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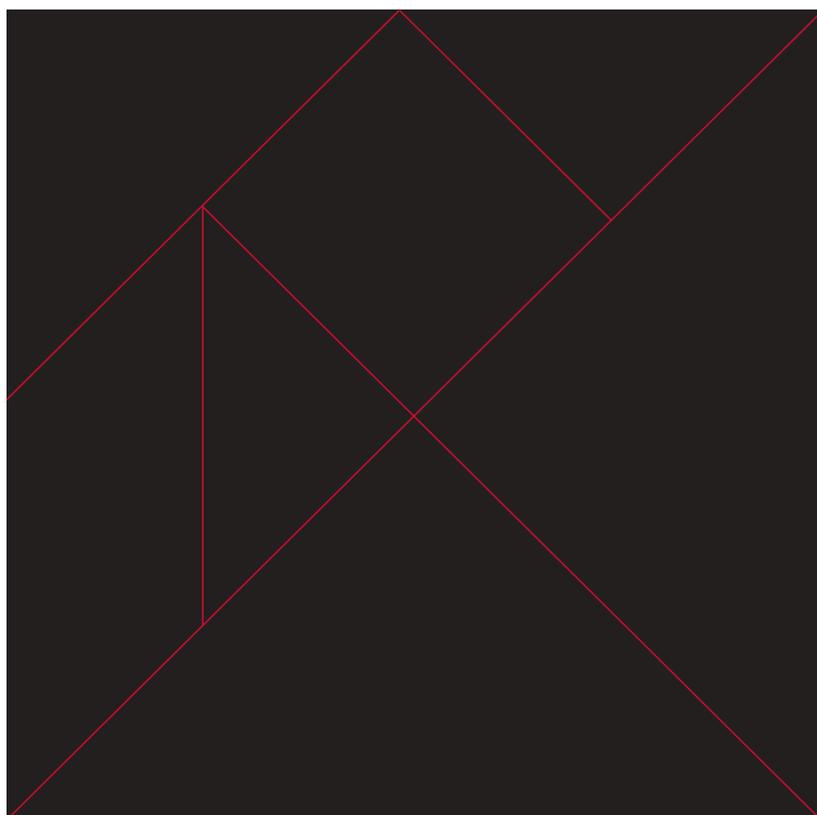
New measures for the new economy

Charles Leadbetter

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A discussion paper for the Institute of
Chartered Accountants in England and Wales

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Summary

Today, economic activity is increasingly intangible.

By 2005 manufacturing and agriculture in the UK could account for just 15% of output and employment. At the same time the service sector is generating a growing share of output and employment in both developed and developing economies.

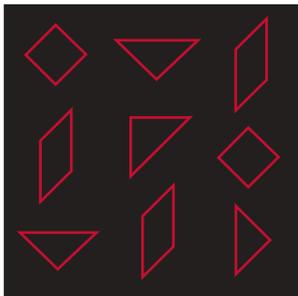
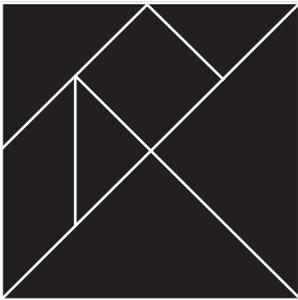
Information technology is making both production processes and products more technologically complex. In manufacturing and services, intangible assets – brands, intellectual property, know-how and copyrights – are more valuable to companies than ever before.

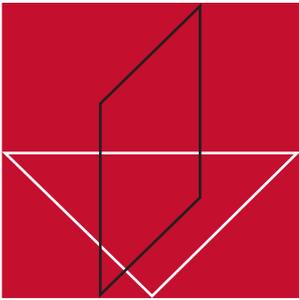
As economic activity increasingly involves processing and analysing information, making judgements and providing services, there is less need for the manipulation of physical commodities. Science is breeding new industries and product families while activities like entertainment and tourism are employing a growing share of the workforce.

More of what is produced and consumed is intangible: information, analysis, service, entertainment or advice. The assets used to produce these 'goods' are themselves immaterial, placing greater reliance upon information technology, software, design and personal skills. At the same time, competitiveness is increasingly based on these intangible assets. And, in an increasingly open world economy, it is harder to sustain competitiveness on the basis of traditional assets which are also available to the competition.

As a result companies are becoming difficult to value reliably and accurately. Stock market valuations, especially of high-tech and service companies, are frequently several times higher than book values. This gap is seen as evidence that intellectual capital is increasingly important to corporate wealth. But it is also the source of many criticisms of traditional financial accounting which encounters growing difficulty in reliably valuing these vital intangible assets.

New Measures for the New Economy presents a comprehensive review of the way policy-makers, accountants, managers and investors could respond to the present uncertainty surrounding the valuation of these increasingly important intangible assets. The paper is divided into two sections: the first exploring the nature of the problem and the second presenting a review of possible solutions.





It starts with an examination of the evidence that economic growth and productivity improvements are increasingly 'knowledge-driven'. It considers the problems for accounting and argues that the nature of intangible assets – particularly their lack of contractability and tradability – makes them difficult to price and thus difficult to value. The system of accounting for intangible assets will only be improved if this underlying economic problem is addressed: better accounting measures of intangible assets will only develop in parallel with better functioning markets to trade these assets.

The evidence that the gap between the market valuation of intangibles and the accounting valuation creates social harms or economic inefficiencies is also examined. There is also reason to believe that inadequate valuations of intangible assets may provide scope for insider dealing, lead capital to be misallocated, raise the cost of capital for knowledge intensive companies or promote volatility.

The second section examines the ways in which more reliable measures of the value of intangible assets could be provided. It suggests that accounting-based approaches, whether built on traditional methods or using new intellectual capital measures, will only offer part of the solution. Improving the market valuations of intangibles by creating better functioning markets for intellectual capital will also be critical. This would require a new type of financial market trading in intangible options with resulting valuations being reflected in company accounts. Accountants would not attempt to measure intangible values themselves but simply record the market valuation.

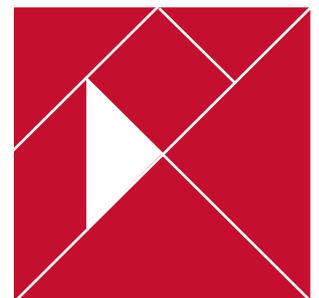
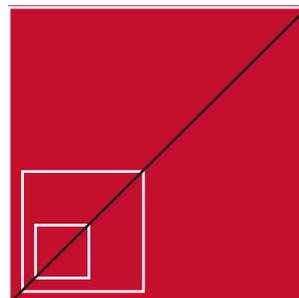
Accounting and market-based measures of value would develop in tandem; the focal point would not be new balance sheets but new markets. But although there could be limitations to the kind of intangibles that can be traded, better and more reliable accounting measures may only develop on the back of these new markets.

New measures of intellectual capital seem attractive but many have drawbacks. They could result in cumbersome inventories which allow managers to manipulate perceptions of intangible values to the detriment of investors. The fact is that too few of these new measures are focused on the way companies create value and make money. In the end, these new approaches may be no better than traditional accounts at dealing with volatility, uncertainty and change.

The key conclusions from this analysis may be summarised as follows:

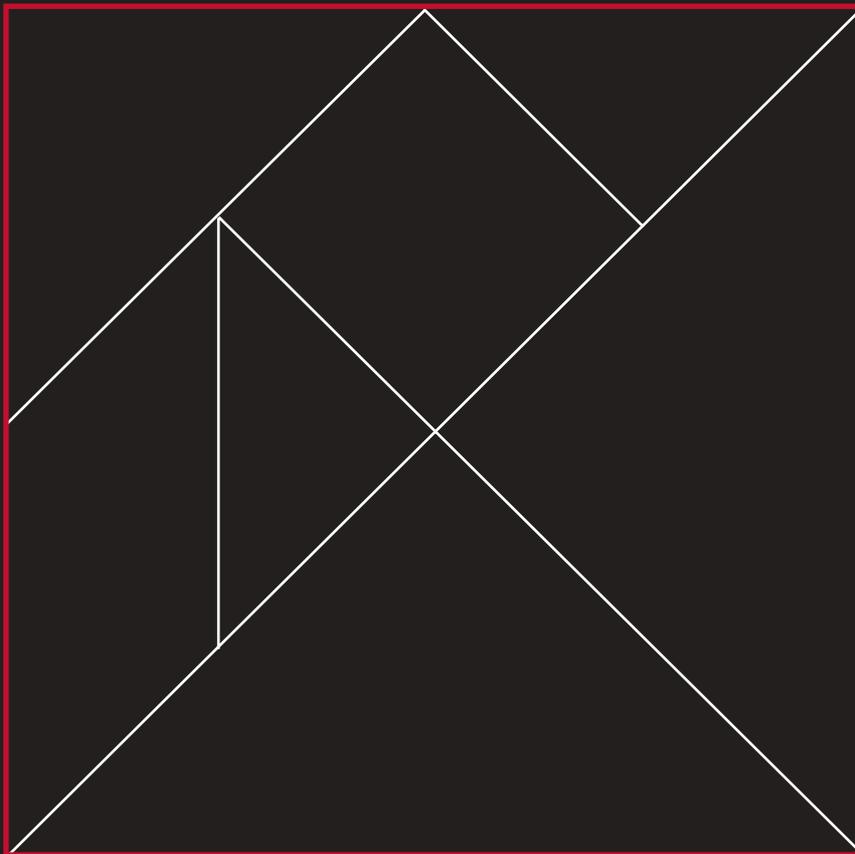
- Accounting valuations of intangible assets will only be reliable with the creation of more efficient and reliable markets to value them.
- Reliable valuation of intangibles is not just an 'accounting' problem. In the absence of properly functioning markets it is an economic issue of pricing intangibles.
- Valuing intangibles cannot be resolved within a single academic or professional discipline. It will require a multi-disciplinary approach involving groups such as economists and accountants working together with intellectual property and employment contract specialists.
- Accounting and market reforms should go hand in hand with legal and institutional reforms, embracing the operation of markets for capital, labour and intellectual property.
- Despite the urgency, provision of more reliable measurement of intangibles should go forward on an incremental basis. Any grand design or global set of standards for measuring intellectual capital would be cumbersome and inflexible. Instead, policy makers should promote an evolutionary process among accountants, investors, managers and capital markets to develop new measures for valuing intangibles.
- Investors' valuation of a company will increasingly result from multiple, overlapping and revisable sources of information. Traditional accounts will therefore become just one source among many. They will principally provide assurance that a company is financially sound. Corporate valuation may become less like a mathematical equation and more like a puzzle with traditional financial accounts forming one – albeit critical – component in its solution.
- As corporate valuations become the product of many information sources, accountants may find themselves competing with others to provide reliable, and relevant information to help investors value a company.

Appendices detail some of the many research findings that are quoted in this paper and which are relevant to the valuation of intangibles in the new economy. Finally, there is a list of sources quoted.



1. The knowledge economy

Two trends are combined in the rise of the 'new economy'. Firstly, today's goods and services are increasingly immaterial because they have become technologically sophisticated and knowledge-intensive. Secondly, for technological and competitive reasons, knowledge is becoming the distinctive factor of production in the new economy.



These trends are not confined to so-called high-tech industries but are evident in the knowledge intensive sectors of all industries from retailing and agriculture to software and computing.¹ There are many examples: the drinks cans that are 80% lighter than they were; the cornfields that produce 80% more crops than they did 50 years ago; and the lap-top computers that have become much faster, more powerful and adaptable in just seven years.

Economic growth is driven by the creation of better recipes to combine available resources in more efficient and innovative ways. That is why the generation, application and exploitation of knowledge are the driving forces of modern economic growth.

The knowledge-driven economy is not just about new high-tech industries built on a science base like software and biotechnology. Nor is it confined to new technology. For it is about new sources of competitive advantage: the ability to innovate and create new products and exploit new markets. It applies to all industries, high-tech and low-tech, manufacturing and services, retailing and agriculture. The key to competitiveness increasingly turns on the way people combine, marshal and commercialise their know-how. That know-how can have sources other than 'knowledge workers' like designers, technologists and scientists. The shop-floor may come up with improvements in quality and productivity, while the sales staff offer ideas on better service to customers.

There is nothing new in the thought that knowledge is a driving force for economic growth. But several factors are combining to make it critical to competitiveness in modern economies.

The Knowledge Push

One is the spectacular growth of organised science, the consequent acceleration of technological change and the speed at which new ideas are translated into commercial products in travel, communications, medicine, pharmaceuticals, robotics, information processing and genetic engineering, to take just a few examples. More scientists are doing more science, more productively and translating the products more quickly into commercial applications than ever before.

More is invested in education than ever before, too. But it is easy to forget just how recent and incomplete this investment has been. In the late 1990s, about 35% of 18 year olds were studying for university degrees and this demand can only increase rapidly in the next few years, partly through government policies but also through the spread of technologies to make learning easier.

The ability to share this 'explosion' of formal knowledge has been dramatically enhanced by the spread of new ways to collect, analyse, store, retrieve and communicate information. In 1997, there were about 200 million computers in the world; by 2001 there will be 500 million. Far more important will be the computers and microprocessors embedded in our everyday life: about 6 billion semi-conductors in 1997; 10 billion by 2001. More information is not better information. The capacity to generate information far outstrips our ability to use it effectively. To compete, companies must call upon know-how which is distinctive to them; not information which is available to all.

It is easy to see the new economy just in terms of this investment in intangible assets and intellectual capital. It is also mistaken. For it leads to an assumption that if the scale of the stocks and flows of these new assets could be measured, the value of the intellectual capital in the new economy could be pinned down. Intangible assets gain value when deployed in competition to serve consumers. Their value is highly context-dependent. Powerful competitive pressures are pulling companies towards know-how as a source of competitive advantage which competitors find hard to imitate.

Market Pull

In increasingly open global markets, products can be made and shipped anywhere. Financial capital is less scarce and production technologies can be copied by developing nations with increasingly well-educated workforces. But developed economies cannot base their future prosperity solely on the traditional assets of the industrial economy, raw materials, land, machinery and labour. All are available to emerging competitors on equal if not better terms. Developed economies must base competitiveness on distinctive assets which can be used to generate high-value added products. These assets are know-how, skills, creativity and talent.

This trend is affecting all industries. Retail bankers used to measure their UK market share by the size of their high-street counters: the longer they were the more customers could be served. Physical assets are no longer key to competitiveness in retail banking. In 1998, the fastest growing bank in the UK, Egg, had no high-street presence. All business was done using the Internet, digital television and telephone.

Globalisation, deregulation and liberalisation are driving companies to base their competitive advantage on brands and other intangible assets like know-how, which cannot be easily imitated or traded. Since the 1960s, international trade has been liberalised. The spread of information technology and the rise in educational standards means production technologies can quickly migrate from developed to developing economies. But a strong brand is difficult to copy because it is so value-laden. Tacit knowledge, often held in the heads of employees or embedded in corporate routines, is similarly hard for competitors to mimic.

David J Teece, Professor of Business at the University of California at Berkeley, has explained why intensified competition in liberalised markets has made intangible assets so valuable.² He believes that wealth creation comes down 'to developing, orchestrating and owning intangible assets which your competitors will find it hard to imitate but which your customers value.'

Another factor making intangible assets more critical is the rising importance of intermediate input markets which organise production of components in many industries that were once vertically organised by large companies. Today, assemblers of products like personal computers buy many components through networks of sub-contractors or on open markets. Competitors can do the same, making it harder for a company to base a distinctive advantage on the quality of these inputs. Instead, it has to control and appropriate assets which cannot be bought from a supplier.

What Knowledge-Based Competition Means

Companies increasingly need strong, distinctive internal capabilities. But their distinctive know-how has to be combined with complementary assets, resources and skills provided by partners, investors and suppliers. A bright idea for a new product has to attract finance to research and develop it; skills and investment will be required to make it and different capabilities will be needed to market it effectively. Intellectual capital on its own is never enough. The job of senior management is increasingly to orchestrate this dynamic combination of complementary skills and assets to generate and then realise innovative ideas and product improvements.

Know-how is important to the way companies compete, yet it will matter for different reasons depending on the competitive conditions that companies face, the kind of know-how they need and its source. There is no universal solution.

In high-volume process industries like oil and chemicals or in low value-added services like fast food and retailing, companies need to marshal the know-how of their staff, suppliers and customers in a continuous effort to improve quality and productivity. Many have begun to recognise this through quality and continuous improvement programmes and through knowledge management initiatives designed to disseminate best practice or to create corporate learning programmes. Most of the required know-how may already be in the heads of suppliers, staff and customers.

Even traditional, relatively slow-moving industries can face sudden and disruptive competition brought on by new technology. The upheaval in UK retail banking is just one example. This kind of competition may soon affect other industries as traditional intermediaries who have sold products to consumers – like insurance brokers – find themselves competing with new entrants who go direct to the consumer using the telephone and interactive television. Meeting this competition means combining continuous improvement with a capacity to reinvent and renew.

Knowledge plays a critical role in industries like pharmaceuticals and aerospace, which have traditionally invested heavily in research and development. These are capital-intensive industries requiring financial resources to generate and exploit their know-how. Ideas are often patented yet in other high-tech and knowledge intensive industries, like software and electronics, patenting is less common.

Know-how is critically important – in a quite different way – in services such as accountancy, business consulting, law, design, architecture and financial services. Here, firms trade on the training, insight and judgement of their staff and human capital is closely regulated by qualifications. Creative industries are also people-driven but their creativity usually comes from a pool of independent producers. Britain has one of the largest computer games software industries in the world, largely organised around young, self-employed producers who sell their products to global companies. But there are no qualifications and few training programmes. Both law and computer games companies depend heavily on human capital but in quite different ways. A qualification-based measure appropriate for a law firm would be next to useless for a computer games company.

Implications for Valuing Intangibles and Knowledge

Intangible assets and capabilities have become more important as technological change has accelerated and markets have liberalised. It makes sense for managers, investors, knowledge-holders and knowledge-workers accurately to value their know-how and other intangible assets. The reasons why intangible assets have become more critical also highlights some reasons why these assets are so difficult to value (see box.) In summary, intangible assets have become so much more important as a source of competitive advantage precisely because they are so difficult to pin down, break up, parcel out and be imitated by competitors. That is also why it is so difficult for investors, accountants, managers and knowledge-holders to value intangibles.

Why intangible assets are hard to value

The kind of know-how that companies need depends on the competitive pressures they face. The knowledge needed by a hotel chain or an airline is different from that required by an advertising company or a biotechnology start-up. The value of intangible assets, knowledge and information is highly context-dependent.

Knowledge assets that are valuable in one setting may lose that value elsewhere. Attaching a durable value to a piece of information, a brand or a competence, is hard, especially in fast moving markets driven by fashion, branding or rapid technological change.

Know-how is valuable because it is hard for competitors to imitate, partly because it usually combines some unspoken, routine or tacit ingredient. Even if formal intellectual property – patents and copyrights for example – can be valued, valuing the associated tacit knowledge is hard. Often explicit know-how – in a manual, a recipe or a patent – is of little value without the tacit knowledge and judgement required to realise it in practice.

Often this is embedded in corporate routines which are constantly evolving. Viewing know-how as an 'asset' may be too static an approach. The intangibles which give companies a source of competitive advantage are better thought of as routine, or capabilities rather than as assets or capital in some fixed sense.

The know-how of a single organisation may only become valuable when combined with the know-how of partners and suppliers, manufacturers and distributors. The value of new treatments for diseases developed by biotechnology companies depends not only on the core intellectual capital but also on the soundness of the commercial strategy to exploit it. Valuing know-how separately from the commercial strategy to exploit it would be a partial account.

2. The problems posed by intangibles

The rise in intangibles poses three different challenges for those attempting to value them.



The first appears to be the **scale** of the role that they play in the modern economy. It is so large that they demand accurate measurement. A second challenge is that this rise in importance is associated with a faster rate of change in business performance as innovation in products and processes drives volatility in corporate finances. The problem is not intangibles per se but the **rate of change** in business performance that investment in intangibles can produce. Any new approach needs to be well equipped to deal with this volatility and uncertainty.

A third challenge stresses the **nature of intangibles**. In particular, it is difficult to write watertight contracts covering intangibles and as a result it is harder to trade intangibles and intellectual capital in open markets than tangible assets. And it is hard to set a market-clearing going-rate for them. The problem of valuing intangibles may show up as a weakness in traditional accounting but it is not simply an accounting problem. Intangibles are difficult for accountants to value. But that is a symptom of a more fundamental economic issue: how difficult it is to trade and so price intangibles.

The accounting system is based on recording and reporting discrete, transaction-based events like sales, purchases, investments, cash receipts and disbursements. In contrast, change in business performance is rarely triggered by specific transactions and is often continuous rather than discrete. These changes may affect the value of an enterprise long before their impact on revenues and costs recorded by accountants becomes apparent.³ When rapid and significant changes in business performance are driven by investment in intangibles the difficulties of accounting for change are compounded.

Problem One: The Scale of Intangibles

One measure of the growing scale of intangible assets is the gap between the value of a company's tangible assets in its balance sheet and its stock market-value. This ratio, the 'market-to-book-ratio,' has grown especially large for service and high-technology companies. In May 1997, for example, the market-to-book ratio for General Motors was 1.6, compared with 13.4 for Microsoft. An analysis in *Business Week* in July 1997 noted that Microsoft's stock market value of \$1488.5bn was the same as that of Boeing, McDonald's, Texaco, Time Warner and Anheuser-Busch combined. Only about 7% of Microsoft's stock market value was accounted for by traditional, tangible assets recorded on its balance sheet. The missing 93% was due to its intangible assets of brands, research and development and people. This trend is not confined to high-tech companies.

In 1997 a working group organised by the Centre for European Policy Studies examined the market-to-book ratios of thousands of companies in Europe and the US between 1990 and 1995. They found that in European companies these ratios rose from an average of 149% in 1990 to 202% in 1995. Over the same period, the US ratio went from 194% to 296%.⁴ One US study of more than 2,000 US manufacturing firms found that tangible assets accounted for just a third of their stock market value in 1994. A decade earlier, book assets accounted for close to two-thirds of the value. Professor Baruch Lev, from the Stern School of Business at New York University, estimates that US industrial companies now invest as much in intangible assets such as R&D and training as they do in physical plant and equipment.⁵

This gap shows up in mergers and acquisitions. When IBM bought Lotus in 1995, it paid \$3.2bn, of which \$1.84bn went on research and development in progress.⁶ A recent study of 400 US acquisitions between 1981 and 1993, with a median value of \$2bn, showed that the mean of the price of acquisition to book value was 4.4. Acquisitions of high-tech companies in that period were based on market-to-book values of more than ten.⁷

Although business surveys in the UK suggest that managers believe intangibles are increasingly critical to their company's performance, these assets are rarely recorded on balance sheets or measured in annual reports. The Accounting Standards Board quoted a 1991-92 survey showing that 81% of large companies reported no intangible assets in their balance sheets. A more recent survey found that 76% of 226 quoted companies did not record any intangibles on their balance sheet.⁸

This suggests that market-to-book ratios may have risen in part because book valuations have been slow to adapt to the changing asset base of modern businesses.

Problem Two: The Rate of Change Driven by Intangibles

Accounting systems are slow-moving and historic. They are not good at dealing with volatility, uncertainty and change. Yet increased investment in hard-to-value intangible assets produces just that. The problem is caused more by the rapid rate of change produced by intangible assets than an intrinsic difficulty in valuing them.

In an extensive study of the financial accounts and stock market values of US companies, between 1978 and 1996, Baruch Lev and Paul Zarowin found that traditional financial information had become less relevant to stock market valuations of these companies (Appendix 1).

This US research found that traditional financial accounting performed reasonably well as a guide to market values when a company's investment in intangibles was high and stable. But it does not perform well when companies increase their investment in innovation, for example, to open up a new market. It is hard for investors and accountants to value this additional investment, particularly because the future earnings it might generate are so uncertain.

Lev and Zarowin suggest the problem is not the **level** of investment in intangibles but the **rate of change**. Changes to investments in intangibles are difficult to track. Those investments can lead to marked and unpredictable changes in business performance, undermining traditional accounting measures as accountants find it increasingly difficult to match costs and investments in one period to earnings and revenues in another.

This analysis suggests five conclusions:

- Traditional financial accounting may perform reasonably well as a guide to stock market value in mature industries with a relatively slow rate of innovation and change, regardless of whether they depend on intangibles or tangibles. The need for new measures may be less pressing in these industries, at least as far as investors are concerned.
- Traditional accounting finds it particularly difficult to cope with fast-moving industries with rapid innovation or driven by investment in intangibles. New measures may be needed in these industries but they must cope with rapid change. Some of those proposed measures for intellectual capital seem just as cumbersome as traditional accounting.
- Financial accounting is undermined by rapid change because it finds difficulty in matching costs and revenues in these circumstances. This suggests that financial accounts could be made more relevant by changes to accounting periods and moving towards more continuous accounting. Corporate reporting would become less a punctuated set of announcements and more a seamless flow of information, both financial and non-financial.
- Another possibility, canvassed by Lev and Zarowin, would be for companies to issue a rolling set of revisable five-year accounts which could provide a more accurate picture of a company's track record. A company could initially account for a risky investment in new product development as a cost during its start-up phase. However, if the product proved successful this expenditure could be restated in past accounts as a capital investment. This would provide investors with different ways of reading a company's financial history and inform their assessment of its prospects.

- A further option would be to create 'safe-havens' in accounts in which companies could account for spending on future products and intangible capabilities as investments rather than as costs. This would allow companies to capitalise valuations of brands or research in progress without those valuations migrating onto the formal balance sheet.

Problem Three: Markets for Intangibles

Accounting is at its best when accountants can record observable transactions. Knowledge assets and other intangibles are difficult to trade and as a result it is difficult to establish a reliable market price for them. One way is to create more efficient markets for trading these assets. Reliable accounting values would emerge as a derivative of more reliable market values.

The market for know-how presents special challenges, as does the market for pollution rights, sports stars or works of art.⁹ These challenges complicate exchange of know-how to such an extent that the market for trading intangibles remains under-developed.

Markets work well when there are many informed buyers and sellers aware of opportunities to trade. The objective performance properties and subjective utility of products can be readily ascertained and contracts written, executed and enforced at relatively low cost. The market for standardised commodities such as wheat, coal, stocks, bonds and cars works well because these properties are largely present. But markets for know-how and intellectual property lack many of these characteristics.

The inherent difficulties in trading know-how (see box) vary according to the type of intellectual property at issue and the industry concerned. The market for knowledge generally works better in chemicals and pharmaceuticals, where patents are ubiquitous, than in software, where such protection is uncommon and source code can be converted relatively easily. Know-how becomes more difficult to value the more tacit and organisationally embedded it becomes. Corporate competences are clusters of knowledge that are typically embedded in routines that do not rely on a single individual and they cannot be bought and sold other than through sale of the entire business.

The Difficulties of Trading Know-How

Buyers and sellers may find it hard to find out about opportunities for trade, partly because companies often like to keep their know-how secret.

It is often dangerous for the sellers of know-how to disclose the details of what they are selling because once the information is released it cannot easily be 'recalled.' Buyers, however, may be unwilling to buy without such disclosure. Trade in know-how requires levels of trust not required for transactions involving standard commodities. It is easy for both sides to fear they will be 'ripped-off.' As a result, transaction costs for know-how are often higher than for standard commodities.

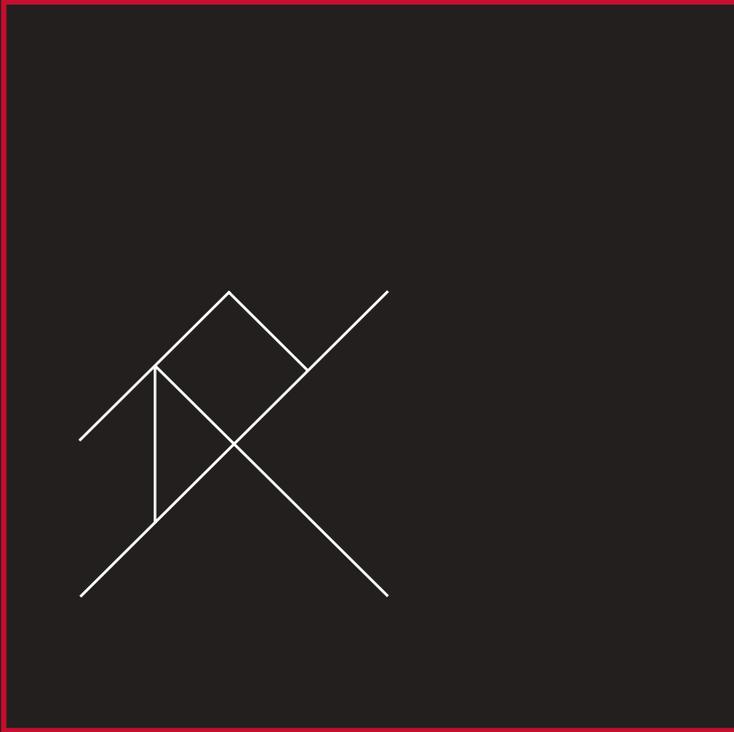
Buyers of intangibles frequently want customised services – for example, legal and accounting services – which may have a limited or even a personalised market. The highly variegated nature of know-how means that markets to trade it are often thin and competition is imperfect. Establishing a fair market-clearing price is therefore more difficult than in heavily populated 'thick' markets.

The subject of a transaction is often not the know-how but a bundle of rights to use it. They are frequently bought and sold: rights to use radio spectrum, fly in airspace, extract minerals, publish or broadcast material. But they are not like a physical commodity. Owners need special policing powers to enforce their rights.

The unit of consumption is often unclear. When rights to use are sold, with ownership remaining in the hands of the originator, this kind of sale requires a metering arrangement for the originator to be paid each time the know-how is used. These royalty agreements are rarely straightforward to enforce, especially in a world of global communications and digital reproduction.

This analysis suggests the following conclusions:

- Accountants would be better able to value intangibles if there were more robust, open markets to trade these assets.
- Reliable valuation methods for intellectual capital may develop more rapidly in industries enjoying strong intellectual property protection. These measures may be more problematic in industries where intellectual capital protection is weaker and less common.
- Policy-makers might explore the creation of new markets for know-how. One might be a financial options market to trade in futures linked to intangibles. Another, the creation of insurance markets in which companies could insure themselves against the loss of talent. There is evidence that a market for research and development is already emerging: R&D already accounts for a high share of the purchase price of high-technology companies in acquisitions.
- The development of open markets for trading intangibles would help accountants value these assets but these changes would rely on policy-makers, regulators and capital market participants agreeing the necessary institutional and legal changes to create the new markets. This would require a multi-disciplinary approach.
- New markets to trade intangibles would still not involve the intellectual capital which companies most value, particularly their competences, capabilities, routines and tacit know-how. The market-valuation route for intangibles is far from a complete solution.



3. The cost of inadequate valuations

There is a growing consensus that purely financial measures do not paint a complete picture of the strengths and weaknesses of a business. Yet for all their alleged weaknesses, financial measures are still the most widely used. There are good reasons for this: rules for public disclosure to investors put an emphasis on financial measures; financial information is easily comparable; companies are wary of disclosing more information because they worry about giving away a competitive advantage.

The starting point for developing new measures for intangibles is to understand the drawbacks of over-reliance upon purely financial measures. A more comprehensive approach would help to value intangibles but also eliminate these drawbacks, which are outlined in the box on the right.

The criticisms of traditional financial accounting are familiar. But they do not show that the gap between stock market values and accounting values for companies creates real costs, social harm and major inefficiencies. In other words – who suffers because financial accounting is so poor at valuing intangibles?

The answer is that the inadequacy of the current approach generates five potential social costs.

1. The Risk of Insider Trading.

Insiders within a company, or close to it, are in a far better position to assess the strength of intangible assets and capabilities than outsiders lacking specialist knowledge. In a biotechnology company with several drugs under development, it is far easier for the executives to assess whether trials will be successful than outside investors who may be ignorant of the science involved. As a result, the insiders may be able to trade on information which is not generally available. This is harder to sustain in, say, oil companies which depend on tangible, observable assets. The more a company comes to rely on esoteric know-how for its competitiveness, the more difficult it becomes for the average outside investor to assess the true value of this knowledge and the larger the gains to be made by insiders.

2. Higher Costs of Capital

Companies with more intangible assets may find it harder to raise capital than those with more tangible ones which investors or bankers might regard as security. Banking regulations, for example, may be biased against lending to companies with few tangible assets which can be used as security. This may especially disadvantage young, high-tech companies having little track record. UK clearing bankers claim to have overcome this problem by lending to smaller, knowledge-intensive companies on the basis of their cash-flow or through debt factoring, lending to a company on the strength of the income the company is owed by its main debtors.

A US study¹⁰ explored one dimension of this issue: the costs of capital for about 340 US firms with high R&D. It found that financial market makers in stocks of R&D intensive firms had a higher 'bid-ask' spread for these stocks which were also less liquid than less R&D intensive stocks. Both factors tend to be associated with higher transaction costs for investors and higher cost of capital. This is *prima facie* evidence that R&D intensive firms face a higher cost of capital, partly because capital markets are less informed about the performance of these companies.

The Drawbacks of Financial Measures for Intangibles

Competitive advantage stems from a wide variety of factors including human resources, financial strength, access to technology and brand reputation. Any measurement system which focuses on a single sort of measure will be partial.¹¹

Published financial information is often historic – it reveals what has happened. Public financial measures often shed little light on the strengths and weaknesses that shape a company's prospects.

Financial measures are often only snapshots which do not account for the dynamics and processes at work inside a business over time. A car's speedometer indicates how fast the vehicle is going over a given distance and time. A systematic account of the power being developed by the engine provides a far more revealing picture of the performance of which the car is capable. Executives, investors and auditors would benefit from a measurement system which looked inside a company's engine.

Companies are increasingly dependent upon networks of relationships with other companies – product development partners, suppliers, distributors, franchisers. The quality of these relationships is often vital to a company's competitive position. Yet the value of these relationships is excluded from an assessment of the company's worth unless there is a financial or equity based relationship. Such relationships are one aspect of organisational capital: it is vital to competitive advantage and needs to be accommodated within a new measurement system.

3. Overvaluation of Intangibles Leading to Misallocation of Capital

The unregulated disclosure of information about intangible assets can create a different problem: too much capital. Without proper regulation of information disclosure about intangibles it may be possible for companies to manipulate perceptions leading to over-valuation by investors. Stocks in some fashionable, knowledge-intensive industries may have been subject to over-valuation. This may attract yet more investment and talent into an already frenzied industry to the detriment of others in which asset value is more transparent. The inadequate disclosure of information may thus distort the allocation of capital between industrial sectors.

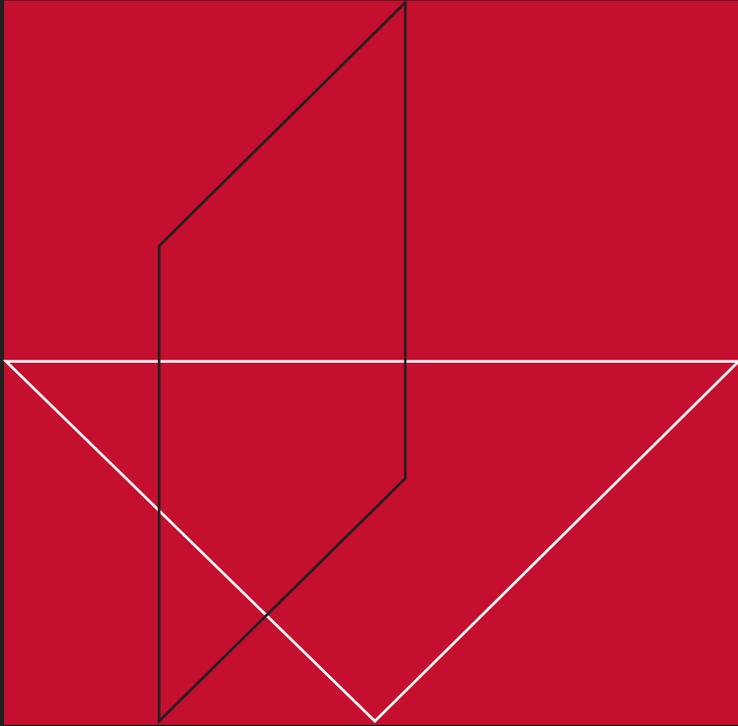
4. Dulled Incentives for Knowledge Workers and Entrepreneurs

The current approach to accounting for intangible assets makes it difficult to unravel the contribution that different people make to a business. As a result, it is difficult for knowledge workers to assess their true worth – and what rewards they should receive. Knowledge workers risk giving away their main asset to their employers too cheaply, allowing the firm to profit from the under-valuation of their human capital.

5. Increased Volatility

Inadequate disclosure about the quality of intangible assets may feed volatility and uncertainty in capital markets. Excessive volatility of stock prices seems to have afflicted the British biotechnology industry recently. During the early 1990s, investors became increasingly attracted to companies which had often made no profits but seemed to have promising drugs in development. A surge of investment inflated stock prices but later, when there were disappointing results in clinical trials, investors became disenchanted and many fled the sector carrying large losses. The result is that promising biotechnology ventures in the UK find it harder to get backing, leading to a roller-coaster ride for stock prices. This volatility might be eliminated with improved disclosure requirements, especially for listed companies that are knowledge intensive.

This analysis suggests that inadequate disclosure of intangibles does bring significant threats, especially as the economy becomes even more knowledge intensive. Inadequate disclosure can exacerbate information ‘gaps’ to the benefit of insider traders and to the disadvantage of ordinary investors. Such gaps within companies can benefit managers and shareholders and disadvantage knowledge workers who might undervalue their work. In some circumstances, knowledge intensive companies might face higher costs of capital than they need to; in others ill-informed investors might pour too much capital into a fashionable, knowledge driven industry they do not understand well enough. Volatility and uncertainty make it harder for capital to be allocated efficiently.



4. Managing intangible assets

Intangible assets are becoming ever more important, yet it is difficult to measure them accurately within the constraints of traditional financial accounts.

Attempts to capitalise R&D or brands have been fraught with difficulty. New, non-financial measures are problematic, unrecognised and untested. The task is not to measure all intangibles but to value those that will significantly affect future cash-flows. Traditional approaches do not work well for intangibles. Some alternatives are assessed below.

1. Replacement Costs

One way to value an asset is to assess its replacement cost. This is difficult with, say, a skilled workforce or a brand value which may be difficult to separate from other assets. Assessing the full costs of replacement is very hard.

2. Income Projections

Another way is to estimate the income an asset will generate over its useful life and work out a net present value. Again, is it difficult to isolate the income attributable to an intangible, especially where it is wrapped up with a tangible product. A past income stream will be a misleading guide to a product's value in a market experiencing rapid technological change.

3. Market Valuation

How much would people be prepared to pay for an intangible asset? There are growing signs in the US at least of a market in R&D and other intangibles. Yet formal R&D is only one of many intangible assets. Most do not have market prices. They are unique, tacit and cannot be traded.

These problems bedevil most intangible assets. For example, how should a customer list be valued? At replacement cost in terms of the marketing and advertising spend of re-building it? Income projections? From the incremental income due to the list? Or a market price, determined by how much it would sell for if it were sold? There are several possible responses to the shortcomings of traditional asset valuation approaches when applied to intangibles.

New Approaches to Valuing Intangible Assets

Attempts to value intangibles more reliably are developing from two directions.

First, there is a range of new approaches to performance measurement and internal corporate reporting, such as the Balanced Scorecard and the European Quality Foundation Model. Both attempt to link financial performance to intangible drivers like employee quality and morale and customer satisfaction. These models are emerging because managers want more information about intangibles to manage them more effectively.

Second, attempts are being made to value intangible assets more accurately for investors. This usually means showing how non-financial information about brands, patents, research and development or customer loyalty can be linked systematically to a company's stock market valuation.

These approaches are not exclusive. Different kinds of measures might be more relevant to different audiences. Some are designed primarily to give managers and workers a clearer picture of the strengths and weaknesses of their business and change the way they think and act. Others, environmental and social impact auditing, for example, are targeted at a largely external but non-financial audience. Still others may be designed to help analysts and investors assess the contribution that intangible assets make to financial performance.

Performance Measures

1. Cash Flow Measures

Cash flow is increasingly used as a measure of performance on the grounds that profits and earnings may be a matter of opinion. But cash is a matter of fact.¹² One measure is cash flow return on investment, arrived at by converting profitability data into cash flow and using real gross assets as a surrogate for investment. Shareholder value-added measures net operating profit after tax and the cost of capital invested in the business. A related cash value-added approach measures past and projected cash flows from strategic and non-strategic investments.

Although there is some general evidence that cash flow generation is better linked to stock market valuations than profits and earnings, the link is far from secure. A study by accountants Deloitte & Touche found a high correlation between cash flow and market valuations.¹³ However, in their work Lev and Zarowin found that between 1977 and 1996 operating cash flows were no better guide to market value than reported earnings. They acknowledge that cash flow measures might be very useful in special circumstances such as when a company is in financial distress or in a high-tech start-up with high investment in intangibles.

2. Economic Value Added (EVA)

EVA was developed in the 1980s by New York consultants Stern Stewart & Co as an indicator of returns to shareholders. It aims to strip out many accounting system anomalies by presenting a simpler measure of the difference between the cost of capital and profit. A related measure of Market Value Added (MVA) compares total market value (less debts) with the money invested in the firm, in the form of share issues, borrowings and retained earnings. EVA is designed to focus managers on the cost of the capital they use and so encourage them to generate more value from the assets they manage. Stern Stewart, however, estimates balance sheets often need restating to give an accurate picture of capital employed and this frequently involves adding in intangibles. EVA has become a common tool among US companies but is still rare in the UK; in 1996 only a few British companies were using it. Critics argue that EVA is still too historic a measure and does not provide any sense of the linkages between a company's investment in intangibles and its financial performance. It has also been criticised for being biased against investments in intangibles.¹⁴

3. European Foundation for Quality Management Model (EFQM)

The EFQM model relates a wide range of weighted non-financial measures to business performance. Based largely on the model used for the purposes of the Malcolm Baldrige Award for quality in the US, it aims to give a more complete picture of the process through which a company sets strategy and manages its assets to deliver business results. This model, or variants of it, is used by some of Britain's largest companies, including BT.

4. The Balanced Scorecard

The scorecard was first described by Robert Kaplan and David Norton in a *Harvard Business Review* article in 1992 and a subsequent book. It aims to balance financial measures of performance, such as cash flow and return on capital employed, with measures of innovation and renewal (percentage of revenues from new products, R&D success rate) measures of internal processes such as cycle times, quality and productivity, and measures of customer satisfaction and retention. The scorecard is principally a management tool for executives to measure the effectiveness of their business strategy in delivering financial results. It measures the performance of a business only in relation to its strategy. One survey in the US found that almost two thirds of large companies were experimenting with a measurement system akin to a scorecard. Norton and Kaplan estimate that hundreds of US companies are using the scorecard which has been taken up by large British based groups, especially in the financial sector, such as the NatWest Group and The Halifax.

The scorecard has been refined to reflect criticisms

among practitioners. One problem was that companies often came up with too many measures. Norton and Kaplan acknowledge that a scorecard used to diagnose how well a company is doing will probably need more measures than one designed to set strategy. A recent US development is the Dynamic Balanced Scorecard which allows managers to track the way financial performance feeds into investment in intangibles. Its attraction is that, properly designed, it should allow managers to view at a glance the key indicators of business performance and their linkages. A possible cost is that by gathering this information in one tool the company and its executives might be deprived of the variety of information flows a business needs to remain agile.

5. The Institute of Chartered Accountants of Scotland

In 1993, the Institute published a review of performance measurements used by managers but often not disclosed to analysts. On the basis of this, the Institute suggests a model based on three main ingredients, supply, demand and corporate responsibility. Included in the supply category were measures of financial health, like stock market ratios; human capital, such as education and training, recruitment and retention; physical plant and equipment, and natural resources and environmental impact. It examined customer satisfaction, customer profile and market share. Compliance with laws and regulations as well as corporate governance structure were also considered. Many of these performance measures are used by British companies, although the ICAS model *per se* is not.

6. Ethical and Social Auditing

A company's performance increasingly depends on its relationships with key 'stakeholders' and partners, among them employees, customers, suppliers, the local community and pressure groups. These relationships are by their nature intangible, yet they are among a company's most valuable assets.

The argument for social and ethical auditing is that to audit a company comprehensively these relationships would have to be examined. Relationships with suppliers, customers and employees, for example, are vital to business performance. Those with pressure groups and the 'community' may be critical in determining a company's public standing and reputation.

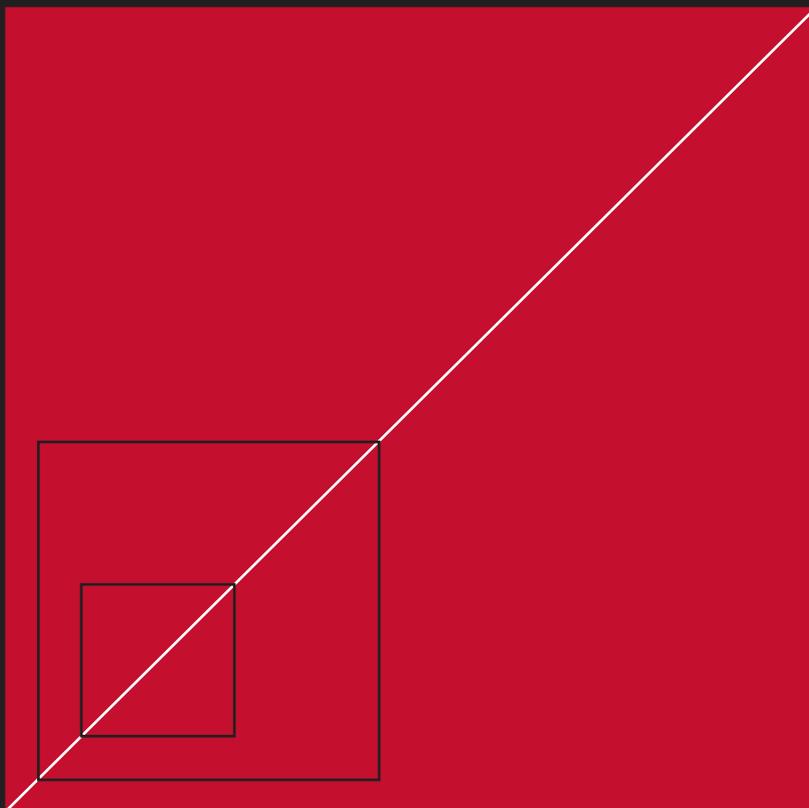
This stakeholder approach was set out in the UK in the Royal Society of Arts' *Tomorrow's Company* project which published several reports in the mid-1990s. At least one investment fund has been based on the inquiry's argument that successful companies have strong relationships with partners, suppliers and employees, together with a sense of social responsibility. John Lewis, the retail chain, and Unipart, the car components group are among the companies which espouse this approach.

The most ambitious attempt to deploy social and ethical auditing is currently in progress at Camelot, the UK National Lottery operator. In its version of the process, which is being audited by the New Economics Foundation,¹⁵ Camelot is engaging in a lengthy consultation with representatives of various stakeholder groups to ascertain their judgements of measures that should be used to assess the company's performance.

7. Environmental Auditing

Auditing a company's impact on the natural environment is increasingly common, especially for those in industries such as oil and chemicals. It is being driven by a recognition that a company's ability to recruit and retain staff and customers depends on its public standing and reputation, of which environmental responsibility is a key ingredient. The BP Environmental report for 1997, for example, issued in parallel with a social report of its work in the community, measures among other indicators the company's energy usage, emissions and spillages. The report was audited by Ernst & Young in line with guidelines issued by the European Federation of Accountants research paper on expert statements in environmental reports.

Shell is working with SustainAbility, the leading environmental strategy consultants, to develop an audit combining financial, social and environmental measures in a so-called 'triple-bottom-line.'¹⁶ These environmental measures, including the environmental costs of product development and process, and accounting for the 'natural capital' a company relies upon, are in their infancy. But they are likely to become more important for all large companies, especially those with significant manufacturing activities. Techniques are emerging to link these environmental assessments to stock market valuation by treating a company's environmental performance as creating assets and liabilities. One recent US study assessed the link between environmental clean-up liabilities and stock market valuations.¹⁷ A different approach to pricing environmental intangibles for a company examines the cost savings that compliance with environmental regulations creates, along with the increased demand from environmentally conscious consumers and improved employee motivation.¹⁸



5. New measures assessed

The measures discussed in Chapter 4 are mainly designed for managers to better understand and manage 'soft assets,' such as employee motivation, which have a direct bearing on a company's financial performance. These new measurement systems often give information about intangibles but they do not lead directly to a market or accounting valuation of an intangible asset. The following is a review of recent attempts to value intangible assets such as brands more directly.

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1. Human Capital

Most recently developed performance measurement systems give a prominent role to assessments of 'human capital' including levels of education and competence, expenditures on training, employee turnover, length of tenure with the company, linguistic and ethnic diversity. Lists of measures of employee quality can become very long: the Skandia Navigator developed by the Swedish financial services company mentions at least 26.

These measures clearly need to be tailored to a company's competitive strategy and needs. One company might need a high turnover rate to bring in younger people; another might wish to lower its turnover rate to create a more stable workforce. Even when the formal qualities of a workforce are assessed, it is not necessarily a good guide to their competitiveness. IBM has always prided itself on recruiting among the brightest graduates, but that did not prevent the sharp decline in its performance in the early 1990s.

Linking these employee measures to a market valuation of a company is difficult. One attempt has been made by Joshua Rosett, an economist at Chicago University, who calculated the capitalised cost of published labour contracts in unionised manufacturing companies in the US.¹⁹ This resulted in a very crude measure (see box, right) but it shows that if there were more reliable measures of human capital they would be worth as much as traditional assets.

2 Customers as assets

The more customers a company can retain the less it has to spend on marketing and so the higher its profits should be. There are good reasons for customer relationships to be treated as an asset yielding an income stream over its lifetime. The resources a company puts into building up such a relationship could be regarded as an investment in an asset, rather than as a current cost, yet this is how they are treated in most accounts. Most of the new performance measurement systems include measures of customer acquisition and retention, life-cycle and market share, turnover and age profile. But, as with human capital, the challenge is to show how these non-financial measures can be translated into financial measures that could be relevant to the accounting or market value of the company.

The Cost of Labour

Rosett wanted to estimate what it would cost a company to treat its workforce as an asset which it had to lease rather than as workers to which it paid a wage treated as a current expense. He argues that, using his technique, it should be possible to represent labour as a debt financed asset. Using labour contracts published by the Bureau of National Affairs' Daily Labor Report between 1976 and 1987 Rossett was able to extract details of wage rates and other elements of compensation. Adjusting the workforce size for rates of productivity growth, he capitalised the cost of paying these people and compared it with the value of the companies' physical assets recorded on their balance sheets. He found that, even excluding non-unionised employees, the capitalised cost of employing the workforce was generally 1.5 times greater than the book value of traditional physical assets and generally 8% higher than the total accounting assets of the mean company in the sample. Rosett measured the total assets of the mean company in his sample as \$2.82bn and the capitalised cost of employing the workforce as \$3.3bn.

One attempt to close this gap was made by Christopher Ittner and David Larcker, from the Wharton School of Management at the University of Pennsylvania.²⁰ Their studies (see box) suggest that there are diminishing returns to investment in customer trust and satisfaction.

Customer acquisition is vital to growth in new consumer technologies where there is often a race between competitors to build up an installed base. These costs are usually treated as an expense rather than as an investment. As a result, financial accounts are far less relevant to market valuations in these industries than non-financial information, such as market size and penetration rates, according to an analysis by Eli Amir, from the Graduate School of Business, Columbia University, New York, and Professor Baruch Lev, more details of which are contained in Appendix 2.²¹

Customer Satisfaction as an Asset

By analysing the American Customer Satisfaction Index, Ittner and Larcker found that a one unit increase in a company's score on the index was associated with a \$240m increase in the stock market value of an average company which had a stock market value of about \$12bn. In other words, investors seem to regard customer satisfaction as a predictor of financial performance although the authors point out that this link varies from being very strong in communications and utilities to being very weak for manufacturing.

By examining in detail the customer satisfaction records of a major US telecommunications group and a set of bank branches in California, Ittner and Larcker also established that, as customer satisfaction rose, so did customer retention. In telecommunications, for example, they found that a customer with a satisfaction score of 30 (on a scale of 100) was 64% likely to do business with the company again in the following year. A customer with a satisfaction score of 60 was 75% probable to give the company repeat business. The link between customer satisfaction and retention should be strong enough to justify some of the costs of customer relationship management being treated as an investment. Yet Ittner and Larcker also found that once customer satisfaction rose above 70 – 80% it had no impact on retention rates. In other words, further investments in building customer trust beyond the 80% level were unlikely to yield any clear return in terms of retention.

They suggest that either customer acquisition costs should be reported separately, rather than being lumped in with other salaries and general expenses, or capitalised in the same way as long-term contracts, insurance contracts and franchise sales. Different kinds of customer information will be relevant to different industries. For example, in airlines yields and load factors may be more important. Yet Lev and Amir's analysis, combined with that of Ittner and Larcker, suggests there should be scope for companies to disclose customer recruitment, retention and satisfaction information with their financial reports, especially as information technology systems make it easier for companies to collect and analyse this information.

Brand Values and Market Values

With a team of researchers, Mary Barth, a professor at the Graduate School of Business, at Stanford University, examined the relationship between brand values and market values. They looked at 1,204 brands owned between 1991 and 1996 by 183 firms and based on a ranking published by the US magazine Financial World.²² Firms frequently owned more than one brand. The analysis showed that the average firm had brands estimated at \$4.2bn, worth about 44% of average market value and a ratio of brand values to book value of 209%. There was a significant correlation between brand values and market valuations, suggesting that investors use non-financial information to reach a valuation of a brand as an asset while accountants do not, at least as far as internally generated brands are concerned.

The significance of the Amir and Lev analysis extends well beyond the cellular telephone industry. They found, for example, that financial accounts were just as inadequate as a guide to the market value of biotechnology companies. This suggests that in a wide range of industries in which growth is driven by investments in intangibles, such as brand recognition and research and development, financial reporting needs to be augmented by relevant non-financial information. The nature of this information will vary from industry to industry and this kind of approach may not be relevant to more mature industries. This suggests that, rather than seeking to draw up accounting standards which are global and timeless, regulators and professionals should focus on standards which may be industry specific and revisable to take account of the industry's special features and stage of development.

3 Brands

A strong brand is regarded as an asset by managers and investors yet brands are not valued as assets in most financial accounts. Apart from trademarks, internally developed brands are not seen as assets although brands purchased through corporate acquisition are so recognised. Expenditures incurred on increasing brand values, for example advertising and endorsements, are expensed as costs rather than capitalised.

This is one reason why companies with brand intensive products often have a higher market-book ratio than those without. A strong brand can give a company benefits like greater customer loyalty, less vulnerability to competitive marketing or marketing crises, larger margins, more inelastic customer response to price increases and opportunities for licensing and brand extension.

The valuation of brands is fraught with difficulty and attempts in the UK to put them on balance sheets have been highly controversial. Marketing specialists like Interbrand, however, claim to have developed reliable models for valuing brands. Interbrand's approach includes an attempt to assess brand earnings through cash flows attributable to licenses and related sales. Brand strength is scored against seven criteria: the market in which it participates; stability and customer loyalty; brand leadership in a market; long-term investment in the brand; geographic scope and degree of protection. This brand score is combined with the assessment of brand earnings to yield a brand valuation. Interbrand's clients use its software to track and manage the value of their brands.

Much needs to be done to refine brand value analysis before these estimates could be included on balance sheets. However, Mary Barth's analysis of over 1,200 US brands (see box on page 21) suggests that financial accounts would be made more useful and relevant for investors if they included adequately regulated and comparable data on brands.

4 Research and Development

Research and development is one of the most fundamental processes through which companies invest in knowledge creation. US firms invest perhaps \$150bn a year in R&D to create new products and processes which consumers and investors will value. This expenditure should be seen as an investment to create an asset – knowledge capital – which in turn produces a flow of income. However, in the US at least, R&D spending is generally not recorded as an asset but treated as an expense. This is because, in the eyes of regulators, the connection between the cost of R&D and the benefits is too opaque – it is risky and often does not lead to any specific benefits. Thus, to allow managers to capitalise R&D as if it were an asset would be to give them too much latitude to 'massage' accounts.

Although some studies have shown a close association between R&D expenditure and subsequent gains in productivity, earnings and stock returns, substantial difficulties remain in valuing R&D accurately at a company level.²³ From an investment management point of view, however, the level of an individual firm's total R&D, as it is disclosed in financial statements, is too coarse an indicator of future performance. There are various kinds of R&D, each with a different impact on future cash flows. Some R&D is basic research which may be highly risky but which might provide the basis for substantial long-term growth. Other forms, such as software development, are aimed at developing products with a short life span. This product development R&D differs from research designed to make production processes more efficient.

Attempts to value corporate R&D face a conundrum. Clearly, some of the investment in R&D will generate future benefits and should not be treated as just another business expense. But it is not clear in advance which portion of R&D is going to be most successful. Capitalising this spending on the basis of the cost of R&D will therefore give a misleading impression.

New measures of intangible assets need to find a way of avoiding the pitfalls of both approaches. One possibility is that the market might develop its own valuations for R&D from which accountants and investors might learn. One recent US study of 375 corporate acquisitions which involved the purchase of 'R&D in progress' found that the value of the R&D amounted to 75% of the purchase price of the average deal.²⁴ These acquisitions, which are becoming far more common, were in essence a trade in R&D.

Accounting regulations in the US mean that this acquired R&D has to be valued at a fair market price, often involving an elaborate procedure of expert review, market analysis and financial calculations. This procedure for valuing acquired R&D could provide a model for a more generalised approach. The case of IBM's acquisition of Lotus Development Corp provides an example (see Chapter 2.)

In the 374 other cases in the study referred to above, the mean acquisition price was \$62m, with acquired R&D accounting for 72%. Subsequent analysis of the stock market performance of the acquiring companies showed that investors regarded the fair market values attached to the R&D as relevant and reliable while the residual goodwill generated by the deals was generally discounted. This trade in R&D intensive companies is likely to grow as the economy itself becomes more knowledge intensive. The fact that investors seem to regard these fair market values of R&D as reliable suggests these approaches could be used to value a company's R&D when it was internally generated.

This suggests that a market for knowledge capital is emerging, at least in the US. It has long been held that R&D and other forms of knowledge capital are hard to value because, unlike machinery, buildings and other forms of property, knowledge is not actively traded. The emergence of markets where R&D and other intangibles are traded should be closely watched since prices established as reliable in these markets could provide guidelines for changes in accounting procedures.

5 Options to value intangibles

A further development is the use of real options, within companies and between companies and universities, to value technology and R&D. Attempts to value R&D are bedevilled by the uncertain research pay-off and that is why there is such opposition to capitalising investment in research as an asset. However, 'options' models, largely borrowed from the financial markets, may help companies and investors overcome the problems of valuing research in the context of great uncertainty.

In theory, 'options' are simple. In the film industry, studios routinely buy options on thousands of scripts that never get made into films. When they buy the option they purchase the right to make it into a film but they are not obliged to do so. An option has a value even if the film never gets made: the script is denied to potential competitors. If it is, the studio then acquires additional flexibility to deliver a wider range of films to a changing market. Options are a way for people to hedge their bets until the very last moment when they have to make a decision to go ahead or pull out. In markets beset by uncertainty buying this extra time and space to make a decision has a value in its own right even if the project does not come to fruition.

Options are commonly used in financial markets, for example in those linked to trade in minerals and agricultural commodities. Financial traders can trade in the options on these products without ever touching a soya bean or a piece of pork belly. Stock options are an increasingly common way for US and UK companies to reward staff.

They are also being used by companies acquiring research and technology from universities in the US.²⁵ By buying an option on a piece of research, a company typically funds patent applications and pays an option fee to the inventor, usually to allow further research. At the outset, basic science research projects often hold a great deal of promise: they could go up in smoke but they could create a new market. The more uncertain and volatile the pay-off, the more it makes sense for a company to hold an option. That way the company avoids a dangerous choice between stumping up the full cost of taking the idea into product development or pulling out and risking the loss of a great product. At each stage, the company can either choose to renew the option, terminate it or even sell it. And as the project progresses, it should be

possible to gather more information about its prospects. The less uncertain the outcome the less sense it makes for a company to hold an option. It then has to make up its mind to pull out or to back the project to completion. The details of these options are rarely disclosed but they provide a way for companies, investors and outsiders to value the underlying asset: the knowledge embedded in the research programme.

Merck, the pharmaceuticals group, already uses a highly sophisticated 'options' pricing model to value its R&D portfolio.²⁷ On average, it costs about \$359m and takes ten years to bring a drug to market. Even then, seven out of ten drugs fail to return the cost of the capital invested in them. Add to that the uncertainties of interest rate and currency fluctuations, plus regulatory and political changes, and the job of valuing pharmaceuticals research becomes extremely hard. Merck invests \$1bn a year in research but according to its chief finance officer the risks and uncertainties attending this spending were not properly valued until the company adopted an 'options pricing' model, akin to one used in financial markets.

This approach to valuing R&D blurs the line between financial market valuations and those made internally within a company.²⁸ In volatile markets, where prices and demand are always in flux, it is hard to predict how a particular investment will ultimately influence a company's value. The options approach shows how a company can incorporate the financial market's measures of value, under uncertainty, into its own strategic decision making.

This is the larger significance of the real options approach: it blurs the line between financial markets and traditional accounting. Indeed, one implication is that a company might become less neatly bounded and defined as a financial entity. In theory, investors should be able to buy shares not only in Merck, the company, but financial instruments which track individual Merck research projects or even individual research teams. Investors could therefore invest not only in the company as a whole but in the parts they liked. Investors' behaviour would help the company to value its own projects and set its strategy. At the moment, intangibles pose such a problem because market value is determined and revised constantly whereas book values are only revised periodically. It is surely technologically feasible for financial markets and corporate strategy, market values and book values to be in constant interaction.

6 Intellectual Property and Patents

Patents are one of the most defined forms of intellectual property. With the advent of computerised databases, particularly in the US, it is now possible for researchers to systematically link a company's patenting track record to its stock market performance.

Patents are becoming a focus for intellectual capital management within companies. One of the most impressive examples is the team at Dow Chemical which took over the management of Dow's 29,000 patents (see box, right).

Companies are developing more systematic internal measures of the value of their patents. At the same time researchers have begun to unravel the links between patents and stock market values. They may be a better measure of a firm's knowledge capital than spending on research and development because they are a measure of output while spending on R&D is a measure only of input. The strength of a company's patent portfolio can be assessed from several different vantage points: the number of patents; the frequency with which they are cited in others within the industry or in scientific research; and the age of the portfolio. Examination of a company's patent stock could be much more informative than a catch-all valuation of R&D which would lump together pure and applied research, product and process development, successful and unsuccessful projects.

One of the most ambitious attempts to test whether patents are a good guide to a company's stock market valuation has been made by a team of researchers led by Bronwyn Hall of the University of California at Berkeley and Nuffield College, Oxford.²⁹ This research (Appendix 3) examined the contribution of R&D, patents and patent citations to valuations of intangible assets.

Dow's Patent Success

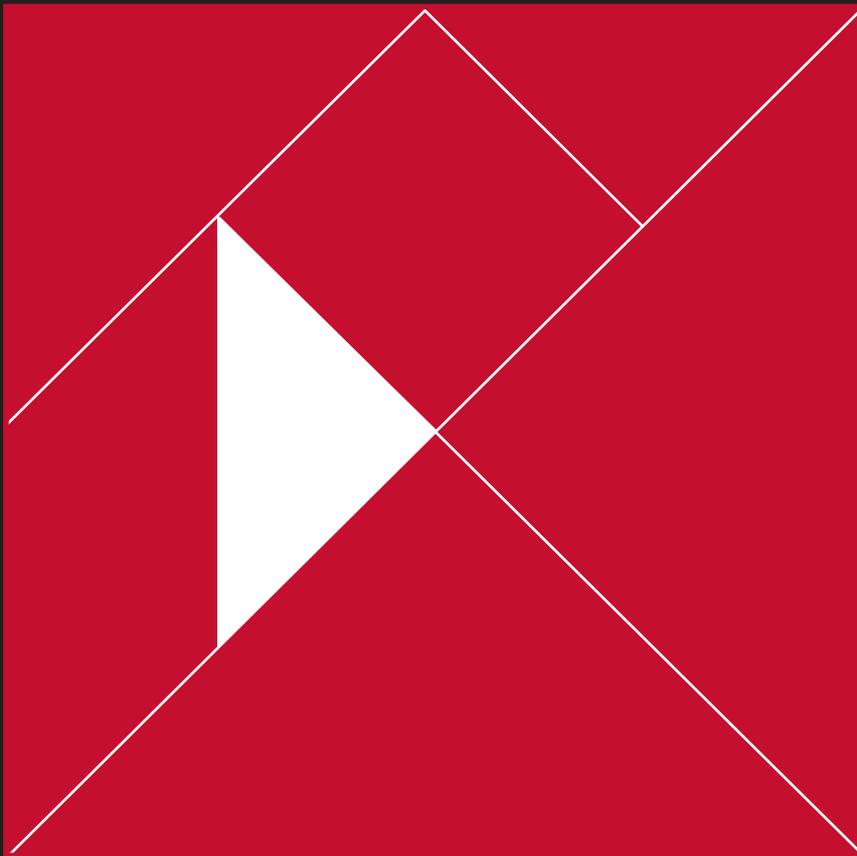
The intellectual capital management team at Dow Chemicals found that, while 200 patents were considered vital to the company, others were being used but were not critical. Some were potentially valuable and many were not used at all. Dow adopted a six-step approach to patent valuation. First, it created a global company-wide database of patents. Then it classified them on the basis of whether they were being used, would be used or were not being used. By linking it to the company's business strategy, a valuation for the patent, based on the revenues it was expected to generate, was arrived at by convening a panel of experts to assess the technology and its market. Finally, the company carried out an assessment of the likely competition and the costs and risks of investing in the patent. The benefits of the approach are already evident. In the first year the team saved \$1m on patent maintenance costs by deciding not to continue maintenance of those not linked to the company's business strategy. In less than five years the team increased the licensing income from patents from \$25m to \$125m.

Analysis of AT&T's Patent Index (Appendix 4) shows that patent data can play a very useful role in providing investors with information about a company's knowledge capital. Measures of the quality of patents, such as the science linkage and industry impact, are one indication of how valuable a company's knowledge is to other companies and the fundamental nature of research. Provision of this kind of information on a regular basis would help investors to understand the link between investment in R&D, the creation of knowledge capital and subsequent financial performance. This sort of analysis should become more feasible with the spread of computerised patent databases.

Of course, there are limitations. Patenting is more common in some industries than others and patenting regimes differ around the world. US companies are more likely to patent than some European and Asian companies. Patent data is not a cure-all for the problems of valuing knowledge capital. But when applied to the right industries and companies, and when combined with data on other intangibles like R&D, it can play a very useful role.

6. Bringing the new measures together

New performance measurement models are yielding far more detailed information about intangible assets and are increasingly being used to help managers track their role in generating financial results. At the same time, attempts to explain the role of these assets in determining stock market valuations are becoming more sophisticated.



New performance measurement models are yielding far more detailed information about intangible assets and are increasingly being used to help managers track their role in generating financial results. At the same time, attempts to explain the role of these assets in determining stock market valuations are becoming more sophisticated. Measures often use non-financial information such as brand strength to illuminate the way investors reach market valuations. They would make market valuations more reliable and could in turn help to inform accounting valuations of a company's intangible assets. The non-financial information needed for such approaches is being generated by the new performance measurement systems many companies are now adopting.

But the question is; how should these new measures be developed and integrated? **Three possibilities are raised and assessed in turn below:**

- Traditional financial accounts remain the focal point of corporate reporting, but are augmented where appropriate by non-financial information to help investors value intangibles – an *incremental approach*.
- New balance sheets (intellectual capital balance sheets) incorporate traditional financial information but focus mainly on measuring intangible assets like human capital, customer capital and structural capital – a *radical approach*.
- Valuation becomes increasingly market-based with devices like real options, blurring the line between financial market valuations of intangibles and internal corporate valuations – a *hybrid approach*.

1. The Incremental Approach

The incremental approach seeks gradually to fill in values for the intangible assets which traditional balance sheets overlook. Traditional financial accounts would remain the focus of corporate reporting but they would be augmented by relevant, robust information on intangibles. This approach would involve accounting procedures used routinely in corporate acquisitions to value intangibles as well as quasi-market valuations yielded by techniques such as real options. This incremental solution would comprise at least these steps.

First, this approach would be based on non-financial measures that were relevant, relatively easy to collect and had a proven relationship to market value. These measures would differ by industry. The aim would be to set industry specific standards for reporting robust, non-financial information on intangibles which could be independently audited. In high-tech industries, with heavy investment in research and development, fair market values for related R&D might be highly relevant. In others, like fast moving consumer goods, estimates of brand value would be more relevant. It would be a mistake to aim for global standards because measures relevant to a large mature company would not apply to a small one. Instead, the aim should be to develop measures tailored to particular industries and which could be adjusted to take account of a company's stage of development.

Second, companies should provide 'safe-havens' in their accounts for intangibles to be valued as assets without putting them on the actual balance sheet. This would allow companies to adopt a more flexible approach by stating possible ranges for intangible asset values. The safe haven would be a way of putting valuations of intangibles in 'quarantine' before allowing them to migrate to the balance sheet.

Third, companies should provide a set of revisable rolling accounts. It might not necessarily be wise to capitalise the R&D of a high risk new technology business at an early stage of development because the future benefits would be so uncertain. But at some point, when the technology and the market have become less volatile, capitalisation may become more realistic. It might then be worth restating past accounts to show how they would have looked if the R&D had been capitalised. Accounts are the financial history of a company and like most histories they should be revised in the light of new information.

The incremental approach is designed to allow companies gradually to combine traditional and novel ways of valuing assets. It would permit them to deal more effectively with volatility and uncertainty by providing safe havens and revisable rolling accounts. Industry standards for disclosing relevant non-financial information about intangibles would allow more robust links to be made between investment in intangibles and market valuations. Traditional financial accounts would become more relevant and responsive by becoming more flexible and adjustable to suit specific circumstances.

The Swedish Experience

In 1996 Skandia issued an intellectual capital report alongside its traditional financial accounts. It divided the company's capital into financial capital (realisable assets, close to book value) and the rest, which counted as intellectual capital. It then divided intellectual capital into human capital (the quality of the workforce) and structural capital, which meant the remaining value in the company after account had been taken of its people. Structural capital was divided into customer capital (the company's relationships with its customers) and organisational capital – the knowledge and routines which allow the company to innovate and process its work. Innovation capital was divided into intellectual property like patents and copyrights and other intangible assets. Skandia has developed an extensive list of measures that should allow it to measure these different kinds of capital. It also employs a navigator system akin to the balanced scorecard.³⁰

Karl Erik Sveiby's approach is far more focused and compact than the Skandia model. He divides intangible assets into three main categories:

- **external structure** – the quality of relationships with suppliers and customers;
- **internal structure** – process efficiency, innovative capacity;
- **people competence** – the quality and motivation of the workforce.

Sveiby then analyses these intangible assets according to three criteria: operational efficiency; growth and renewal and stability/instability. This model is simpler than the Skandia approach and has much in common with Norton and Kaplan's Balance Scorecard.³¹

The greatest merit of this approach is the gradualism which would enable investors, managers and regulators to learn as they go. For all their shortcomings, financial reports are familiar formats. This approach would attempt to build on that strength rather than risk throwing the baby out with the bathwater. However, there are risks. A patchwork quilt of methods for valuing companies would be created and this might undermine the consistency and reliability of the accounting framework. There may also be a risk in not going further and faster. Arguably, the incremental approach would not make intangible assets prominent enough. This is why a more radical approach might be needed.

2. The Radical Approach

The radical approach is to devise entirely new balance sheets for companies – Intellectual Capital Balance Sheets – which put intangible assets at the heart of the accounts. Financial information is included but as a measure of success and as a resource for investment. The generation and deployment of intangible assets forms the core of these new models. The best known of these new balance sheets is the intellectual capital report by Swedish insurance company Skandia. Another Swedish approach is the intangible asset monitor developed by management consultant Karl Erik Sveiby (see box).

Yet another approach is the Intellectual Capital Index developed by Goran and Johan Roos.³² It provides an intellectual capital tree which divides the intellectual capital of a business into human capital, organisational capital and customer relationships. A company's organisational capital can then be further divided into business renewal and business process capital. The process of drawing up such a balance sheet often forces companies to focus on the intangible assets and competences which most matter to them.

Intellectual Capital Services, the UK-based consultancy which markets the index as a business tool, reports that companies generally focus on four main components:

- Relationship capital, measured by growth in number of relationships, levels of trust, customer retention, quality of distribution channels;
- Human capital index, measured by value creation per employee, training and education quality, employee motivation and morale;
- Innovation capital index, measured by ability to generate new ideas and turn them into products while improving productivity;
- Infrastructure capital index, measuring tangible and intangible assets which allow the company to get its job done.

Intellectual capital measurement is a fast-growing part of the knowledge management market. It has many attractions, at least in theory. The process of drawing up an intellectual capital balance sheet focuses managers on intangible assets. It also helps managers and investors to visualise the role of intangible assets in creating corporate value. These new measurement systems all use similar measures of human capital, customer relationships and structural capital, for example in the latter case, those embedded in corporate relationships and joint-ventures.

There are also significant downsides. Many of these new systems appear elegant but would require large investments in data collection. Many measure 'assets' which have no obvious bearing on financial performance. The Skandia approach has a long list of possible measures. For example, it recommends companies to measure the proportion of the workforce below the age of 35, but there is no indication of whether the number should be above or below 50% or whether it should be going up or down.

The new balance sheets seem to endorse the idea that intangible assets can be tied down and measured if only accountants had enough time and information. This is a mistake: intangible assets are highly complex and fluid and their value is volatile and highly context dependent. These IC inventories could prove costly and cumbersome tools which would be too slow to adapt to fast moving markets. One test of their effectiveness would be to apply them retrospectively. Had the Skandia IC balance sheet been applied to IBM in the mid-1980s it would probably have shown a highly efficient, well-resourced company with lots of innovative ideas, bright people and happy customers. It would not have highlighted the way IBM's position was being eroded by fast-moving competitors with radical ideas and operating at the margins of IBM's mainstream markets.

IC measures may prove a very useful way to visualise and present the intangible assets of a company, especially when combined with the ethical and social audits now becoming more common among large companies. They also overlap with new performance measurement systems such as the balanced scorecard. As they stand, however, they will be less useful in putting a reliable valuation on intangible assets for outside investors.

3. The Hybrid Approach

In some ways the hybrid approach is the most radical. It would involve far more sweeping changes, not just to the way managers and accountants value intangibles but also the value placed upon them by society as a whole. An underlying assumption of the debate about intangibles is that there should be an accounting solution to the difficulties of valuing them. This may involve gradual or radical reform but it would essentially involve accountants in drawing up a balance sheet for a company.

The hybrid approach would explicitly recognise that more reliable values for intangibles will only emerge if there are more open, active and 'thick' markets to trade them, or at least financial instruments linked to intangibles. There are two main attractions to the development of new markets for intangibles.

First, intangibles are difficult for accountants to value because they are so volatile and uncertain, their value shifting with markets and demand. Accounting measures of intangible value – whether traditional or radical – are too slow, cumbersome and backward-looking to keep pace with this change. What is needed is constant adjustment of the value of intangibles according to market conditions, technologies, regulatory changes and so on. Financial market models are much better at this than accounting measures.

Second, accounting, like the tax system, is at its best when it is recording observable, discrete transactions. Intangible assets create a problem for accountants because they are difficult to disaggregate and so are hard to trade. To value intangibles accountants need either to acquire radically new skills to value assets which are not traded or to create open markets and a trade in intangibles which they can record.

This hybrid approach argues for the creation of new financial markets to allow the trade of options on intangibles. Investors would be able to invest in companies as combinations but also on a disaggregated basis. An investor might wish to invest in Nestle, which holds many consumer brands, but may also wish to invest in one like KitKat. Similarly, an investor may wish to buy shares in Manchester United but could also buy options in Ryan Giggs or David Beckham. The intangibles options market would allow this flexibility.

Incremental vs Radical vs Hybrid – The Key Features

Incremental

- Industry-specific rather than global
- 'Safe havens'
- Revisable rolling accounts
- Gradualism would enable investors, managers and regulators to learn as they go.

But...

- Might lead to patchwork quilt method of valuing companies, thereby undermining consistency and reliability of accounting framework
- Risk in not going further faster
- Might not make intangibles prominent enough.

Radical

- New intellectual capital (IC) balance sheets
- Intangibles placed at heart of accounts
- Financial information included to measure success
- Drawing up IC balance sheet focuses managers on intangibles.

But...

- Large investment in data collection
- Assets measured which have no bearing on financial performance
- IC inventories could be too cumbersome for fast-moving markets
- Less useful in putting reliable valuation on intangibles for outside investors.

Hybrid

- Big changes in valuation of assets
- Recognition of need for markets to trade them or financial markets linked to intangibles
- Market-based system for valuing assets could be reflected in accounts
- Accountants would not try to measure intangibles but record financial markets' valuation of them
- Accounting and market-based measures of value would therefore develop in tandem leading to new markets – not new balance sheets.

But...

- Limitations to intangibles that could be traded
- Options market might lead to uncertainty and volatility.

This approach would see the creation of a new breed of financial market: the intangible options market, a market-based system for valuing the future prospects of intangible assets which make up a business. The valuations reached could be reflected in company accounts. Accountants would not attempt to measure intangible values themselves but simply record the values put on intangibles by the financial markets.

The great merit of this market-led approach is that accounting and market-based measures of value would develop in tandem. Companies would be pulled towards providing more information to investors to inform their trading. The focal point would not be new balance sheets but new markets.

There may, however, be limitations to the kind of intangibles that can be traded. People may not object to financial options being linked to research programmes but might balk at the idea of talent-based options linked, for example, to the performance of a research team being traded on open markets.³³ These option markets might help investors deal with the uncertainty of intangibles but may themselves spread uncertainty and volatility. By disaggregating the value of a company's intangibles this approach might create the impression that a company is no more than a temporary combination of people, ideas and resources which can easily be broken up and reconfigured.

Conclusions: the way forward

The gap between the stock market values of many companies and their accounting or book values is growing. This is especially true of high-tech and knowledge intensive industries in which companies invest heavily in intangible assets like R &D and brands. As the economy becomes increasingly knowledge-driven, these intangible assets will acquire more value in industries from retailing and agriculture to software and biotechnology.

The accounting system was not designed to deal with companies which invest heavily in intangible assets. It performs poorly in measuring high-tech sectors like cellular telephones and pharmaceuticals as well as brand intensive companies in consumer industries.

This mismatch between the value put on a company by investors and the value recorded on formal balance sheets is not simply due to the scale of investment in intangibles. Just as unsettling for traditional financial accounting is the volatility, uncertainty and pace of change associated with higher investment in intangibles. Accounting is not just poor at dealing with intangibles but also at dealing with rapid and discontinuous change.

The case for reforming the way that companies disclose information about intangibles and account for their value is substantial. But it cannot be sustained on the basis of defending traditional accounting or administrative tidiness. Still less, it cannot be used to uphold the professional position of accountants who are increasingly under threat from the spread of alternative systems of valuation developed outside the profession.

The mismatch between market values and book values may risk creating space for insider trading, leading to capital being misallocated or raising the cost of capital for knowledge-intensive companies and increasing volatility and uncertainty.

A new approach to disclosing information about intangibles and valuing them should start from recognition that intangible assets are highly context-dependent and variable in their value. This value cannot be 'added-up' in the way that can be done with traditional, tangible assets. In particular, intangible assets have become so valuable for companies, partly because they are difficult for competitors to imitate or acquire. They are also difficult to trade and exchange. The features which make them so valuable to companies also make them difficult for accountants and traders to value.

This implies that any new approach should be multi-disciplinary and multi-institutional. More reliable accounting measures of intangible asset values will only emerge with more reliable market-based measures of their value such as an intangible options market. The two must develop in tandem. There is no pure accounting solution to the valuation of intangibles.

The need for more and better information about intangibles is reflected in the rise of new business performance measurement systems, such as the Balanced Scorecard, EVA and the European Quality Foundation model. All aim to provide managers with a way of understanding how intangibles like customer loyalty and human capital generate financial results. These new approaches do not provide a ready way to value intangible assets per se but they offer much useful non-financial information which could help outsiders to better assess the value of intangibles.

There is growing evidence of industry specific, non-financial measures which would help to put a more reliable value on intangibles. Research shows that patent citations, some aspects of R &D, customer satisfaction and loyalty, human capital and brand values can all be systematically linked to stock market valuations given to companies. This non-financial information is highly value-relevant.

The above suggests that the immediate focus should be placed on industry specific best practice and regulatory changes to improve the disclosure of non-financial information about intangibles, alongside traditional financial accounts.

The new approach cannot be developed by regulatory intervention alone. Public pressure can play a vital role as it has in forcing oil companies to report on environmental and social issues. Market pressure will also play a role: there is some evidence that companies are rewarded and more trusted by analysts for providing more relevant non-financial background information about their research. When a financial announcement is made, the non-financial information plays a role in setting the context and background.

The most promising approach would be to develop a set of standards to augment, complement, revise and amend company accounts. These standards should be industry-specific. This will provide better information about intangibles and allow them to be valued more reliably.

'Safe havens' could be created in accounts to value intangibles and the provision of revisable, rolling accounts could present different ways of valuing intangibles. Outsiders would thereby gain multiple and overlapping perspectives from which to value a company. The provision of a continuous flow of information to investors, rather than periodic accounts, may make it easier for them to track the way investments in intangibles might lead to improved performance.

This approach needs to be combined with the development of new markets to trade intangibles or financial instruments linked to intangibles – an intangibles options market to enable valuations to be determined. These market-based measures of intangibles could be built on emerging models that value them through option pricing models. This approach would blur the line between financial market models and accounting models of value thereby helping to reconcile market values and book values.

Finally, new intellectual capital balance sheets, of the kind pioneered by Skandia, can play a useful role in presenting and visualising the intangible assets a company relies upon.

These new approaches are valuable but could also be as cumbersome and slow-moving as traditional accounts and so no better at dealing with the volatility and uncertainty which attends intangible assets.

Appendix 1

Lev and Zarowin's Study of US Company Values

In their extensive study of the financial accounts and stock market values of between 3,700 and 6,800 US companies between 1978 and 1996, Baruch Lev and Paul Zarowin found that traditional financial information – earnings, cash-flows, book-values – had become less relevant to stock market valuations of these companies. In the 1960s and 1970s, changes in corporate earnings accounted for about 25% of the changes in stock market valuations. By the mid 1990s it was less than 10%. Lev and Zarowin found cash-flows and book values had become similarly less relevant.

They argue that traditional financial information has become less relevant, largely because the rate of change in business performance has accelerated so markedly in the last 20 years. They organised the companies in their panel into ten groups on the basis of their market and book values. The top comprised the 10 per cent of firms with the highest values; the lowest the 10 per cent with the lowest values. Lev and Zarowin then measured how frequently companies changed their position in the rankings by moving between groups. They found that change had become more common and more significant. In the 1960s, the likelihood of a company changing its position in the rankings based on its market value was between 30 – 40%. By the 1990s that had risen to between 50% and 60%.

Lev and Zarowin argue this accelerating change spreads uncertainty and makes it increasingly difficult for accountants to match a company's investments and expenses in one period with its earnings and income in another. Earnings in one accounting period are increasingly a poor guide to earnings in a subsequent one. This rate of change is partly due to deregulation and technological change which has exposed companies to new competition and opened up new markets which are difficult to value. However, investment in intangibles – research and development to create new products for example – also plays a significant role in driving change.

Appendix 2

Amir and Lev's Analysis of US Cellular Telephone Companies

Eli Amir from the Graduate School of Business, Columbia University, New York and Professor Baruch Lev, from the Stern School of Business at New York University, examined the relevance of financial and non-financial information in determining the market value of cellular telephone companies in the US in the mid-1990s.³⁴

Cellular telecommunications companies have to invest heavily to acquire customers and to set up an infrastructure to serve them. These costs are expensed so that financial variables such as reported earnings and books values are severely depressed. The total market value of the 30 independent, publicly quoted cellular telephone companies in their survey was \$34bn in May 1993, their earnings and cash flows were negative and the median market to book ratio was 12, six times the corresponding ratio for industrial companies.

Mobile telephone companies have to spend heavily to acquire customers. At the time of Amir and Lev's survey commissions of \$200 – \$300 per customer were being paid. The faster a company was growing its customer base, the more it was spending, the worse its financial performance became. However investors generally viewed customer acquisition positively and gave the same company a higher stock market valuation.

The analysis showed that traditional financial accounting measures such as earnings, cash flow and book value were largely irrelevant to how a company was valued on the stock market. However, non-financial information about the potential size of an operator's market, the make-up of its consumers and its customer acquisition rate, were highly correlated with stock market valuations. When financial and non-financial information was combined the information became even more 'value relevant.'

The analysis concludes:

The evidence presented in this study indicates that current financial reporting of wireless communications companies – a large, world-wide and technologically leading industry – is inadequate. Specifically, significant value-enhancing investments in the cellular franchises and in expanding the customer-base are fully expensed in financial reports leading to distorted values of earnings and assets. Investors are cognisant, to some extent, of these accounting deficiencies and therefore rely primarily on non-financial information.

The significance of this analysis extends well beyond the cellular telephone industry. As the authors put it:

In the cellular industry, the value-relevance of non-financial information overwhelms that of traditional, financial indicators... we expect this to be the case in other science-based, high-growth sectors.

Appendix 3

Research into the Contribution of R&D and Patents

The research led by Bronwyn Hall of the University of California at Berkeley and Nuffield College, Oxford, examined a computerised database of about 1 million patents held by 4,800 US manufacturing firms over a 30-year period to explore the contribution of R&D, patents and patent citations to valuations of a company's intangible assets. A quarter of the patents had no citations, 150,000 had just one, 125,000 had two and four patents had more than 200 citations. The research found that R&D stock was a better guide to the scale of intangible assets or knowledge capital than patents but that patent citations were more relevant than the number of patents. The most successful approach was to measure the number of patent citations in combination with the amount spent on R&D. This found that an increase of one citation per patent was associated with an increase in the market value of the firm of three to four per cent.

Hall and her team then looked at five groups of firms. They found that the 82 firms with more than 20 citations per patent had a stock market value 55 to 60% higher than would have been expected, given their R&D capital and the number of their patents. So while patent citation data is generally relevant it becomes particularly relevant for companies which focus their research on fundamental innovations which are widely cited in other patents. Information about patent citations would be potentially very useful for investors to judge these high tech, science based companies, especially in electronics, semi-conductors, pharmaceuticals and plastics.

Hall's findings were supported by a more detailed examination of the quality of patents in 398 US firms in four patent intensive industries: pharmaceuticals, chemicals, communications equipment and electronics.³⁵ This examined several aspects of the quality of patents, including their science linkage (a measure of how closely related to basic scientific research the inventions were, based on how frequently scientific papers were cited in the patent); their industry impact (how frequently a company's patent was cited by other patents) and life cycle (how young or old a patent portfolio was). The analysis found that science linkage and industry impact were both strongly related to a company's market to book value and its subsequent stock price performance. For example, chemical companies with a low science linkage and low industry impact in their patents had a market to book ratio of 2.024, while those with a high linkage had a 25% higher market to book ratio. The year ahead stock returns of companies with high impact patents was 11.2%, about 27% higher than those with low impact patents. Further research on the panel of companies found that the science linkage

measure of a patent's quality was associated with markedly higher market-to-book ratios: science based patents were associated with investor's perceptions that the company was capable of long term growth. However, near term stock performance and short term returns was more associated with the level of innovative activity measured by the volume of patents the company issued.

Professor Baruch Lev's Calculations on AT&T

The table below sets out some of the figures derived from an analysis of AT & T's performance calculated by Professor Baruch Lev from the Stern School of Business at New York University.

| Year | (1) Number of Patents | | (2) Industry Impact | | (3) Science Linkage | | (4) Patent Age | |
|------|-----------------------|---------|---------------------|---------|---------------------|---------|----------------|---------|
| | AT&T | Ind Ave | AT&T | Ind Ave | AT&T | Ind Ave | AT&T | Ind Ave |
| 1989 | 525 | 28 | 1.48 | 1.34 | 1.49 | 0.32 | 6.6 | 7.7 |
| 1995 | 814 | 58 | 1.94 | 1.37 | 1.81 | 0.75 | 5.5 | 6.7 |

Row one shows that AT&T generates far more patents than the industry average. Just as important in terms of the link to share prices is the quality of patents. The second row is a measure of the importance of AT&T's patented inventions to the rest of the industry. It measures how frequently the patents are cited in other products used in the industry. The rate of citation is much higher for AT&T than for other firms: that means the innovations AT&T is generating are far more fundamental than those generated by other companies. The third row is a measure of the scientific quality of AT&T's patents. This is a measure of the quality and radical character of AT&T's inventions. This column measures how frequently AT&T's patents are cited in scientific journals and patents claimed by scientific research institutes. Here, AT&T's lead over the industry is even greater, suggesting that it is engaged in far more basic, fundamental and radical research. The fourth column measures the median age of the patents issued by the company. This is a proxy for the rate of technological change and the velocity of knowledge generation. This column shows how much new knowledge a company is generating. The lower the number the better. Again, AT&T is clearly ahead of the industry.

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