Modelling Scale and Scope in the Telecommunications Industry:
Problems in the Analysis of Competition and Innovation (*)

Alain BOURDEAU de FONTENAY
Columbia University Institute for Tele-Information (CITI), New York

Jonathan LIEBENAU
London School of Economics and Columbia University, New York

Abstract: A theory of scale and scope that takes into account the endogenous nature of technology and the contextual manner in which systems architecture and functionality are shaped by market structures requires an alternative approach to modelling and analysis. Following on from "A new view of scale and scope in the telecommunications industry; implications for competition and innovation" (BOURDEAU *et al.*, 2005) , we apply the concepts of embeddedness, integration and competition to show how the current models can be improved. We also show how the many-layered "network of networks" can be evaluated.
Key words: scale and scope; modelling; innovation and competition

■ Introduction: the problem of modelling scale and scope

Regulators, business strategists and industry analysts face major challenges in trying to understand the structural transformations that the telecommunications industry is undergoing. One major inhibitor to our ability to conceptualize an industry structure differing from current forms is that we generally start with inappropriate assumptions about how to model scale and scope for network industries. An alternative approach to analyzing scale and scope will provide us with the means not only of understanding the status of alternative structures, it will also allow us to see how the dynamic characteristics of such transformations can emerge.

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Our approach entails a reconsideration of firm structures in a dynamic market context (e.g., STIGLER, 1951; CHANDLER, 1990; WILLIAMSON, 1985; and YANG, 2001) and addresses the static-technology models that characterize neoclassical analysis (ARMSTRONG, 2002; WOROCH 2002). By starting from a dynamic market framework, we can demonstrate that scale and scope economies of the kind that can generate substantial market growth and profit opportunities today operate on a network of networks level, rather than at a firm level. Furthermore, the "network of networks" structure is many layered, which means that economies need to be evaluated at the level of individual activities – not "end to end" vertical services. Consequently, the legacy structure of the incumbents, characterised most notably by their vertical and horizontal integration, serves as both a handicap and an opportunity to their greater profitability. Their structure, and the technology they developed to support their business form, protects legacy markets by constituting entry barriers, but that structure also handicaps incumbents from responding fully to market signals, investing efficiently and, ultimately, sustaining their competitive advantage.

■ The problem of data

The most concrete (and often only) data available are the data that describe the incumbent's performance. Those data at the aggregate level do not reflect competitive market forces, except to the limited extent that incumbents' stock shares are publicly traded in the economy-wide capital market. Therefore such data do not offer an understanding of the competition problem and the dimension of the challenges actually faced by incumbents and entrants alike. Even if costs data are adjusted through cost allocation formulae, these methods are at bottom arbitrary and without any direct link to what firms could be expected to do when confronted by competitors. The problem this creates can be illustrated by Gould's 1889 monopolization of the all the railroad facilities in Saint Louis, Missouri (LIPSKY & SIDAK, 1999). Through this action, all market signals about the relative value of the various bridges, stations, etc. disappeared. Information about the efficient use of assets in a monopoly-dominated environment is similarly difficult to come by. While there have been occasional small steps to recognize and correct some of these problems (see SIDAK & SPULBER, 1997), most are grossly inadequate, if not misleading (ECONOMIDES,

1997) [1]. Much more significantly, none of the attempts reflect the proper characteristics of incompletely developed markets, yet the existence of a competitive market that is unaffected by any one firm's decision to integrate vertically is set out by COASE (1937) and WILLIAMSON (1985) as a prerequisite [2]. The fundamental problem appears to have been acknowledged by Spulber when he developed the "market determined" ECPR [M-ECPR] access pricing method.

The distortion of economic analysis by inadequate data has myriad ramifications. For example, FUSS & WAVERMAN'S (2002) work implies that it is impossible for an entrant to recover its fixed cost from the incumbent's technology unless it is duplicating the entire range of outputs the incumbent produces. This means that cost-based pricing methods that do not look at alternative technologies will be biased in favour of the legacy technology. Cost-based pricing approaches such as ECPR accept the legacy cost structure as efficient and free of entry barriers. Once the basic problems of these approaches are understood, it is not unreasonable to argue that prices so derived exceed the market value that would emerge as competition becomes established [3].

The inadequate data problem is much more than a problem for regulatory debates, although many of these debates have important outcomes for the players and policy. It is, moreover, a fundamental challenge to the internal management of incumbents and would-be entrants alike. Without an ability to know more about how to efficiently deploy assets to best meet evolving markets, there is an unusually high degree of risk attached to making business decisions. Useful thinking about what competition might look like can be accomplished using our estimation. To achieve this successfully primarily relies on using the limited historical experience we have had with

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1 SIDAK & SPULBER (1997, p. 371) do consider the social opportunity cost, but only when regulation is perfect. At that point, the opportunity cost tha incumbents would receive for foregoing a downstream customer is zero and "efficient component pricing rule" [ECPR] reduces to LRIC. They do not consider how the private opportunity cost deviates from the social opportunity cost at other regulated prices in the form of a private rent for the incumbent.

2 WILLIAMSON (1976) illustrates what a player with market power may be able to do and how neglecting the competitive assumptions can produce totally different results. His analysis helps to highlight the contrast between his competitive model and a model where a player has market power.

3 TELRIC ("total element long run incremental cost") represents a conceptual step toward correcting cost-based pricing from this inherent "monopoly-centric" bias (MANDY & SHARKEY, 2003).

elements of competition and carefully extrapolating from them [4]. It also implies integrating into one's model assumptions that have at least some market basis.

■ Modelling

In building useful models, we believe it is important to begin with an understanding of policy changes to competition and why it is both responsive to, and itself represents an instrument for changing the technology and industry structure environment.

We have previously discussed how scale and scope economies have been misunderstood and how that misunderstanding has clouded over a realistic picture of what is happening in today's telecommunications marketplace (BOURDEAU de FONTENAY *et al*. 2005). At the same time, an accurate understanding of scale and scope economies at work in the sector is critical to industry members, potential investors and policy makers who must navigate today's uncharted waters. To be useful for this purpose, scale and scope measurements must be considered at both a sector level and the level of the individual firm, although properly applied economic analysis casts strong doubts about there being efficiency characteristics to most currently alleged economies. Measurements at the product (or function) level can also be important, because they define the parameters of technology givens.

At the sector level, we have observed that a government-acquiesced monopoly is not compatible with the common neoclassical hypothesis of an exogenous technology that constrains the monopoly's decision-making ability. Effectively, the technology hypothesis is currently being improperly used with, as a consequence, the perception that the technology restricts the incumbents' degree of liberty when, in fact, it is the reverse that holds. Therefore, observed legacy scale and scope does not inform us about what competitive efficiency may be like other than highlighting the complexity that is involved in a transition process from legacy to competition. The

[4] For the policy maker, there is the Schumpeterian model that all works out in the end - but it may take a very long time to work itself out. That model is of little use to the businessperson. Besides, the approach implied by STIGLER (1951) and CHANDLER (1990) should be more efficient once the time dimension and its associated cost are taken into account.

incumbent's scale economies are of no forward looking value to the policy planner implementing open entry.

Telecommunication systems almost always exist as layers within networks of networks [5]. In addition, they often tend to be interconnected. In every dimension they are complex systems. For instance, at the access level, an IP or ATM layer may overlay a DSL layer, itself layered over the construction layer of the infrastructure. Even the infrastructure layer is typically layered on more basic layers like poles or conduits that are built along city streets, country roads and railways.

Although it is rarely modelled in this way, economies of scale and scope can be assessed at any of these levels and even among them. Properly assessing them can help us to understand the cost advantages and disadvantages in structures, such as between BT and Kingston Communications, or the internet compared with centralized networking. Ultimately, such investigations help us to discern the critical trade-off points between markets and organization that Coase described in his theory of the firm (COASE, 1988). That knowledge can in turn better enable planners to recognize the potential in and for markets, as well as for optimizing asset use.

It is also necessary to translate the implications for modelling and planning so that appropriate benchmarks can be applied to assess changes in efficacy of network layers. For an existing firm, over a short period it can be hard to adjust production processes, especially those having significant fixed and sunk costs. In such circumstances short run economies of scale and scope can be relatively high [6]. Similarly, a change in the output

[5] PUPILLO & CONTE (1998) is the only econometric study to date that has taken a credible step toward lookings at activity and layer-specific economies of scale and scope.

[6] Properly, we should speak of returns to a set of factos that are changed in a fixed proportion, while the remaining factors are held constant. It is a basic result of classical economics that, eventually, those factors that are increased 'to scale' will exhibit diminishing returns to scale. In many situations, say, the local loop, those diminishing returns are rarely reached before the telephone company increases capacity. The same is true of most industrial processes since few things are as harmful to a firm as not being able to satisfy demand and prices can rarely be changed, even in a competitive sector, as flexibly as presumed in theoretical neoclassical models. It follows that in most industrial processes, and especially in telecommunications, the fixed costs or inputs that cannot be changed in the short run do not act as a constraint, since they are available in excess capacity (CAVES & BARTON, 1990). For such reasons, in spite of the eventual diminishing returns to a subset of inputs, telecommunications firms commonly operate where there are indeed substantial increasing returns to variable factors. This factor is rarely considered in policy debates, where most assertions about scale economies do not even consider the long-run and only refer to situations where a subset of inputs are held constant.

measure, from time-based circuit usage to "always on" access, for example, will have a significant and often hard to predict impact on economies of scale and scope, even although nothing is changed in the technology itself. Still, established firms often need to change in response to changing market conditions. Frequently it is changing scale and scope opportunities made possible by technology or competitive innovation that pressure such moves.

Sunk costs and monopoly legacy may be the cause of apparent economies within an existing structure, but they may not relate to true economic efficiencies that benefit the firm (or society). Instead, these factors may have both inefficiency consequences and anticompetitive consequences.

The example of the numbering plan invention can again be used to illustrate this point. Once trunking was placed under the control of a ubiquitous monopoly service provider, the manufacture of specialized equipment became possible that might not otherwise have been developed under open market conditions.

In the American networking environment, one might think of a class 4 switch that routes large amounts of traffic across regions to a small set of assigned points. Economists recognize that specialized equipment can reduce the time of producing a unit of output, but the set-up time required for such specialized equipment can be high [7]. Therefore, small firms, and those operating in a competitive environment, might instead choose to use more general-purpose equipment "off the shelf." Such a decision may make the most sense in a market environment where costs are constantly challenged. The class 4 switch represents a large commitment of "sunk" resources that may make it harder to introduce innovation, but which does provide a substantial advantage for a limited set of functions.

It is probably inefficient as a technology when compared to distributed processing, and it may well constitute a barrier to entry, although improved efficiency resulted by some measures. Regardless of the choices made, the normal systems model poorly informs operators about the efficiency of their investments.

We talk of short-run economies of scale to specify those assertions found in literature, in reports published by operators and in regulatory decisions.

[7] See virtually any text on industrial organization, such as WALDMAN & JENSEN (2000): Industrial Organization, Addison-Wesley.

Whether the incumbent's net short-run costs, i.e., the sum of all (implicit and explicit) namely, the short-run costs, are negative or positive, the entrants' corresponding short-run costs are unlikely to be negative, hence producing a net benefit. The incumbent's net direct costs are always negative. As far as incumbents are concerned, it is futile to compute meaningful implicit short-run costs from accounting data. That does not mean that the situation is hopeless. Those costs relate primarily to factors such as the incumbent's obligation to provide certain services, universal service etc. ARMSTRONG (2000) provides a partial list of these costs, as well as the costs born by incumbents. If the total cost, i.e., the sum of the direct and indirect costs, is higher than it would be under some alternative organization, then it is reasonable to argue that the incumbent, in the light of its fiducial obligations to its owner, would choose the alternative organization. An alternative organization would consist in some divestiture of those elements of the business that are the source of losses. The advantage of such a divestiture is its ability to provide an improved estimate of the incumbent's local costs. If we assume that the regulator has no intention of making the local loop financially unviable, it is rational to conclude that the regulator will act on the revealed cost of the local bottleneck and impose reasonable access tariffs without concerns about crosssubsidization. This scenario implies that the benefits the incumbent derives from the existing organization are superior to those derived from a divestiture, i.e., that the incumbent is able to derive a rent from the service obligations. That rent was probably in the form of influencing public authorities to set access conditions that would make competitive entry less likely. If this were not the case, the kinds of arguments found in the literature or in such places as Justice Breyer's dissents would make it a fiduciary obligation for incumbents to seek such a divestiture. One of the authors was asked informally as a member of a team of experts to prepare a proposal for an overseas incumbent to evaluate whether the latter would not be better off divesting of its local networks in light of what it saw as new and exceptionally extreme regulated access pricing conditions. Within weeks that incumbent changed its mind (not its public relations campaign). It never divested itself of its local network. Similarly, a few years ago BT made a proposal to divest its local facilities. After having received two offers within a very short time, it pulled out of this project and is still vertically integrated. In all of these situations and in many others, had service obligations not been a cost, those incumbents would have had the opportunity to reveal their implicit losses by placing the source of those losses on the market and thus revealing the actual size of those so-called losses. On the contrary, it is probable that an increase in their fixed costs, including an increase in uncertainties, can only undermine new entrants' chance of success. From that perspective, what we observed beginning in 2001 with the fall of competitor after competitor is hardly surprising. Moreover, the correspondence between economies of scale and the high entry cost is generally taken for granted by economists (WOROCH, 2002) and some regulators (e.g. POWELL, 2001) as an efficient outcome, yet there is no logical basis for such a conclusion.

The competitive failure that comes about when investors are reluctant to accede to entrants' non-recurring costs is clearly a benefit to the incumbent (DAWSON, 2002). However, this benefit is likely to be short run since innovations that might have assisted incumbents to better anticipate and react to market changes are eliminated (HORAN, 2002). Entrants who anticipate this will be far better informed about effective entry conditions and thus far more dangerous.

■ Firm-based economics versus practices

In an interconnected networking economy, the firm's production structure becomes disconnected from its output [8]. Firms correspond to piece-parts of the overarching greater network web and are no longer entirely self-sufficient. This is a feature of the emerging informatics governance structure. In even a simplified model such as the one studied by SENGUPTA (2001) [9], economies of scale and scope have been shown to depend upon the system's governance and its institutions. Observed "ex post" economies of scale and scope include the inefficiencies that are integral to its governance structure. Consequently, one must start the study of economies of scale and scope at a level where there is some reasonable hope of isolating engineering and organizational dimensions from other factors, say, agency problems due to information asymmetries. This can only be done at both the most elementary levels, i.e., at individual layers within the operator's production process (reduced to reasonable geographic areas to address horizontal integration concerns) and at the complete system level. Literature on telecommunications economics generally does not get to these levels. We must also incorporate the time dimension required of useful analysis, that is, the need to recognize and accommodate short run and long run cost differences. We know that short-run pricing does not provide a stable long-term solution since it needs to cover only variable costs. In the case of a sector where costs are largely fixed, whether the economies of scale and scope properly reflect the long-run is quite relevant and generally has not been subjected to much scrutiny.

A further dimension that needs to be taken into account is the process of output. Here the specification becomes hard to interpret where scale and scope are dealt with at the network level. Since the time of Marshall, the analysis of economies is typically presented in the context of a plant, i.e., a geographically constrained place with a small number of discreet functions that can be modelled as a black box with fixed inputs and outputs. However,

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8 See, for example, GULATI, LAWRENCE & PURANAM (forthcoming).

9 While Sengupta's analysis is used to study a very different environment, he is studying a complex and fully interconnected network. Individual agent's opportunistic behaviour is an integral dimension of his analysis and the extrapolation to, for example, a telecommunication network appears to be straightforward. His analysis covers most of the issues addressed in the economic analysis of networks, including the issues of network externalities. Evidently, his scope is much broader since he also studies the institutions and their evolution. His analysis is also interesting because, both at the activity level and at the level of the complete network, it is characterized by very large economies of scale with very large inter-firm dependence.

a product only becomes a commodity and subject to analysis once it is traded. The problem is far greater in the monopoly environment where many activities are not subject to trade. This can be illustrated by the local loop. One could consider the output in terms of a capacity measure or a usage measure or, still, many other ways. In this situation, one output measure, such as the number of calls as in Australia, implies a very different form of scale and scope analysis from an output measure such as the flat rate charge for the line used in New Zealand. In addition, calls and usage become, at a minimum, customer-specific, with the need to specify both origination and termination. A local loop situated in a city such as Wellington, New Zealand will also have different characteristics from one situated in, say, Montpellier in France because the characteristics of the soil, the way the cities are laid out, the way people live, etc. In practice, those characteristics are averaged and typically treated as differences in efficiency [10].

The unique nature of a telecom incumbent's integration warrants a careful analysis of its key determinants and how those determinants affect the balance between efficiencies and inefficiencies. GASMI *et al.* (2002) show that, under information asymmetries, a profit-maximizing incumbent will automatically discriminate against competitors in making perfectly natural day-to-day decisions as basic as resource allocation. The initial question to ask then is, what determinants might affect our best guess of the efficiency's cost/benefit of vertical integration? This effectively leads us, after weighing all the determinants, to evaluate the possibility of inefficiency caused by the aggregation of functions within the incumbent firm's management structure.

The interpretation of vertical integration is sensitive to the environment within which it is observed. COASE (1988) and WILLIAMSON (1971, 1985) have shown how one could establish the efficiency of vertical integration in a competitive environment. A firm that integrates functions that are more efficiently produced by a market places itself at a cost disadvantage *vis-à-vis* its competitors. Correspondingly, properly integrating a function within a firm means that the function is not efficiently separable and exhibits scale or scope economies. As this does not easily lend itself to clear product or functional segmentation, it lacks the many intermediate markets that could be expected in a functionally competitive environment. Thus, there is little hope that meaningful discussion can be had of upstream and downstream

[10] Cost models, especially engineering-based cost models, attempt to address those factors.

markets and their technology – the starting point of most integration analysis. ARMSTRONG (2002) considers another possibility, namely, a monopoly that does not produce an intermediate good, i.e., whose production process is not separable, or, equivalently, that is not vertically integrated. Armstrong assumes also that the monopoly is able to produce an intermediate good at a cost (to compensate for the lack of separability) [11]. Under those circumstances, the entrant has to be sufficiently innovative to be able to compensate for the incumbent's cost for producing the intermediate good. In addition, because there is no intermediate goods market it would have limited or no ability to extract rent from its innovation. ARMSTRONG's model is commonly found in the literature that considers the (dis)incentive of incumbents to invest when unbundling is mandated (HARRIS & KRAFT, 1997; JORDE, SIDAK & TEECE, 2000; QUIGLEY, 2004) [12]. The model's construction and the assumption that the unbundling rate is too low result tautologically in the incumbent's disincentive to invest. In those models, the assumption that the vertically integrated incumbent would base its investment decision exclusively on the aggregate returns of the integrated upstream and downstream activities is inconsistent with its profit maximization. The incumbent has to consider the probability of a more efficient downstream provider who would take advantage of such greater efficiency (STIGLER, 1951). A former Hewlett-Packard CEO illustrates this process:

> "We used to bend all the sheet metal, mould every plastic part that went into our products. We don't do those things anymore, but somebody else is doing them for us." [13]

If incumbents do not follow that path, then they are not subject to competitive discipline in a meaningful way. If this is not the case, then an incumbent's actions, such as investment and resource allocation decisions, may not be efficient for society or its shareholders.

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[11] While Armstrong lists a number of potential market failures that can be expected to affect consumers, entrants, and the monopoly incumbent respectively, he models only the gross cost impact of universal service on incumbents.

[12] JORDE, SIDAK & TEECE (2000) state that "[m]andatory unbundling decreases an ILEC's incentive to invest in upgrading its existing facilities by reducing the ex ante payoffs of such investment… It makes no economic sense for the ILECs to invest in technologies that lower its own marginal costs, so long as competitors can achieve the identical cost savings by regulatory fiat" (p. 8). Their approach implies that there is no way for incumbents to differentiate between the return on upstream and downstream activities. Yet, it is interesting to note that their results are only based on assertions about TELRIC being too low that they have not established and that cannot be established.

[13] Quoted from BESANKO, DRANOVE & SHANLEY (2000), p. 109.

The task of identifying conditions that may help decide, in a particular setting, whether the integration of functions is efficient is most usually based on game theory. While game theory is ideal to study comparatively static environments that can be differentiated by their level and form of vertical integration, the telecommunication sector raises unique challenges. Of all of them, perhaps the most basic challenge is the lack of experience with competition, hence the problems associated with establishing a benchmark. The problem requires some attempt to identify the issues inherent in transitioning from monopoly to competition and constructing a transition path.

Incumbents and policy makers tend to emphasize sunk costs in the implementation of competition. Insofar as competition takes place through the duplication of facilities, then the problem is a real one. While we do not know enough, at the most basic level, it may well be that we are going through what Justice BREYER (1979, 2004) saw as a major policy concern, the wasteful duplication of facilities [14]. The danger of wasteful duplication of facilities was addressed to some extent when Congress forced U.S. telephone companies to provide cable operators with access to the telecommunication zone of poles and, later, to ducts and conduits. Those conditions have been extended to some extent to new entrants.The economies of scale and the sunk costs dimensions of this form of real estate are real. While CAVE *et al.* (2002) acknowledge Spulber's conclusion that sunk costs are probably relatively low, they also acknowledge examples by Woroch that would suggest economies of scale and sunk costs in parts of the local network. They consider that the low sunk costs, if real, stop at the local loop.

In practice, we argue that discussions of economies of scale and of sunk costs have little meaning as long as what they relate to has not been clearly specified. In CAVE *et al.* (2002), such discussions always relate to wireline telephone companies as we still know them. The same is true for Spulber and Woroch. With such an aggregation of heterogeneous activities, concepts such as scale and sunk costs can only be ex post concepts that have no policy or business relevance. Once we look at activities such as, say, conduits or cables or switches, we observe significant scale economies and significant sunk costs that are restricted to small geographical areas, say, sections of Newark, NJ or of Montpellier, France or Wellington, NZ.

[14] See BOURDEAU de FONTENAY & LIEBENAU (forthcoming).

Those economies of scale and sunk costs do not relate to the incumbent telephone companies we observe today.

When we look at higher layers, the layer of interconnected networks, we observe large economies of scale at the aggregate level, i.e., at the network of networks. However, once more those economies are unrelated to any individual operator. Whether those individual networks are large or small has little to do with economies of scale and with sunk costs. The only economies of scale that are relevant are the economies of scale that all networks are able to achieve when they are interconnected into a network of networks. Similarly, the sunk costs are related to limited geographical areas, neighbourhoods in cities, and the extent to which they are actually "sunk," i.e., not recoverable is questionable. Individuals in any of those neighbourhoods would still have the same demand for telecommunications services, i.e., there would be entrepreneurs willing to take over those facilities to continue offer those services. This may not be done at the price existing incumbents may like, but this may reflect nothing more than, for example, increased efficiency in the use of rights of ways, conduits, and poles. Telephone companies as monopolies created artificial costs by refusing to share conduits or ducts, while new entrants have been efficient at making use of existing rights of ways such as sewage systems, canals, and subways. So, we can see that in these cases, the problem of sunk costs is largely fictitious. It mostly reflects the organization incumbents have chosen for themselves, organizations that have fought against vertical and horizontal disintegration, hence against what appears to be normal long term trends (STIGLER, 1951; CHRISTENSEN, 1997; BOURDEAU de FONTENAY & HOGGENDORN, 2005).

■ Innovation

The telecommunications environment exhibits an extraordinarily high degree of innovation and capturing that innovation potential has been from the outset a primary purpose of the change of policy from monopoly to open entry. Innovation certainly poses potential threats to existing markets. At the same time, it offers greater growth and profit potential, and stimulates differing views.

From the monopoly-centric vantage point, innovation appears particularly focused on lowering costs to improve profits. HDSL (high-speed digital

subscriber line) is an example. HDSL implementation happened to be largely transparent to customers and it increased profitability. HDSL did not contribute to the expansion of the private line segment, as retail prices were largely maintained. Its primary contribution was to lowering the cost of procuring private lines, hence increasing incumbents' profits.

From the competitive-centric vantage point, innovation primarily seeks new market opportunity. Deployment of ADSL and SDSL are cases in point. At the same time, combined with unbundling, those technologies created an immediate threat to incumbents in the form of cannibalization of private lines' revenue. A legacy monopoly that is not a natural monopoly can be expected to be susceptible to innovation. This can be illustrated by operations and support systems (OSS) development. New entrants did not want to carry the cost of the internal software development organizations incumbents use to build the huge network management systems and OSS (operating support systems) and BSS (business support systems) systems. Consequently, a market developed to serve entrants, resulting in dramatically lower costs. These systems are now modularized and built largely with off-the-shelf elements. Although incumbents have been slow to follow this trend in their core activities, it is not unusual to observe an arms-length subsidiary such as a long distance subsidiary subject to the challenges of competition, adopt such new technologies and reject the legacy systems.

Optimizing planning calls for a fuller understanding of innovation opportunities from all perspectives including cost savings, anticipating competitive challenges, new market opportunity, and managing transition markets. Economists have consistently argued that beyond traditional regulatory oversight, higher social welfare can be achieved in this sector through a credible threat of entry that pressures established players to be efficient. The credibility of that threat is a direct function of the cost of entry (TEECE, 1995), as well as the institutional costs of facilitating the innovation process, including improved cost management. In addition, that threat must identify and address the cost imposed by entry barriers [15]. Such an objective

[15] This is well illustrated by many experiences in telecommunications and not just by the regulator's often successful efforts to lower wholesale transaction costs by creating wholesale markets throughout the 1980s and 1990s. For instance, the videotext experience of the 1980s produced the same results. While videotext was introduced in such countries as Canada (Telidon), France (Teletel), Germany (Bildschirmtext), Japan (Captain), Sweden, the U.K., and the U.S., it was only in France that its deployment was successful. One of the key differences between France and all the other countries is that France was the only nation to provide information service providers a decentralized (i.e., not vertically integrated) public address on the X-25 network. All the others adopted a vertically integrated, centralized approach. Teletel's

is complex and costly to implement, but policy makers accept that challenge because of the common assessment that the welfare cost of continued monopoly in a dynamic environment is much more costly [16]. By the same token, the dynamic environment creates new challenges for existing players and existing markets, but it also creates new opportunities for growth and profit. The public policy purpose of achieving greater efficiency to benefit public welfare is mirrored by the opportunity and the need for existing players to become more efficient.

■ Conclusion: models of static monopolies do not apply to dynamic networks of networks

There are other activities in telecommunications that would seem to exhibit large economies of scale and scope that are not bounded geographically in the manner that construction and the maintenance of the network's physical layer is. One example is the perceived economies of scale and scope associated with network management. Such activities have historically been centralized within the operator and this is still the dominant situation for most incumbents. However, the emergence of competition has given some impetus to the division of labour, as Stigler implies with new markets developing allowing outsourcing of such functions (CRANDALL, 1988; FRANSMAN, 2002; Telstra and Telecom New Zealand's recent move to outsource some of the tasks associated with local service provision). It is the emergence of competition that gave rise to markets for such functions, although many are still vulnerable to fluctuations in demand despite the efficiency improvements being offered. Insofar as incumbents maintain their highly integrated structure, and entrants remain marginal, the market for such new services is small and most fragile. The traditional economic modelling of competitive telecommunications markets and performance has been biased by unexpressed and unchallenged assumptions concerning economies of scale and scope. Those assumptions are most likely false and thereby threaten a good deal of the analysis made by industry mangers and policy makers alike – the analysis specifically devoted to anticipating

entry cost was so low that a majority of the information service providers created their services and managed them on the Apple E computers. Some of those were exceptionally successful.

16 FCC Chairman Powell (2001) argues that "[s]uch an approach requires heavy regulation to protect against the anticompetitive and anti-consumer tendencies of a monopolist. And, it requires heavy government management of expenses, revenues and rates... Economic scale does matter and it does take a great deal of resources to deploy these networks...".

markets, assessing competitive challenges and determining pricing. It also has impact on a firm's organization and efficient use of assets or profit maximization. Analysis based upon the old policy and old industry structure model will be accurate only insofar as the old model is preserved and unchallenged by Schumpeter's "winds of destructive innovation." What is being missed is a better ability to recognize new market opportunities opened by the change of policy and a better way to prepare to prosper within a dynamic environment. There are tools that can be created for planning within this world. However, creating such tools cannot be done based on existing economic assessments of the sector. This involves seeking market benchmarks and helps us identify the levels at which economies of scale and scope actually operate in today's dynamic environment.

In the case of the local provision of telecommunication services, the activities to be considered would include activities such as rights-of-way, real estate and buildings, ducts, conduits and poles, switching, fibre optic and copper cable etc. Stigler shows that some of those activities are indeed characterized by large economies of scale and scope, activities such as ducts and conduits and poles, both in the construction and in the operational phases. However, those kinds of activities have no "telephony-specific" or "telecom-specific" characteristics, hence their economies of scale and scope, to be properly exploited, would need to be exploited across a much broader range of activities including, say, electricity and water [17]. There is a hint of Stigler's model in the sharing of poles by incumbent telephone companies and incumbent public utilities. However, poles were not treated as a profit maximizing activity commercially separate from other activities in the production chain, as demonstrated by the telephone companies' refusal to provide excess capacity on the poles' communication space when cable companies began to expand. In other words, incumbent operators have preferred to foster vertical integration over divesting such activities in order to achieve lower costs and it is left to governments to impose the obligation to share. Our approach to modelling explains this sort of competitive behaviour.

[17] Even where there are significant "sector-specific" constraints, as in the case of electricity, those need not prevent the sharing of facilities, for example, between telecommunications and electricity. In that case, a dominant case in the U.S., poles for the transport of electricity are used because, for safety and security concerns, they have to be higher. The poles are organized horizontally with, in the upper part of the poles, an electricity transport zone, under it, a "no man's land" that acts as a safety zone, and still below it a communication zone for all telecommunications needs. This type of arrangement would seem to be unique to North America, even though there is considerable pressure on a large number of municipalities around the world to share facilities, even at the construction stage.

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