An Industry Unbundled:  
IBM and the unbundling of the Personal Computer Industry  

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To God, Me and We.
Abstract

This paper explores the phenomenon of Hi-tech Industry Unbundling. Studying the case of the unbundling of the US PC industry between 1980 and 2004, the paper identifies and analyses a number of the causal factors driving unbundling in the PC industry.

Focusing on the two factors of Organisational Capability and Consumer preference, the study evaluates these factors in an unbundled industry setting. Drawing from theory and case study findings, the study determines the subsequent influence on a firm’s industry value chain position and vertical scope.

Applied to the IBM case, the framework is outlines the suggested industry value chain position and vertical integration strategy IBM should employ.
Executive Summary

The purpose of this study is to develop a conceptual framework that aids strategy formulation in the context of an “unbundled” Hi-Tech industry.

This framework draws from the relationships between key drivers and influencers of the unbundling process, prescribing a means by which a vertically integrated firm can build a case for where, in the new industry value chain they should be positioned and the corresponding vertical integration strategy that determines their firm boundary.

Through the case study exploration of the unbundling of the PC industry, from the perspective of the vertically integrated IBM Corporation, the paper is able to identify and extract the factors which led to the Unbundling of the PC industry from 1980 to 2004.

Importantly the case study enables the contextual identification and analysis of the linkages between these causal factors, the narrative form aiding a better understanding of how they contribute to and compounded the unbundling process over time.

From the case study we learn that indeed this phenomenon is one that not only has an impact on industry structure but also on firm level dynamics. The case demonstrates how the combinations of architectural design and control, organisational capabilities, industry clockspeed, hyper-competition and consumer preference interact to erode the forces that provide incentive for highly integrated structures and dominant industry players. Furthermore the case illustrates the crucial role decision making plays throughout this process and how it can benefit or hinder an organisation within an unbundling industry emphasising the significance of misguided decisions on long term competitiveness.

The importance of effective decision making and strategy formulation particularly in an unbundling industry context forms the basis for the development of a framework.
that seeks to remove the uncertainty from decision making in a little known and rarely studied form of industry evolution.

Organisational capabilities and consumer preference are identified as important exogenous and endogenous factors influencing unbundling, they are analysed in the context of an unbundled industry setting and subsequently selected as the two dimensions that make up the decision making framework.

The study outlines a detailed construction of the framework and its constituent elements, embedding both existing theory and findings from exploratory analysis of PC industry unbundling.

The study is concluded by the application of this framework using IBM's case as the foundation for prescribing an industry value chain position and suggested vertical integration strategy and scope for the firm in an unbundled industry context.
Introduction

The unbundling phenomenon is not unique to the PC industry having previously occurred in the automobile industry. The process that reorganises the structure of an industry by pulling apart integrated firm and industry structures has not been fully understood or explained, particularly in the context of strategy formulation.

The phenomenon is particularly salient for vertically integrated organisations within industries that are experiencing this change in an industry's structure, coincidentally influencing their own position, structure and behaviour within the industry.

The PC industry is one that experienced the unbundling phenomenon and also bore witness to a large scale casualty. IBM had begun the PC era as figure head but finished at the tail end of the industry unable to replicate the successes of its Mainframe era.

Today a number of industries are either on the verge or experiencing the unbundling of their respective industries, raising questions about how it is identified and how a firm respond in this context are crucial.

This study explores the phenomenon of unbundling, using the case of the US PC industry as a context to identify its drivers and using them to create a conceptual framework that provides clarity to how a firm responds and develops new strategy in that context.
Literature review

Vertical integration

Vertical integration refers to the degree to which an organisation controls its inputs and manages the distribution of its output (Afuah 2001)

According to Chandler (1977) vertical integration is an organisational response to “fundamental processes of production and distribution made possible by new sources of energy…where new markets had difficulty in handling the output of the new process of production, the manufacturer’s integrated mass production with mass distribution.

This form of organisation design draws from transaction cost theory (Williamson 1975) one of the early tenets underpinning the rationale for vertical integration.

Williamson’s Transaction Cost Theory (TCT) (1975) drew attention to the high relative costs of market to demonstrate the benefits of vertical integration made possible by the lower relative cost of exchanges in vertically integrated structures.

The basis for the lower relative cost of administrative exchanges over market alternatives lay in; asset specificity, opportunism and uncertainty.

Asset specificity refers to transaction specific investment between a supplier and buyer greater degrees of asset specificity increase the potential for hold ups in supply, giving rise to opportunism on the part of a supplier when negotiating contracts and other exchanges.

Consequences of entering into contractual agreements increases uncertainty and risk associated with fluctuations in demand and the costs of incomplete contacting (Grossman & Hart 1982).

By bringing operations, transactions and exchanges under one administrative structure doing so will reduce the inefficiencies that increased transaction costs.

The resource based view (RBV) of the firm reinforced TCT rationale for the integration of the firm as well promoting the efficiency gains and reduced transactions costs. The RBV stated the purpose of the firm is to generate, combine and exploit
knowledge. This ability to generate and exploit knowledge is determined by the “relative ease with which conversation is carried out within an organisation” (Monterverde 1995). It is argued that this is best conducted in vertically integrated organisations, where the channels of communication experience less friction than market based channels. The passages of knowledge that underpins the development of organisational capability of the firm are tacit, as a result of bounded rationality and limitations or languages and expression. Therefore it is deemed the most efficient method of knowledge transfer is through observation or learning by doing, a task made easier through close quarters interaction best organised with a vertical structure. (Conner & Prahalad, 1996).

Argument and theory supporting vertical integration did not withstand the growing number of firms or industries opting for a more focused approach and narrower vertical scope. Factors reducing market side transaction costs such as internet technology, created de-incentives for vertical organisations and accelerated the perceived necessity to reduce scale and scope.

The retrenchment of vertically integrated industries switched the vertical integration debate to how firms establish focus through outsourcing (Hamel 1992, Garud & Kumraswamy 1995, Quinn 2000). The changes in industry structure and the competitive environment required a new approach to questions of vertical scope, one that went beyond appreciation of transaction cost fundamentals but understood the dynamism of firm boundaries and the importance of prompt response to exogenous factors.

Afuah’s (1996) study of technological change and the impact of the firm boundary support the notion that firm boundaries are dynamic particularly in times of rapid technological change.

Given that the old prescription of vertical integration had been readdressed, the work of Harrigan (2001) re-emphasizes the need for firms to responsive to changes in the market and the need for such changes to be reflected in firm boundary decisions.
Teece's (1997) study addressed the ability of vertical structures to respond to the uncertainty created by innovation driven technological change. Thus it can be concluded that the uncertainty associated with such change may determine the vertical structure of the firm (Afuah, 1996).

Understanding of firm boundary decisions and its effect of technological change is still in its infancy. Wolter & Velso's (2008) study elaborates on uncertainty associated with technological change and dynamism of firm boundaries.

The study frames technological change in the context of innovation typologies, previously characterised by Henderson and Clark (1990) measuring the impact of the particular innovations on the vertical scope of the firm. Studied from a assemblers perspective the paper demonstrates technological change/innovation in an industries upstream activity influences firm boundary decisions.

The analysis of change in value chain activity and its influence on the vertical scope of the firm provides a basis from which this study, will build a better understanding of how this influences value chain position in the context of a unbundled industry.

Harrigan's framework for looking at vertical integration presents alternative vertical integration strategies that reflect the exogenous market conditions in prescribing a strategy for vertical scope in an unbundling industry setting.

This paper aims to build on this aspect of vertical integration strategies by analysing how the drivers of industry unbundling affect vertical scope, subsequently deriving dimensions from which decisions regarding vertical scope can be made in an unbundling industry setting.
Unbundling

Unbundling is the process in which vertically integrated industries are pulled apart into its composite pieces (Singer and Hagel, 1999). Also known as 'disaggregation', unbundling occurs under the pressure of exogenous and endogenous factors that are loosely in-sync with the evolution of the industry (Singer and Hagel, 1999).

Unbundling as an area of academic study that has not been covered extensively, to date only a small number of studies and commentary on the phenomenon have been developed, mainly studied from the practitioner perspective.

Hagel and Singer's (1999) analysis of the “unbundling of the corporation” derives its main arguments from transaction cost theory. The paper argues unbundling occurs as a result of a firm’s motivation to minimise transaction costs. They argue that as “interaction costs determine the way companies organise themselves and form relationships with other parties” change in interaction costs also influence the unbundling of the firm and industry structure.

The key unbundling driver identified in Hagel and Singers study is “development in technology”. Development in technologies such as the internet has allowed greater and easier interaction across an evolving industry landscape that has aided reduction interaction costs and provided incentive to reorganise at firm and industry level.

According to Hagel and Singer, firms and industries reorganise along the “fault lines” of the core process of customer relationships, product innovation and infrastructure business, due to the conflicting economic priorities of these three core processes. They offer little further analysis into how these processes are affected by the “unbundling of the corporation” or how an organisation identifies which of these processes they should operate in once the firm has been unbundled.
Raynor and Christensen's (2001) commentary begins to address the issue of how firms should respond to industry unbundling, citing the disk drive industry as an example of how a change in industry structure reorganises its value structure. Entitled “Skate to where the profit will be” looks at the demand side shift in consumer behaviour, triggering the unbundling of PC industry, prompting the Original Equipment Manufacturers to develop modular product architecture in order to sufficiently meet the consumers needs for more flexible, quicker, compatible computers. According to Christensen modular product design was to further add to the forces that unbundled the firm and industry as the modularity increased the amount of sufficient information required to develop standards and reduce the need for vertically integrated firms.

Significantly, Christensen discusses the factors that caused highly vertically integrated PC assembly firms to loose market power and architectural control, as further upstream activities began to dictate the basis on with the OEMs and assemblers would compete.

These arguments provide a basis for exploration in this study and reference points for the dimensions that constitute this paper's conceptual framework.
Modularity

Modularity is a method of architectural innovation that determines the degree to which components and modules in system architecture can be separated or combined (Orton and Weick, 1990). The degree of modularity is indicated by how tightly or loosely coupled components in a system are combined (Sanchez and Mahoney 1996).

Modular architecture allows for greater flexibility in design and production as individual components can be replaced or adjusted without the entire system being modified (Sanchez & Mahoney 1996). Variations in component design are made possible because of sufficient information available in the market, at this point designs and configuration of system level are developed into standard interfaces and the interaction between components are well specified (Mikkola 2003).

Adopting modular product architecture enables firms to respond faster to increasing competitive pressures, driven by the consumers need for customisation, flexibility and speed. A Modular architecture allows firms to mix and match embedded components and therefore benefit from offering product variety and achieve cost savings through the economies of scale created by mass component manufacturing (Shilling, 2000).

Successful execution of this approach requires two types of knowledge (Henderson and Clark 1990). Specifically architectural knowledge; which is an understanding of how components are integrated and linked at systems level and sub system level, component knowledge of the “core design concepts” and the way in which they are implemented in particular components (Henderson and Clark 1990).

This knowledge requirement provides both incentives and disincentives for vertical integration. In the circumstance where technology is in early phase of development it is very likely like a firm will require and have deep understanding at systems level.
and subsystem level. The emphasis on pushing the performance threshold of the system will undoubtedly require intensive and specific work at component level to drive system improvement. The absence of technological alternatives at this point in the market at subsystem level forces firms to seek solutions internally. Both factors give incentives for creating a vertically integrated structure that enables proximity and the clear channels of communication required for continuous iteration in new product development. On the other hand the requirement for deep knowledge at system and subsystem level also provides incentive for division of knowledge (Mikkola, 2003) and further disintegration, providing there is sufficient capability in the supply chain.

If there is diversity of capability and technologies outside the firm, pressures accelerating unbundling, simultaneously reducing transaction costs will encourage firms are more likely to outsource the production of components to smaller firms specialising in the production of these subsystem part. According to Mikkola (2003) such firms are better positioned from a cost and knowledge base to focus on improving price performance and developing a range new components.

In circumstances of increasing modularity, considering to make-or-buy (Womanck 1990) becomes more significant. Increasing modularity and the abundance of capabilities across the value chain makes it easier to outsource (Mikkola, 2003). However the approach to this issue determines the firm boundary.

Studies emanating mainly from the automotive industry examine a number of methods in which component outsourcing occur; three definitive methods emerge: Supplier proprietary components, detail control and black box. Each strategy dependent on the type and extent of information sharing between firms subsequently shapes the supplier – buyer relationship. Mikkola (2003) concludes that modularization will lead to greater supplier – buyer collaboration and dependence, measured by the level of transaction asset specificity and approach to information sharing.
This may suggest therefore that in an unbundled industry environment “collaborative networks” take on a new importance to firms within the industry. Of particular importance to OEM and assemblers who as standards emerge, incentives for vertical integration decrease, the loss of market power and architectural control places a new emphasis on building collaborative networks and maintaining good supplier buyer relationships to remain competitive.
Industry Clockspeed

The concept of industry clockspeed was first introduced by Fine (1998) in recognition of the increasing pace of technological change experience in the modern global economy.

The measure of technological change has provided considerable academic challenge (Mendelson and Pillai, 1999) It has previously been measured in terms of innovation (Dahlin 1998), capital obsolescence (Nadakarni & Karyanan) sector life-cycle (Blackburn 2000), rate of investment in R&D (Grillches, Rakes & Hall) and total factor production (Solow, 1957). Each criticised for the lack of robustness and validity. (Mendelson and Pillai 1999)

Many of these methods of measurement have fallen short on the subjective nature in which they are measured, still to date little quantitative work has been completed in the field of measuring clockspeed.

Fine's (1998) work introduced a new set of metrics for the measurement of technological dynamism or what he described as “industry clockspeed”. These metrics covered product technology clockspeed and organisational clockspeed. The detail of Fine's metrics measure the frequency of new product innovations, intervals between the introduction of new products and the rate of change of organisational structures.

Mendleson and Pillai (1999) developed Fine's proposals with independently developed measures which supported the original findings. Mendelson and Pillai study provided an operational interpretation of Fine''s measures, providing a clear indication of organisational implications of industry clockspeed.

The use of clockspeed also proved useful for industry classification and benchmarking (Mendleson and Pillai 1999)
Their findings indicated also that industry clockspeed had some bearing over the rate at which internal operations functioned, supporting again Fine's measure of organisational change and emphasising the significance of industry clockspeed on the firm operationally. These findings better equipped firms with the knowledge necessary to plan a strategic response to instances of technological change.

Fine (1998) observed that some industries evolved at a faster or slower rate, an indication that some industries have faster clock speeds than others (Perrons, Richards, and Platt, 2005) This variance suggesting clear implications in the way in which certain industries respond to technological change and in regards to industry evolution possibly the way in which industries unbundle.

To that effect understanding the organisation implication of different clockspeeds has become a particular focus of academic study in this field.

Shilling's (2000) study of inter firm product modularity briefly discusses the role of technological change and the pressure to migrate towards modular solutions. Her findings indicate that in higher clockspeeds there is an increased rate of technology proliferation increasing consumers choice from, this accelerates demand side pressure for product flexibility and customisation. This demand side driver increases the pressure for firms to migrate towards modular solutions to satisfy consumer need. The heterogeneity of inputs facilitates the migration towards increasing modular solutions by improving upgrade capability, slowing system obsolescence and improving competitiveness.(Shilling, 2000) These factors stimulate the entry of participants across the value chain, who provide specialist production and services and at the same time eroding the forces of that encourage highly vertical forms of integration.

Perrons and Platt (2005) study the effect of clockspeed on the success or failure of vertical integration strategies during a period of radical innovation. They propose that
during a period of radical innovation medium clockspeed industries draw greater benefit from long term relationships with principal suppliers and such relationship are unaffected during period of radical innovation in slow and fast clockspeed industries. Their findings indicated the opposite that in fact links with suppliers play more of a role in the success of manufacturers in fast clockspeed sectors than in medium clockspeed sectors. This is attributed to the higher level of technological uncertainty that drives a high frequency of interaction during a period of radical innovation. Therefore long term relationships are preferred as a means of reducing uncertainty and controlling transaction costs, involved in frequent interaction. This implies that in fast clockspeed sectors where unbundling is taking place the type of innovation that has occurred may have an influence on the type of supplier relationships required and the incentives to internalise activities in particular parts of the value chain.

Wolter and Velso's (2007) recent study provides useful commentary on how technological change affects firm boundary decisions, using Henderson and Clark's representation of technological change in the context of innovation typologies. The paper discusses the extent to which, types of innovation disrupt upstream and downstream capabilities and how an organisation subsequently determines the firm boundary.

Wolter and Velso's model is provides a practical basis from which this paper's framework will draw, however for the purpose of this study, further exploration into the specific role of clockspeed will not be studied in great depth.
Research Objectives

The key objective of this paper is to develop a conceptual framework, intended for use as a decision making tool for vertically integrated firms in the context of an unbundled hi-technology industry.

To achieve the primary objective this study will;

1. Identify the key drivers of hi-tech industry unbundling.
2. Analyse the extent to which these drivers contribute to hi-tech industry unbundling
3. Articulate the causal links between the selected drivers
4. Adapt and apply selected drivers to DTI Unbundling Strategy Framework that aims to aid strategy formulation for firms in an unbundled industry setting.
Methodology

Research approach and strategy

Inductive reasoning

This study uses an inductive rather than deductive theory building approach. The primary distinction between the two is the point at which theory is developed. (Yin 1995)

By using deductive reasoning theories are formed from which hypothesis are developed tested using observation and data to validate theory. This approach assumes a narrow perspective and rigid scope, which is often not appropriate when exploring phenomena where little or no theory previously exists. In an inductive approach, “theory would follow the data and observation” being explored (Saunders 2004) allowing for a more flexible intuitive research strategy whereby the “process of data collection and observation will help draw attention to the themes to pursue (Glaser & Strauss 1967, Schatzman & Strauss 1973, Yin 1994).

The absence of appropriate theory in the area of industry unbundling dictated it was most appropriate to use predominantly inductive theory building and where suitable, deductive reasoning to draw from related areas of study to strengthen the findings from the exploratory data.
Qualitative research

Given nature of this study, qualitative data, is the most appropriate form of research to undertake. Assessed against Lang's (2004) five general distinctions between qualitative and quantitative research, the use of a small sample, non-statistical analysis and inductive exploratory theory building, provides reasonable qualification for using qualitative data to complete this research.

Qualitative data analysis

Tesch (1990) outlines the following strategies for qualitative data analysis.

1. Understanding characteristics of language
2. Discovering regularities
3. Comprehending the meaning of text or action
4. Reflection

The first two imply a deductive research approach, whereas the latter two strategies are more inductive in their approach to qualitative data analysis. In analysing the developments of IBM from 1980 through to 2004, the research will require the use of strategies 2, 3 and 4. However the analysis will predominantly by reflecting on historical data, interpreting and analysing factors driving the unbundling of the PC industry and the change of IBM's vertically integrated structure, this is therefore suited to the inductive research approach generally employed in this study.
Secondary Data

Research for this study is conducted using secondary data. A variety of classifications for secondary data have been generated (Byman 1989; Dale et al., 1988; Hakim 1982, 2000; Robson, 2002 Saunders, 2003) However to better capture the range of secondary data types Saunders, devised three broader categories of data. This study will primarily use data of a “documentary” variety (Saunders 2003) as opposed to survey-based and multiple data types.

Such use of documentary data is considered archival research, a method which encompasses recent as well as historical documents (Bryman 1989). Although documentary data is occasionally criticised for the reporting and selection bias, the advantages of using documentation include the data is stable and appropriateness for repeated use, accuracy and broad coverage, these factors prove to be beneficial for corroborating information to verify its accuracy.

Categories & Coding
Themes that emerge from the collation of data are categorised, the terms used for categories derived from the data and existing theory on modularity, industry clockspeed and vertical integration. The codes applied to data, indicate linkages between themes and interpretation of the emerging themes in the context of PC industry unbundling. (King, 1998).
Case Study

A case study is a method of research that enables an in-depth study of a phenomenon and emerging body of knowledge (Perry 2001). The use of case study to analyse the unbundling of the PC industry is an appropriate means of identifying trends and relationships between these trends thus aiding further understanding of the unbundling phenomena.

Selection

The case study focuses on IBM’s role and perspective during the unbundling of the PC industry from 1980 till 2004. Describing the exogenous and endogenous events that reflect the occurrence of the unbundling phenomena, the case study seeks to highlight the drivers of unbundling and analyse their effects on IBM and the wider PC industry.

This approach allows holistic understanding of multiple aspects of the unbundling phenomenon and interactions between different factors driving the process (Gummesson, 1988).
Case study design

This paper will use a single case study design focusing on the PC industry. The PC industry is one of the few clear examples in recent times of the unbundling of a hi-tech industry. This enables the study to identify and observe with greater accuracy the causes and residual effects of the unbundling process.

IBM has been chosen as the focal firm of the case study, in light of the firm’s prominent role in the PC industry during the period of covered in the case and the appropriateness of the firm’s structure in light of this paper’s emphasis on firms with a high degree of vertical integration.

The choice of IBM is regarded as an appropriate firm to explore the unbundling process in a hi-tech industry setting in the context of the PC industry. In all the findings should be regarded as an example of a broader class of events (Saunders, 2004) and in such suitable for the further use in developing a broadly applicable conceptual framework.

The IBM case study will be organised in a theory building fashion with embedded units of analysis to draw particular attention to the key drivers of PC industry unbundling and the relationships between them.

Framework

The framework will be devised using specific findings from the case study analysis and draw from existing elements of theory from the fields of Consumer Behaviour, Modularity, Organisational Capability and firm boundary decision making.
For Full Case Study See Appendix 1

An industry Unbundled - case study summary

The case study crystallises a number of key elements which drove the unbundling of the industry, the pressure point it can be argued was the open product architecture, and this provided a platform around which standards could easily coalesce reducing the need for a vertically integrated firm like IBM to control functionality and reduced incentives for vertical integration within the industry.

This combined with the divided technical leadership at the beginning allowed no one actor to take proprietary control over the early development of the PC, giving opportunity for any firm to work towards establishing themselves as industry standards.

The diversity of capabilities and continuous development of new capability across the value chain, unlike in the mainframe industry, the dominance of IBM mainframes stifled the emergence of firms or the dissemination of knowledge and capability anywhere outside the firm boundaries of the IBM mainframe business. This diversity spurred the hyper competitive landscape of the PC Industry, where a large number of disaggregated specialist firms grew in segments of the industry, delivering better services and products than a non specialist vertically integrated firm. Many firms upstream could leverage their capabilities to create sustainable competitive advantages; however Original Equipment Manufacturers like IBM could not as the assembly and product design capabilities which was deemed to be their core competence did not satisfy two key conditions Peteraf (1993) set out for building sustainable competitive advantage. IBM soon found to their detriment that the open PC architecture meant; their core capability was imitable and therefore heterogeneity could not be preserved resulting in undifferentiated profits for an undifferentiated product (Christensen, 2001), the resources necessary to build competitive advantage for example the microprocessor and the operating system became perfectly mobile within the PC industry.

Finally as the industry evolved consumer preferences began to shape the behaviour of
the industry effectively defining the terms on which companies would compete and therefore organise to fend off competitors. This influence manifested itself in the increasingly modular approach taken in order to meet consumers need for flexibility, compatibility and speed, creating further stimulus for disintegration and the emergence of specialist firms able to serve the needs of computer manufactures competing on lower price and improving performance.
DTI Unbundling Strategy Framework

For the purpose of this paper, the framework will focus on organisational capabilities and consumer preference as two of the key aspects that have driven unbundling in the PC industry. These factors will form the dimensions that aim to aids strategy formulation in the context of a high tech product based unbundled industry setting.

The framework is designed for use by vertically integrated firms like IBM having to adapt to the new industry setting and should add clarity to the firm’s current position and crystallise thoughts on what the firm should be doing in the future.
Dimension one – organisational capability

Organisational capability is an organisation's 'capacity to undertake a particular productive activity' (Grant, 2002)

The concept of capability derived from the 'resourced based view' of the firm a strategy concept which addresses the role of resources and capabilities in strategy formulation. According to the resource based view 'resources and capabilities are primary determinants of the strategy and performance of the firm' (Grant, 2002) Capabilities which are leveraged from a firm's resources are key in strategy formulation and organisational sustainability and longevity.

Evaluating core strategic questions about 'what the firm does or it intends to do' in an unbundled or unbundling industry setting requires a firm to consider what its capabilities are. Any such assessment of the role of the firm's capabilities in a newly unbundled horizontal industry structure like that of the PC industry however, must take into consideration that the capabilities of a firm prior to the change in industry structure may be materially different in a new industry context.

Assessing the IBM case study there are a number of lessons and key points that emerge regarding the role of capabilities in an unbundling and unbundled industry. Organisational Capabilities are not of instantaneous origin, they develop over a period of time as a result of the acquisition and dissemination of knowledge in and across an organisation. They can emerge out of routine and a pattern of behaviour that is internalised within individuals and then shared in firm. (Grant, 2002) The knowledge that often triggers the development of a capability is often tacit and therefore difficult to share without the appropriate channels to communicate them and mechanisms to capture then operationalise them.

From the case study the dynamics and management of capability development were key in the development of technical capacity of the individual firms and the trajectory of the unbundling PC Industry itself. The case also demonstrates how the changing
role of relationships, supplier-buyer linkages and firm boundaries in the development of capabilities in firms.

IBM's decision to outsource key components of the PC resulted in capabilities that were to define the technological leadership of the PC platform being developed outside the IBM firm boundary. In deciding to adopt a “supplier proprietary parts”\(^1\) component outsourcing strategy the relationship IBM had with MSFT and Intel in the early stages of development would allow Intel and MSFT to dominate the technological path of innovation of key performance drivers of the PC.

Commentators would argue that this was an unknown quantity at the time when the decision was made however this could be considered the first letter of writing on the wall. The outsourcing decision gave IBM little control over these two key components and little opportunity to develop similar capabilities if at any point IBM would need to compete on an equitable basis. This was compounded by the retrospectively weak core assembling and product design capability that was open to attack mainly because of the open architecture, that would accelerate the build up of sufficient information and standards that subsequently encouraged clones that eroded differentiators and market share. In an unbundling industry preparation for a larger diversity of capabilities and the possibility of firms encroaching into activities an incumbent firm like IBM once dominated is crucial, more importantly understanding the relative capability strength is key in deciding the future industry position.

Developing a complex capability has associated risks as it can prove costly, time intensive and eventually fruitless if exogenous innovations are competence destroying or if others have developed capabilities to the point at that makes it hard to compete meaningfully.

However developing capabilities to compete immediately or short term can be

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\(^1\) Harrigan, K.R, 2001, A framework for looking at vertical integration
strategically misleading; by taking a long view developing a capability in a desired area may prove to be an inspired choice. For example Sony continued to develop their video technology capability after loosing the VHS Beatamax war but continued the learning that helped them develop the successful Playstation product line.

Starting the learning relatively promptly to gives a firm a platform to compete both short term and long term. However starting late does not preclude a firm from eventually having the resources and capability to compete and succeed. This however means, mechanisms for knowledge transfer, a culture of continuous learning and an organisational physiology to accommodate new capabilities efficiently must be cultivated first.

Unbundling therefore presents a number of challenges to firm’s organisational capabilities, the key challenges being;

1. What capabilities now exist in the unbundled horizontal industry value chain?
2. What are the firm’s relative strengths (capability) in this context?
3. Do the firm have the capabilities necessary to remain competitive?

To address these questions, the learning from this key unit of analysis will be embedded this into the framework using a three phase model that will feed into a the broader framework.
The following two phase model gives a practical approach to carrying out an assessment of firms relative capabilities in the industry.

**Phase One - Mapping the value chain**

Mapping the value chain gives a snapshot of the current industry landscape and a view of the firm’s relative position within it.

a) Use porters value chain as a basis of identifying and classifying activities of firms across the industry value chain.

![Figure 1 – Porters Value Chain](image)

**b) Industry participants should be plotted across the value chain according to what is considered to be their core capability, illustrating a crude snapshot of the industry landscape and competitive structure of the relevant industry.**

![Figure 2 – Horizontal PC industry value chain](image)
As a means of assessing relative activity the participants should be displayed by individual market share if possible, this aids the identification of the best in class across the industry.

c) Once participants have been mapped on the value chain a more thorough analysis of the nature capabilities possessed by the best in class participants should be conducted to better understand the potential development path the organisation must assume to develop competitive capability.

d) Plot the firm’s core capability across the value chain, displaying market share and market capitalisation data.

**IBM's Core Capability: Product Design**

e) Identify other activities in which the firm engage in at present as a means of identifying the vertical scope of the firm and the scope of its organisational capabilities in an industry context.

**Other IBM Capabilities: Software development management, micro processing design and development.**
This at a glance map of a firm and an industries capability provides a basic assessment of potential barriers to entry into parts of the value chain. The map also displays the relative distance of capabilities from the firm’s core capability, which will contribute to the assessment of the cost of the firm developing a new or existing capability.

Phase two - Value Chain Condition

According to Henderson and Clark (1990) and industry is exposed to different types of innovation during periods of technological change. These varying types of innovation characterised by Henderson and Clark (1990) and later Veloso are said to have an impact on the condition of certain value chain activities.

Disruption or reinforcement of a value chain activity is likely to shape the strategy for potential entry into a particular position in an horizontally structured industry. Having identified the firm’s relative strength and capability distribution across the industry value chain a firm will have a general idea about where it is best equipped to participate. Understanding the condition of particular segments of the value chain can help crystallise a firm’s thinking with regards to where it may decide to locate.

Constructed from the point of view of a firm similar to IBM this model developed by Shilling focuses on the impact of different types of innovation on the condition of Upstream activities.

Providing there is a thorough understanding of the type of innovation that has taken place in the industry the firm can undertake the following assessment of the value chain condition basing the analysis on the following dimensions:

- Impact upstream
- Level of technological uncertainty
Innovation typologies

a. Incremental

**Impact downstream – Downstream capabilities reinforced**

**Level of technological uncertainty – Low, no change in innovation trajectory**

In this situation the risk of component obsolescence and therefore risk investment in upstream activity is low. Upstream activities retain their market power and control, therefore barriers to entry remain relatively high.

b. Modular

**Impact upstream – upstream capabilities destroyed**

**Level of technological uncertainty – High, unknown change in innovation trajectory**

In this situation the risk of component obsolescence and therefore risk investment in upstream activity is high. Upstream activities loose due to the disruption caused, barriers to entry are moderate however there is an even base for developing capabilities upstream that have the potential to compete with former incumbent.

c. Architectural

**Impact upstream – upstream capabilities reinforced, midstream capabilities destroyed**

**Level of technological uncertainty – Moderate, unknown change in innovation trajectory at architectural level**

In this situation the risk of component obsolescence and therefore risk investment in upstream activity is low however the risk of further development midstream is high. Upstream activities retain their market power and no changes in component knowledge occur. Barriers to entry are likely to be high to moderate depending on the level of existing capabilities in that segment of the value chain.

d. Radical

**Impact upstream – upstream capabilities destroyed**

**Level of technological uncertainty – High, unknown change in innovation trajectory at architectural level**

In this situation the risk of component obsolescence and therefore risk investment
across the whole value chain activity is high. A radical innovation will likely benefit those who have existing capabilities in corresponding parts of the value chain but lowers the barriers for entry into a new industry segment.

The question of 'what the firm does or it intends to do' can be simplified by using the aforementioned tools. Mapping a firm’s relative capability, giving the organisation a better understanding of where it may or may not consider doing based on its current circumstance combining this with the assessment of the value chain condition contextualises that understanding bringing a firm to the point where it can understand how endogenous factors fit within the unbundled industry setting.

However once an understanding has been formed of the firms relative capability it is important that it is measured against demand side factors that also drive the evolution of an industries structure and determines the structure and strategy of a firm operating in that environment.
Dimension two: Consumer preference

The IBM case study highlights the impact consumer preference potentially and actually has on a firm’s boundary decisions and also the drivers of industry unbundling.

IBM’s previous activity in the mainframe business reflected the preference of the consumer in that point in time. IBM's control of the entire supply chain process for the mainframe systems reflected consumer’s preference for a black box integrated package that effectively served their needs and compensated for the lack of expert computing knowledge in business at the time. The trade-off, were high prices and a dependence on IBM for every aspect of the mainframe system from training, repair to procurement.

In the PC market however consumers were quick to yield their influence on the direction of PC development. As the market developed so did the factors that determined consumer preference, such as diversity of input spurring the demand for increased customisation and speed.

To respond to demand it was necessary for the behaviour across the value chain to adapt. Consumer preference for speed and customisation, pressured the shift in architectural control to the participants who determined those elements, namely Intel and to a lesser extent Microsoft. Industry clockspeed which is argued to determine the rate of technological change and subsequently the pace of the unbundling process is also according to Mendelson and Pillai (1999) driven by consumer preference for speed and customisation.

There were two consumer demographics that shaped the shift in consumer preference that contributed to the unbundling of the PC industry.
The first and most prominent in the initial development was the business consumer community. The PC was introduced as a business machine for demanding business customers. The difference between the PC and its mainframe predecessor was the PC's modular architecture. This difference determined the way in which changes to the system were approached and the ability for business to have more control in the relationship between themselves and the vendor.

Business had incentives and opportunity to develop a reasonable level of IT competency in order to solve problems effectively and internally, reducing transaction costs by removing the need for the excessive and expensive IBM support and at the same time developing architectural and component level knowledge putting them in a position to demand flexibility, compatibility and speed, that delivered more cost effective and better performing machines.

This differed from the non-business consumer behaviour that in early industry phase rarely had a business like incentive to improve price performance levels and did not develop the competency at component and architectural level as quickly as their business counterparts.
Anticipating the shift in consumer preference can shape how a firm responds to change.

If IBM had anticipated the shift consumer preference they may have invested in developing the capabilities to produce an Operating system and or microprocessor sooner, hence developing a deeper and more intrinsic knowledge of how to produce these components that drove the PC performance and put them in a position where they were able to compete earlier and more effectively.

Knowing your customers prepares a firm for change

Knowing and understanding who the firms customer are whether they be business or non business consumers will help in gauging how quickly the anticipated shift is likely to take place and give time to plan an appropriate response.

In the study of inter firm modularity Shilling (2000) identifies factors driving the degree of vertical scope in an organisation & industry, one of these factors is synergistic specificity.

Synergistic specificity is the ability to provide greater functionality by optimising components to work together through obviating the need for customer assembly (Shilling 2000, Pg 321).

The obviation of the need for customer assembly forms a basis on which this study believes consumer preference can be anticipated and subsequently indicates how a vertically integrated firm like IBM can adjust its firm boundary and value chain position.
**Shilling’s 2nd proposition**

“the degree of difficulty customers face in assessing the quality and interaction of components will be negatively related to inter firm product modularity”

It can be suggested that where there is difficulty in assessing quality of the product and understanding how components interact with the architecture consumers may be more likely to seek an actor to fulfil the role of selecting components and completing assembly.

Where quality is easier to assess and there is a knowledge of how components and architecture interact consumers may be more inclined to select components themselves and also complete assembly.

**Shillings 3rd proposition**

“the degree of difficulty customers face in assembling components will be negatively related to increasing inter firm product modularity.”

It can be suggested that consumers who face difficulty in assembly are likely to seek an actor to complete assembly. However in an unbundled environment where there is a demand for flexibility and choice they may require the choice of component parts and architectural structure and may seek a solutions integrator that can offer the range of choice and fulfil assembly.

The assessment of consumer preference illustrates the necessity of particular organisational structures within an unbundled industry and the extent to which forces of consumer preference determine the choice of firm boundary and vertical scope.

The attributes of the consumer preference being used to evaluate this dimension reflects the consumer behaviour model of AIDA developed by St Elmo Lewis in
1898. AIDA which stands for Attention, Interest, Desire and Action is a “model of consumer behaviour that traces the sequence of cognitive events leading to a purchase decision or other action; also called hierarchy of readiness”\(^2\).

See appendix 3 for full AIDA description

Building on the premise of Shilling's propositions, the framework provides qualitative attributes of consumer preference for assessing consumer preference for purchasing pre-assembled products. For the purpose of attributing a quantifiable measure each attribute should be measured on the following scale:

<table>
<thead>
<tr>
<th>Attribute measure</th>
<th>Low</th>
<th>1 – 4</th>
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<tr>
<td></td>
<td>Moderate</td>
<td>5 – 7</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>8 – 10</td>
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**Availability and range- Draws attention and stimulates interest**

Consumer’s ability to choose is dependent on there being an adequate range of technological options available. To measure this firm can utilise the value chain map to identify where these options may exist through the volume of firms operating in the particular segment of the industry.

**Consumer knowledge - Demonstrates desire**

The level of consumer knowledge at architectural and component knowledge is a good indicator as to ability to assess the interaction between component and product architecture and therefore the preference to self-assemble or seek an assembler.

Acquiring this data requires a combination of historical analysis and contemporary consumer market research.

Historic data analysis: comparing sales of component to sales of system I.e. PC, provides a sales ratio that highlights consumer purchasing behaviour and gives an indication to the level of component knowledge in the market. A high component to

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architecture sales ratio demonstrates a probable high level of component knowledge and preference to assemble and a low component to architecture sales ratio demonstrates a low level of component knowledge and preference to purchase pre-assembled architecture.

*Consumer market research:* To corroborate the findings from the historic sales data analysis, primary consumer field study should be conducted to gauge the level of consumer knowledge that may or may not exist.

**Product Complexity - *Facilitates Action***

The level of complexity in assembling a product is likely to influence a consumers ability and incentive to assemble independently. This can be assessed using the following barometers:

*Evidence of standards:* Standards emerge as a result of sufficient information necessary to develop standard interfaces that remove any unpredictable interdependencies (Christensen, 2001) thus reducing the complexity and the depth of knowledge necessary to assemble components.

*Modularity:* Product architectures with a lesser degree of modularity have a smaller number of components to combine, providing consumers with a simpler assembly process than if there were several components and modules to assemble.

**Aggregating the results**

The first two attributes should be considered in equal weight product complexity should be double weighted as this attribute determines the ability to actualise the consumer preference. As this is a qualitative measure effort must be made to remain as objective as possible when making judgement.

The sum of the attributes should be calculated to determine whether the consumer has a strong, moderate and weak preference for self-assembly.
Strong preference for self-assembly/aggregation

A strong preference for assembly is likely to occur if there is:

- Wide availability and range of technological options across the value chain particularly upstream.
- There is a low component to system architecture sales ratio and moderate to low level of component knowledge amongst consumers
- No clear standards at a component and system level and a high degree of modularity

In this instance it is likely that consumers would prefer that the product was pre assembled before sale and the options regarding what components were included in the system were made by the assembler.

The consumer preference implies that midstream assembly functions would be under little pressure to disaggregate in the short term and a firm like IBM would be able to maintain their position in this segment of the industry.

Moderate preference for self-assembly/aggregation

A moderate preference for assembly is likely to occur if there is:

- Wide availability and range of technological options across the value chain particularly upstream
- There is a low component to system architecture sales ratio and moderate level of component knowledge amongst consumers
- Some standards at a component and system level and a high degree of modularity

In this instance it is likely that consumers are aware of the choices available and a reasonable ability to distinguish between components however due to the complexity of assembly would prefer that the product was pre assembled before sale and but given the option to choose which components were included in the system.
The consumer preference implies that midstream assembly functions would be under moderate pressure to disaggregate in the short term and a firm like IBM would be able to maintain their position in this segment of the value chain if they were able to develop a capability to give consumers a direct role in selecting the components in the final product. Examples of where this has happened include Dell, who gave consumers the flexibility to select the composition of their machine but conducted the assembly and shipping of the product.

**Weak preference for self-assembly/aggregation**

A weak preference for assembly is likely to occur if there is:

- Wide availability and range of technological options across the value chain particularly upstream.
- There is a high component to system architecture sales ratio and moderate to high level of component knowledge amongst consumers.
- Clear standards at a component and system level and a range of degree of modularity.

In this instance consumers are aware of the choices available and and possess the ability to distinguish between components and they have the skills and resources necessary to conduct assembly independently hence a preference that the product was not assembled before sale.

The consumer preference implies that midstream assembly functions would be under significant pressure to disaggregate in the short term and a firm like IBM would not be able to maintain their position in this segment of the value chain without reducing their margins and/or changing their business model. Upstream component manufacturers such as Intel thrive in this setting and have the ability to by pass midstream and go direct to the consumer.
Application of Framework

Let’s take for example the IBM case and follow through with the capability assessment exercise.

IBM's core capabilities have been identified in figures 13 and 14 as product design followed by assembly which places it in one of the more competitive segments of the PC Industry. In previous analysis it has been established that according to Peteraf’s conditions of sustainable competitive advantage these capabilities are not hold these conditions and therefore IBM are at risk of conceding market position and share.

The industry is in a horizontal hyper competitive phase and entirely unbundled having gone through its most turbulent period of technological change the industry is now experiencing a phase of incremental innovation. Therefore upstream capabilities are reinforced and the level of technological uncertainty is low in this part of the industry value chain.

Recommendation

Given that upstream activities retain their market power and IBM have limited capabilities in this area and the strong market position and capacity of upstream incumbents they should consider continuing to develop these capabilities with a view to full utilisation of these capabilities longer term. The firm should look down stream and closer to the consumer to establish its future focus using its preferably capability in aggregation/assembly to develop its business.

Phase two – Consumer preference assessment
IBMs relative capabilities have been mapped and value chain condition assessed, with the recommendation that the firm should move further downstream and closer to customers. Phase two of the framework adds clarity and form to that decision, indicated what firm boundary decision is best suited to the demand side conditions prevalent in the market.

Working hypothetically through the assessment of consumer preference it is evident that:

**Availability and Range**

There is a high degree of availability and range of technological options at subsystem and system level. This is supported by the figure 14.

This increases awareness and interest of options at both subsystem and system level forming the basis for a higher preference to self-assemble a product (PC)

**Consumer Knowledge**

Historical data, the first measure of consumer knowledge indicates that for every purchase of a pre assembled system there are two unassembled individual components purchased, 2/1 component to system sales ratio. We can draw from this that there is consumers have demonstrated a moderate to high knowledge of how components interact with the system architecture indicating a moderate to strong preference to self-assemble. This can then be confirmed by the second measure of consumer market research.
Product complexity

The final measure, product complexity shows us through observation that there is evidence of established standards in the industry, subsequently removing assembly uncertainty and reducing the depth of knowledge required to self-assemble. However there is a high degree of modularity indicated that assembly may be moderately to very difficult. Together this measure of consumer preference indicates that the preference to self-assemble is low to moderate and therefore this measure of ability to action reduces the overall preference to self assemble.

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<th>Low</th>
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<tr>
<td>Availability and range</td>
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<tr>
<td>Consumer preference</td>
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<tr>
<td>Product complexity</td>
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<tr>
<td>Aggregate Consumer Preference</td>
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This demonstrates overall a moderate consumer preference for self-assembly that will get stronger as product complexity reduces. This suggests that there may be a short to medium term role for a firm that can accommodate consumer preference to select system components and clearly but compellingly present the options available and completing this service by assembling the parts chosen by the consumer. This model is similar to that of current market leader Dell.
Application of Framework 2

This visual display of the framework is from the perspective of the firm carrying out the assessment and embeds the learning and information from Phase One, Two and Three of the framework.

The x axis uses the aggregate consumer preference scale, representing consumer preference, from the company perspective and indicates to what degree the firm should perform an assembly/aggregation function (dimension two) and incorporates into it the representative vertical integration strategies characterised by Harrigan. (See Appendix 4 for full explanations of these strategies)

The Y axis incorporates the value chain repositioning recommendation. Illustrating if a firm should participate upstream or downstream.

By bringing the two dimensions together it is possible to visually represent the recommended strategy in the setting of an unbundled industry setting.
In the case of this example it is recommended IBM move further downstream closer to the customer and adapt its firm boundary to assume a quasi integrated or contracting approach to vertical integration, both requiring a reduction in the vertical scope of the firm. As such they utilise elements of their current capability to perform the role of a solutions aggregation, providing a moderate level of guidance, facilitating the consumer selection of components and aggregating these choices and assembling the product or service.
Limitations and recommendations for further research

Due to the nature of this study there are a number of factors that have limited the scale, scope and findings of the research and therefore a number of areas that have been recommended for further research.

Whilst the framework above, looks principally at the factors of capabilities and consumer preference, another key driver; industry clockspeed has not been taken into account in the construction of the framework and therefore does the model does not reflect accurately the role of clockspeed in the repositioning decision.

A study of how different clockspeeds influences the decisions made in regards to repositioning in an unbundled industry would be recommended as a key area of further study.

This studies use of secondary qualitative data provides foundation and initial insight into unbundling and strategy formulation however, further validation of the findings would add rigour to these findings adding to the depth of work in this area.
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Appendix 1 – Case Study

The Industry Unbundled – IBM and the Unbundling of the Personal Computer Industry

Background: Pre 1980

IBM were market leaders and dominant players in the computer industry propelled into perceived unassailable market leader position as a result of their dominance in the mainframe computer business. This market power established IBM as one of the most powerful companies in the world and reinforced with a ubiquitous brand associated with business and excellence.

Such dominance was achieved by the exemplary execution of a mainframe computer strategy that was based on a high degree of vertical integration.

IBM Mainframe Value Chain

![IBM Mainframe Value Chain Diagram]

Figure 5. IBM 1401 Data Processing System
The dominance of IBM's Mainframe strategy would be in stark contrast to that of the PC era. The IBM mainframe used integrated product architecture; IBM controlled everything from design, assembly and sales. Business customers relied on IBM for every aspect of delivery and maintenance, the strangle hold on this market was challenged but never loosened, in time the mainframe platform was eventually overturned and replaced by the minicomputer and swiftly followed by the PC. This was to mark a very different landscape for IBM and their role in personal computing.

**Development of the PC 1980**

IBM played a significant role in the development of the PC, taking the role of lead sponsor of the development of the platform. IBM were able to leverage their dominant role in the computing industry and trusted brand name to coordinate the efforts between the necessary parties to launch this new computing platform, opting to adopt an open architectural model rather than a close proprietary model similar to their mainframes and microcomputers.

IBM retained responsibility with approximately 70% of the core design, thus opting to make rather than buy the majority of the modules and components. This perspective would allow IBM the opportunity to lead and develop the architectural knowledge whilst having general oversight at component knowledge level. The control of the system would come from their control of the motherboard and their proprietary computer bus interface that controlled how components would interact with the system architecture.
Fatefully two key components of the PC were outsourced to third party developers. Those two components were the microprocessor and the operating system, both primary drivers of system performance and came to determine the future innovation trajectory of the PC. The microprocessor development was awarded to Intel, a breakaway of Fairchild Semiconductor, who produced the Intel 8088 Central processing unit (CPU) which was to power the first IBM PC. The operating system was outsourced to Microsoft who would be responsible for the development of the operating system (O/S) and later the dominant Windows software platform.
Divided technical leadership

Although IBM was the lead partner in the development of the PC, the dynamics of the relationship between the IBM, Intel and Microsoft (Msft) was one of mutual dependence. At the early stages of the PC platform development, each assumed technical leadership in areas of modular and architectural development in order to enhance the performance of the PC platform to the point were it could be adopted by its desired consumer. The balance of the divided technical leadership was never equal however shifting over the evolution of the PC industry.

The type of component outsourcing strategy employed by IBM was one of a hands off variety, MSFT assumed the role of a supplier of proprietary parts (Mikkola). Gates and Ballmer together with a small team of developers took the O/S from conception to create the first version of an IBM compatible O/S (February, 1981). This was made possible by IBM giving them two PCs to take away and interrogate giving MSFT the benefit of a well specified interface with which they could work. MSFT later negotiated a licensing agreement with IBM in which they retained control of the O/S Intellectual rights and collected royalties on the sale of every IBM PC.³

<table>
<thead>
<tr>
<th>1981 Market Share</th>
<th>Radio Shack</th>
<th>Apple</th>
<th>IBM</th>
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<tr>
<td></td>
<td>20.00%</td>
<td>17.00%</td>
<td>1.90%</td>
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</table>

Figure 7 – US PC Market Share. 1981

It is important to note that IBM had limited capability to develop a

³ Andrews, P. Manes, S: Gates
microprocessor that would sufficiently power the PC but possessed the capabilities to develop an operating system. The desire to reach the market quickly forced an outsourcing decision that would later damage their market position and role in the development of the PC. (Langolis and Robertson, 1995).

Msft were not the only actors capable of developing an operating system for the PC. Digital Research who had also contributed O/S to the IBM minicomputer had developed the CP/M which was suitable for the PC but gave preference to a MSFT led development. This choice hindered future adoption of the CP/M and by choosing to opt strongly with MSFT, IBM also reduced any opportunity for genuine competition in the O/S and software segment, leaving MSFT in position to dominate the future install base and gain unrivalled visibility.

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<tbody>
<tr>
<td>IBM</td>
<td>Equipment</td>
<td>Materials</td>
</tr>
</tbody>
</table>

**Adoption**

Still dominant, IBM maintained the role of primary coordinator of PC development. Their brand name carried over the PC concept and added to the credibility of this new machine. By October 1981 the PC was designed, developed and began shipment.  

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5 Ferguson, C.H: Computerwars – the fall of IBM & the future of Global technologies Morris 1994

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An Industry Unbundled – IBM and the unbundling of the Personal Computer industry  
Cass Business School  
Damola Timeyin, 2008
Third party developers almost anticipating the appeal of the PC coalesced around the product and began developing and manufacturing peripherals, that would add to the usability and the appeal of the product.

As sufficient knowledge developed the openness of the architecture enabled and encouraged third party development. The complementary production was a sign of the future and also a sign of the threat facing IBM, imitability.

**Attack of the clones**

The openness allowed those who saw the potential of the market enter with relatively low barriers to entry with regards to the knowledge required for development. This was to encourage a raft of IBM clones to attempt entry into the lucrative PC market. Produced by Columbia Data products, the first IBM close appeared only a year after IBM first shipped their first PC\(^6\). More were to follow but possibly none more significant than the Compaq which was announced in 1982 and due for release the following year\(^7\).

**Demand side trends**

IBM had an established business customer base and reputation for business ready machines and therefore this demographic provided the main driver for sales growth in the early phase of the PC industry. Contributing to Sales was a small proportion of non-business consumer sales, mainly early adopters. Sales of the PC grew at an astronomical rate over a period of two years.

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\(^6\) Ichbiah D, Knepper, S: The making of Microsoft 1991

\(^7\) Ichbiah D, Knepper, S: The making of Microsoft 1991
Emerging value chain - 1984

As well as IBM PC and IBM clones, Apple machines were present in the PC space, competing primarily on the basis of performance and efficiency, prices were high and general consumer knowledge was low. The shift in consumer preferences that would drive the further disaggregation of the PC industry had not yet taken effect.

The emerging structure of the industry began to take shape, evolving not in a vertically integrated fashion as the mainframe business before it, but in a horizontal disintegrated structure; the linkages between activities cultivated by market interaction rather than internalised administrative mechanisms. Within this horizontal industry structure a value network (Porter, 1985) was emerging where industry participants collaborated and coordinated activities beyond their traditional firm boundaries driving the improving performance of the PC.
The competitive climate intensified as firms entered across the value chain. IBM remained the dominant actor in the industry and dominated market share amongst its direct competitors. The firm still remained highly integrated in its other areas of business, particularly in the Mainframe segment of the computing industry. The growth of hyper competition coincided with the first signs of IBMs loss of architectural control over the PC platform.

Perfect Mobility

IBMs position as principal coordinator of the technological development or the PC was based on their ability to control the relationship of the other significant parties involved in the development of the PC ie. Microsoft and Intel. To date IBM had enjoyed the leadership it had assumed, using the Intel microprocessor as a primary differentiator. The signal of IBMs weakening position was soon to be marked with the release of a Compaq PC in 1983 that integrated the Intel 8088 processor; the component that previously differentiated it from its competitors.

By 1983 Microsoft enjoyed an install base of 1 million, as a de facto partner in the development of the PC platform and owner of the O/S it was in a strong position, strengthened by developing software that leveraged the natural synergy between the O/S and the software. This effectively locked out most
other software which wasn't compatible with the MSFT O/S. Despite having co-developed the follow up to the original DOS O/S IBM was the dependent participant in the relationship and the path dependent capability.

Synergistic Specificity
Sensing MSFT's dominant position, IBM embarked on the development of its own O/S that would shift the O/S from command led functionality to a graphic & icon led GUI functionality, their attempt, named Top View was abandoned within several months of conception and IBM turned back to MSFT because they were “much smaller and easier to deal with” working with them to provide an advanced operating system that would manifest as Microsoft windows.

By 1986 IBM had sold over 1.2 million machines and had a range of PC that continued to grow and a worldwide brand that was still a household name.

<table>
<thead>
<tr>
<th></th>
<th>IBM</th>
<th>Compaq</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>43.00%</td>
<td>16.50%</td>
</tr>
</tbody>
</table>

Figure 10 – US PC Market Share. 1985

Industry disintegration
The 43% market share achieved against a backdrop of an industry that was becoming even further disintegrated, competitive and mainstream. New forces were emerging as the diverged technical leadership once shared by IBM now was shifting towards Intel and Msft, who in the pursuit of greater adoption of their technology made it widely available for manufacturers and consumers. The time when an IBM logo sold a PC were slipping away and instead the WINTEL combination drove demand and commanded the perception of performance in consumers minds.

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An Industry Unbundled – IBM and the unbundling of the Personal Computer industry
Cass Business School
Damola Timeyin, 2008

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Architectural control continued to slip away from IBM, such was the growing strength of its direct competitors attempts to wrestle back control failed. Notably when IBM redeveloped a standard interface for the motherboard IBM 16 bit computer bus IBM PC AT was replaced by IBM's Micro Channel Architecture MCA in 1987. Within a year the “gang of nine”\(^9\) direct IBM competitors developed an IBM compatible computer bus known as the Extended Industry Standard Architecture (EISA)\(^10\) which was also backwards compatible and was well adopted. This alone would not destroy IBMs last point of control but it would erode its influence and demonstrate clearly that IBM no longer could dictate the technological trajectory of the PC.

Emergence of standards
WINTEL (An Acronym combining WINdows inTEL) and became the de facto industry standard for PC O/S and CPU.

The industry was now fully fragmented and horizontal. New and existing firms becoming more focused and less integrated. IBM at this point was loosing market share (10% US market share) and had ended the co development relationship with Microsoft\(^11\) who went on to develop and launch windows independently in 1992.

<table>
<thead>
<tr>
<th>1995</th>
<th>Compaq</th>
<th>Packard Bell</th>
<th>Apple</th>
<th>IBM</th>
<th>Gateway</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12.20%</td>
<td>11.30%</td>
<td>11.10%</td>
<td>8.30%</td>
<td>5.10%</td>
</tr>
<tr>
<td>Dell</td>
<td>4.60%</td>
<td>4.50%</td>
<td>3.60%</td>
<td>3.50%</td>
<td>2.40%</td>
</tr>
</tbody>
</table>

Figure 11 – US PC Market Share. 2000

The complexity of MSFT and Intel's products could not be matched by IBM however IBM began focusing more seriously on developing their capabilities

\(^9\) Ast research, Compaq Epson, HP, NEC Olivetti Tandy WYSE, Zenith Data Systems
in both microprocessing and software development. Although it would not have been feasible to compete directly with WINTEL in their respective areas of strength however developing the capabilities were deemed to be a wise strategy for strengthening future market position.

Consumer preference and clockspeed

Non-business consumption of the PC was steadily increasing and with it the diversity of demands and the pressure on price performance. The IBM PC was now retailing between $1600 - $2700.\(^{12}\) Margins for assemblers such as IBM were squeezed as the industry dynamic and power shifted to the component manufacturers whom commanded greater importance in the industry as assemblers competed on price and required more from their suppliers who were able to charge a premium for this necessity.

At the same time the rate at which technology was developing would increase the ferociousness of competition at assembly level as they sought to meet the needs of demanding business and non business consumers.

As the industry de-fragmented IBM took an increasingly vertically

\(^{12}\) Internet News - http://www.internetnews.com/bus-news/article.php/3445951
disintegrated approach, adapting their business model to go direct to consumers and developing components and software across the value chain but acting as suppliers for other vendors, such as Apple\(^\text{13}\).

IBM switched its focus to using its existing capabilities in the Laptop PC space and developing new capabilities in software development and microprocessing striking agreements to fledging Apple to provide IBM manufactured PowerPC CPU’s and develop its OS2 operating system for the Apple Mac. At the same time IBM retracted from its desktop computer business closing plants in and withdrawing the desktop from Europe\(^\text{14}\).

The Decline

Between 1995 and 2004 IBM would continue to recede in market share, making way for former IBM clones that fed on the WINTERL standard and competed increasingly on price. The IBM ThinkPad though successful for some time began to follow the same route as the desktop PC, falling in price experiencing reduced margins and loosing market share to more nimble competitors, the final chapter ending with the protracted transfer of IBMs Laptop business to Chinese Manufacturers Lenovo for $billion in 2004.

<table>
<thead>
<tr>
<th>Market Share</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dell</td>
</tr>
<tr>
<td></td>
<td>19.10%</td>
</tr>
</tbody>
</table>

Figure 13 – US PC Market Share, 2000

\(^\text{13}\) Software Magazine - [http://findarticles.com/p/articles/mi_m0SMG/is_n6_v13/ai_13728379](http://findarticles.com/p/articles/mi_m0SMG/is_n6_v13/ai_13728379)

IBM had begun as figure heads but finished at the tail end of the PC industry unable to replicate previous successes in computing in this PC era. The industry had changed around them from vertically bundled to horizontally unbundled and hyper competitive, IBM changed also, after the experience of operating in an industry that seemingly punished their inability to adapt their vertically integrated business model they continued in their mainframe business and repositioned themselves downstream in systems and business consulting once again providing a vertically integrated proprietary business model that served them so well in the pre PC era.
Appendix 2 - Innovation Typologies (Henderson and Clark 1990)

**Radical innovation**- Essentially establishes a new dominant design and hence a new set of core design concept embodied in components that are linked together in a new architecture.

**Incremental innovation**- Refines and extends an established design. Improvement occurs in individual components but the underlying core design concepts and the links between them remain the same.

**Modular innovation**- innovation that changes only the core design concepts of a technology and innovation that changes only the relationships between them.

**Architectural innovation**- changes a product's architecture but leaves the components and the core design concepts that they embody unchanged, importantly the scientific and engineering knowledge at component level remains the same.

Appendix 3 – AIDA Definition

- **A - Attention (Awareness):** attract the attention of the customer.
- **I - Interest:** raise customer interest by demonstrating features, advantages, and benefits.
- **D - Desire:** convince customers that they want and desire the product or service and that it will satisfy their needs.
- **A - Action:** lead customers towards taking action and/or purchasing.

Cited: marketing Profs, 2008,
Appendix 4 – Harrigan’s Vertical Integration strategies

**Full integration** –: Fully integrated firms buy (or sell) all of their requirements for a particular material or service internally.

**Taper Integration** –: Taper integration firms rely upon outsiders for a portion of their requirements. They produce or distribute a portion of their requirements internally but purchase (or sell) the remainder through specialised suppliers or distributors.

**Quasi – integration** -: Quasi – integrated firms do not own 100% of the adjacent business units in question, but they may consume (or distribute) all, some, or none of the outputs (or inputs) of adjacent, quasi integrated units (without fully owning them) can be highly variegated, and there are certain investments where firms cannot fully control the joint venture, franchisee or otherwise quasi integrated unit.

**Contracting** – Contracts require careful drafting of documents delineating responsibilities but no internal integration. Because virtually every function that firms perform internally could also be provided by outside suppliers, fabricators, wholesalers, and marketing representatives, a knowledge of how to use this network could be crucial when the firm must disintegrate or to go to the external market.