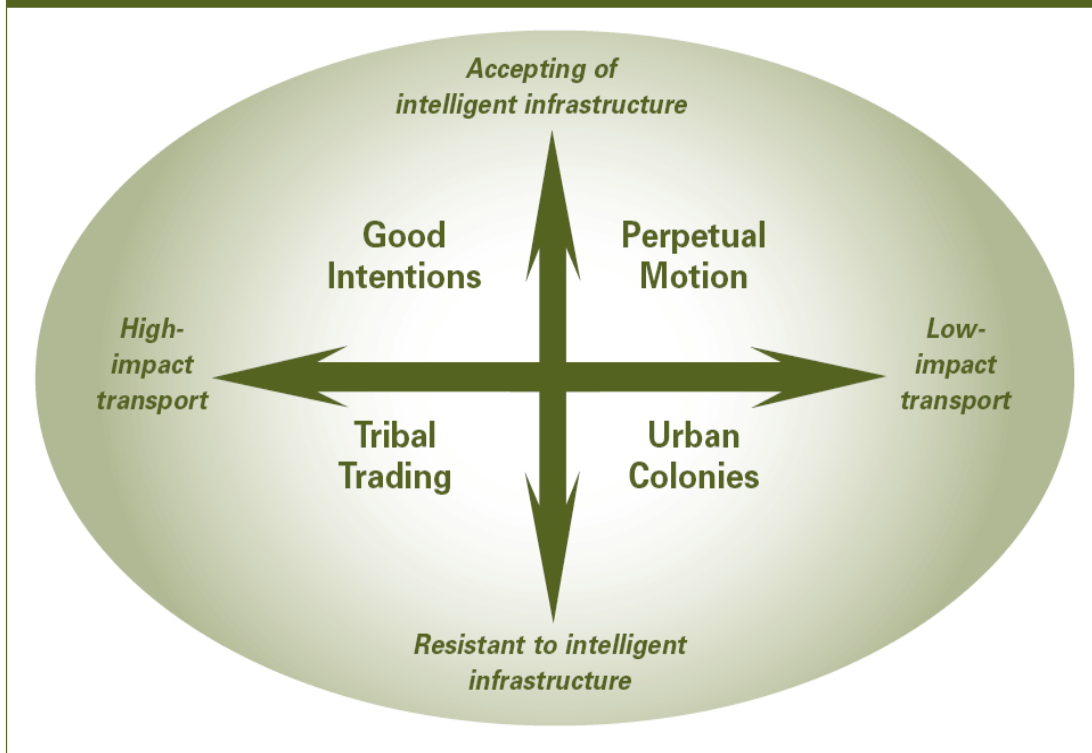


Figure1 the Scenarios of the Future of Infrastructure

The vertical axis is between acceptance and resistance and the horizontal axis between high and low impact transport. Taken to their extremes, the four combinations lead to very different futures represented by the four titles. As we have stated earlier, however, under the pressure of thinking through multiple scenarios, people easily slip into blurring the distinctions between the scenarios. All scenarios contain similar elements derived from the fundamental driving forces and common predetermined elements. The differences often show up as different shades of those common elements. This reduces the impact of the ‘wind tunnelling’ and hence the value generated through the exercise. Oversimplification loses both plausibility and requisite variety.

One of the reasons for the blurring between scenarios is certain mental habits that cause us to

- a) want one single predictive scenario
- b) find it hard to appreciate the value of thinking in more than one reality
- c) be disinclined to think through the impact implications of ‘unbelievable’ scenarios

The cognitive challenge in a typical scenario impact workshop is to assimilate the four scenarios, then to single them out one at a time and imagine the fate of a possible strategy or policy in that future world. Then, that image must be dropped and another one taken up without confusion. And so

on. Mental overload and the tendency for memory to 'stick' from one stage to the next makes some degree of blurring inevitable. There is a strong tendency for the mind to get drawn to the centre of the four-box diagram where 'it is all the same'.

Working with Deeper Structure

Making it easier to hold several scenarios in mind and switch between them without confusion, is rather like memorising several plays on the same theme and being able to act each of them distinctly without confusion. Clearly it helps if, beyond the common ground of the domain of interest, there are clear distinguishing marks. Some of the ways this is done include story lines for each scenario, perhaps with different characters; diagrams which create a space showing how the scenarios inhabit different zones in the diagram; and using pictures or sketches of different scenes for each world. I will refer to these kinds of devices as cognitive stabilisers; they help you to know where you are.

For effective "what if?" thinking in a given scenario, however, there needs to be a way of digging deeper into the structural dynamic of each scenario. The approach described here is based on a particular technique from systems thinking called *causal loops*.

The aim of deepening structure is to get beyond the surface behaviour in, say, a story line and try to understand what might be driving the situation from a deeper level. The problem with a story is that it is a fixed narrative whereas real structure is dynamic and will change the story depending on what impacts and interventions occur. Figure 2 shows the typical layers we need to penetrate.

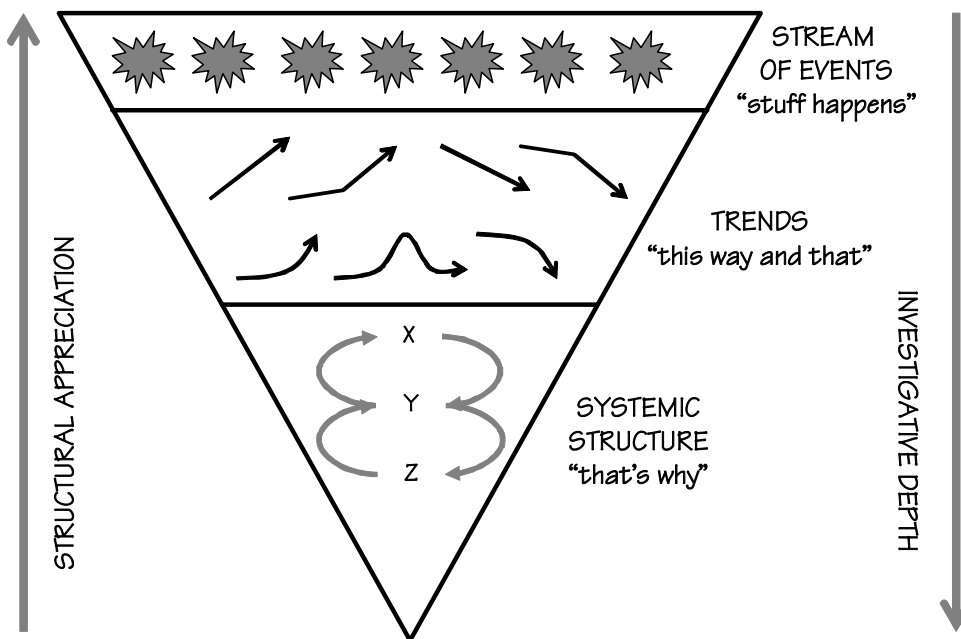


Figure 2 – Deep Structure

We can use this diagram to describe how we see our current world and then use it to frame a way to construct a new scenario thinking tool. In a news driven society the feature we are most familiar with is a sequence of events. Usually these events (if referred to by the daily news) are all over the place and in no particular pattern except when there are events which have repercussions that stretch out a little longer. They can include surprises. We can dig deeper into events and enter the second layer which may reveal themes and trends. These give a slightly better predictive capacity to see things coming. But there are dangers here because of unexpected trend breaks (e.g. “avalanches” and “storms”) and erroneous assumptions about the trend (e.g. mistaking exponential for linear). We enter the third layer when we ask: what is causing the trend breaks and discontinuities to occur? This is where the application of causal loop thinking can be helpful. It gives a tool to grapple with non-linear behaviour that may be driving the trends and events, thus improving our predictive capability. The key principle at this third level is that *structure drives behaviour*. By structure we mean coupled variables such that effects can be causes, that feedback determines the behaviour of systems more strongly than linear change.

Now turning to scenarios, we can see that each scenario in a set can be treated in this way. Thus in a set of four scenarios there needs to be four different structural models. We can refer to this as the scenario archetype which sustains its supposed behaviour. Since this approach is clearly going to be limited by the level of effort required to develop the models (even doing one model for one situation is usually a stretch!) we need an artful simplification. The work described here begins from a basic working hypothesis that

1. Any scenario will have a dominant dynamic that reinforces its existence and continuation.
2. Any scenario will have a dominant balancing loop that prevents a runaway continuation. Put another way, any scenario has a half-life.
3. A scenarios set will have a common core variable relating to the domain of interest to the decision makers around which all causal loops will hinge.

We can now apply causal loop tool as shown in Figure 3.

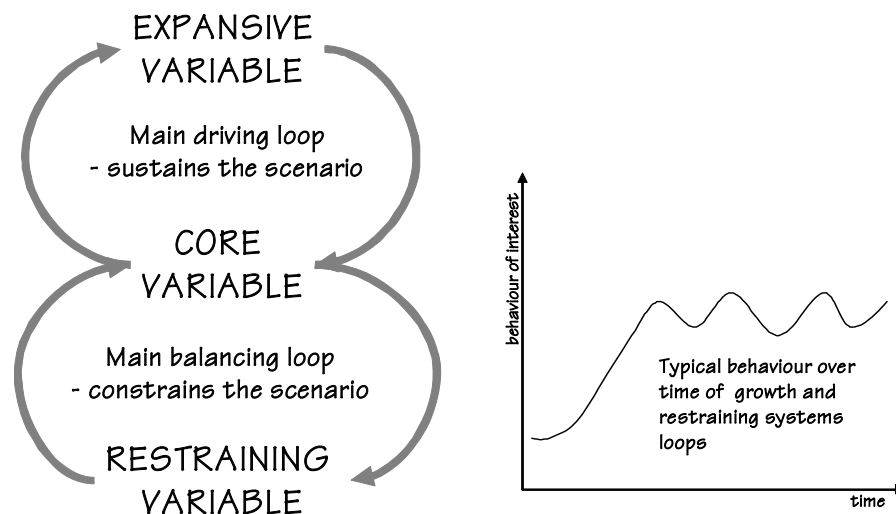


Figure 3 Reinforcing and Balancing Loops

Suppose the core area of interest in a scenario set is political power. This may have quite a different future in one scenario compared to another. The policy maker will be interested in this. As a core variable political power has a double effect. The reinforcing side is that the more you get the more you get because you can effect changes that consolidate your power. On the other hand as power increases the level of dissent and opposition increases, especially if the consolidation of power is towards one faction. So this builds up opposition, perhaps until a tipping point occurs, and there is a change of power holders through, say, an election. We can call this the changing cycles of power as in Figure 4.

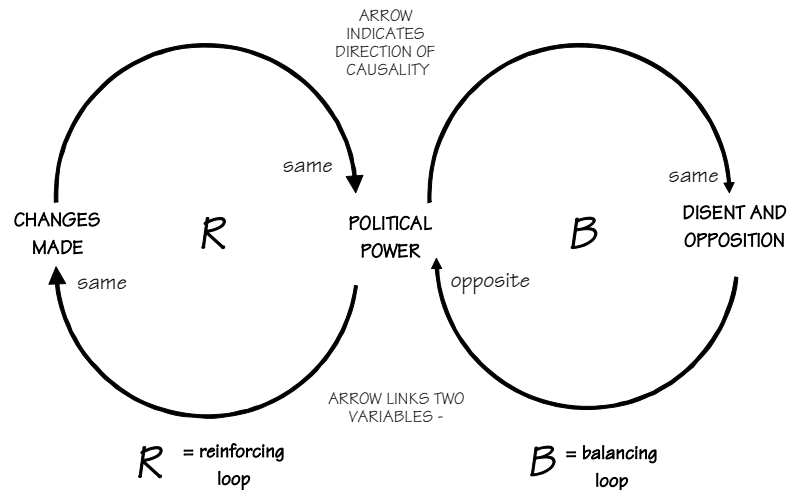


Figure 4 Changing Cycles of Power - Dynamic Structure

The two loops combined represent a structure which is not very complex but can explain quite complex behaviour. The task of the scenario creators is to identify the most promising and useful variable across all the scenarios, then to identify a likely dominant loop that will cause the scenario to grow and endure and then to see what counter-effects retard the growth of the central variable. These could be, for example, limits to growth, backlashes or unintended consequences. If this proves impossible or unsatisfying it could well mean that the scenarios themselves are intrinsically flimsy and not clearly distinct where it counts. Rethinking the basis of the scenarios may be required.

Having developed a double loop for each scenario the question becomes: under what circumstances can this endure? For example, what would bolster the reinforcing loop and what would inhibit the balancing loop? How far could growth or a balanced state continue? The forces which balance may also not happen immediately, but have a delay. This could lead to a story line which oscillates through a number of cycles before it reaches a tipping point.

This technique was applied to the four Infrastructure Scenarios shown in Figure 1 and the central variable chosen was *volume of transportation* as shown in Figure 5.

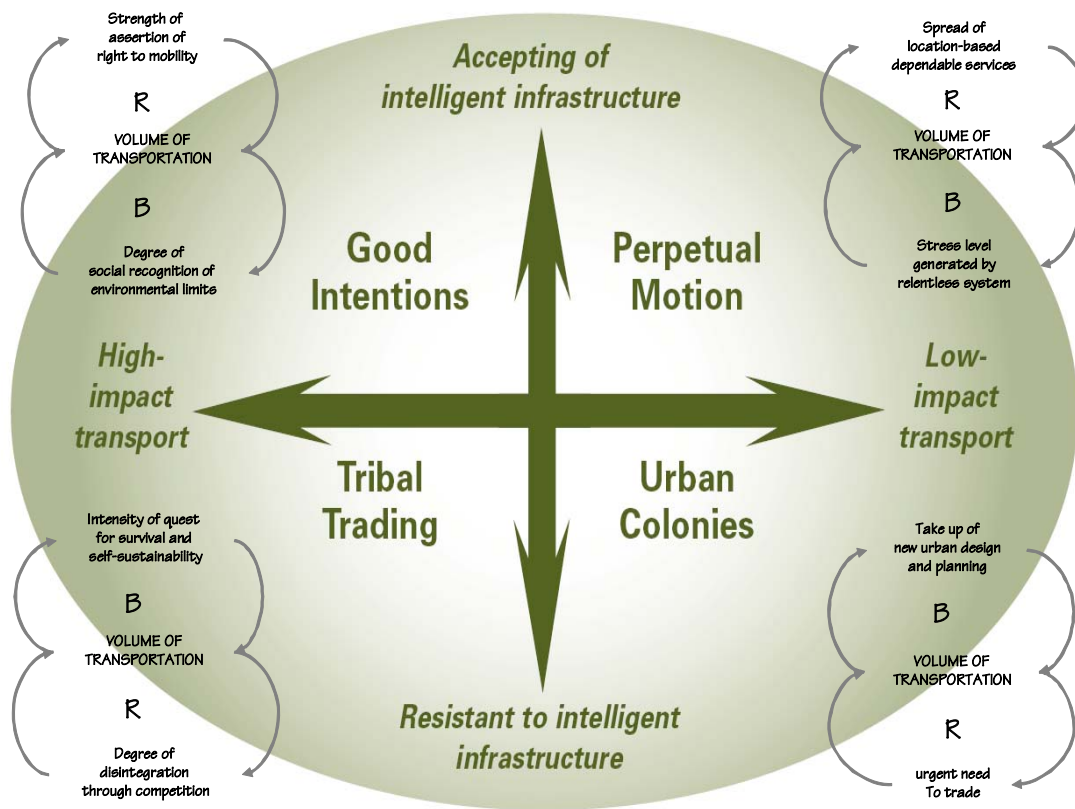


Figure 5 The Four distinct Double Loops

In Figure 5, notice that in the top two scenarios, the dynamic indicates an increase in the volume of transportation, whereas in the lower two the volume is tending to reduce. This is determined by which loop is reinforcing. Each scenario story is a dynamic battle between the two loops.

Translating Systems Models Back To Narratives

These four distinct causal loop models become key anchor points to reinforce the distinction between the scenarios. However, this is all taking place against a much more complex set of drivers and uncertainties. So the core model can now be elaborated with secondary loops, some of which augment the growth loop, and some, the balancing loop. For example, in the scenario *Perpetual Motion*, the upper reinforcing loop, ‘spread of location-based dependable services’, is likely to be further reinforced by a combination of increasing demand and increasing adoption of technology. However, the balancing loop of ‘stress level generated by relentless system’ is also strengthened by factors like the take-up of alternatives to travel, such as virtual working, that reduce the travel stress.³

Once we have developed a more complex elaboration of the core model, it is possible to return to the narrative form to help visualise the implications of the deeper structure. The technique is often referred to as ‘vignettes’, that is small stories around particular aspects of the scenario that also

bring to life the dynamic. These short stories fill in illustrations of the big story of the scenario. One example shown in the box is taken from the *Perpetual Motion* scenario in Figure 5.

A Family Get-together

Andrew was looking forward to the family reunion. He had spent many hours juggling with the integrated travel system to find the easiest and cheapest way to get his two sons and his five grandchildren together for 24 hours.

They were coming from Southampton and Glasgow to near Nottingham using the latest fashion, the 'family meeting caravanserai'. These were located at different hubs in the country designed on the lines of a hi-tech village with actual and virtual gathering rooms and accommodation. They were specifically designed to make use of the new intelligent modal integration which had evolved over the past 20 years to exploit the breakthrough in low-cost transport energy.

He remembered his own childhood, when it had been difficult and expensive to meet up for family events because of the high cost of fuel and the fragmentation of travel systems. His two sons, however, were plotting to persuade him that the twice-a-year get-togethers be reduced to one, and instead to install the new 'home virtual meeting' system so that they could schedule impromptu exchanges. Then they wouldn't need to be tied up helping him to play with his grandchildren. It was proving hard to persuade him that a virtual hug was as good as a real one.

His response was to try to persuade them to spend the money on one of the new hydrogen-powered cabervans that he could plug into the automated motorway network and drive safely to see them despite his age.

The negotiation is still proceeding!

Figure 6 Narrative Relating to the Scenario Perpetual Motion

Behind this story, of course, there are more complexities than the initial double loop. There are many subsidiary loops affecting both the reinforcing and the balancing. These supplementary loops are different for each scenario. The more complex system for *Perpetual Motion* is shown in Figure 7.

The application of systems thinking to scenario insights is not a linear process. It is a reiterative interplay between the background material, the structure, such as drivers and axes, the world view perspective, the angle of interest in the scenarios and the system thinking methods themselves. When shared between scenario builders and decision-makers, this search for the dominant loop in

each scenario strengthens their feeling that this world is plausible: it might well happen. This, in turn, energises the search for real options that exploit entrepreneurial opportunities, in the sense that the mind becomes primed to pick up the signals that a given scenario is coming about. It also helps increase the resilience of the strategic thinking, and awareness of the full range of underlying uncertainties and their implications.

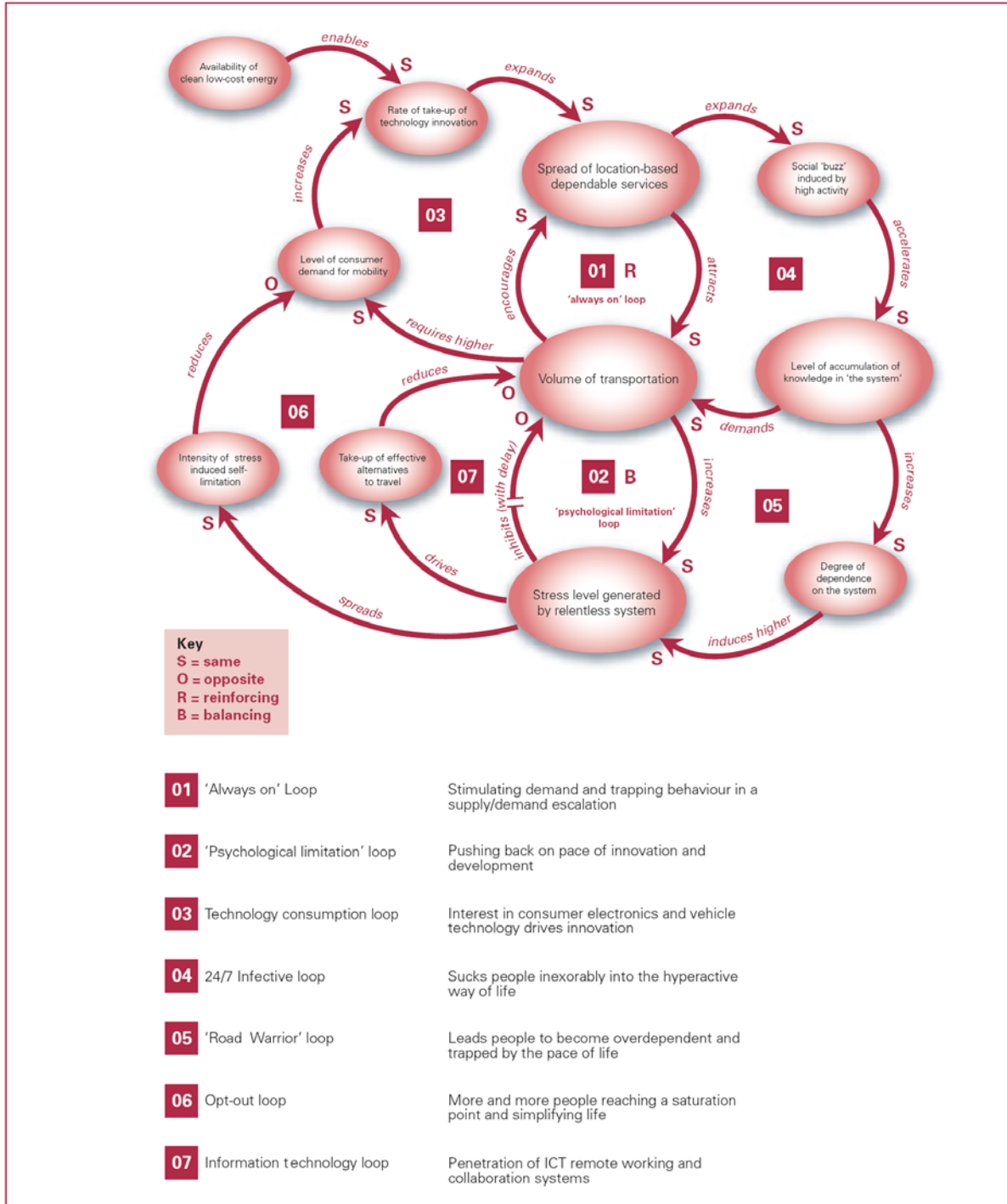


Figure 7: Perpetual Motion - The Additional Loops Around the Core Dynamic

Conclusion

One barrier to the effective application of scenario thinking is that it needs combining with systems thinking. In this way a possibility is opened up that the dynamics of strategy (the world of management) and the dynamics of the environment (the world of business or practical social affairs) can be brought into juxtaposition in a fruitful way. For example, a search can be made for favourable reinforcing loops that can be taken advantage of. We might call this a surfing strategy. It may turn out that the actor or decision maker has the power to intervene in an unfavourable balancing loop and slow or inhibit its effect. Again a strategy may be able to create its own additional loop which acts, say, like a turbocharger or a trim-tab.

The key idea we have put forward to gain a conceptual handle on this challenge is that, by searching for a 'dominant loop' in an imagined future, it is possible to bring out and contrast the essential dynamics that distinguish scenarios in a set. We then can build around that supplemental loops which elaborate the dynamics of a selected scenario. In the case of major projects we can also use this as a basis to construct system dynamic simulations that give hints about the behaviour over time of that scenario structure. The examination of options can then take on a more subtle strategic approach of looking for ways to ride on the back of positive dynamics and thwart or avoid negative dynamics.⁴

References

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