# 4 Developing the New Product Design

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The early life of new markets is something of a muddle. Numerous entrants arrive in a relatively short space of time, and many of them champion different product architectures, or different variants of one or more of these product architectures. Common sense and a quick glance at the well-established markets that we are all familiar with suggests that this state of affairs does not persist forever, or possibly even for very long. There are many fewer fundamentally different types of cars now on sale than there were 90 or 100 years ago, and far, far fewer car producers. What is particularly interesting about this transition from a very new to a well-established market is the fact that it is marked by a major shakeout of producers and, at pretty much the same time, there is a major shrinkage in the range of products available on the market. In fact, as we shall see, this shrinkage in product variety is what precipitates the shakeout amongst

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producers. One way or the other, the outcome of this consolidation process often comes to define the market: it yields a well-defined, widely recognized product, and (typically) a small set of associated producers who form the backbone of pretty much everything that happens thereafter.

## Typewriters

'Clunky' is a word which might have been devised solely to apply to typewriters. The first clunker to go on sale was the Remington Rand No. 1, in 1874. This rather large device came on its own platform, it had only upper case letters, no tabs and, since the keys struck the paper inside the machine, one could not see what one had typed (there was a four row lag before something appeared). In the hands of an expert, it was apparently capable of 75 words per minute, a typing speed which very few modern typists would choose to brag about. With a high price, it is hardly surprising that only 400 of these things were sold in their first 6 months on the market. There were many attempts to remedy the various design challenges posed by the clunkiness of the No. 1. The Remington No. 2, for example, which arrived on the market in 1878, had a double typeface and shift keys, while the Yost Caligraph No. 2, introduced in 1881, offered upper and lower case letters, but on two separate keyboards. The Crandell, the Hammond and the Hall all followed in short order, each with a different design for how the type keys should strike the paper. The big breakthrough, however, came with the Underwood No. 5 (one wonders whatever happened to the Underwoods Nos. 1-4), which placed the type bar in front and in the centre of the machine, making visible type possible for the first time and, therefore, allowing the typist to correct his/her

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typing mistakes as s/he went along. This particular design was so obviously superior to its clunky predecessors that it claimed about 50 per cent of the market by 1920. Underwood, L.C. Smith, and Royal were the leading manufacturers—in total, about ninety manufacturers had entered (and, for the most part, exited) by 1909—in what became a relatively highly concentrated market.

The subsequent history of this industry was one long drive to reduce clunkiness, and it involved, amongst other things, the development of smaller—and ultimately portable—machines, and electric typewriters (which brought famous names like IBM into the business). However, electric or portable, these developments did not displace the basic typewriter: whatever it was, it still performed pretty much the same function as it had in the early days of the Underwood No. 5. What insured that the names 'Underwood', 'Smiths', and 'Royal' (much less the more exotic 'Yost') no longer register on the consciousness of most MBA students is that these original typewriters—and virtually all of their marginally less clunky successors—were ultimately displaced by PCs, machines that do typing plus about 1001 other things. In fact, nowadays we 'word process' rather than just type, something which gets done on screens and printed off on other machines (and seems to require the assistance of extremely irritating cartoon characters who appear when they are least wanted and offer what they erroneously regard as helpful advice).

The development of the PC, however, had much in common with that of the typewriter. Arguably, its most direct antecedent was the IBM Magnetic Tape Selectric, introduced in 1964, which brought digital technology to typewriters and made text editing possible. By the early 1970s, stand alone 'word processors' began to appear, produced by Wang, Xerox, ITT, Olivetti, and more than fifty other firms (including Exxon, who wished

to diversify out of the oil business). All told, more than 4m. of these things had been sold in the United States alone by 1984. They were, however, largely destined for the scrap heap (or, like some of the original typewriters, for display cabinets in industrial museums). The first PC was (arguably) the Altair 8800, which started out as a kit sold for $395 to enthusiasts (who else would buy it?). Its sheer clunkiness stimulated a generation of tinkerers to try to do better, and many of them did. By the early 1980s, more than thirty firms were making personal computers, including Apple, Commodore, Tandy, Heathkit, and many others. The landmark event in the history of PCs, however, was the introduction of the IBM PC in 1981. Although it was very clunky by the standards of the laptop which I am currently working on (which is, itself, very clunky compared to those now available on the market), the IBM PC effectively defined what a 'personal computer' was, and it generated a huge shakeout of alternative products and producers in the sector. With the exception of Apple (and, perhaps, one or two others), PCs after the IBM PC were either IBM PCs or clones of IBM PCs. The architecture of PCs has come to be defined around its microprocessor (typically made by Intel) and associated operating system (usually Microsoft's Windows), things that have long since passed out of the control of IBM. But, this architecture was there in the IBM PC, and, by and large, we are still stuck with it.

One other thing that we seem to be stuck with is the keyboard arrangement that we use to word process, something which was devised by Christopher Scholes, the former newspaper editor turned inventor behind the Remington No. 1. He apparently initially laid out the keyboard alphabetically on his early machines, but found that the keys kept jamming. The trick, he decided, was to insure that frequently used keys were located far apart from each other, and that produced the QWERTY keyboard which



we are all familiar with. The really interesting thing about the QWERTY keyboard, however, is that we are all familiar with it more than 100 years on. There have been countless apparently less clunky alternative keyboard arrangements that have been proposed over the years. Indeed, many people believe that the so-called Dvorak keyboard, introduced in 1936, is more ergonomically efficient (it distributes frequently used letters more evenly between both hands, and loads them more heavily on to the stronger fingers). And yet, long after the rationale for its introduction has been superseded by technical advance (PCs do not use keys to strike rolls or sheets of paper), we are still clunking away on QWERTY style keyboards.

## The Importance of Making a Choice

These several stories all have a common theme, and it is one that we want to flesh out in what follows. The nature of competition in very young markets is as much between firms as it is between different product designs, different product architectures with different ranges of peripheral characteristics: different types of typewriters, different PC architectures, different keyboards. In all cases, competition between these different product designs seems to have come to an end with one particular design emerging as the market standard: the Underwood No. 5, the IBM PC, the QWERTY keyboard. The champion of the winning design usually ends up dominating the industry (together with one or two of its quickest and most adept imitators), and the widespread adoption of that design by consumers usually signals the exit of most of the other would-be product design champions. Out of muddle, it seems, comes some kind of order.

To understand why and how this happens, it is necessary to recall why such a wide variety of product variants appears in



new markets in the first place. As we have seen, when a new technology spins off from a technological trajectory and bursts out into a market, it typically does so in a relatively unformed, underdeveloped state. The product variety that we observe being brought to market is the mechanism by which suppliers and producers on the one hand, and buyers and users on the other, explore its possibilities. It is one thing to understand a new technology, and quite another to translate it into a product that works; it is one thing to build a prototype and quite another to manufacture it efficiently in large volume at low cost; it is one thing to know that a new product exists, and quite another to know what to do with it. What is more, this kind of information is often experiential and tacit in nature: experiential because sometimes the only way to learn about something is to do it or to try to use it for something, and tacit because some of the knowledge that one gains by doing so is hard to communicate to others who have not had the same experience (and sometimes even to those who have). As new products with new architectures or new characteristics appear on the market, suppliers learn more about what can be done with the new

technology and how it can be done economically, and buyers learn more about what the products embodying the new technology can be used for and how valuable they are.

Needless to say, this process of experimentation can be quite involved, depending on the number of suppliers, product variants and consumers involved. The time a market takes to evaluate the possibilities inherent in a new technology depends on how complex the new technology is, and on how much useful information about it can be generated and shared by suppliers on the one hand, and buyers on the other. When the most valuable information about how to manufacture a new product or how to use it is experiential, would-be suppliers must make, and

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would-be consumers must use, one or more variants of the new product for themselves in order to learn about its possibilities. When most of the useful information generated about a new technology is tacit, then suppliers and buyers will have difficulty in sharing what they have learned (even if they wanted to), meaning that pretty much everyone will have to learn about it for themselves. In both cases, it seems clear that it will take longer for a market to evaluate the possibilities thrown up by a new technology than it would be if information was available by simple inspection, or if it could be obtained by looking it up in a textbook. And, this process will take longer when there are many possible uses and different types of buyers with different needs or preferences who could use the new product than if there were a single big, leading user who thoroughly understands the new technology.

Behind any process of experimentation is a need to reach a decision or make a choice, but it is not immediately evident why producers and consumers actually need to choose between the different product variants which the possibilities opened up by the new technology presented to them. For a start, most consumers are different, and it would, therefore, seem that the more product variants which are produced the better off everyone will be. There are, however, at least three reasons why it is in the interests of both consumers, on the one hand, and producers, on the other, to make a choice between the different product variants which are generated by the rush of entry to the market. That is, there are at least three reasons why it is in (almost) everyone's interest to limit the range of products available and concentrate on one (or possibly more) standard versions of the new product.

The first gain from standardization arises on the supply side. Early product offerings are typically made on a small scale or on

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a prototype basis, and unit production costs are, therefore, high. In the earliest stages of the market, this is not a problem as costs are unlikely to be a major source of competitive advantage for any producer. There are, after all, few buyers, their needs are poorly defined and in a state of change, and they are typically not very price sensitive. Further, in a market where product designs are continually changing, there is always going to be a much greater premium placed on manufacturing flexibility than on manufacturing efficiency. However, all of this flexibility has an opportunity cost: manufacturers who only build prototypes or who keep switching product specifications do not have a chance to move down learning curves or exploit potential economies of scale. It is, of course, possible that production can continue on a small batch basis indefinitely, but if that happens it is likely that the market will never become anything more than a high priced market niche. Large mass markets are populated by consumers who are more price sensitive than early, pioneering users, and if the new market is to attract these buyers, prices will have to come down. This means that costs will have to come down, and that will almost certainly require a switch in production methods. Economies of scale and learning curve advantages can only be exploited when product standardization has occurred, since they involve making the same product over and over again in large volume year by year, and this creates strong incentives to standardize.

A second gain from standardization arises from the fact that many goods and service are consumed with other complementary goods and services, and, indeed, sometimes they have no value at all in the absence of such complements. Having a petrol-burning car is not of much use if there are no petrol stations; CDs are next to useless without a CD player and a set of speakers. The problem with new markets is that it is very difficult to

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organize the provision of complementary goods until one knows exactly what they are supposed to complement. Similarly, some new goods or services require new, specialized inputs to produce, and, again, it may be difficult to organize the supply of such inputs until it becomes clear to potential suppliers what 'the' product is (or is going to be).

In this connection, it is worth making a distinction between (what one might call) *generic* complements (or inputs) and *specialized* complements (or inputs). Generic complements are those which may be

specialized to the new market but will complement almost any of the new product variants on offer. No matter what propulsion method one chooses, one is going to need car tires and car seats; every typewriter, whatever its keyboard layout, requires paper of a certain size, typewriter keys, and inked ribbons. Once it becomes clear that the new market will become established, suppliers will have strong incentives to produce generic complements (or inputs), and this can happen well before any choice is made between the various particular product variants being developed. Specialized complements (or inputs), on the other hand, must be customized to a particular product variant, and no supplier will have an incentive to produce them until it becomes clear which product variant the market will choose. Potential petrol station owners will not be willing to set up and service car owners no matter how good the potential car market looks until it is clear that cars will be powered by internal combustion systems that work by burning petrol; music listeners will wish to be sure that music will be produced on CDs rather than as vinyl records or on cassettes before they invest in a CD player, and, if more than one type of CD is available, they will wish to wait and see which one is likely to be established before investing in complementary equipment.

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A third gain from standardization occurs when goods generate value only if they are consumed by several people. In this case, their value to any individual consumer is likely to depend on just how many other people also purchase and consume the good, and this, of course, means that it is important for as many people as possible to choose the same product variant. Thus, for example, the value of a telephone depends on how many people you can call using it; the attractiveness of a particular type of video cassette recorder (VHS or Betamax) will depend on whether there is a good rental library nearby, and whether or not someone decides to set up such a library depends on how many other people in the neighbourhood own (VHS or Betamax) video cassette recorders and will want to rent videos. Such effects are typically called 'network effects', and if they are to be realized, then the product choices of many different people must be coordinated, for if they are to enjoy network effects, all consumers must all end up choosing the same thing. This is hard to do if there are many different but incompatible variants of the same basic product on the market.

One way or the other, then, the simple economics of early market evolution suggests that a choice will have to be made between the various product variants that entrants bring to the new market. That is a product standard must be set, or, in the language which we are going to be using, a 'dominant design' must be agreed on if the market is to develop and prosper. It is in the nature of a standard that only one (or perhaps just a very few) standards will be set in a market: they are, after all, designed to reduce (or at least bring some order to apparently excessive) product variety. A dominant design is, therefore, in the nature of monopoly design, and, as with all 'natural monopolies', it inherently limits the number of alternatives that can survive. It follows, then, that when a dominant design is

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established, those firms who are not producing the winning design must either switch to producing that design or exit from the market. Monopoly designs do not necessarily create monopoly market structures (unless the owner of a design has a proprietary hold on the technology from which it emerged), but the need to realize economies of scale will almost certainly limit the number of producers who can viably operate on the market, even when they are producing the same design.

## What Exactly Is a Dominant Design?

Given the profound consequences that it has on market structure, it is clearly worth trying to be more precise about what exactly a dominant design is, and why it comes into being in most new markets. One way to identify something is to identify what it does. Dominant designs play three roles in a new, evolving market, roles which (not surprisingly) are bound up with the reasons why a standard emerges in the first place. Let us consider each in turn.

Dominant designs are, first of all, a 'consensus good'. They are effectively a compromise between the different needs or preferences of many different users—current and potential—of the good. This compromise sets out a vision of what the good is and what it is to be used for; it sets performance standards and expectations which will help consumers formulate exactly what their reservation price for the product is. Amongst other things, this means that it is likely to play a major role in transforming the inchoate demand of consumers into something much more articulated and specific. Further, setting a product standard reduces consumers risk in two ways: it helps to insure that people get what they think they are going to get from the product when

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they buy it, and it increases the likelihood that they will be able to take as full advantage of network effects as possible. Consensus almost always involves compromise, and this means that the dominant design is likely to be the one which appeals to a broad range of needs, and probably also to consumers who have yet to become active in the market. Dominant designs do not always reflect the full possibilities of the new technology, and, for this reason, they often disappoint early pioneering consumers and suppliers.

The second role that dominant design plays is in defining interfaces between the new product and various complementary products. They are, if you like, a 'nexus good' which both identifies the specific complementary goods (or inputs) which need to be assembled to produce the package that consumers want, and describes how these complements get hooked in with the core good. In part, this arises because the choice of a dominant design is often effectively a choice of a particular product architecture. Since different architectures are likely to present different interfaces with complementary products, settling on a particular architecture is usually a pre-requisite for determining the exact nature of the complements that are needed. This, in turn, must occur before suppliers of these complements will be willing to enter the market.

The third role that dominant designs play is to order the various characteristics from which the good or service is constructed. At its simplest, this means selecting which characteristics are core characteristics and which are peripheral. Indeed, some people define a dominant design simply as a set of core characteristics organized in a particular way. In a sense, this means that a dominant design is a 'platform good'; that is, that it is basically a generic template. The broader this platform, the more specific product variants can be constructed from by

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adding peripheral characteristics to the specific architecture of the good; that is, the easier it will be to customize the good to the specific tastes or needs of numerous different consumers. As one might imagine, there is often a trade-off between the breadth of a platform and the ability of that platform to do any one specific thing efficiently. Broad platforms are necessary in order to broaden the consensus behind a particular dominant design, but they may not meet certain kinds of needs very well. As we shall see, one implication of this is that when a broad, single dominant design conquers a market, it can create niches for much more specialized products that meet very particular needs particularly well.

## Computer Operating Systems

An example might help make all of this more transparent. Computer operating systems typically perform two functions. In the first place, they manage the resources of a computer, allocating time and memory to different users or different applications. They are also the interface between the computer hardware (principally the chip) on the one hand, and programmers and users on the other hand. Different operating systems are used for different computers, and we will focus mainly on systems designed for desktop PCs (other operating systems have been designed for networks, mainframes, and so on). To operate effectively and efficiently, operating systems must be closely customized to the particular chip that is at the core of their computer's processing facility; to provide an attractive base for programmers, they must provide application programming interfaces (APIs) that permit a particular application to use features of the underlying software platform efficiently; and to be

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attractive for users, operating systems must be easy to use, provide many applications and easy access to other computers (e.g. via the internet).

The gains to standardization across operating systems are enormous. For a start, their development costs are high (Microsoft's MS-DOS apparently had cost at least $20m. to develop, while by 1996 Microsoft Windows cost $40-60m. and Windows NT had cost £170m. to develop), and they are largely sunk. Variable costs (e.g. cost of training users, manufacturing costs, documentation and customer support costs), on the other hand, are typically very low. This, of course, means that, like any natural monopoly, operating systems display sharply falling unit costs. Further, all operating systems come fully equipped with a wide range of more or less subtle faults (slanderously known in the trade as 'bugs'), and a considerable amount of time must be spent ironing these out. This effectively forms the basis of a substantial learning curve which separates the initial design and production of an operating system from the version which comes into widespread use. Since it is rarely sensible to travel down more than one learning curve for a particular type of product, this too means that there are substantial cost efficiencies in selecting just one operating system to go forward to users.

Second and no less important, there is a positive feedback cycle which pushes users and programmers towards a single, common operating system. Consumers choose operating systems largely because of

the number and range of applications they offer, while applications programmers write for operating systems that give them access to the largest number of users (because APIs differ across operating systems, the same application usually cannot run on different operating systems). Hence, the more users that select operating system A over B, the more applications programmers will write for A rather than B. Since

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this means that more applications will be written for A rather than for B, these actions by programmers will reinforce users preferences for A rather than B, and A's market share will increase. This, in turn, will lead to more applications being written for A, and so on.

Under these circumstances, it is no surprise to discover that there has almost always been a dominant design for desktop PC operating systems (and their associated microprocessors). We all are familiar with Windows; indeed, most of us more or less automatically regard operating systems as something that throws up an ordered sequence of choice boxes, and we organize our life in a series of files and folders that are easily accessible by clicking on one cute icon or another. However, it is worth recalling that Windows was not the first desktop PC operating system ever developed, and Windows 95 was not the first Windows product offered by Microsoft. The Altair 8800 had a system devised by a young Bill Gates and Paul Allen that used a programming language called BASIC. Other early PCs had customized operating systems based on BASIC or FORTRAN-80, and, needless to say, in those early days buying a new PC usually meant rewriting all of one's files for the new system ('enthusiast' seems like exactly the right label to use for these early users). Eventually some semblance of order arrived with the IBM PC. It came with an operating system written by Microsoft called MS-DOS which used Intel's 8088 processor, and it was made available to other PC manufacturers (greatly facilitating the rise of the IBM clone). Together, the IBM PC and MS-DOS displaced a number of previous operating systems, so much so that by the mid-1980s, MS-DOSs market share was (reputedly) above 80 per cent.

MS-DOS had many attractive features, but it was largely text based and it was not exactly the most user-friendly operating

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system that one could imagine (particularly for unsophisticated users who were not anxious to improve their working knowledge of programming languages). In the middle 1980s, Microsoft developed an early version of a graphical user interface system (itself based on a system first used in the Apple Macintosh), which they called Windows. It was originally designed to run on top of MS-DOS and was customized to use Intel's 80286 and 80386 chips. For Microsoft, the decision to back Windows as a stand alone operating system was a major gamble, and, in the run up to the release of Windows 3.0 in 1990, they withdrew from a joint project with IBM which was designed to produce a long term successor to MS-DOS (the product of this work was OS/2, released by IBM in 1988). The pay-off from this choice came with the success of Windows 95, which became the dominant operating system very soon after its release (killing off OS/2 in the process). Despite a number of carefully managed upgrades, Windows 95 is, for better or worse, still with us in spirit (and largely in form).

Just how long Windows will be with us is, however, an interesting question. Two possibilities offer a rather different future. One is the internet. Most desktop PCs are based on the notion that the core of the computer—its memory, processing capacity and operating system—need to be located right there, on the desktop. However, the internet is itself a network of computers, and it is possible that it could be used as a computer, obviating the need for having lots of memory and operating capacity on the desktop. In that case, virtually all that users would need is access to the internet—say, through a browser like Netscape—and an operating system like Windows need not be part of that picture. A second possibility is that a programming language, like, for example, JAVA, will be developed that is not operating system specific. This would enable applications writers to write

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for all operating systems as it were, without needing to customize their application to particular APIs. This, of course, would break the positive feedback cycle that we discussed earlier, and might make it much easier for the market to support more than one (non-Windows) operating system.

## So, How Many Designs Will Dominate?

Notwithstanding our discussion of desktop PC operating systems, there is no obvious reason why there must be a single, monopoly dominant design established in a market.

As we noted earlier, the forces which press towards a single design are those which drive the product standardization process: the need to exploit economies of scale or learning curve advantages, assemble

complementary goods and exploit network effects. When economies of scale are extensive (or the learning curve is very steep), there are large gains to concentrating production on a single product design. If this drives costs and prices down, then even those consumers for whom the design is not a first choice may be willing to purchase it (this will be true at least for those for whom the price difference between the dominant design and their second choice is larger than the difference in the value they perceive between the two). Similarly, when network effects (which, after all, are a form of increasing returns on the demand side) are large, many consumers will be willing to purchase the dominant design (which offers the benefits of network effects) rather than their preferred choice (which would suit them best in the absence of network effects, but may offer little in the way of network benefits). Finally, the producers of complementary goods (or inputs) are likely to be unwilling to invest in producing them until it is clear

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that there is a market for their goods and services which is large enough to make it profitable. This may not be a major problem for producers of generic complementary goods (or inputs), but it will be a problem for those producing more specific complements.

There are, however, forces which work in the other direction. The main one is the diversity in tastes and needs of consumers. As we noted earlier, dominant designs are consensus goods, and this means that they have to appeal to a broad base of consumers. However, the more diverse are the tastes and needs of consumers, the more difficult it is to build a consensus and still leave the vast majority of consumers satisfied. Clearly, two or more groups of consumers in a very diverse population may well be willing to forego some of the benefits of economies of scale and network effects in order to get something closer to their needs, and when this is the case it is possible that more than one dominant design will survive on the market. Members of these groups may only interact with other members of their groups (in which case, they may be willing to forego some network benefits), or they may have a strong desire for a particular version of the product (in which case, they will effectively be willing to forego some of the benefits of economies of scale or make do with a reduced set of complementary goods). One way or the other, and provided that they are large enough, they may (in principle) form the basis of market which will support a particular dominant design. As numerous users of Apple computers—and its associated operating system—continue to demonstrate, it is possible to swim against the tide and still stay afloat.

A second force which tends to work against complete standardization is the self interest of producers. Although it is in their interests for a dominant design to emerge, each producer of every candidate design is likely to feel that theirs is the design

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which ought to dominate. This means that each will have some incentive to persist as long as possible with their own proprietary design, turning the standardization process into something of a 'war of attrition'. This willingness to persist with an apparent loser may just be a manifestation of the sunk cost fallacy, but if the rewards to championing the victorious dominant design are large (and typically they are very large), it will pay to remain in contention as long as possible. Needless to say, the more would-be champions there are who feel this way, the longer it is likely to take for a winner to prevail. What is more, some of the luckier losers in the battle to establish a standard or dominant design may at least end up colonizing a niche in the new market that will support profitable operations (although on a more modest scale than is likely to be the case for those producers involved with what becomes the dominant design), and this too may make them more willing to hang on and fight it out to the bitter end. Again, one thinks of Apple computers as a loser in the personal computers standards race which has, nonetheless, found a niche in which to survive and, indeed, prosper.

Thus, there is no necessary reason to believe that a single dominant design will always emerge in every new market (and, therefore, there is every reason not to rewrite the history of particular markets as if only a single design had come to dominate). Several designs may survive and coexist, and, when this happens, it ought to be possible to identify each surviving design with a distinct segment of the using population that supports it. The market for professional video recorders, for example, differs noticeably from that for personal or home use, and has, as a consequence, supported a different product standard. Similarly, there are disposable and single use cameras, instamatics, single lens reflex cameras and digital cameras all coexisting in the same market. And of course, not only do Apple's Macintosh

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operating system and Linux coexist with Windows (well, sort of) in the desktop PC market, but there are different operating systems for workstations, mainframes and so on. In all of these cases, the claim that a single dominant design prevails oversimplifies a more complex reality, even if it does point to the basic truth that the current range of products available on these markets is much, much narrower than it could, in principle, be.

## Two More Complications

As we have just seen, there are circumstances where it can be seriously misleading to simply assume that there will only ever be one, single dominant design in a particular market. There are at least two further circumstances where an uncritical search for a single dominant design may be seriously misleading.

The first circumstance arises when the product under consideration is very complex. As we noted in the last chapter, products are ordered collections of characteristics. Each product has an architecture (or basic design), and, needless to say, very complex products can have very complex architectures. In many cases, a very complex design can be (and usually is) simplified into a series of 'modules', each of which has its own architecture. A car, for example, has an engine, a body, a braking system, a power transmission system, and so on. The components of each of these modules can potentially be put together in numerous ways; that is, each can have many possible architectures which are consistent with the overall product architecture. And, of course, the different modules can, in principle, be put together as a car in several different ways. When there is a lot of freedom in module design or inter-linkage, strong incentives will exist—for all of the reasons discussed above—to standardize on

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a particular design for each module (or, at least for those which display massive economies of scale in production, and so on) and on a particular inter-module architecture. Thus, very complex products may have a dominant design which essentially consists of a series of (sub)dominant designs linked together by a particular architecture. In this case, 'the' dominant design could as easily refer to the overall architecture as to the design of any one or all of the particular modules linked by that architecture. Since it is unlikely that the design of different modules will develop—or standardize—at the same rate, one may well observe a sequence of important innovations in particular modules that occur well after the overall system architecture has been established. In this case, it may be more accurate to recognize the existence of dominant (sub)designs in particular modules that are nested within an overarching dominant design that describes the product as a whole.

The second circumstance arises when it is not possible to unambiguously identify core and peripheral characteristics, a problem which often arises as the nature of the product evolves over time. A dominant design establishes a ranking between core and peripheral characteristics, and sets out the interface which identifies how the latter can be added to the former to differentiate the core good. As time goes on, however, some peripheral characteristics become very popular and, in effect, no longer become a basis of differentiation or customization; they are present in all variants of the product offered to the market because all customers insist on having them. This apparent migration of peripheral characteristics into the core can easily be confused with changes in the core good itself; that is, with a change in the dominant design. However, peripheral characteristics are, by definition, those characteristics whose presence or absence has no implications for the basic product design or for

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any core characteristics. The fact that they appear to be part of the core is just the consequence of a functional upgrading of the core good. Modern cars have air bags, car radios, and come in many colours, but that does not mean that they are necessarily fundamentally different from the Model T. Computer operating systems often come bundled with word processing applications, spread sheeting, internet browsers and a variety of other applications that almost no one wants or knows how to use, but this does not mean that they differ in any fundamental way from operating systems with the same architecture designed for the same microprocessor that come without all the frills.

Needless to say, these two observations means that it is not always easy to identify what the dominant design is in any particular market, and some people have (in effect) used this observation to argue that there is no such thing as a dominant design or that the concept of a dominant design is not a helpful way to think about market evolution. This may be so, but in a sense it misses the point. Dominant designs are an important part of the story of the evolution of new markets because they are the result of a process of standardization which drastically reduces product variety. This drastic reduction in variety tends to be associated with major changes in the structure of the market (i.e. the shakeout amongst early entrants), and, as we shall see, in the nature of competition in the market. Further, the product standards which emerge at this time tend to persist, locking firms and, indeed, all participants in the market, into particular ways of thinking about the product and the market. It matters little in all of this whether only one single design is established or several, or whether (sub)designs are standardized at different times and in slightly different ways from the dominant product architecture. What matters is that what is left in the way of viable designs is much less than was present at the beginning of the

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market when the new technology first pushed through the technological possibilities upon which everything is founded.

## Cars (Again)

Our discussion of the US car industry in the last chapter suggested that the arrival of the Model T was a seminal event in the early history of the industry. Most people regard it as the dominant design which identifies what a car is, and, therefore, hold it responsible for launching what became the 'new economy' of the twentieth century. However, as we have also seen, innovation continued to occur in this sector (at least for a while). The interesting feature of most of the post-Model T innovative activity is that it centred the development of particular components or sub-systems: the Cadillac's V-8 engine was introduced in 1914, the closed body design was pioneered by Hudson in 1926 (following the all steel enclosed body first seen in 1923), the electric starter was produced by Dayton Engineering Laboratories in 1912, hydraulic braking systems were introduced by Duesenberg in 1922, independent front wheel suspension was introduced by GM in 1934, and so on. Indeed, '. . . by the early 1920s, product innovation had largely rendered obsolete the novel features of the Model T, which itself had undergone significant changes since 1908. Its magneto integrated into the flywheel, planetary transmission and brakes were all targets for criticism when it was finally retired. Furthermore, four cylinder engines had largely been replaced by six cylinder ones, and closed bodies . . . were widespread. Indeed, the Model A that replaced the Model T bore little resemblance to its famous forebear . . .', except, of course, that the overall architecture of the Model A was as recognizably like a car as the Model T's was.

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Each of these innovations transformed some component or sub-system that is part of the make up of a car, and each of these innovations stamped their character on that component or sub-system in a way which, 70 or 80 years later, seems almost permanent. The closed body design was not only a major innovation, it also became the template from which car bodies subsequently came to be made. Hydraulic brakes, front wheel suspension, the V-8 engine and other innovations all had more or less the same effect. Considered at the level of a particular component or sub-system, each has a legitimate claim to be a dominant; considered at the level of the car overall, none is 'the' dominant design which defines what a car is and how it is to be used. Of course, innovation at the component or sub-system level ultimately has an impact on the overall design of a car, meaning that each of these innovations had subtle effects on the (very gentle) post-Model T evolution of the over-all architecture of cars. But, that is not the same thing as saying that major developments in component architecture lead to major developments in the overall architecture of cars.

## Dominant Designs and Niches

It is worth a short digression to explore a conjecture that is sometimes made about what drives fragmentation in markets. In particular, some people have argued that the process of niche creation in a market is essentially driven by the same standardization process which produces a dominant design. That is, dominant designs, and the mass markets that they serve, create their own niches.

The argument runs as follows. Dominant designs are, as we have seen, consensus goods, meaning that they are designed to

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appeal to a broad range of consumers. However, not every consumer will want to buy into the consensus, not every one will wish to be part of the great majority. Although there are gains to being part of the crowd (lower prices, access to a full set of complementary goods and the benefits of network effects), following the crowd also has its drawbacks. In particular, those individuals whose needs are noticeably different from the needs of the majority of consumers may be poorly served by the dominant design, and at least some of them will be willing to pay for something different. Indeed, there are an enormous number of (particularly fashion) goods which exist mainly to cater for the desire of some consumers to be different—or at least to appear to be different—from everyone else in certain ways.

Whatever the moral rights and wrongs of this, the observation suggests a further consequence of establishing a dominant design. If that design defines the mass market—the product which most people consume in one form or another—then it must also, at the same time, define the set of things which could be made and used by certain consumers, a set of products which differ from the dominant design. To put the matter another way, a dominant design will offer a platform for further differentiation based on adding various peripheral characteristics in various ways (think of the number of different cars that you can construct from a single base model by perming the various options offered by your friendly local dealer). Many of those consumers who wish to be different or who have quite different needs from the

majority may be able to satisfy their needs simply by constructing a product variant based on the platform provided by the dominant design using an unusual combination of peripheral characteristics. However, not all needs can be satisfied in this way, and there may also exist a demand for a very specific alternate goods, based on a different design. If there are

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only a small number of these consumers, it is likely to be the case that the specific good that they require will be produced by specialist producers using different production methods from those used by producers of the general good (i.e. custom or craft production to order rather than mass production using an assembly line). Such pockets of resistance to the dominant design are often labelled 'market niches', and their size and depth depends both on the diversity of tastes between consumers as well as on whether small scale production methods can economically cater to these particular minority tastes.

The recent rise of micro-breweries in the United States provides a clear illustration of this point. There are huge economies of scale in brewing, and the desire to exploit them fully powered a big consolidation wave in the United States over the post-War period. Between 1933 and 1980, the number of breweries fell from 710 to 43, and the leader, Anheuser-Busch, achieved a market share of just over 30 per cent. In the process, beer in America came to be dominated by a very few national brands with a very distinct flavour—light, a bit gassy and not terribly strong—one that was rather similar across brands. In the early to mid-1980s, the industry was subject to a burst of entry by microbreweries (defined as those producing less than 15,000 barrels per year), often (but not always) selling to consumers in their own bar (known as 'brewpubs'). These brewers use handcrafted processes, expensive ingredients (they use more hops, very few added ingredients and do not use barley substitutes) to brew what they often call 'real' beer, and, for the most part, they adhere to the Reinheutsgebot (i.e. the Bavarian Purity Laws) of 1516. This beer typically has a very distinctive taste, it competes with English and German imports, sells at a premium price and serves a local community. It is impossible to see a beer like 'Anchor Steam Beer' forming the basis of a mass market in the

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way that Budweiser does; equally, it is not difficult to see how a Budweiser can form the basis of a mass market with an Anchor Steam Beer in existence catering to the needs of consumers who are not, for one reason or another, content to swig down a dozen or so Budweisers every night.

The important point is that a dominant design is not something that necessarily restricts product differentiation in a market; it does, however, guide it along certain channels, focussing it, on the main, towards peripheral rather than core characteristics. Further, while the dominant design is likely to form the basis of a mass market good, its existence can often help to identify particular niches which certain types of product variants persist, often produced and sold in a very different way from the good which embodies the dominant design. This, of course, means that the creation of market niches may be endogenous to the process by which a dominant design emerges.

## The Problem of Choosing a Dominant Design

It is one thing to understand that a dominant design needs to be established in a particular market, and quite another to get it to happen. While it may be in almost everyone's interest to make a choice between the different product variants available in a new market, not everyone on either side of the market will want to make the same choice. In fact, although everyone involved in the market will probably agree that a choice must be made, almost everyone will also want to insist that it is their choice which prevails. Needless to say, this can be a recipe for disaster.

There are at least three problems which need to be overcome.

In the first place, different consumers have different needs and different tastes, and it is extremely unlikely that the product

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variant which best suits person A will also best suit person B. Some differences between consumers are relatively easy to resolve: A and B might both agree on a product variant with a particular architecture, but differ on which peripherals they wish to see added on. In this case, a product offering that creates options for further add-ons (or customization) may be enough to get A and B to agree. In other situations, however, the disagreement between A and B will be more fundamental, involving products with quite different and incompatible architectures. Intuitively, it seems clear that the broader the consensus that can be built up around a particular product variant, the more likely it is to be selected as the dominant design. Consensus building requires finding a design that suits (or can be made to suit) as

many people as possible (which is why a dominant design is sometimes referred to as a 'consensus good'). This will obviously be less difficult to manage the more similar are consumer preferences and the easier it is to customize the product variant which is ultimately selected. Note that consensus goods are those which meet the needs of the majority of consumers, and (like the Model T) they are rarely state of the art or of the highest quality possible.

Further, network effects, if they exist, can enormously complicate the choice process. To take full advantage of network effects a large group of consumers must make the same product choice, and managing this can be difficult the larger and more diverse is the group and the more content they are with their current consumption activities. Individual consumers will be reluctant to adopt new product designs if they feel that there is a risk that another product variant might become the dominant design, leaving them stranded. Expectations are, therefore, bound to play an important role in this process: if everyone believes that product variant A is much more likely to be

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adopted than B, then they will opt to choose A rather than B even if their own personal preferences incline them towards B. No one who values network effects will wish to risk being the only consumer of B. Managing the consensus building process across a large group of consumers with diverse preferences will almost certainly be a tedious and complicated business. Indeed, it may require the sponsorship of a particular product variant by a leading producer, or by some outside party able to command the attention of consumers.

Finally, producers have an interest in which product design is ultimately selected. As we shall see, a dominant design is likely to have a profound effect on the structure and subsequent evolution of a market, and the sponsoring firm whose product is selected as the design is likely to enjoy one or more of the first mover advantages discussed earlier. As a consequence, producers are likely to compete actively with each other to promote their own designs, and disadvantage those of their rivals. This competition between designs may well hasten the learning process discussed earlier, but it may also confuse consumers and cause risk averse consumers to delay entering the market. If competition between rival designs takes the form of bidding wars to acquire important complementary assets or high levels of advertising, then fixed (and sunk) costs will rise, hastening the shakeout and reducing subsequent entry.

## Whatever Happened to Quadraphonic Sound?

These problems are real, and, in the limit, may block the emergence of a dominant design, killing the market before it becomes established. Quadraphonic sound is a good example of what

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might happen. Quadraphonic sound was four-channel, 'surround sound' that was designed to liberate long suffering music lovers from the confines of stereo. It used four speakers to create the illusion that the sound was coming from all around the listener, as it would in a concert hall. By all accounts, it was clearly better than stereo. However, its life on the market (from 1971 to 1976) was nasty, brutish and short.

The action started in 1971 when Columbia Records (CBS) introduced its SQ (or 'matrix') system. Its main rival initially was the confusingly labelled QS system championed by Sansui, but in January 1972 RCA records backed JVCs CD-4 ('discrete') system. The two systems were not compatible with each other, forcing consumers to make an either/or choice; both were, however, backward compatible with stereo (meaning that they could play stereo records in stereo). However and despite a heavyweight prediction from Chase Econometrics that '. . . quadraphonic sound will eventually replace stereo . . . by the end of the 1980s, this takeover should be almost complete . . .' in 1974 and a massive promotional effort at the 1975 Consumer Electronics Show, sales consistently fell short of predictions. By 1976, most manufacturers were desperate to unload unsold inventory, and the most actively interested buyers were industrial museum curators.

So, what went wrong? The battle between these two systems was fought out on at least three fronts. The first was a battle of words. Matrix was described as a '. . . Mickey Mouse approach which only simulates four channel', while RCA was described as a 'spoiler' and its product as 'pre-mature'. This war of words '. . . led to a diversion of manufacturers promotional efforts into internecine battles (the "quad wars") instead of efforts to promote quad in general . . . promotion of one system over another . . . contributed to the confusion and skepticism of prospective

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consumers by creating an atmosphere of contradictory and unverifiable claims'. In the circumstances, most consumers wisely decided to stay with the safe bet, namely stereo.

The second battle was a technology battle. Both products went through a series of upgrades and further developments on a regular basis. For example, '. . . the discrete system had many bugs in 1972; discs lacked durability, demodulators badly restricted dynamic range, recordings suffered from noise and distortion, etc. . . . it was not until late 1974 that CD-4 was truly capable of fulfilling its potential . . .'. While these undoubtedly improved both products, they also contributed to the general sense that these technologies were not yet ready to be brought to market. They also considerably increased the risks faced by consumers: after all, even if the discrete system was ready in 1974, the previous three years of frantic technological upgrading would almost certainly have provided a sound basis for believing that more progress could be expected in the next three years. In these circumstances, the smart move for prospective consumers was to wait, and that is basically what they did. However, with no one buying the new system, neither manufacturers nor retailers had much incentive to remain in the market. '. . . after years of haggling over which type of 4-channel to promote for Christmas (in 1974), audio dealers have finally agreed to back a single system—stereo . . .'.

Third and finally, buying a quadraphonic sound system is all well and good, but it is useless unless there are quadraphonic records to play on it (there is, after all, a limit to the number of times one's neighbours will be willing to look impressed by a fancy new system that has nothing to play on it). The intimate link between hardware and software (as it were) in this market was recognized right from the beginning (which is why CBS and RCA turned out to be the champions of the two systems), but

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that seems to be as far as it went. In 1973, CBS had issued only 160 albums using the SQ system, while the other side had issued only 25; in 1974, the total sales of quad records was less than $13m. At the core of the problem was the fact that artists had little financial incentive to record using the new technology, and, in addition, were reluctant to entomb their creativity on records which might be part of a losing standards battle. Further, both the record companies and record retailers followed a 'double inventory policy', releasing albums on both quadraphonic and stereo formats. This, of course, made it even easier for consumers to sit on their wallets.

The moral is easy to see. Making choice is difficult. It requires consumers to evaluate complicated alternatives, something that can involve considerable resources. When fixed costs are high, producers will be wary of committing themselves too much; if network effects are important, consumers who move too quickly face the not inconsiderable risk of being stranded with the losing (and therefore totally useless) design. Standards battle like this are confidence games: people will move when they feel that they can see the outcome, and, when they move their actions are often instrumental in bringing that outcome about. The various participants in the quad wars managed to do almost everything they could to destroy the confidence of consumers, retailers, and artists, and in this one thing alone they succeeded.

## So, How Does It Actually Happen?

For a dominant design to become established, a consensus must form amongst consumers about which design amongst those on offer is the right one. This cannot occur until consumers have sampled the various alternatives, and formed a view on which

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characteristics are most valued and which architectures seem to produce products best adapted to their needs. Further, consumers form views about the preferences of other consumers, and about the likely preferences of as yet inactive consumers. A dominant design will emerge when it becomes clear that the majority of consumers are content for a particular design to be selected, when a bandwagon forms that focusses the choices of consumers on a single particular design. In the next chapter, we will focus on how a bandwagon may start of its own accord, and the process by which it maintains or even increases it momentum (for a while). However, having discussed the actions of the champions of the two competing designs in the quadraphonic sound case, it is worth getting slightly ahead of ourselves and look at how this process can be helped along by the actions of producers. There are at least three complementary strategies which might be used to bring this about.

One way to create a bandwagon is to manage consumer's expectations, giving them the impression that a choice has already been made. If consumers feel that a choice has already been made, they will feel little need to gather information on their own; those consumers who are particularly risk averse will no long be concerned about making the 'wrong' choice and becoming orphaned. As we shall see in the next chapter, there are many ways to manage expectations in this manner, including broadcasting, peer group or expert testimony, advertising much more than rivals, and so on. Another way to speed up the

process is simply to engineer a merger with major rivals, using that to retire major competing designs. A second way to generate a bandwagon is to cut prices, forcing consumers to consider switching from their first best but expensive choices to a second or third best but much cheaper option. This strategy was certainly an important part of the establishment of the Model T,

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and it generally means that firms make losses on their initial sales. These losses are investments designed build up a large initial installed base of customers. The gains to this strategy come from one of two sources. One is the kind of demonstration effect discussed above: this large initial base may make it credible to claim that 'a choice has already been made', and create a bandwagon of following customers. A second source of gain arises when switching costs can be used to lock these initial customers in, enabling firms to extract profits through higher prices later on.

Alliance strategies are a third way to compete in standards battles. Co-opting rival suppliers or potential entrants by allowing them to manufacture a particular design is a third strategy that would-be champions of particular designs might follow. This directly reduces the range of alternative designs that are on, or can come to, the market, and may also contribute to the sense of inevitability that supports every successful bandwagon. Consumers may feel less anxious about being locked into a particular supplier if they perceive that there are alternative suppliers they can turn to. Alternatively, when complementary goods are important to consumers, then insuring that they are present will bring more consumers to market, particularly when rivals designs are not well supported by specific complements. This sometimes requires that the champions of particular standards produce important complementary goods themselves. More commonly, however, it leads to alliance strategies which link the producer of a particular design with producers of particularly important complements.

## Satellite Television, Video Cassette Recorders, and Other Stories

In 1986, the UK government gave a 15-year franchise for high powered direct satellite broadcasting to a consortium called

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British Satellite Broadcasting (BSB). It planned to develop the market at a reasonable pace, selling 400,000 dishes in 1990, 2m. by 1992, 6m. by 1995 and 10m. by 2001. However, in June 1988, News Corporation announced the arrival of Sky television which planned to broadcast via a medium powered satellite called Astra. It began broadcasting in February, 1989. BSB missed its initial launch date, but finally got on the air in April 1990. The two companies offered incompatible systems—the round dishes of one could not receive the signals sent out to the square dishes of the other, and vice versa. This incompatibility meant that consumers had to make a choice (no one wanted to have two dishes stuck to the side of their house), and the battle raged across several fronts.

For a start, both companies raced to install as many dishes as possible, each keen to create as large an installed base as possible to win the confidence game. Price was the major competitive weapon that both used. Although no one knows the exact details, both companies almost certainly gave dishes away to unlucky (or, perhaps more accurately, unwary) households, or subsidized their purchase (a tactic which mobile phone companies seem to have been quick to use in more recent years). Needless to say, both companies vastly under performed in this area. While Sky was reputedly out-installing BSB 2 to 1 in 1990, by the end of the year they had still installed less than 1m. dishes, and both companies were bleeding money (Sky was reputedly losing £2m. per week, while BSB was losing £6-7m. per week). Both companies also raced to sign up influential outside parties in an effort to mobilize consumers who were either unwilling to sign on or waiting for even better deals on their dishes. Here Sky had the clear advantage as News Corporations newspapers shamelessly plugged the new, in-house satellite television station. Both companies also rushed to sign up the rights to Hollywood films, by one account paying more than twice

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what they had initially budgeted in their desire to come out on top. Needless to say, this kind of competition could not continue in the face of widespread waiting by consumers (some thought that the correct characterization was widespread consumer indifference), and in November 1990, the two firms merged (i.e. Sky took over BSB). Those people who watched satellite television in the 1990s in the United Kingdom watched Sky's version of it, using Sky's dishes.

The quadraphonic sound case we discussed above showed the importance of alliance strategies—the two champions of the new system were not producers of stereo equipment, but record companies. The more recent Time-Warner AOL merger had this character—linking a content provider with an online

internet service proprietor anxious to make its walled gardens more attractive to would-be users. However, the classic business school example of a standards battle that was fought along these lines involved video cassette recorders (VCR). Although there were at least six different designs involved, the key battle ended up between Sony's Betamax system (introduced in 1975) and JVCs VHS system (introduced in 1976). Sony took the initial lead, but by 1978 Betamax's sales had fallen behind those of VHS and Sony stopped producing Betamax at the end of the 1980s. The two systems had a common heritage in U-matic, a system developed by Sony in the early 1970s, and they were, as a consequence, broadly comparable in cost and performance (although Betamax was initially put on the market with tapes that allowed for only one hour's playing time). Sony's main advantage was, therefore, one of timing, and JVC countered by forming an alliance with other manufacturers and agreeing to 'original equipment manufacturing' (OEM) deals. As part of this process, they kept their product design fluid, and they provided extensive manufacturing and marketing support to their

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new allies. By 1984, JVC had more than 40 partners (and most of the leading manufacturers in the United States and Europe); Sony's belated efforts yielded a more meagre harvest of 12 partners. With this kind of heavy weight support, it seemed clear to most that VHS was going to be 'the' system.

It is worth noting that getting a consumer bandwagon rolling involves more than cutting prices, signing up heavyweight partners or sponsors and refraining from rubbishing the opposition. In the early 1980s and despite the best efforts of JVC and Sony, VCRs were still basically a niche product used mainly for time shifting (recording television programmes and watching them later, fast forwarding through the more stupid or tasteless adverts), or for making and viewing home films. The big market growth came with the arrival of pre-recorded tapes, and it started in Europe. There are a number of possible explanations for why this happened in Europe first. The United Kingdom was one of the leaders in this respect, and it had both a well-established television rental market (making the rental of VCRs a low risk option for consumers who were unwilling to make the substantive investment of purchasing a VCR), and a television system that involved only four channels which, some have argued, were only minimally differentiated from each other. It is also the case that companies like RCA saw a marketing opportunity and began putting more pre-recorded material on the market. As supply and demand coalesced around the notion of using the VCR as a substitute for going out to the cinema, local video rental shops sprung up around the country and made it easier for more and more people to choose this option. Since by then it was clear that whatever we watched it would be using the VHS format (and not Betamax), the last major source of risk disappeared and the market took off.

Finally, note that the alliance strategy pursued by JVC essentially involved sharing their design with potential rivals. In other

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sectors, alliance strategies of this type often involve some sharing of intellectual property rights by the champion of a particular design, making it less of a 'proprietary standard' (privately owned and exploitable only by its owner) and more of an 'open standard' (effectively collectively owned and sometimes in effect collectively designed). It is a strategy that Sun Microsystems (and, slightly less enthusiastically or successfully, MIPs Computer Systems and later entrants like IBM and HP) pursued in trying to establish reduced set instructions computer (RISC) microprocessors on the market against the complex set instructions computer (CISC) architecture championed by Intel and Motorola. It is also a feature of most of the challengers to Microsoft's Windows operating system, Linux being a good example.

## Does Every Market Go through This Process?

It is important to step back and put all of this into perspective. Although most very young markets support the emergence of a dominant design, this is not true for all of them. It is important to establish as clearly as possible just when it is reasonable to expect a dominant design to emerge from the kind of market led process which we have discussed in this chapter.

Some have argued that the dominant design hypothesis really only applies to assembled goods. The basic thinking here is that it is only assembled goods which need a design. Coal comes out of the ground as coal; similarly, if anyone designed the basic properties and structure of electricity, it was certainly not a group of would-be entrepreneurs struggling to establish a market for electricity. Although there is some merit in this view, it is easy to overstate it. In most cases, a purchase of something that

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looks like a commodity is actually more involved, and requires more of a structure, than the commodity itself. I buy coal for my fires, but my contract is for the delivery at a certain time, in a certain place, for a

particular type of coal. The transaction itself is highly structured, and there is very little in the nature of the good itself which structures the transaction. For anything but the simplest transaction, there are usually a number of different ways to make the transaction, and each transaction is liable to have a number of characteristics which consumers value. It is, almost always, a 'package' which includes both the good to be supplied as well as the conditions of supply and subsequent service support. And, somehow, the structure of these packages needs to be established. We all take the structure of our normal transactions for coal and electricity for granted, but might that not be because they have become embodied in a package for which there is a dominant design?

Consider, for example, the apparently prosaic business of shopping for groceries on the internet (which we discussed in Chapter 2). Shopping is shopping, it would seem, something that we typically do on a weekly basis (with lots of short, hit and run top-up shops for those of us who cannot construct a coherent and comprehensive weekly shopping list, or who just like fresh food to be really fresh). Internet shopping for groceries is different, however, from grocery shopping in the local supermarket. Amongst other things, it involves someone else making choices for you (which piece of steak, which particular apples, and maybe even which brand of drinking chocolate?), and it involves delivering the groceries to you somehow. It could involve delivering them to your home (leaving them on the porch perhaps, or arranging a time to deliver when you will be home), or possibly to your office (this is bound to be much more efficient from the suppliers point of view), or possibly it might just involve you in

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picking them up from either a shop or a depot (shops are expensive places to warehouse goods). Evidently, there are a number of choices here that need to be made before a well-defined 'package' emerges—before something that unambiguously defined 'internet grocery shopping' as an activity—emerges.

Clearly, 'a' dominant design is not going to emerge in markets (like, perhaps, internet grocery shopping) that will ultimately support several designs. As we noted earlier, this arises when consumer tastes or needs are very diverse, and when little in the way of economies of scale, learning curve effects, complementary good provision or network effects are sacrificed by catering to minority tastes. There are some markets which display extreme fragmentation—too many designs, too many niches, too many modules—and, in this case, they can hardly be said to have produced any kind of dominant design at all. These markets—where tastes are extremely diverse, where there are no scale economies, learning curves or network effects at all—are clearly exceptions to the rule that we have been discussing throughout the chapter, but they are also likely to be rather rare.

It might be argued that there is a second class of exceptions to the rule that a dominant design will prevail in most markets, and this arises in big standards battles where public policy makers play a large role in choosing between alternative standards. Public policy makers can have this effect through their procurement decisions, through their control of standards setting processes and sometimes through the power they have to licence the use of particular technologies. One way or the other, the process by which a 'sponsored' dominant design—particularly one that is sponsored by public policy makers through procurement or regulatory action—is established is different from those which happen in unregulated markets. Sponsored standardization processes are, one might argue, so different from the market based

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standardization process that we have been discussing as to be *sui generis*. This may be, although it is hard to deny the fact of standardization or its short and long run effects in such markets. Actually, a better way to think about sponsored dominant designs is to recognize that they belong to a broader class of user led innovation processes, and, as we have seen, the markets which are created by these processes can evolve in very different ways from those discussed above.

The real limit on the applicability of the arguments that we have discussed in this chapter was mentioned in Chapter 2. Dominant designs arise to simplify the range of product variants which are present on a market at its birth. This variety, in turn, arises because of the nature of the way that new technologies push new products on to markets. The process of establishing a dominant design is all about choosing from amongst this variety, and it happens because most consumers have, at best, only an inchoate demand for the good. It follows, then, that when new products emerge in response to an articulated demand by users—when innovative activity is 'user led'—it is unlikely that they will burst forth into the market with a great variety of different variants. If consumers are able to specify and accurately articulate exactly what they want, then innovators can (try to) produce exactly what is required. In a sense, dominant designs precede the emergence of the market in these situations, and one might say that this kind of process is an example of the emergence of a sponsored dominant design. The important point, however, is that a choice between competing technological possibilities is made. What

is different about user led innovation processes or sponsored designs is who makes the choice, and how it is made.

In an odd sort of way, this last observation leads us back full circle. Every market which, in the fullness of time, displays only

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a small fraction of the design variety which the technology that supports it makes possible has something very much like what we have called a 'dominant design(s)'. Every market where standardization brings real benefits to producers or consumers is likely to have gone through a process of choosing between different design possibilities, regardless of whether that process was market led, user led or sponsored by outsiders. In this sense, then, every market has a dominant design of one sort or another.

## And So . . .?

This chapter started with muddle and has ended with some semblance of order. The emergence of a dominant design is, in this account of market evolution, a crucial transition phase. Before the design becomes established, very young markets host many producers (and experience very high entry and exit rates year by year) and many different product designs. After it is established, the range of products available on the market shrinks considerably, and what variety there is is often ordered or organized in various ways: between different dominant designs serving different segments, between a dominant design and various niches and between a core good and a range of variants which differ mainly in the number and types of peripheral characteristics they embody. The consequences of the changes brought about by the creation of a dominant design go well beyond the shakeout of producers which inevitably follows. In the short run, the emergence of a dominant design often sets the stage for the emergence of a mass market; in the longer run, the design shapes that market—and the mind sets of those who participate in it in fundamental ways which often create problems much further down the line.

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These short- and long-run effects will be the subject of our last two chapters.

**References and Further Reading**

The typewriters story is told in J. Utterback, *Mastering the Dynamics of Innovation*, Harvard Business School Press, 1994, a book that sets out the so-called 'dominant design hypothesis' in a very readable form. There is now a fairly large literature on dominant designs; see, amongst others, J. Utterback and F. Suarez, 'Dominant Designs and the Survival of Firms', *Strategic Management Journal*, 1995, K. Clark, 'The Interaction of Design Heirarchies and Market Concepts in Technological Evolution', *Research Policy*, 1985, and M. Tushman and J. Murmann, 'Dominant Designs, Technology Cycles and Organizational Outcomes', *Research in Organizational Behaviour*, JAI Press, 1998. There are many good accounts of the early history of personal computers, including R. Langlois, 'External Economies and Economic Progress: The Case of the Microcomputer Industry', *Business History Review*, 1992. For both heat and light on the QWERTY story, see P. David, 'Clio and the Economics of QWERTY', *American Economic Review*, 1985, and S. Leibowitz and S. Margolis, 'The Fable of the Keys', *Journal of Law and Economics*, 1990. Much has been written about computer operating systems, particularly in the aftermath of the Microsoft anti-trust case. For a readable account of that trial which also sets out many of the basic issues fairly clearly, see R. Gilbert and M. Katz, 'An Economists Guide to US v. Microsoft', *Journal of Economic Perspectives*, 2001, or K. Auletta, *World War* 3.0, Profile Books, 2001; on the computer software industry more generally, see D. Mowery, 'The Computer Software Industry', in D. Mowery and R. Nelson (eds), *Sources of Industrial Leadership*, Cambridge University Press, 1999, or S. Davies *et al*., 'Economic Perspectives on Software Design', NBER Working Paper 8411, 2001. The quote about the Model T is taken from S. Klepper and K. Simons, 'Technological Extinctions of Industrial Firms: An Inquiry into their Nature and Causes',

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*Industrial and Corporate Change*, 1997; J. Utterback and F. Suarez, 'Innovation, Competition and Industry Structure', Research Policy, 1993 argue that the dominant design in cars was not the Model T but, rather, the emergence of the all steel enclosed body. However, their argument seems to be based on a mistiming of the shakeout in producers which occurred in this sector. The conjecture about market niches is based on an interesting argument about 'generalists' and 'specialists' developed by G. Carroll, 'Concentration and Specialization: Dynamics of Niche Width', *American Journal of Sociology*, 1985; for applications of the argument to micro-breweries, see A. Swaminathan and G. Caroll, 'Beer Brewers', in G. Carroll and M. Hannan (eds), *Organizations in Industry*, Oxford University Press, 1995. There are many studies of the battles which have been fought to establish dominant designs or standards in