Telecommunications Regulation, Regulatory Behavior and its Impact – A Systems View

John DAVIES, Bronwyn HOWELL & Victoria MABIN
Victoria Management School, Victoria University of Wellington,
Wellington, New Zealand

Abstract: This paper examines the case of telecommunications sector regulation in New Zealand, and does so by providing a constructive illustration of the mutually informing use of systems methodologies and alternative systems representational tools as a means of building understanding of the dilemmas faced by regulators. In doing so, the paper not only seeks to provide a means of providing an appropriate decision-making platform for regulatory and industry decision makers, but also complements other work that seeks to harness the use of systems methodologies in addressing problematic situations. The paper highlights the importance of regulators distinguishing between the short-term 'local' outcomes that arise from their actions, and the systems behaviour that may be described as the unpredictable or unanticipated 'emergent' properties of the system that evolve over time.

Key words: Telecommunications, Regulation, Unbundling, Multi-methodology, Systems Thinking, Theory of Constraints, Causal Loop Diagrams, Systems Archetypes.

The task of the regulator in industry-specific regulatory regimes is complex. The regulator is typically charged with calibrating a complex market system comprising multiple participants, each with separate strategic and operational agendas. Often, the regulator is required to arbitrate between parties whose agendas appear to be mutually exclusive and directly in conflict with each other, or to make and impose rules that conflict with the agendas of one or multiple participants. These activities require the regulator to develop a considerable, in-depth understanding of both the operation of the specific market which must be calibrated, and the effects that any rulings or decisions made will have upon the operation and outcomes of that market. These understandings must take into account the complexity of the market system, the interrelationships between various participants, the effects upon individual participant strategies and activities that the decisions will have, and the ways in which the actions and reactions will alter the nature, form and outcomes of interactions.

The degree of complexity embodied in regulated market systems means that it is unlikely that a single set of decision-making tools will be sufficient for regulators in the majority of industry-specific regimes. Multiple tools may be necessary to support the types of decisions that must be made. However, the use of multiple tools also introduces its own complexity, as the results of different decision-making tools may lead to conflicting or mutually exclusive conclusions about the required regulatory interventions. Decision-making methodologies that integrate the use of complementary tools and techniques thus offer some considerable advantages to regulators in the course of their decision-making activities. Recent developments in multi-methodology therefore offer considerable promise of improved decision-making by industry-specific regulators.

The development of multi-methodology has received increasing attention over the last three decades as practitioners and academics have sought to develop approaches that guide multi-methodological intervention, and thus to understand and create benefit from the use of different yet complementary tools, techniques, methods and methodologies (MINGERS, 2003; MINGERS & BROCKLESBY, 1997, NICHOLLS *et al*., 2001; DAVIES & MABIN, 2001; MIDGLEY, 1995). Some such work has sought to demonstrate how the tools, methods and systems methodologies collectively known as the Theory of Constraints (TOC) can be used to complement the use of traditional systems approaches involving Causal Loop Diagramming (CLD) and System Dynamics (SD) (MABIN *et al*., 2006; DAVIES & MABIN, 2004). Other work explores the benefits arising from the mutually informing nature of systems methodologies in addressing problematic situations, especially how the use of one methodology may mutually inform the use of the other, and how insights derived from use of one methodology can mutually inform the development of insights from the other (DAVIES *et al*., 2006). Elsewhere, issues of a meta-methodological nature have been addressed that relate to the use of TOC methods in multi-methodology (COX *et al*., 2005; DAVIES *et al*., 2005).

As an example of the application of multi-methodologies in assisting regulators, we examine a recent regulatory decision relating to the New Zealand telecommunications sector – that of the recent decision to implement local loop unbundling - by exploring the mutually informing benefits of using different problem representational devices and processes such as the Conflict Resolution Diagram (CRD) / Evaporating Cloud (EC) of TOC and the CLD of SD. We suggest that the benefits of our approach encompass enhanced understanding of the telecommunications sector in New Zealand, in general, and of issues faced by industry regulators and

telecommunications companies, in particular. Whilst the analysis presented here is qualitative in nature, we note that the CLDs provide a necessary step in problem formulation. Indeed, the qualitative analysis constituted in the CLD provides a basis for developing a quantitative System Dynamics model, which would need to be calibrated and validated before use as a simulation tool to examine the long term dynamics of alternative policy options.

The paper will first provide some background to the New Zealand telecommunications sector, specifically the history and nature of regulatory intervention, as a means of providing a context for understanding the specific issues facing the regulator with respect to the unbundling decision. Subsequent sections will then outline and provide constructive illustration of use of the individual representational tools, the CLD of SD and the EC of TOC. A final section attempts to draw together further insights that emerge from an analysis of what we term the Telecom NZ Unbundling situation, which insights relate to the NZ telecommunications sector, its regulators and constituent companies, as well as the particular methodologies used.

■ New Zealand telecommunications regulatory history

Contrary to the trends prevailing in the majority of OECD countries throughout the 1990s, where regulated telecommunications providers of voice services became subject to extensions of those regulations into the provision of their new broadband products OECD, 2003; 2005), between 1990 and 2001, New Zealand eschewed the industry-specific regulation of incumbent provider Telecom New Zealand Ltd (Telecom), in favour of light-handed regulation via generic competition law (Commerce Act, 1986). The solitary industry-specific regulation imposed related to a simple set of price caps (prices could be raised by no more than the CPI index each year) and minimum quality requirements (the "Kiwi Share", later the Telecommunications Service Order) on the provision of local residential voice telephony services (BOLES de BOER & EVANS, 1996).

From 2001, however, following a change in government and a Ministerial Inquiry into the telecommunications sector (FLETCHER, 2000), an industry-specific regulator, the Telecommunications Commissioner, was established, with a specific mandate to investigate and make binding decisions in a number of clearly defined areas (e.g. interconnection, number portability), and to make a recommendation to government about the advisability of

introducing local loop unbundling. In December 2003, having been provided with evidence that Telecom already provided ADSL services to over 90% of customers, that at least three other alternative technologies (wireless, mobile broadband and fibre-optic cable) were already being deployed in many locations, and that further regulatory intervention in the market would likely distort future investment patterns, the Commissioner recommended against full unbundling. Instead, he recommended the mandatory, non-discriminatory provision by the incumbent to competitors of a limited number of bitstream products (Commerce Commission, 2003). The Commissioner's recommendation was endorsed by the Minister of Telecommunications in May 2004, with the proviso that the situation would be reviewed if evidence emerged that the bitstream arrangements were failing to stimulate the desired increase in New Zealand's broadband penetration (Ministry of Economic Development, 2004).

In February 2006, the Commissioner reported to the Minister that, although the number of broadband connections sold under the bitstream arrangements had exceeded the targets established following the 2004 Ministerial endorsement, three quarters of all broadband connections were sold by the incumbent rather than new entrants, whereas the target was for at least one third to be sold by new entrants (Commerce Commission, 2006). The Minister subsequently announced that a 'stocktake' of the sector would be undertaken by the Ministry of Economic Development (MED), the government department charged with overseeing New Zealand competition policy. As a consequence of the MED 'stocktake', the Minister announced in May 2006 that, in order to "address New Zealand's relatively poor broadband performance", regulations requiring full local loop unbundling would be introduced (MED, 2006).

According to the Minister, unbundling was deemed necessary to overcome a perceived underinvestment by Telecom in the range of broadband product qualities offered, and to stimulate the introduction of a greater range of broadband products and services, including bundles of infrastructure access and applications (MED, 2006). Unbundling, he claimed, would lead to greater investment in the broadband markets by new entrants, expansion in the number of market participants competing with the incumbent provider, and therefore increased uptake of broadband connections (Minister of Communications, 2006). The proposed unbundling regulations included requirements for full local loop and sub-loop unbundling, the provision of 'naked DSL' connections (that is, that DSL lines be made available without the concomitant requirement that the purchaser also purchase voice telephony services associated with that line), and the

requirement that Telecom institute accounting separation between its wholesale and retail operations, in order to facilitate enforcement of the requirement that Telecom make its services available to all parties, including its own retail operations, on equivalent terms. The proposed regulations would, according to the Minister, encourage new entrants to climb the "ladder of investment" into the ownership of complete alternative competing infrastructures that would ultimately compete with Telecom's (and the owners of the various wireless, fibre-optic cable, mobile and satellite) infrastructures (CAVE, 2006), and as a means of increasing the penetration of broadband connections per capita by lowering the prices and increasing the variety of service qualities and product bundles offered to consumers (ERG, 2005; Network Strategies, 2006).

The key tensions arising from the proposed regulations surround the ways in which they will affect investment incentives. Whilst unbundling offers a low-cost way for new entrants to begin infrastructure investment by 'adding on' equipment to Telecom's network, the requirement to unbundle will likely affect Telecom's incentives to invest in both maintaining the existing infrastructure and investing in new infrastructures that may also subsequently become subject to future unbundling requirements (CRANDALL, *et al*. 2002; SHELANSKI 2002). Access to unbundled lines may also 'crowd out' existing and planned investment in competing infrastructures (HAUSMAN & SIDAK, 2004), thereby ultimately slowing, rather than accelerating, the degree of inter-platform competition which has, internationally, been shown to have a more significant effect upon stimulating broadband uptake than unbundling stimulating intra-platform competition (WALLSTEN, 2006; CRANDALL *et al*., 2003; ARON & BURNSTEIN, 2003: OECD, 2003; HOWELL, 2002).

The 'dilemma' facing the regulator (in this case, the combined regulatory bodies represented by the Minister of Communications, the MED and the Telecommunications Commissioner) is whether to require local loop unbundling to proceed, given the complex, interacting and at times contradictory outcomes stimulated by the proposed course of action. The application of multi-methodologies discussed below was prepared at the time of the 2006 decision as a means of facilitating clear analysis and communication of the understanding of the problem situation, and thereby supporting enhanced regulatory decision-making. Whilst the analysis is undertaken at a macro level, the application illustrates the interconnectedness of important variables, and the predictable and otherwise emergent properties of the overall system.

With the benefit of hindsight, we demonstrate that the conflicts identified in the multi-methodology analysis, but not fully addressed in the regulatory decisionmaking, have led to predictable downstream consequences.

■ Building a multi-methodological approach

The initial Causal Loop Diagram (CLD)

In this section, we provide an illustration of how relationships embedded in the unbundling situation may be framed using a Causal Loop Diagram (CLD). However, in doing so, we offer the caveat that the CLD deliberately presents a macro or 'helicopter' view of the problem situation. Furthermore, we defer full consideration and discussion of insights that may emerge from the building of that representation, including the identification of possible core issues and choice dilemmas, until we have outlined the possible contribution of TOC, especially the conflict resolution process of TOC.

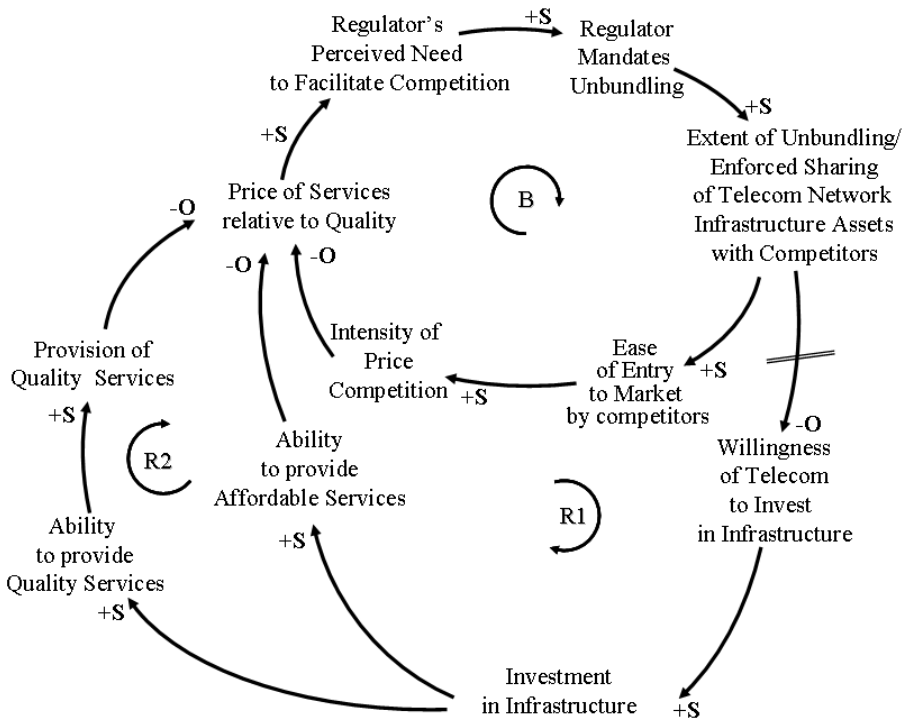
Usually, a CLD is developed by a process of surfacing variables as contributory causes or consequential effects of existing entities, and then by building on and extending links in iterative fashion until a sense of systemic wholeness and understanding is achieved. The CLD shown in Figure 1, was developed in this way. We note that it displays how the 'unbundling' response to perceived poor price/quality relativity has impact beyond that which may have been expected for Telecom NZ. In relation to the latter expectation, we further note for loop B that:

> As the price of services relative to quality increases, the regulator's perceived need to facilitate price competition grows stronger, driving up the regulator's desire to mandate unbundling, increasing the extent of unbundling that takes place, improving ease of access to market for competitors, leading to increased intensity of price competition, and finally driving down the price of services relative to quality.

Indeed, the initial unwanted state of increasing price of services relative to quality promotes action and effects within the loop that reduces price, reflecting what is termed a Balancing (B) or negative feedback loop. In similar fashion, we can show that an initial state of decreasing price of services relative to quality could promote action and effects that lead to increasing price as we close the loop. (By contrast, we can demonstrate that

a Reinforcing (R) or positive feedback loop, would result in an initial increasing value of X increasing even further as we close the loop, creating a virtuous spiral of behaviours and beneficial effects or a vicious spiral of negative effects.)

Figure 1 – Illustrative Causal Loop Diagram (CLD) for the telecom unbundling case



We note that CLD convention requires entities to be described in neutral mode, where possible. The + ^{ve} S and –^{ve} O annotations then allow relationships to be described in the context of starting or changing conditions.

The + ^{ve} S annotation indicates that the more we do the action at the tail of the arrow, the more the effect at the head of the arrow. For example, the more we have X, the more Y is needed. Additionally, the less we do the action at the tail of the arrow, the less the effect at the head of the arrow – ie the variables move in the Same direction for a + ve cause-effect relationship.

By contrast, the –^{ve} O annotation indicates that the more we do something, the less the effect. For example, the more we do X, the less we

do Y. Similarly, the less we do X, the more we do Y - ie the variables move in the Opposite direction for a - ve cause-effect relationship.

The double bar // across an arrow denotes a delay – the effect will occur over time or after a time, but not immediately.

In addition, insights that emerge from, and are communicated by the CLD, show that whilst regulated unbundling may have its desired and intended impact in the short term (as shown by the loop B), it may also have unintended and unwanted effects on long term investment in infrastructure that is considered necessary to address and improve quality.

For example, in examining the extended loop R1 (shown as thick black links), we find that:

> As the price of services relative to quality increases, the regulator's perceived need to facilitate price competition grows stronger, driving up the regulator's desire to mandate unbundling, increasing the extent of unbundling that takes place, impacting adversely on the willingness of Telecom to invest in infrastructure, leading to decreased investment in infrastructure, undermining the ability to provide affordable services, and then closing the loop, further increasing the price of services relative to quality.

… suggesting that unbundling may lead to a longer term worsening of already poor price/quality relativity (as indicated by both of the loops R1 & R2). As such, these observations not only raise the question of whether we should unbundle or not, but whether - if the government/regulator is committed to unbundling - it should also mandate investment in infrastructure. At the time of writing/submission, this would have been seen as politically infeasible.

In passing, we note that, for purposes of exposition, our CLD does not incorporate the actions or behaviors of any of Telecom NZ's competitors – who, of course, may react in a similar way to Telecom. We also note that our CLD structure can be identified as a modified version of Senge's Fixes that Fail archetype – where a so called Quick Fix can make the problem worse in the longer term (SENGE, 1990, 1994, 1999, 2006). We interpret the generalized meaning of Quick Fix as being inclusive of those options chosen for expediency, which options may be readily brought into use, without say, too much expense or effort. The Quick Fix may also be regarded in terms of its effect, for example, as an option having a more immediate and/or limited effect. On the other hand, alternatives to the Quick Fix may have more

widespread and durable impact, perhaps requiring a longer term commitment.

Yet, a weakness of our CLD is that although it captures the problem situation as it relates to the unbundling 'fix' or option, it does not capture other alternative options available to the Regulator, other than gradations of unbundling - including what may be construed as the alternative of 'no unbundling'. We suggest that one such alternative regulatory action - to insist on investment in infrastructure - would have created a dilemma for NZ regulatory decision makers, with such action considered to be politically infeasible or unacceptable. In order to shed light on such issues, we will now show how the conflict resolution process of TOC can help identify and structure a dilemma, and how it can aid attempts to resolve often inherent conflict between alternative plausible and seemingly mutually exclusive actions or options.

Theory of Constraints (TOC)
Conflict resolution diagram or Evaporating Cloud (EC)

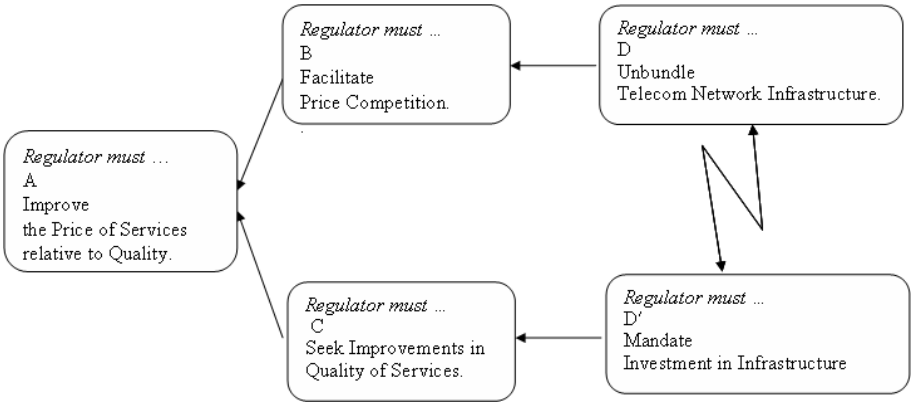
TOC as an espoused methodology seeks to assist with the 'management of beneficial change' in organisations by using logic-based modelling and analytical tools in the belief that organisations as systems can be subject to on-going improvement aiding long-term survival. In many cases, such change relates to the resolution of dilemmas which may have been assumed to be too hard to resolve, resulting in compromise or 'flip-flop' solutions.

The conflict resolution process of TOC is known as both the Conflict Resolution Diagram (DETTMER, 2007) and the Evaporating Cloud (COX *et al*., 2003; GOLDRATT & COX, 1992; GOLDRATT, 1990, 1994). We will refer to it hereon as the EC. This EC process is one that seeks to resolve such choice dilemmas, and does so by linking it to the overall system goal, and also the assumptions that underpin or give life to the dilemma – that is, it draws attention to, and emphasises different features of the problem situation compared to the CLD in Figure 1, which is characterised by cause-effect relationships and causal feedback loops. The EC is constructed as a schematic portrayal of the dilemma, using necessity-based logic relationships, depicted here by arrows connecting the boxes in the diagram in Figure 2A.

For our situation, the dilemma could be framed as whether or not to mandate unbundling, given the overall goal or objective of improving the

price of services relative to quality. However, for the illustration captured as Figure 2A, we note how the dilemma has been framed as to whether the Government as Regulator should intervene to enforce the sharing of Telecom infrastructure assets or act to promote, encourage or mandate investment in infrastructure. Such choice of alternative actions reflects our desire to take a system-wide view, rather than the local view pertaining only to the unbundling action; and represents, for illustration, two mutually exclusive actions that the Regulator might consider in order to improve the price of services relative to quality.

Figure 2A - TOC evaporating cloud for the Telecom unbundling case



The dilemma in Figure 2A would be read as follows:

… that in order to ensure objective A the improvement of price of services relative to quality, the Regulator must B facilitate price competition …

… and in order to B facilitate price competition, the Regulator must D intervene to ensure the enforced unbundling or sharing of Telecom's asset infrastructure.

On the other hand, another view is:

… that in order to ensure objective A the improvement of prices relative to quality, the Regulator must also C seek improvements in the quality of services…

… and, in order to C seek improvements in the quality of services, the Regulator must intervene to ensure Telecom D′ invests in telecommunication infrastructure.

Hence the conflict!

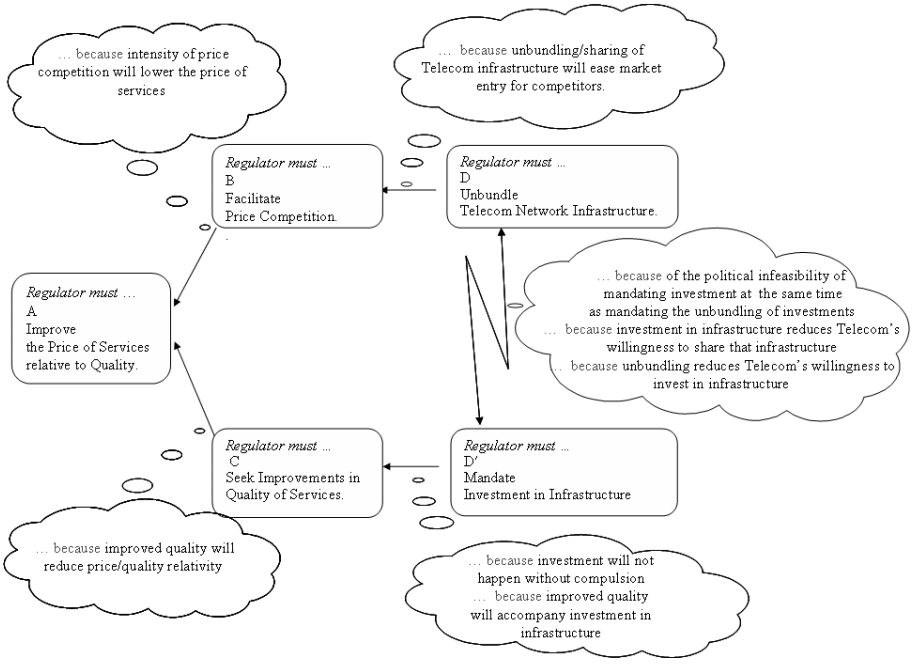
The EC representation frames the problem starting with what is believed to be two diametrically opposed actions or views (represented in boxes D &

D'), and implicitly assumes that the apparent conflict can be resolved by a win-win solution, rather than a compromise solution. In order to find such a solution, we elicit those assumptions, perceptions or reasons why the relationships are thought to hold. Such assumptions are usually surfaced by using the constructive device of sentence completion, as follows:

In order to ensure A, we must have B, because AB… finishing the sentence with an adverbial clause of reason. An illustrative subset of such assumptions relating to the logical relationships AB, BD, AC, CD′ and DD′ is shown here as annotations in the thought bubbles or clouds on the EC diagram (Figure 2B). These assumptions will sometimes provide a substantive rationale for the existence of the logical relationship or link between two entities; other times, they will be found to be flawed or weak.

Quite often, the link or relationship between, say, A and B, is regarded as a long link – meaning that further clarification, information, explanation or reason, is required to make sense of, or validate, the relationship.

Figure 2B - TOC evaporating cloud for the Telecom NZ unbundling situation with underpinning assumptions



Often when surfaced and articulated in this way, the reasons or assumptions may be seen as false, and the conflict 'evaporates.' Even where assumptions are initially considered to be valid, they may often be addressed in a manner that invalidates or 'evaporates' them, that reduces their importance or impact, and that allows for a resolution of the conflict. The best ideas or action choices surfaced by the EC process would normally be further developed and tested not just by using the EC, but also by using other TOC tools such as the Current Reality Branch (See COX *et al*., 2005). Rather than pursue the normal dissolution/resolution/solution process of the EC in this paper, we will explore links to the CLD. In doing so, we note that the surfacing of assumptions, explanations or reasons for the existence of a 'long' link between say, X and Y, may often provide evidence of additional intermediate links. Here, whilst we foreshadow the importance of these intermediate links in building a solution to the dilemma using the full EC process, we seek to illustrate the use of such links in building a second more comprehensive CLD.

The second Causal Loop Diagram

We now comment on the further development of the CLD representation and how it relates to the EC. We must first state that neither the EC nor CLD characterization of a problem situation can be expected to depict a fully comprehensive or exhaustive picture of the logic underpinning the various relationships between entities. Although the EC conflict resolution process requires the overall objective of dilemma resolution to be specified, the EC diagram may represent only a subset of the necessity logic underpinning the relationships, which is why, of course, relationships depicted in the EC diagram are often perceived as long links.

In a similar way, we often recognize the existence of long links within CLD representations, and as such, for these representations, interpretation of the CLD will also depend on assumption or assumed or implicit logic, and then be explained through accompanying narrative. Indeed, it is important to note that whilst a CLD representation will seek to provide or reflect a holistic view, it can not hope to show all necessary and sufficient logic for all relationships. In general, a CLD attempts to achieve a balance between parsimony, creating the helicopter view, and the depiction of important relationships between variables. As a consequence, the cause-effect links displayed in the CLD can be interpreted as representing some but not all necessary conditions, and some but not all sufficiency conditions for the

depicted relationships. As such, we must accept that neither the EC nor the initial CLD may necessarily depict the full logic for the relationships embedded in the problematic situation, and as such, it will be difficult to demonstrate or fully exploit the nature of isomorphism between the representations. However, we may attempt to do so with a second and more comprehensive CLD (Figure 3) which includes the alternative to unbundling of asset infrastructure already surfaced in the EC. We also note that in examining and assessing the nature of properties that underpin our ability to translate from the EC to the CLD representation, we need to be mindful of the subtle differences in the nature and representation of the logic – and especially how the assumptions 'underpinning' a logical relationship between entities in the EC will often be intermediate links in the CLD logical chain.

For example, we note for one branch (A-B-D) of the EC, the necessary logic can be expressed as:

In order to have A improvements in price/quality relativity, we must B facilitate price competition, because AB the intensity of price competition will drive prices downwards…

… and can be reframed in the CLD as:

the objective A influences B the need to facilitate price competition.

However, we note that the assumption AB requires us to somehow create the effect β intensity of price competition.

Similarly, we note for the same branch of the EC, the logic can be expressed as:

In order to have B, we must have D, because BD unbundling will ease market entry for competitors…

... and can be reframed in the CLD as:

B the need to facilitate price competition influences D the action to mandate unbundling.

Additionally, we note that the assumption BD requires us to acknowledge that unbundling creates the effect δ ease of market entry for competitors.

Bringing these notions together in the CLD, we have:

… the objective A influences B the need to facilitate price competition influences D the action of unbundling of infrastructure influences the effect δ ease of market entry for competitors influences the effect β intensity of price competition influences objective A.

In summary, our CLD represents how:

… the objective A influences the need B influences the action D influences the effect δ influences the effect β influences the objective A. … as loop B1, and …

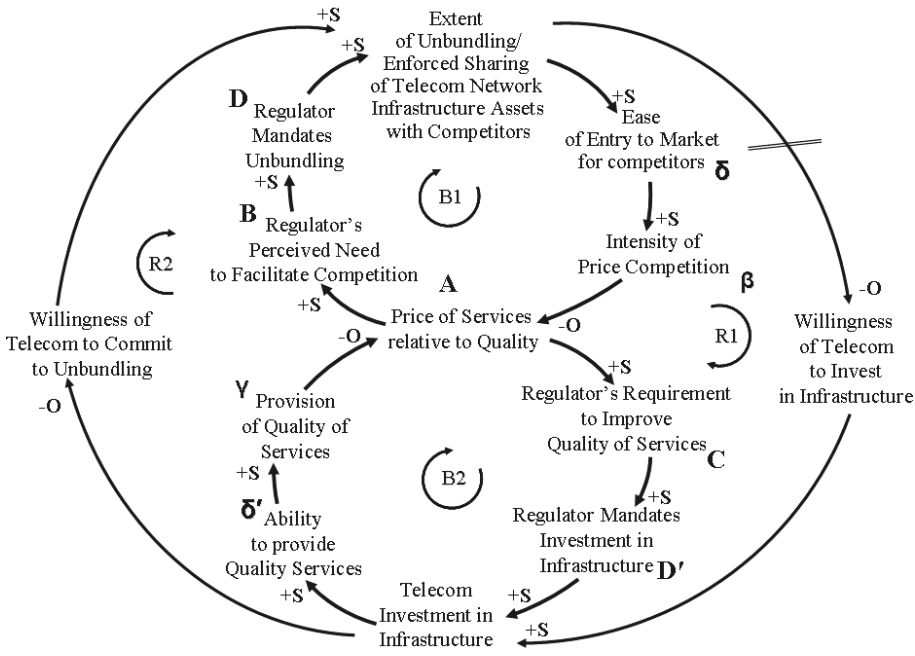
… the objective A influences C influences D′ influences δ′ influences γ influences A … as loop B2.

In examining the structure of the second CLD, we note the logical (and spatial) centrality of the overall objective variable A - the price of services relative to quality. We also note that the CLD embodies and displays the balancing or reinforcing nature of the constituent causal loops, appropriately annotated as B1 & B2, and R1 & R2.

For example, the CLD describes how each of the loops B1 & B2 show sequences of cause-effect relationships that 'start' with an initial unwanted state of price of services relative to quality increasing, and which drive Regulator needs and actions, and how each loop 'closes' with the price of services relative to quality decreasing. In illustration, we note for loop B2 of Figure 3 that:

> As the price of services relative to quality increases, the regulator's requirement to improve the quality of services grows stronger, driving up the regulator's desire to mandate investment in infrastructure, increasing Telecom investment in infrastructure, improving ability to provide quality services, leading to increased provision of quality of services, and finally driving down the price of services relative to quality.

Figure 3 - A second illustrative Causal Loop Diagram (CLD) for the unbundling case



We also recognize that our second CLD captures and displays the essence of the EC's necessity logic through a subset of individual cause-effect links, relationships and loops. For example, the outer reinforcing loop, incorporating R1 and R2, suggests how the Regulator actions D and D′ are in conflict, such that taking the action D works against taking the action D', that is, how:

> … the stronger D the mandate for unbundling, the greater the extent of unbundling, the lower the willingness of Telecom NZ to invest in infrastructure, the less the investment in infrastructure.

… that is, the greater the undermining of D', the mandate for investment in infrastructure

The CLD suggests how the taking of either action D or D' may also lead to other consequences and side-effects which have the impact of undermining the effectiveness of each other, and consequently the overall objective. Here, we can show how, for instance,

> … the stronger D the mandate for unbundling (loop B1), the greater the extent of unbundling, leading to a lessening of willingness to invest in infrastructure (via loop R1), lowering the investment in infrastructure, adversely affecting the ability to provide quality services, lowering the quality of services (loop B2) - effectively jeopardising the prior requirement C to improve quality services - and undermining objective A.

That is, in the terminology of the EC, our dilemma is that although A necessitates C necessitates D', the alternative action D puts in jeopardy the requirement C to provide quality services thus undermining objective A.

Similarly,

> … the stronger D' the mandate to invest in infrastructure (loop B2), the greater the investment in infrastructure, reducing Telecom's willingness to commit to the unbundling strategy (loop R2), lessening the extent of unbundling, undermining the ease of entry to market of competitors, lowering the intensity of price competition (loop B1) - which reflected the need B to facilitate competition - and once again undermining objective A.

That is, again, in terms of the EC, whilst A necessitates the need B necessitates D, the alternative D' puts in jeopardy the perceived need B to mandate unbundling, thus undermining objective A.

The CLD thus provides a basis for better understanding the nature, extent and reasons for the chronic conflict often identified by the EC conflict resolution process and the EC representation, which conflict is often responsible for the see-sawing and pendulum swings from one 'preferred' action to the other as each may falter in turn. It thus draws our attention to the need to mitigate or remove the undesirable side-effects of alternative actions. In addition, it draws our attention to the need to strengthen the likelihood that the intended and desirable effects will occur and that they are not put at risk.

We note that these systemic structures and effects or emergent properties of the system are redolent of the characteristics of Senge's Shifting the Burden (STB) archetype, where the Quick Fix undermines our ability to execute an alternative Longer Term Fix. Indeed, our CLD can be viewed as an example of a modified version of Senge's STB archetype, where each alternative Fix has the capability to undermine the effectiveness of the other in chronic conflict unless the dilemma is recognized and addressed.

We therefore suggest there is promise of being able to enhance understanding of the inherent dilemma facing the telecommunications regulator through mutually informing use of CLDs and the EC process of TOC. We further suggest that such transfer of insight from a CLD representation to the conflict resolution process is more likely given an awareness of commonly occurring systemic structures or archetypes described by Senge (2006). Indeed, we agree with Wolstenholme (2004) that such archetypes can provide an improved basis for recognizing any equivalent systemic structures embedded within the chronic conflict situations and dilemmas identified and described by TOC practitioners using the EC conflict resolution process.

■ Discussion and conclusions

We now draw together the various elements that have been laid out, detailing how the different tools/approaches have been harnessed and applied to the Telecom NZ Unbundling situation; offering comment and insight on the nature of issues within the telecommunications sector; and how they may be addressed by the regulator. We note, for example, that the CLDs, shown in Figures 1 and 3, capture and communicate the

interconnectedness and interdependence implicit in the situation much more readily than the narrative of say, the second section. In doing so, they can help build an understanding of the systemic nature of relationships, not only highlighting the dynamic time-based nature of feedback, the existence of balancing (B) and reinforcing (R) feedback loops, delays and side-effects; but also distinguishing between individual (say, Regulator or Telecom) and systems behavior, between seemingly predictable individual behavior and local outcomes, and the systems behavior that may be expressed as the unpredictable or unanticipated 'emergent' properties of the system.

We find that construction of the CLD draws attention to particular patterns of behavior that arise from the interdependent and systemic structure of relationships. We may note that positive reinforcing loops (R) can lead to virtuous or vicious cycles of escalating individual behavior (that of the Regulator or Telecom), and/or to outcomes that either get better and better, or persistently deteriorate over time. Additionally, we may gain recognition of how such individual or system behavior can lead to unintended, unanticipated, unwanted, yet often patterned and predictable outcomes or consequences – and therefore, how alternative actions may be more appropriately evaluated.

Regulatory dynamics

Interpreting the CLD of Figure 3, we note how Regulator intervention that leads to the unbundling or sharing of Telecom NZ asset infrastructure may reduce Telecom NZ prices in the short term, in keeping with the system goals - as shown in the balancing or negative-feedback loop B1. However, the sequence of behaviors and effects that play out in the longer term, shown, for example, via the extended feedback loop R1, may lead to a lowering of Telecom's willingness to invest in the infrastructure necessary to provide and maintain the quality services also necessary to meet system goals. As an aside, we would suggest that any rationale for Telecom NZ's willingness or unwillingness to invest would be likely mirrored in the behavior of its telecommunications competitors in due course, although this is not shown in the CLD which has not been extended to include other industry players or competitors. Similarly, we note that Regulator intervention that promotes and leads to greater investment in infrastructure may improve quality in the short/medium term, but would likely lead to a lowering of Telecom NZ's willingness to commit to unbundling, that is, enforced sharing of assets, in the longer term.

The CLD can thus generate and communicate insight about the nature, extent and reasons for the chronic conflict often initially identified using the EC approach, and how that conflict is often responsible for pendulum swings from one 'preferred' action to the other as each is undermined or falters in turn, even though the pendulum swings 'slowly' over the long term. Our attention is thus drawn to the need to mitigate or remove the undesirable side-effects of regulatory actions, and to the need to strengthen the likelihood that the intended and desirable effects expected to flow from the chosen actions will occur and to ensure they are not jeopardized. In the simplest of terms, we recognize the need to accentuate the positive, eliminate the negative and… avoid the temptation to oscillate from one action to another.

Methodological insights

Usually, a CLD is developed by a process of surfacing variables as contributory causes or consequential effects of existing entities, and then by building on and extending links in iterative fashion until a sense of systemic wholeness and understanding is achieved. Here, we developed the initial CLD (Figure 1) in this way, but subsequently, we used the EC process and its underpinning logic to provide a platform for the development of a more meaningful and comprehensive CLD that encompasses the system goal and the alternative actions available to the Regulator.

The CLD representations of entities and relationships, shown in Figures 1 and 3, are meant to be reflective of the perceived systemic reality of the situation facing the Regulator and Telecom NZ. The initial CLD (Figure 1), however, does not capture any perceived choice for intervention, other than unbundling - that is, it does not necessarily or explicitly present a choice dilemma of mutually exclusive options. Nevertheless, it does implicitly present action options for different modes and degrees of unbundling, and then maps the systemic consequences and interactions that emerge. Thus, whilst it may be claimed that identification of the core choice dilemma, which is the raison d'être for the EC, may be drawn from the initial CLD, we suggest that constructing the EC (See COX *et al*., 2005) demands that we identify the overall system goal and devote attention to other viable alternative actions, all of which can then be mapped to a CLD representation. In this case, the overall goal identified for our illustrative purpose was improving the price of services relative to quality.

We suggest that iterative and mutually informed construction of EC and CLD diagrams is possible and desirable. Additionally, we note that the assumptions embedded within the EC, and supporting the EC logic, can surface as intermediate entities - causes and effects - within a more comprehensive CLD. Similarly, entities introduced to the CLD for clarity and completeness, can also be usefully incorporated into the EC, forming part of the underpinning logic as intermediate actions or as explicit assumptions.

One of the seeming drawbacks of the EC is its apparent simplicity and parsimony in presentation. However, the basis for such parsimony must be understood in terms of the EC's logic protocols, especially so, if the EC is to be used to its fullest extent and/or used in complementary fashion with the CLD of SD. We foresee benefits in using CLD representations to better diagnose and understand the nature of chronic conflict, captured in EC representations, and to better understand how and why the taking of any one action can undermine our ability to enact an alternative, when both are necessary requirements for the overall objective to be satisfied. Such understanding is necessary to build lasting solutions when confronted by dilemma or conflict, and is especially so, with respect to regulatory intervention in the telecommunications industry.

Our experience in using the EC process to guide development of CLD representations, and then using managerial insights from the EC to inform the development of insights from the CLD, has been, in the main, beneficial. Similarly, benefits have arisen from knowledge and recognition of systems archetypes, not only in the development of CLDs, and understanding systemic structure, but in taking insights from the CLD to better understand the regulatory dilemma. In particular, the role of the CLD and EC as communication devices cannot be understated. Indeed, our CLD representation not only captures an understanding of the inherent dilemma about unbundling faced by the telecommunications regulator, but also facilitates the development and communication of insights – especially those that relate to the need to mitigate the undesirable side-effects of unbundling and/or any other alternative actions, the need to deal with moral hazards, the threats to desired outcomes, as well as the need to ensure that intended effects eventuate.

Epilogue

The 2006 unbundling decision led to increased competition (at least three companies have committed to invest in unbundled exchanges), but resulted in Telecom claiming that it could justify investing only $500 million of the estimated $1500 million required to deliver the network envisaged in the government's Digital Strategy. Following months of Ministerial brokering and a revision upwards of the prices for unbundled loops initially proposed by the Regulator, in October 2007, Telecom announced that it would invest $1400 million over the next five years to bring services of at least 20Mbps to all exchanges serving more than 500 lines (HOWELL, 2007). However, it would appear that Telecom's commitment has been insufficient to meet the government's estimated investment wishes. In the May 2008 Budget, the government committed an additional $350 million for investment in telecommunications infrastructure, and as a general election approaches, the opposition National party has pledged to spend $1.5 billion on a new fibre-to-the-home network. As predicted, the systemic interconnectedness of the unbundling and investment subloops as depicted in our analysis has resulted in inevitable downstream consequences, which will in turn impact upon the relevance of the unbundling decisions. For example, new entrants with assets already installed in Telecom exchanges are claiming Telecom's investment will result in the bypassing of these exchanges and the stranding of their assets.

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