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The Case of Telecommunications

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DISRUPTIVE ACTIVITY IN A REGULATED INDUSTRY: THE CASE OF TELECOMMUNICATIONS

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INVESTOR IN PEOPLE

This book is dedicated to Colin Blackman, the retiring editor of Emerald journal info, *for his sound advice over more than a decade.*

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List of Abbreviations

AGR	Adjusted gross revenue
ARPU	Average revenue per user
BEREC	Body of European Regulators for Electronic Communications
CDMA	Code division multiple access
CEO	Chief executive officer
CMA	Competition and Markets Authority
DiD	Difference in differences
DoJ	Department of Justice
DoT	Department of Telecommunications
EBIT/LBIT	Earnings/loss before interest and taxation
EC	European Commission
EU	European Union
FCC	Federal Communications Commission
GB	Gigabyte
GHz	Gigahertz
GSM	Global system for mobile
HAT	Hutchison Asia Telecommunications
HTIL	Hutchison Telecommunications International Ltd
IP	Internet protocol
IPO	Initial public offer
ISP	Internet service provider
ITU	International Telecommunication Union
IUC	Interconnection usage charge
LTE	Long-term Evolution
LTE-A	LTE-Advanced

M&A	Mergers and acquisitions
Mbps	Megabits per second
MMS	Mobile messaging service
mmWave	Millimetre wave
MNO	Mobile network operator
MHz	Megahertz
M2M	Machine-to-machine
NGN	Next generation network
NCLAT	National Company Law Appellate Tribunal
NCLT	National Company Law Tribunal
OTT	Over-the-top
QoS	Quality of service
RAN	Radio area network
SEB	Securities and Exchange Board
SDR	Strategic debt restructuring
SMP	Sgnificant market power
TDD	Time dimension duplex
TDSAT	Telecoms Disputes Settlement & Appelate Tribunal
TRAI	Telecom Regulatory Authority of India
UMTS	Universal mobile telecommunications system
VHA	Vodafone Hutchison Australia
VoIP	Voice over Internet Protocol
Wi-Fi	Wireless fidelity
WiMAX	Worldwide interoperability for microwave access
2G	Second-generation
3G	Third-generation
4G	Fourth-generation

About the Authors

Peter Curwen joined Sheffield Hallam University in 1970. He took early retirement in 2002 having risen to the post of Professor of Economics. He then took up the post of Visiting Professor of Mobile Communications, first at Strathclyde University and subsequently at the Newcastle Business School, finally retiring in 2017 to become a 'gentleman scholar'.

Jason Whalley joined Newcastle Business School in 2013 as Professor of Digital Economy, after a brief period as a consultant followed by more than a decade spent at Strathclyde University. His research focuses on the telecommunications industry. He has published on the development of broadband markets, the Internet of Things and the use of ICT in the Himalayas.

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Preface

This book has its origins in a series of articles written by Peter Curwen and Jason Whalley in the journal *info: The Journal of Policy, Regulation and Strategy for Telecommunications, Information and Media* published by Emerald that evolved into *Digital Policy, Regulation and Governance* from Volume 19 onwards commencing in January 2017. At the time, these articles were not written in order specifically to shed light on the issue of disruptive activity. However, it became apparent to the authors in early 2018 that disruption was a common theme that ran through a number of articles. A third author, Pierre Vialle, was also working with Jason Whalley on material that encompassed the theme of disruption and hence the idea was born of compiling a book about disruptive activity in the telecommunications industry.

There is nothing new about the concept of disruptive activity. Historically, a term that was used to describe a key aspect of the phenomenon was creative destruction – customarily associated with Joseph Schumpeter (Wikipedia, 2018) – whereby inefficient old ways of doing business would be displaced by newer, more efficient methods. Entire industries could be affected such as transport which was revolutionised by the arrival of the railways in the late nineteenth century and, more recently, the telecommunications industry which is the subject of this book. However, this book is not about how new technology has revolutionised the telecommunications industry; rather, it is about how disruptive companies have entered the industry – in this case, primarily the mobile sector – and thereby affected its structure and the treatment of customers.

In dealing with the effects of disruptive activity, a number of considerations have to be taken into account. In the first place, disruption largely takes place in a free market – in other words, it is essentially a scenario whereby a winner can acquire a potentially dominant share of the market while governments look on indulgently. However, there is not necessarily a single winner if a new technology cannot be protected by patents or where governments decide to intervene in order to prevent a monopoly. Hence, whereas in a free market the way is always open in principle for a new entrant to disrupt the market by challenging established players (incumbents) via improved technology and/or a more attractive model of service provision, this is not necessarily the case if there exist any market interferences that confer a degree of monopoly power.

In the telecommunications industry, creative destruction and disruptive activity are effectively uneasy bedfellows. On the one hand, a long-established technology – using fixed-wire connections – is increasingly usurped by one based

upon mobile connectivity while, on the other hand, the restrictions that limited competition in the former case are retained in the latter.

The mechanism that restricts competition in both cases is the issuance of licences by regulators that are ultimately agents of government. This mechanism is not limited to telecommunications – it applies to utilities of all kinds where public welfare considerations overrule the benefits of free competition. However, it is important to bear in mind that there is no requirement that public ownership is involved. Typically, telecommunications was originally provided – via fixed-wire links – by public corporations, but this was not the case in the USA and the privatisation of British Telecom (now BT) in the UK set off a wave of public-to-private transfers of ownership across Europe even if, initially, governments retained 'golden shares' to prevent an excess of free market zeal.

It is no doubt fair to argue that since the number of industries operating under largely free-market conditions – albeit probably with some controls applicable to antisocial side-effects (adverse externalities) – greatly outnumbered those that were tightly regulated via licences or some equivalent system of state control, the literature was bound to concentrate upon these industries. Nevertheless, the utilities alone comprise a significant share of a modern economy so the almost total absence of discussion about how to disrupt an industry where licensing is in force comes as something of a surprise.

This book attempts to address this omission. It does so essentially via a series of case studies on the basis that the issue is empirical rather than theoretical. The book is not so much interested in what might happen in a licensed industry but in what actually does happen insofar as this can be ascertained by a study of past and current experience. One major reason for this is that, in the case of telecommunications, the emphasis must be upon what has happened since it became possible to transfer data at high speed via mobile devices given that the fixed-wire links in most countries were traditionally provided by a state-owned monopoly.

In this respect, one key factor was the issuing of so-called '3G' licences in the period commencing in the year 2000. It took many years for these licences to be issued on a worldwide basis but the process was relatively quick among the more advanced economies. And then, in 2007, came the launch of Apple's iPhone which introduced a period during which an operator's ability to provide this handset became its main competitive advantage. Subsequently, high-speed packet access (HSPA) made it possible to access video and other services requiring higher-speed access and smartphones that were effectively mini computers became commonplace. But, inevitably, with every incumbent operator able to provide the same technology – albeit with some variations in coverage – and the same handsets and applications, the issue of how an operator could distinguish its service offering became paramount.

The book analyses the response in a wide range of countries but places most emphasis upon the main disruptors led by Hutchison Whampoa – now CK Hutchison – and the main countries such as France and India where disruption has occurred. As these case studies demonstrate, it is difficult to draw conclusions that encompass the entire industry since while it is true that disruption has invariably taken the form of price competition and the provision of non-standard

packages of services, no two countries are truly alike. For example, what is happening in India today – see Chapter 7 – has never happened previously anywhere else in the world.

This makes it almost impossible to construct a general theory of disruption in a regulated industry and this book does not attempt to do so. It should be noted in this regard that there is considerable controversy surrounding attempts to formulate such a theory even in the context of a free market – see Chapter 1 – let alone a regulated one, although the concluding chapter tries to pull together the various ideas that permeate the book. A second major issue is that the nature of service provision is undergoing something of a revolution. Whereas, historically, an operator largely confined itself to either fixed-wire or mobile provision, the trend is increasingly towards the provision of packages, particularly quad-play – see Chapter 5. Since the arrangements that operators need to make in order to do this are for now in a state of flux, it is too early to draw any definitive conclusions about the role of disruptive activity in the multi-play market.

The book is structured as follows. Chapter 1 brings together some of the literature concerning disruptive behaviour. This begins with an analysis of disruption in the free market, but there is only a limited review of the contributions to this debate as it has very limited relevance to what happens in a market regulated via licences. The chapter ends with the analysis presented by Ofcom in the UK which is the only body to have examined how disruption occurs in such a scenario. This underpins the content of Chapter 2.

Chapter 2 comprises a detailed analysis of the recent Ofcom document concerned with disruption in mobile markets with a view to establishing whether its conclusions were valid at the time of writing and whether recent developments need to be taken into account. The chapter goes on to identify the operators that have behaved in, and are currently operating in, a disruptive manner, as well as the countries in which disruption either has taken place or is currently taking place.

Chapter 3 is an extensive study of how new entry can be effected through the issue of mobile licences within the context of Europe, widely defined. It contains an extensive database compiled by the authors covering a lengthy time period. It concludes that new entrants have rarely succeeded in establishing themselves via the acquisition of new licences and that in the case of the most recent technology, long-term evolution (LTE), known alternatively as 4G, the authorities have largely ceased even to try.

Chapter 4 moves on to consider a different aspect of regulation, namely antitrust. In principle, disruptive activity can have its roots in the acquisition of an existing mobile incumbent – as against a licence – by a new entrant, particularly as the acquired incumbent is likely to have the smallest share of the market. Alternatively, one incumbent may seek to take over another or two incumbents may attempt to merge in order to build a market share comparable to their larger rivals. Whereas market structure is not directly affected by the former activity, takeovers and mergers clearly have structural implications. The chapter considers the situation in Europe – there is also an analysis of the USA in Chapter 5 – via a series of country case studies.

Chapter 5 picks up on the issue of multi-play – that is, a package containing some combination of fixed-wire and mobile access, high-speed broadband and TV. Until fairly recently, mobile, for example, was a specialised operation in the hands of a few large operators in each country. Equally, these operators tended not to own fixed-wire networks or to provide TV. However, as mobile has become increasingly the delivery of a very similar service, competition has switched to the provision of multi-play where there is far more flexibility in terms of the pricing of different packages. Hence, the potential for disruption is greatly increased.

Chapter 6 comprises a case study of the situation in France where there has recently been considerable disruptive activity by a company that entered the market on the back of an established reputation in other parts of the telecommunications sector.

Chapter 7 comprises a case study of India. This was for a considerable period a market with far too many operators, in good part due to its unusual policy of offering regional rather than national licences. With a number of large incumbents coexisting with what were effectively regional operators and some state ownership, it was difficult to envisage what could upset this uneasy equilibrium. And then Reliance Jio arrived on the scene. Starting from scratch, it set out to become the market leader by the simple, albeit highly unprofitable, method of offering free connectivity. Disruption does not come in a more brutal fashion than this.

Chapter 8 analyses the history of the 'great disruptor', the former Hutchison Whampoa now known as CK Hutchison. A significant difference between itself and Reliance Jio is that Hutchison sought to acquire market share primarily via the offer of lower prices than its rivals in multiple markets, whereas Reliance initially charged nothing at all in a single, albeit much larger market. As the study reveals, this was nevertheless not a profitable exercise, and much less market share was gained than had initially been expected, effectively causing Hutchison to examine and occasionally see through to completion the alternative strategy of mergers with rivals.

Chapter 9 serves to bring together the lessons learned from the preceding chapters. Because there are considerable differences between the operators and countries involved in the case studies, there is no attempt to produce a general theory of disruption in regulated markets, although that may emerge in due course as a result of further research.

It is worth noting, finally, that the contents of this book have been continuously updated up to the point at which the manuscript was submitted in December 2018. Many monographs rely upon data from years long past. However, the telecommunications industry is in a permanent state of flux and the authors have accordingly made it their business to present a picture of the industry only a matter of months prior to publication.

Reference

Wikipedia. (2018). *Creative destruction*. Retrieved from https://en.www.wikipedia.org/wiki/Creative_destruction. Accessed on July 16, 2018.

Chapter 1

Literature Review

Introduction

The purpose of this chapter is to bring together discussions in the literature that underpin the case studies that are examined in subsequent chapters. However, the chapter is not designed to be all-encompassing for one simple reason, namely that the literature specifically related to disruption was originally developed in the context of unregulated industries and has never been amended to take account of the possibility of regulation via a licencing regime.

What follows necessarily begins with a review of the literature concerning disruption in an unregulated context since, if nothing else, it has to be demonstrated why this has limited applicability for this book. This is divided into three parts that examine three significant contributions to the debate about disruption.

The final main section examines the issue of consolidation. Given that telecommunications provision is restricted via licences, it is not possible for a potential disruptor to enter the industry unless it either obtains an additional licence – which is more likely to occur if there is a new technology to be exploited – or takes over an existing operator that in the majority of cases has proved to be unsuccessful in challenging the main incumbents using essentially identical strategies.

The Christiansen Interpretation of Disruption

The main purpose of the theory of disruption is to explain why incumbent firms fail to respond appropriately when confronted with innovations introduced by new entrants. It provides a different perspective from previous contributions on the same topic, such as the notion of architectural innovation (Henderson & Clark, 1990), or the distinction between competence-destroying technologies and competence-enhancing technologies by Tushman and Anderson (1986).

The initial conceptualization of disruption theory was based on the PhD thesis of Christensen which was developed somewhat in Bower and Christensen (1995), Christensen and Bower (1996) and Christensen (1997). In Christensen and Raynor (2003), the theory was widened from technological to other types of innovation such as the business model and service innovation. The concept of 'new-market' disruption was also introduced in addition to 'low-end' disruption.

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However, discussion around the theory has resurfaced in more recent times, and hence what follows is based on the updated version of the theory presented in Christensen, Raynor, and McDonald (2015). The summary below sets out the key contents of that article. Their basic premise is that disruption theory's core concepts 'have been widely misunderstood and its basic tenets frequently misapplied'. Furthermore, disruption as a concept is used loosely to 'invoke the concept of innovation'. In effect, the concept of disruptive innovation is used to describe any situation in which 'an industry is shaken up and previously successful incumbents stumble.'

So what exactly is disruption? The answer provided is as follows:

- 'It describes a process whereby a smaller company with fewer resources is able to successfully challenge established incumbent businesses.'
- 'Specifically, as incumbents focus on improving their products and services for their most-demanding (and usually most profitable) customers, they exceed the needs of some segments and ignore the needs of others.'
- 'Entrants that prove disruptive begin by successfully targeting those overlooked segments, gaining a foothold by delivering more suitable functionality – frequently at a lower price.'
- 'Incumbents, chasing higher profitability in more-demanding segments, tend not to respond vigorously.'
- 'Entrants then move upmarket, delivering the performance that incumbents' mainstream customers require, while preserving the advantages that drove their early success.'
- 'When mainstream customers start adopting the entrants' offerings in volume, disruption has occurred.'

The authors provide certain clarifications as follows:

- Disruptive innovations get started in two overlooked markets – 'low-end footholds' and 'new-market footholds'.
- The incumbents' customers are not initially interested in new disruptive innovations because performance is lower on the dimensions such as quality of service (QoS), customer service and handset subsidies valued by them. However, if QoS becomes acceptable, the price stays low and/or their preferences change to value other dimensions, they switch provider.
- Disruption is a process. While it is going on, incumbents will defend their territory, yielding up first market share and later profitability.
- Following a disruptive path does not necessarily lead to great success, and not every successful newcomer follows a disruptive path.
- Incumbents need to react, but should not overreact by dismantling a still-profitable business; rather they should invest in sustaining innovations – making good products better.
- The theory of disruption predicts that if a new entrant offers better products or services, 'the incumbents will accelerate their innovations to defend their

business.' Either they will offer 'even better services or products at comparable prices, or one of them will acquire the entrant'.
- The theory predicts that entrants 'pursuing a sustaining strategy for a stand-alone business will face steep odds.'

It is of particular interest that the authors take the view that Uber does not fit the model because it did not start from a low end or new market and directly attacked the mainstream market with a high-quality offering. They explain the success of Uber by reference to the regulatory constraints that occur within the taxi industry. Where entry and prices are regulated, they note that incumbents have few ways to innovate.

Critiques of Christiansen

It is particularly important to note that the above argument is process-driven – it is concerned with how a particular outcome is achieved rather than with measurement of that outcome. Indeed, treatment of the entire issue of measurement is distinctly low-key. It would seem to be the case that disruption can only be said to have occurred when the new entrant is perceived by customers as a direct substitute for incumbents – in other words, it is itself seen as an incumbent – which could occur within a wide range of market shares gained by the disruptor.

The methodology underlying the Christensen theory has been extensively criticized. In particular, he has been accused of using 'hand-picked' case studies (Cohan, 2014; Lepore, 2014; Tellis, 2006). Cohan notes that the cases used are exclusively cases in which the disruptive technology does succeed, and that Christensen did not consider cases in which it failed. Lepore (2014) even appears to challenge the integrity of Christensen by accusing him of hand-picking case studies and also criticizes his analysis of these cases. She notes that the choice of the disk-drive industry, which Christensen himself describes as not comparable, makes an odd choice for an investigation aiming to design a model applicable to other industries. She also observes that the outcomes of its main case study could be considered differently by adopting a longer time frame.

Tellis (2006) is more moderate and claims that Christensen's sampling is acceptable for building a theory. Chesbrough (2001) states that the theory is focused more on internal validity than external validity, and that it may be context-dependent as all cases were located in the USA. Most empirical work has been in the form of well-documented and thorough case studies of particular industries, but the extent to which findings from these case studies can be generalized across industries has not been addressed. Weeks (2015) notes that anomalies identified in several cases by other authors have not been sufficiently addressed by Christensen. He also suggests that the perceived deficiencies of the theory may be caused by the fact that the main contributions have not been subject to an extensive peer review as they have been published in books or in the *Harvard Business Review* (HBR). Weeks (2015, p. 419) assumes that 'a more rigorous peer review of his methodology and of some of the disruptive innovation

concepts may have allowed Christensen to refine the exposition of his theory more thoroughly through the years.'

The reliance on analysing cases after the event raises the issue of the predictive power of the theory. In practice, Christensen made himself (in)famous for his poor predictions. For example, Christensen predicted that the iPhone would fail (McGregor, 2007) as it was a sustaining technology relative to Nokia. Lepore (2014) also relates that in March 2000 Christensen launched a 'Disruptive Growth Fund' for which stocks were selected according to his theory. The fund went on to perform less than the NASDAQ and was liquidated less than one year later. Weeks (2015) also questions the relevance of Christensen's analysis of digital photography and of his prescriptions for Kodak.

A more problematic issue is whether the theory actually accounts for the cases that Christensen himself has investigated, as several authors have come to different conclusions derived from the same cases. For example, on the disk-drive industry, which constitutes one of the key case studies on which Christensen based his theory development, McKendrick, Doner, and Haggard (2000) challenge the conclusion that most disruptive innovations have been introduced by new entrants and that incumbents mostly failed. Similarly, King and Tucci (2002) and Chesbrough (2003), analysing the same industry, found out that established incumbents were more likely to introduce innovations in new niche markets and also to exhibit a higher survival rate. King and Baatartogtokh (2015) reviewed 77 cases discussed by Christensen in his two books by interviewing experts on the industries concerned. They tested four key propositions of the disruption theory and found out that they were only partly verified. In 24 cases (31% of the total), leading incumbents were not following a trajectory of sustaining innovation. In 60 cases (78%), sustaining innovation was not outperforming the mainstream customers' expectations. In 30 cases (39%), incumbents did not have the capability to respond to the disruption threat. In 29 cases (38%), incumbents were not displaced. Overall, the four key propositions were verified in only 9% of the cases.

Weeks (2015) also highlights the lack of specification of the unit of analysis. He questions which unit of analysis the research is targeting. There are several choices including the technology (or innovation), the industry, the firm or firm leaders. He notes (pp. 421–422) that at various times, Christensen's work makes statements about each potential unit of analysis. He comments (p. 426) that 'if the unit of analysis is the firm, one might consider which firms are more likely to be able to introduce disruptive innovations….If the industry is the unit of analysis, one encounters other possible questions. Are certain industries more likely to survive disruptive innovations? What characteristics influence these outcomes: supplier networks; customer networks; rivalry; labor practices?'

Markides (2006) observes that the theory, initially designed for technologies, has been inappropriately widened to other types of innovations. 'A disruptive technological innovation is a fundamentally different phenomenon from a disruptive business model innovation as well as a disruptive product innovation: these innovations arise in different ways, have different competitive effects, and require different responses from incumbents.' He adds that 'To qualify as an

innovation, the new business model must enlarge the existing economic pie, either by attracting new customers into the market or by encouraging existing customers to consume more….It is important to note that business model innovators do not discover new products or services; they simply redefine what an existing product or service is and how it is provided to the customer.' In particular, a business model innovation does not usually end up by dominating the market for three reasons: (1) the new business model may not be superior to the incumbent's one; (2) the best incumbent's response is not necessarily to adopt the innovation and (3) if the incumbent adopts it, it is not necessarily better to create a separate unit for it.

Danneels (2004) also raises the time issue and wonders at what point of time an innovation can be characterized as disruptive: once it is marketed or only after it disrupts incumbents? This issue is developed further by Tellis (2006) who notes that it makes it difficult to identify ex ante which ones, among the multiple underperforming innovations on the market, may become disruptive.

It is significant that only a few articles relate disruption to external influences, and when they do, they do so without much explicit reference to regulation. In some cases the work is noted by others only in passing. Among the first category, Chesbrough (1999) found that, contrary to the USA experience, incumbents in the disk-drive industry in Japan have not been disrupted. He attributes this difference to country-specific factors such as regulations, culture and financing system. Weeks (2015) raises the issue of the possible characteristics that would make some industries more likely to be disrupted. Hagel, Brown, Wooll, and de Maar (2015) put more emphasis on the external context – market conditions, such as product characteristics, demand characteristics and industry structure; and catalysts, such as macroeconomic factors and public policy. King and Baatartogtokh (2015) found that in 40% of the 77 cases analysed by Christensen, changing economies of scale played a role in disruption as it reduced the number of players who could profitably serve the market.

Yu and Hang (2010) raise a number of issues about context and environment: the environmental determinants of disruptive innovation, the factors explaining why disruption happens in some countries rather than others, and the identification of emerging markets and of the needs of new customers. Urbinati, Chiaroni, Chiesa, Franzò, and Frattini (2018) highlight the relevance of context factors by analysing the case of Uber in four different cities in the world (although Uber is not considered as a disruptive innovation by Christensen). They suggest that the market concentration, the regulatory system, the offering diversification and the culture of a country can play a key role in explaining the different patterns observed. Corsi and Di Minin (2014) add a geographical dimension to the theory by relating disruptive innovation to the case of emerging economies.

A Telecommunications-based Critique

It is evident from the above that the line of argument pursued by Christensen has attracted a great deal of criticism. But that is in the context of unregulated

industries, and his work invites the following response in the specific context of telecommunications:

- There is no provision for a hugely well-resourced company such as CK Hutchison that chooses to pursue a disruptive strategy to gain a foothold in a new market while accepting massive losses in the short (and probably medium) term as the consequence of so doing – see Chapter 8.
- There is no provision for companies that can operate at a profit by obtaining from incumbents the ability to provide a similar product or service to that provided by the incumbents. In the case of telecommunications, this refers to 'virtual' operators – most importantly mobile virtual network operators (MVNOs) – that lease capacity from incumbents and use it to provide products and services under their own brand.
- The telecoms services on offer from incumbents and disruptors are largely homogeneous which is why so much emphasis is put on lower prices – as noted in Ofcom (2016) – as the sine qua non of proving the existence of disruptive activity.
- But if the disruption arises because of licencing a new generation of mobile technology (2G/3G/4G), there must be a case for download speeds to be added in as a factor.
- What exactly is a 'low-end customer'? In the case of mobile, is this one who is happy with 2G or 3G?
- How can a 'post-paid' customer be defined, given the emergence of SIM-only contracts?
- Is coverage also an issue because in many places – albeit a falling number – you get a much stronger signal from specific networks?
- Are there any 'new-market footholds'? Is this more to do with software than hardware? And do new application areas like machine-to-machine (M2M) or the Internet of Things fall within this definition?
- Are new entrants in mobile communications all proto-Ubers as discussed in the *HBR* paper, building a position in the mainstream market first of all then, looking for un-served segments of the market, and if so what are these segments?
- What is a sustaining innovation for a mobile incumbent?
- Can a regulator be considered as disruptive, given that regulators play a pivotal role in the telecommunications industry, shaping the market conditions that influence the level and speed of distribution?

As is evident from the above, mobile communications in particular does not fit the Christensen model. New entrants seek to enter the core market, not a neglected under-served segment, and the strategy is almost always to undercut the incumbents' prices while providing essentially the same service.

An Outcome-based Approach

It is accordingly helpful at this point to turn to authors who have opted to concentrate upon outcomes rather than processes. A good example is Hagel et al.

(2015) who analyse several cases in which incumbents have been significantly displaced, most notably Kodak. The authors identify nine patterns of disruption that belong within two broad categories: harnessing network effects and transforming the value–cost equation. They also consider that disruption may differ between various industries according to their characteristics and also the trends affecting them.

The article starts by asking whether there are 'ways for incumbents to recognize the potential for disruptive strategy in advance'? Some challenges are expected, some are not. In the latter case, 'something changes in the larger environment – technology or customer preferences or supporting infrastructure/ecosystem – to make the new approach possible and profitable.' The incumbent, 'preoccupied with the status quo, doesn't recognise that the ground beneath it is shifting.' The very reasons that explain why an incumbent has become successful now cause it to misinterpret the true nature of the threat.

After analysing dozens of cases over the previous two decades, the authors identify the following nine patterns of disruption: 'expand marketplace reach; unlock adjacent assets; turn products into platforms; connect peers; distribute product development; unbundle products and services; shorten the value chain; align price with use; and converge products'.

The obvious difficulty is that none of this seems apposite for a regulated industry, and there is no mention of regulation as such. Interestingly, the only reference to matters that can be deemed to be telecoms-related is to 'exponential organizations' that 'are designed to leverage the abundance of resources afforded by exponentially advancing underlying technologies' including 'bandwidth'. However, this is a problematic assertion. The overall amount of bandwidth is of course fixed in supply, so to increase its availability one must either switch its use from, say, radio to mobile, use improved technology to increase the capacity of an existing network or open up new blocks of bandwidth previously left unused because they were uneconomic. All of these procedures take place over a period of years, and in no sense can improved technology lead to an 'exponential' increase in bandwidth.

It is difficult to conclude, therefore, that the standard literature on disruption, whether process-based or outcome-based, can shed much light on regulated industries.

Introduction to Ofcom

Under the circumstances, it would appear to be more productive to examine material that has specifically been designed to shed light on disruption in the context of telecommunications. This discussion is based upon Ofcom (2016), the core hypothesis of which proceeds as follows:

- Certain market conditions may result in firms acting collusively in an anti-competitive manner, raising prices above the competitive level or lowering quality.

- Disruptive firms that actively disturb existing market dynamics are generally seen by regulators as beneficial to consumers.
- The mobile communications sector has historically been associated with a number of disruptive firms such as Hutchison Whampoa (now CK Hutchison).
- Recent mergers involving disruptive firms have led to fears that their influence is fading.

To test the effect of disruptive firms, Ofcom undertook a cross-country econometric study that 'compared mobile prices across 25 countries between 2010 and 2015, controlling for the characteristics of different mobile tariffs and country-specific factors'.

It concluded (p. 2) that in countries where a disruptive firm was identified as present, its analysis 'suggested (with a 95% confidence interval) that prices [were] lower of the order of between 10.7% and 12.4% compared to countries where a disruptive firm [was] not present'. The analysis also indicated (with a 95% confidence interval) that 'prices [were] lower of the order of between 7.3% and 9.2% where there [were] a greater number of players.' Combining these two variables 'suggests that prices could be between 17.2% and 20.5% lower on average in countries where there are four or more mobile operators AND a disruptive firm is in the market'.

In setting out to define a disruptive firm, Ofcom states (p. 4) that:

- 'Disruption is often much easier to recognise than it is to define.'
- 'We consider disruptive firms to disturb the existing market dynamics by doing or offering something different to that which already exists within the market. … For example, Free's entry in France drove the competing players to create spin-off brands.'
- Disruption is distinguished from other instances of entry or changes in strategy by the fact that it is not easily accommodated by competitors that need to respond with 'non-trivial changes in strategy or business model'.
- 'However, each case of disruption is usually unique, and it is this variation amongst disruptive firms which makes it difficult, if not impossible, to establish a rigid, catch-all definition of disruptive players.'

So are there any general behaviours and outcomes that will identify disruptive behaviour? The answer given is a 'yes' in the form of (1) 'Introduction of services which supersede others', (2) 'Introduction of new production technology for existing services' and (3) 'Aggressive behaviour'.

The effects on investment are said to be (p. 3):

- There can be negative effects because an incumbent may be reluctant to invest in projects where the expected rate of return has been adversely affected by a disruptor's acquisition of an increasing share of the market.
- But there can also be positive effects where the disruption takes the form of new innovations and technical developments since incumbents are likely to need to follow suit if they are to remain competitive.