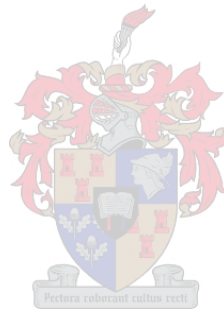


*Towards an  
Operational Definition  
of the  
Knowledge Economy*

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*Thesis presented in fulfilment of the requirements for the degree of Master of  
Philosophy (Decisionmaking, Knowledge Dynamics and Values) in  
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## Declaration

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## Opsomming

Die oogmerk van hierdie tesis is om by te dra tot die gangbare definisie van die kennis ekonomie – ’n term wat net so wyd gebruik word as wat dit misverstaan word. Ten spyte van twee dekades van akademiese nadenke en debatvoering, is daar steeds onduidelikheid rondom die kennis ekonomie as konsep, wat dit vir navorsers, akademici en beleidmakers moeilik maak om ’n algemeen-aanvaarde perspektief te bereik. Die probleem is nie bloot semanties van aard nie – sommige definisies behels onderliggende aannames wat die potensiaal het om besluitneming and handeling te beïnvloed.

Hoofstuk Een dien as inleiding tot die doelstellings van hierdie tesis en omskryf die benadering van die tesis. Dit beklemtoon spesifiek die uitdagings rondom die skryf van ’n literatuuroorsig wat gebaseer is op ’n uitgebreide en hoogs-gevarieerde stel bydrae tot die konsep van die kennis ekonomie.

Hoofstuk Twee se doel is om lig te werp op die konsep van die kennis ekonomie en hoe dit onderskei kan word van die breër, meer omvattende term van die kennis samelewing. Nadat onderskeid getref is tussen die twee konsepte, ontwikkel Hoofstuk Twee die kennis samelewing se meer insluitende aard, en stel voor dat die uitgebreide omvang van die term afbreuk doen aan die nut wat die term as ’n riglyn vir beleidmakers het – spesifiek in verhouding tot die meer presiese konsep van die kennis ekonomie.

Hoofstuk Drie begin die fokus op die ekonomiese komponent van die term ‘kennis ekonomie’. Ten einde konseptuele duidelikheid te skep, word die mees algemene en/of blywende bydrae gegroepeer onder vier kategorieë, wat blyk uit die bespreking in hierdie hoofstuk, naamlik: Propositionele Kennis, Voorskriftelike Kennis, Kulturele Kennis en Begrip.

Hoofstuk Vier fokus op die volgende komponent van die term kennis ekonomie en rig die aandag op die ekonomiese aspekte van kennis, wat oor die laaste twee dekades na vore gekom het as gevolg van tegnologiese en akademiese klemverskuiwings wat gedurende hierdie tydperk plaasgevind het.

Hoofstuk Vyf gebruik die grondslag van begrip wat tot dusver geskep is, om die vraag te beantwoord: wat is nuut omtrent die kennis ekonomie? Hier word die impak van ICTs duidelik deurdat dit illustreer hoe hierdie tegnologieë moderne samelewings op ’n fundamentele en diepgaande vlak verander het. Tweedens, ontwikkel Hoofstuk Vyf verder die manier waarop kennis as ekonomiese kommoditeit wydverspreide omwenteling in Industriële Era ekonomiese teorie. Hieruit word dit duidelik dat die beginsels wat die fisiese paradigma ekonomie onderskryf nie meer geldig is met ’n kern kommoditeit wat nie die beginsels van fisiese paradigma goedere gehoorsaam nie.

Hoofstuk Ses sluit die besprekings wat in die loop van die tesis ontwikkel het af, en beklemtoon hoe die voorafgaande hoofstukke almal bydra tot die doelstellings wat aanvanklik in die tesis voorgestel is. Verder, beklemtoon dit die uitdagings wat uitgelig is in die tesis wat steeds beperkings stel ten opsigte van die bepaling van ’n presiese definisie van die kennis ekonomie. Die gevolgtrekking wat gemaak word is dat die besprekings wat ontwikkel is tydens die tesis hul doel van ’n waardevolle en omvattende operasionele definisie bereik. Dit is van nut vir akademici en beleidmakers in terme van konseptuele duidelikheid en ’n basis of gemeenskaplike grond vanwaar besprekings en debat kan geskied.

## Summary

This thesis seeks to contribute towards a much-needed operational definition of the knowledge economy – a term which is as widely used as it is misunderstood. Despite two decades of academic contemplation and debate, much uncertainty still surrounds the concept of a knowledge economy, making it exceedingly difficult for researchers, academics and policymakers to find a shared perspective. The problem extends beyond just semantics – often contained within a certain definition are underlying assumptions that have the potential to inform decision-making and guide action.

Chapter One introduces the aims of this thesis, and outlines the intended approach. In particular, it highlights the challenges of conducting a literature review based on an extensive and highly varied set of contributions towards the concept of the knowledge economy.

Chapter Two seeks to clarify the concept of the knowledge economy and how it distinguishes itself from the broader, more inclusive concept of the knowledge society. After drawing distinctions between the two concepts, Chapter Two develops upon the knowledge society concept's more inclusive nature, and suggests that the extensive scope of the term detracts from its usefulness as a guide for policymakers – in particular, in relation to the somewhat more precise concept of the knowledge economy.

Chapter Three begins the focus on the In order to provide some conceptual clarity in this regard, a number of the most prevalent and/or enduring contributions are grouped under the four overarching categorisations that emerged as a result of the discussion in this chapter: namely, Propositional Knowledge, Prescriptive Knowledge, Cultural Knowledge and Understanding.

Chapter Four focuses on the next component of the term knowledge economy, and places attention on the economic aspects of knowledge which have emerged over the past two decades as a result of the technological and academic shifts that have taken place in this period.

Chapter Five uses the foundation of understanding built up to this point to answer the question: what is new about the knowledge economy? Here, the impact of ICTs comes to the fore in illustrating the way in which these technologies have altered modern societies on a deep and profound level. Secondly, Chapter Five develops upon the way in which knowledge as an economy commodity has caused widespread upheaval in Industrial Era economic theory. Here, the idea that the tenets that governed the physical paradigm economy of industry and manufacturing are no longer relevant or valuable in the face of a core commodity which does not obey the principal rules of physical paradigm goods.

Chapter Six concludes the discussions that have unfolded in this thesis, and highlights how the preceding chapters all contribute towards achieving the initial aims of the thesis. On top of this, it highlights the challenges uncovered during the course of the thesis that will continue to provide limitations to the achievement of a precise definition of the concept of the knowledge economy. It is concluded that the discussions developed in this thesis would achieve their goal in providing a valuable and comprehensive 'working definition' of the knowledge economy for academics and policymakers seeking to find conceptual clarity and a platform of 'common ground' from which to base their conversations and debates.

## Acknowledgements

I wish to thank all the individuals and friends who gave me their kind support during this study. I would like to extend my thanks to the wonderful lecturers, friends and colleagues at the Departments of Information Sciences at Stellenbosch University who challenged and inspired me during my academic career at Stellenbosch University, and all of whom in some way have contributed to making this thesis possible. Alma van der Spuy – you are a saint!

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I would like to thank my mother for constantly reminding me that I hadn't finished my thesis, as well as the countless tea/hot-chocolate breaks during those sporadic moments of late-night focus. Thanks to my dad for so convincingly pretending to read and/or understand the contents herein.

Above all, I would like to thank Professor Johann Kinghorn, who was undoubtedly the reason why this thesis was undertaken in the first place, as well as the wisest of sounding-boards when the multiple demands and distractions of my non-academic endeavours were hounding at my heels. A fifteen minute chat about flying (usually over scones and/or wine) was usually interrupted with the silver-bullet insight that made the whole thing seem both possible and worthwhile. Thanks Prof for the encouragement, for the breathtaking insights and for your tremendous patience.

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# Chapter One

## Introduction

The overriding consensus regarding definitions of the Knowledge Economy and/or Knowledge Society is that there is no consensus. Academic contributions from a wide array of leading economic and social theorists have contributed greatly to the enrichment of the field, providing numerous perspectives and critiques regarding the Knowledge Economy and/or Knowledge Society. However, this broadening of the field has also led to a debilitating lack of conceptual clarity surrounding these terms, as competing perspectives and theoretical distinctions make the concepts increasingly inaccessible to those outside the academic debate. At once, it seems, the concepts of the Knowledge Economy and Knowledge Society seem to refer to “*everything and nothing*”<sup>1</sup>.

What makes this conceptual confusion particularly important is the reality that those involved in public policy formation at a governmental level are often those ‘outside of the debate’. Strategic policy formulation refers liberally to the Knowledge Economy and Knowledge Economy in any country (or organization) which intends to present an informed countenance, but more often than not, participants in the same discussion all bring different understandings of these terms – especially when they come from different economic, political and social backgrounds. The problem extends beyond just semantics – often contained within a certain definition are underlying assumptions that have the potential to inform decision-making and guide action. On top of this, definitions help to delineate measurement criteria, which are fundamental tools in the design and analysis of public policy. For these reasons, among many others, some form of conceptual unity regarding the Knowledge Economy is of pressing importance. This will not involve merely a systematic gathering of different perspectives in the literature – rather, the end goal will be to build some conceptual clarity in a field which is riddled with confusion.

Achieving this is, of course, no easy task. Part of what has made the Knowledge Economy such a ubiquitous concept is the fact that it is used in a wide range of contexts, and under many other names – for instance, the ‘weightless economy’, the ‘knowledge-based economy’, the

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<sup>1</sup> Smith, 2002: 6



“goldilocks economy”, the ‘new economy’, and the ‘network economy’.<sup>2</sup> It has been used to describe (and often *account for*) things like developments in Information and Communications Technologies (ICTs), globalisation, and the changing nature of modern business. At its core, however, each of these perspectives seems to make use of the term to articulate, at the very least, a shift in the fundamental nature of the more advanced economies and societies, as well as the characteristics of competitive advantage and wealth creation.

## 1.1 - Towards an Operational Definition

The primary intention of this thesis is to move towards an operational definition of the Knowledge Economy that, in a single document, details the most prominent understandings of the term, while critically analysing each in relation to competing understandings, as well as the current state of ICTs and other knowledge-related technologies. It is acknowledged from the outset that the expansive and often divergent nature of perspectives regarding the field of the Knowledge Economy means that it would be impossible – if not highly improbable – to try to reconcile these perspectives completely. For this reason, the intended ‘unified’ definition will seek to be *operational* in that it will provide a lucid and suitably comprehensive encapsulation of the most important work done thus far in the field, surfacing the main assumptions implicit in these works, and addressing relevant critiques. In this way, it is hoped that a more comprehensive, ‘nested’ definition will be developed that takes cognisance of the various inter-related elements comprising the Knowledge Economy. This will hopefully provide a suitable bridging document for those seeking to engage in strategic discussions surrounding the Knowledge Economy – especially those from different academic and / or working perspectives, where it can be used to ensure that conversations are being conducted around the same conceptual foundations.

In order for the aims of this thesis to be achieved in practice, it will be necessary to make some personal judgments with respect to the available literature which will influence both which academic works are to be included in this document, as well as how they are perceived in relation to the current economic and social environment. Where possible, I will try to note any assumptions made in this regard, and will generally retain a high degree of reflexivity in my decision-making. However, being almost exclusively a review of literature in the field of the Knowledge Economy, these judgments will above all be an interpretation of the academic integrity of the sources involved. In this way, conclusions drawn in the course of this thesis will,

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<sup>2</sup> Coyle, 1996, Castells, 1997

at the very least, be upheld in terms of the academic foundations that support the premises of the argument.

## 1.2 - Intended Approach

The first major section of this thesis will entail an in-depth analysis of the concept of the Knowledge Economy. This will involve several facets. From the outset, it will be necessary to investigate the distinction between the term 'Knowledge Economy' and 'Knowledge Society' – two concepts that are as often used as *substitutes* for one another as they are argued to be wholly distinct. In this pursuit, various works on this particular distinction will be cited which argue for and against the conflation of these two terms. In particular, Ungar<sup>3</sup>, Rooney<sup>4</sup>, Castells<sup>5</sup>, Leadbetter<sup>6</sup>, and Sörlin and Vessuri<sup>7</sup> will help to guide my investigation. Discerning whether or not this distinction is necessary and, if so, what it entails, will be necessary to allow the discussion to move on in defining the 'Knowledge Economy' – the key focus of this thesis.

Once some clarity is obtained in this area, the focus will shift towards the term 'Knowledge Economy'. Firstly, it will concentrate on the concept of 'knowledge' – a widely used (and *misused*) concept. There has been a significant amount of work done in the generation of academic definitions of 'knowledge' for some years, and a vast amount of literature is available to investigate this aspect of the definition. A selection of the most prominent and most informative classifications of knowledge will provide the starting point for this chapter, where it will become clear that even the most simplistic definitions of knowledge become the subject of heated debate and controversy. When the exploration of different categorisations of knowledge is taken further, the fact that knowledge is a subject of great interest in a large number of academic disciplines only adds to the complexity of the term as new insights from different perspectives inevitably highlight interesting new attributes. The challenge will be to navigate through the myriad taxonomical classifications and definitions proposed by the many respected authors who have contributed to the development and understanding of this highly complex term, and to try to draw attention to similarities and complementarities between different authors' conceptualisations.

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<sup>3</sup> 2003

<sup>4</sup> 2003

<sup>5</sup> 1996

<sup>6</sup> 2004

<sup>7</sup> 2007

It is also crucial that this section considers both the prevalent economic conceptions – which deal with the *commoditisation* of knowledge (among many other things) – as well as the sociological elements of knowledge which are often overlooked for the reasons that they are both difficult to measure and are often less substantiated in terms of rigorous academic theory.<sup>8</sup> It is not in the scope of this thesis to provide this ‘rigorous’ substantiation. However, it is necessary to include sociological aspects in order to properly discuss the concept of ‘knowledge’.

Clearly, a definition of ‘knowledge’ could warrant a thesis on its own. For this reason, and in pursuit of an *operational* definition of the Knowledge Economy, this section of the thesis will attempt to draw relevant elements from the wide range of works available with the intention of presenting a holistic conceptualisation of the term ‘knowledge’ in the context of governmental and organisational application. While I will seek to be inclusive of significant and enduring academic and philosophical aspects concerning the definition of ‘knowledge’, this will only be done if these aspects will in some way contribute toward a better understanding of the term ‘knowledge’ as it fits in to the phrase ‘Knowledge Economy’.

For purposes of comprehensiveness, the next step will be to consider the definition of ‘economy’ as it applies to the phrase ‘Knowledge Economy’. This section will therefore incorporate the most relevant aspects of the most prominent *economic* definitions of knowledge in terms of how they may help to enrich our understanding of the ‘Knowledge Economy’. Thereafter, an analysis of the most significant *economic characteristics* of knowledge will be performed, which will lead into a brief discussion of the (attempted) incorporation of knowledge into economic models. This will help to illustrate some of the complexities encountered when trying to deal with ‘knowledge’ as an economic commodity. In this respect, Boisot<sup>9</sup> will be worth noting, both in terms of his analysis of the paradoxes faced when attempting to deal with ‘knowledge’ as an asset from within the perspective of a “physical paradigm”, as well as in his proposal of a scheme with which to consider knowledge as an economic asset.

With both of the constituting words considered in terms of informing an ‘operational definition’ of knowledge, it will be possible to move on to the Chapter 5 of the thesis. The onset of the Knowledge Economy is widely considered to be a ‘new’ phase in human development – as can

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<sup>8</sup> Oxley, Walker, Thorns and Wang, 2007: 37

<sup>9</sup> 1998

be evidenced in the works of Castells<sup>10</sup>, Bell<sup>11</sup>, Stehr<sup>12</sup> and Drucker<sup>13</sup>, among others. At the same time, however, authors like Webster<sup>14</sup> note that these are often misguided attempts to delineate a distinct economic 'era' - on the basis of changes to society and the economy that are as likely to be extensions of the previous era as they are to be piecemeal changes in an altogether broader (and still ongoing) shift. The purpose of this chapter of the thesis will not be to offer a solution to this debate. Rather, it will be to utilise the understanding and contextual clarification of knowledge and the Knowledge Economy developed up to this point in the thesis to consider whether there are any aspects of the modern economy which can reasonably be argued to represent a distinct phase in economic history.

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<sup>10</sup> 1996; 2004

<sup>11</sup> 1973

<sup>12</sup> 2002

<sup>13</sup> 1969

<sup>14</sup> 2002

# Chapter Two

## *The Knowledge Economy and the Knowledge Society*

### *– same difference?*

#### 2.1 - Introduction

The concepts of the 'Knowledge Economy' and the 'Knowledge Society' have been subjected to much theoretical scrutiny and debate, as people strive to come to terms with the pace and nature of the changes felt in the advanced countries of the world. While there is no difficulty in distinguishing between the terms 'economy' and 'society' by themselves – or recognising the tangible linkages between the two in reality – the addition of 'knowledge' to both of these concepts has been the cause of substantial confusion and lack of clarity in theoretical and policy discourses. In a large number of cases, 'Knowledge Economy' and 'Knowledge Society' are employed as synonyms –used interchangeably to describe the same dominant axial principle from which the overriding trends of the modern way of life can be inferred. Add the familiar 'Information'/'Knowledge' conflation to the mix, and it is easy to see how a conversation about the *Information Society*, and one about the *Knowledge Economy* could easily be about exactly the same thing.

At the same time, however, there are a number of authors who regard this 'interchangeability' as a misrepresentation of two terms which each have their own distinct meanings, characteristics and disciplinary heritage. Michael Peters<sup>15</sup>, for one, notes how the "easy dualism" of the terms *Knowledge Economy* and *Knowledge Society* is highly problematic in the academic arena. In this regard, he asserts that the two concepts are "separate and parallel discourses that are not cross-threading – in each case the trajectories of the disciplines seem to be powered by their own problematic, by the set of problems thrown up by the discipline, rather than any external pressures, and they seem particularly impervious to radical cross-disciplinary borrowing or analysis"<sup>16</sup>. As a result, any 'blending' of the two terms, he feels, should necessarily be avoided.

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<sup>15</sup> 2003

<sup>16</sup> Peters, 2003

Either way, it seems, what *is* clear is that the pursuit of an operational definition of the 'Knowledge Economy' requires an investigation into the usage of these most commonly-used terms involved in the discussion. Whether the idea of the Knowledge Society should be considered theoretically distinct from the Knowledge *Economy*, or whether the one simply enriches or simplifies the other, it is necessary to outline the primary differences and similarities in order to be able to attain any form of conceptual clarity.

## 2.2 - Disciplinary Traditions – The Sociology of Knowledge

At the heart of it, the distinction between the concepts of the Knowledge Economy and the Knowledge Society represents the separation of two disciplinary approaches to the concept of knowledge – respectively, sociology and economics. The sociology of knowledge has a particularly rich history, with a wide array of astute minds contributing to the study of how the accumulation and use of knowledge continually shapes all aspects of the social condition. Even before the Second World War had taken hold in their respective countries, great founding sociologists and philosophers, from Marx to Weber and Heidegger, had postulated the power of ideas – and how they are inseparable from the social context in which they are born<sup>17</sup>. However, it is only with more recent contributions from, among others, Robert Lane<sup>18</sup>, Daniel Bell<sup>19</sup>, Nico Stehr<sup>20</sup> and Manuel Castells<sup>21</sup> that the concept of the 'Knowledge Society' – as a metaphor and/or descriptor for the condition of 'advanced societies' – has been brought to the fore. These contributions might be considered the 'sociology of post-industrialism' – where the embedded social structures of the manufacturing-driven industrial societies have started to give way to service industries through the sheer force of technological change<sup>22</sup>. Crucially, as Peters<sup>23</sup> points out, it is with this post-industrial sociology where knowledge, society and economics become more intertwined than ever before.

While the impacts of the economic changes are recognised as a major contributing factor to this move to post-industrialism, it is important to realise that this does not mean that post-industrial sociology has heightened its focus on *economics* – or even the *economics of knowledge* – at the exclusion of other concerns. Instead, as Peters suggests, the field of sociology has generally

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<sup>17</sup> Burke, 2002

<sup>18</sup> 1966

<sup>19</sup> 1973

<sup>20</sup> 1994

<sup>21</sup> 2000

<sup>22</sup> Peters, 2003

<sup>23</sup> 2003

restricted itself to the confines of its own disciplinary boundaries, tending to “*accept dominant descriptions of the changing western or global economy, and [concentrating] on its social and stratification effects, rather than [engaging] directly with mainstream neo-classical and neo-liberal economists*”<sup>24</sup>. With some exception, this lack of desire for inter-disciplinary dialogue at the theoretical level between sociologists and economics seems to have been mutual.

While this is certainly not the place to delve into the details of this aspect of sociology and the history of its development, what *is* important for the purpose of this investigation is to acknowledge the fact that the sociology of knowledge is considered an abundant, important, and significantly *distinct* academic domain. When a sociologist speaks of a ‘Knowledge Society’ in a theoretical discourse, the usage of the term is in no way intended to be an easy substitute for ‘Knowledge Economy’. Instead, as Rooney<sup>25</sup> makes clear, “*a knowledge society is a broader term than ‘Knowledge Economy’, or ‘knowledge-based economy’, in that it encompasses more intellectual activity than narrow economic, commercial and industrial concerns*”. In this mould, Stehr<sup>26</sup> directs his attention beyond just the economic aspects of this knowledge ‘era’, and speaks of knowledge in terms of it being a new capacity for social action. What becomes relevant is not only the technological aspects of this social condition, but also the *knowledge contents*, and how individuals position themselves within this complex domain of technology, media, politics, and other institutions leveraging the social power that knowledge increasingly presents. More than just an increasingly dominant basis for productive and innovative capacity, Stehr sees the Knowledge Economy as constitutive of our reality construction, noting how ‘*we increasingly arrange and produce the reality within which we exist on the basis of our knowledge*’<sup>27</sup>. Knowledge is thus seen as a key agent of social change – for this reason, “[*knowledge production*] is consequently social production”<sup>28</sup>. Surely, the definitional ‘boundaries’ of what the Knowledge Economy can entail cannot be extended any further than this rendering!

This view that the Knowledge Society is a far *broader* term than the Knowledge Economy is shared by many. The changes brought about by advanced societies’ increasing focus and dependence on knowledge has been pervasive in many ways – far beyond just the field of economics. For this reason, it is argued that the concept of a *Knowledge Society* should include

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<sup>24</sup> 2003

<sup>25</sup> 2003

<sup>26</sup> 2002

<sup>27</sup> Stehr, 2002: ix

<sup>28</sup> Bohme and Stehr, 1986:16-19

all aspects of society affected by these changes, recognising causes and consequences in areas including economic, political, social and cultural spheres. Even though it may be that the most noticeable and widespread changes are being felt through shifts in the economic and commercial aspects of society, many important consequences and implications are likely to be overlooked by those focusing solely on economic concerns.

Leadbetter<sup>29</sup> takes this idea further by highlighting the importance of ‘social capital’ in combination with financial and intellectual capital as the key drivers of the new era. Knowledge, he feels, is at the heart of economic progress and also *social* progress, and therefore the concept of a ‘Knowledge Society’ is a necessary one in order to maintain a comprehensive, as well as holistic perspective on the extent and nature of any changes taking place. Technologies and ideas carry with them embedded structures of social and cultural legacies, which makes their usefulness and the value attached to them different in diverse contexts. Rullani<sup>30</sup> cites the importance of everything from cultural values, communication, language and experiential capabilities that are crucial in the ‘framing’ of knowledge and social capital production. Wang<sup>31</sup> interprets this as indicative of the fact that knowledge is being produced in both formal ‘academic’, as well as informal ‘social’ contexts.

This view is shared by Thorlindsson and Vilhjalmsón<sup>32</sup> who see the Knowledge Economy as the term used to describe how science, expertise and innovation have begun to assert increasing influence over social and economic development. In particular, they note how science has come to be ‘*controlled*’ by a wide variety of forces outside traditional knowledge-generating sources like higher education and academic research institutions. These ‘outside forces’ include the organisations which arrange and coordinate ‘knowledge’ transactions, and a major focus of sociological study has been the role of ‘social capital’ in these exchanges – namely the role of trust, reciprocity, culture, communication and the social networks of the people involved in the knowledge-producing processes<sup>33</sup>. Crucially, economic models and attempts by economists to incorporate knowledge and innovation as factors of production often overlook these aspects of knowledge sharing and production. One of the primary critiques of the enduring ‘economic growth models’, for instance, has been the ‘Level Problem’. This critique highlights the fact that many learning processes are not easily classified into the categories designated to ‘innovation’

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<sup>29</sup> 2004

<sup>30</sup> 2003, in Wang, 2007

<sup>31</sup> 2007

<sup>32</sup> 2003: 98-101

<sup>33</sup> Rullani, 2003; Wenger, 1999



and 'productive knowledge' as defined by economists, and thus are often not included in the growth models. As Tang<sup>34</sup> and Lewis<sup>35</sup> make clear, the most significant omission in these models is often 'social knowledge', and "*knowledge of the particular circumstances of time and place*"<sup>36</sup>. These are often not classified as scientific or technological knowledge, but they are absolutely vital for production, and thus an understanding of economic growth<sup>37</sup>. Clearly, many forces are at play, and it is important to recognise that *any* influence which can shape and direct the course of knowledge generation and distribution should be taken into consideration.

It is not difficult to see how many of these 'sociologically-oriented' aspects of knowledge are immediately valuable in generating an enriched understanding of the Knowledge Economy. By encouraging one to focus on the social aspects of knowledge, the Knowledge Economy term serves as a reminder that the reason that this increased focus on the primacy of *knowledge* in modern societies is considered by many to be a new 'era' in human development is the very fact that changes brought about by knowledge are more pervasive and extensive than ever before. Far more than instituting changes only in our scientific, commercial or industrial aspects of life, knowledge has become "*the most crucial driving force for the constitutive mechanism of the contemporary society*"<sup>38</sup>. More so than ever before, the importance of considering the impact of social, political and cultural factors on the production and distribution of knowledge is coming to the fore, as these aspects are recognised as having far-reaching consequences – even in the economic and commercial spheres. The Asian-Pacific Economic Cooperation (APEC) highlights this in noting how technological knowledge alone is not enough to power the move towards a knowledge-creating society – cultural, social and managerial knowledge are also of pivotal importance<sup>39</sup>.

Another sociological treatment of the importance of knowledge is that of Manuel Castells<sup>40</sup>, who refers to the *network* society in describing the significance of information and knowledge in the shaping of economic, social and political life in modern societies. This will be discussed in greater detail in section 5.1.4.

### 2.3 - Is inclusivity necessarily a bonus?

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<sup>34</sup> Tang, 2005

<sup>35</sup> 1955

<sup>36</sup> Hayek, 1945

<sup>37</sup> Tang, 2005

<sup>38</sup> Wang, 2007 – referring to the work of Stehr, 1994

<sup>39</sup> Australian Bureau of Statistics, 2002

<sup>40</sup> 2004

In the above review of some of the primary sociological discussions regarding the impact of knowledge on modern society, it can be seen that a remarkably diverse range of factors are expected to be encapsulated in the term Knowledge Economy. However, if this 'broadness' and inclusivity of the 'Knowledge Economy' represents the conceptual relevance and *strength* of the term, it may also represent its biggest vulnerability. In trying to avoid the reductionism associated with the narrowing of the conceptual focus (as, perhaps, with the concept of the Knowledge Economy), it is argued that descriptions of the Knowledge Economy have tended to suffer from the lack of substantial discussions concerning definitional issues. Adhikari and Sales<sup>41</sup> see the concept as both imprecise and incomplete, and cite its vagueness as a serious challenge to its continued relevance.

Carlaw et al<sup>42</sup> see this lack of conceptual clarity as the major shortcoming of the Knowledge Economy term as an effective guide for policy formulation. While the Knowledge Economy, or the Knowledge Based Economy (KBE) continues to encourage attempts to provide robust measurement criteria, for the concept of the Knowledge Economy, "*much ambiguity still exists, and the measures are not precise*"<sup>43</sup>. Further, they cite how the idea of the Knowledge Economy has been employed in a "*wider discourse*" than the Knowledge Economy, which inevitably makes it more challenging to apply the necessary focus. The Knowledge Economy is said to comprise a wide variety of elements which are, at best, notoriously difficult to measure – from the "*foresightedness a country displays in its quest to become a 'knowledge society'*"<sup>44</sup>, to the "*creative potential and knowledge embodied in people*"<sup>45</sup>. While measurement criteria for the Knowledge Economy are also still lacking in theoretical comprehensiveness, Oxley et al<sup>46</sup> recognise that the economic features, by design, are easier to quantify, and their prescriptions for potential progress in measurement for policy purposes are almost exclusively geared towards the *economic* understanding of knowledge. The Knowledge Economy, on the other hand, remains too broad and under-defined to inform policy strategy that can be controlled and measured effectively.

Should further definitional scrutiny bear any fruit, there can be little doubt that the concept of the Knowledge Economy will be of relevance in policy discourses – at least, according to Knorr

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<sup>41</sup> 2001

<sup>42</sup> 2007

<sup>43</sup> Oxley, Walker, Thorns, and Wang, 2007

<sup>44</sup> UNESCO World Report, 2005

<sup>45</sup> Oxley, Walker, Thorns, & Wang, 2007: 13

<sup>46</sup> 2006

Cetina<sup>47</sup> and Ungar<sup>48</sup>, if it is approached in the right way. The concept is at its weakest when considered merely as an ‘extension’ to the concept of a Knowledge Economy, where its distinctive characteristics are constrained by its reliance on the more precisely defined Knowledge Economy. In this form, the concept simply cannot exist separately to the concept of Knowledge Economy – if anything, it is argued that it is little more than a contextual descriptor for the Knowledge Economy term. As McLennan<sup>49</sup> puts it: *‘cultural and social forms are seen as the functional prerequisites of an endogenous techno-economic momentum at the heart of the pre-industrial order.’* Instead, the concept of a Knowledge Economy must rather focus on the intricacies and social processes of *knowledge itself*, looking at the social and cultural factors determining how it is generated, controlled, distributed and eventually commoditised<sup>50</sup>. This would emancipate the ‘Knowledge Economy’ from the concept of the Knowledge Economy, encouraging the recognition that there are numerous, divergent influences that affect knowledge growth – and the crucial idea that knowledge has intrinsic value beyond its worth as a commodity. While this development of the term Knowledge Economy does happen in academic discourses, policy-makers are unlikely to want to engage in this debate – rather, the eventual *results* thereof are what is required most.

Thus, in the face of the more narrowly-defined *Knowledge Economy*, the Knowledge Economy term’s broadness and inclusivity can arguably be considered less of a benefit, and more of an indication of uncertainty as a result of a pressing need for sustained, systematic definition and exploration.

## 2.4 - The Knowledge Economy and Society at the Level of Policy

The discussion thus far serves mainly to elucidate the remarkable complexities of the terms Knowledge Economy and Knowledge Society, as determined by their rich academic histories, as well as the lively debate still surrounding their development. What should be clear is that, despite its tendency to be misused as a ‘metaphor’ or mere extension of the concept of the Knowledge Economy, the term Knowledge Economy does bear major theoretical significance in the sociological study of knowledge as an agent of social transformation. Importantly, too, it serves as a reminder that there are many factors involved in both the causes and consequences

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<sup>47</sup> In Adhikari and Sales, 2001: 1-16

<sup>48</sup> 2003

<sup>49</sup> 2003

<sup>50</sup> Knorr Cetina, 2001:15

of knowledge production - that lie *beyond* the realm of commerce and economics - that often have lasting and far-reaching effects.

It is perhaps tempting to want to avoid the Knowledge Society term in policy discourses in favour of more narrowly-defined 'Knowledge Economy', which is arguably more 'actionable' in terms of the creation of policy measures that can actually be targeted at leverage points. As opposed to the in-depth theoretical debates that outline the social dynamics of knowledge (as characterised by the term Knowledge Economy), references to the Knowledge Economy tend to be immediately 'more concrete'<sup>51</sup>, albeit as a result of the 'strenuous reductionism' that surrounds the term<sup>52</sup>. The economic approach to knowledge has forced theorists and policy-makers alike to work toward establishing measurement criteria that - despite being far from flawless – are absolutely vital for the construction and analysis of policy measures. The more sociological aspects of knowledge continue to be relatively un-measurable, owing largely to the lack of conceptual clarity in the field. As Oxley et al<sup>53</sup> note, "*much of what passes for measurement of the knowledge society is based not on a rigorous theory of the knowledge society, which determines what should be measured and how it should be measured, but more on whatever data is convenient and available...offering little in the way of guidance to policy-makers*".

It is also argued that simplifying discussions by using only the term Knowledge Economy does not necessarily exclude important sociological aspects that would be included if the term Knowledge Economy were used. Built into any comprehensive definition of knowledge are the social and cultural aspects which are vital in understanding the true complexity and reach of the term – as will be outlined in the next section of this thesis. On top of this, Carlaw et al<sup>54</sup>, among others, maintain that technological and economic change in this day an age is inextricably linked with both political and social change. Sociological elements, in many cases, are thus included by default. This echoes Stehr<sup>55</sup> when he insists that "*the origin, social structure and development of knowledge societies is linked first and foremost to a radical transformation of the economy*".

Whether or not this view is shared by all (it isn't), or whether this type of thinking makes one guilty of the crime of reducing the concept of the Knowledge Economy to a mere extension of that of the Knowledge Society, it is difficult not to agree with the proposition that, from the

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<sup>51</sup> Ungar, 2003

<sup>52</sup> McLennan, 2003

<sup>53</sup> Oxley, Walker, Thorns, and Wang, 2007: 37

<sup>54</sup> 2006

<sup>55</sup> 2002

perspective of policy studies and policy discourse, the use of the term Knowledge Economy is more practical and actionable than that of the term Knowledge Economy. Crucially, this argument must be treated cautiously if it seems to be an attempt to purge the concept of the Knowledge Economy – or even to relegate it exclusively for the consideration of academics. As has been seen in the course of this discussion so far, there are a wide range of theoretical or *specifically non-economic* aspects of ‘knowledge policy’ that fall outside of the concept ‘Knowledge Economy’ that will both enrich and inform policy discussions. In search of a comprehensive operational definition of the ‘Knowledge Economy’, it is therefore of critical importance that these relevant Knowledge Economy aspects are not overlooked. Many of these aspects require consideration in the comprehensive handling of the concept of knowledge itself. This will be the focus of the next section of this thesis.

# Chapter Three

## Knowledge

### 3.1 - Introduction and Chapter Outline

There is no simple, clear-cut definition of knowledge. Part of what makes terms like ‘Knowledge Economy’ and ‘knowledge management’ so difficult to grasp is the fact that the knowledge component can carry a wide variety of meanings in different contexts. Attempts to define knowledge are often largely dependent upon the context in which the definition is expected to offer value – whether it is in epistemological, ontological, philosophical, historical, organisational or other settings. On top of this, the concept’s usage over the past few decades has skyrocketed as it has become something of a buzzword for any company, organisation and even government that wants to be on the cutting edge of economic and social development. This has led to the widespread misuse of the concept - as evidenced, for example, in the tendency to equate knowledge with information and data. However, the enhanced focus on the term has also led to many positive developments, in which different types and characteristics of knowledge have been explored and expanded upon, shedding new light on its reach and complexity.

In pursuit of an operational definition of the Knowledge Economy, it is necessary to build a comprehensive understanding of knowledge. As indicated in the previous chapter, a suitably inclusive definition of knowledge may help to enrich the concept of the Knowledge Economy, so that it includes important social and cultural aspects which have economic implications, and which may otherwise be considered in the jurisdiction of the ‘Knowledge Society’.

Thus, in this section of the thesis, the primary developments in the definition and exploration of knowledge will be examined, giving an indication as to the intrinsic complexity of the term, as well as considering which aspects are most relevant in order to better understand the concept of the Knowledge Economy. This will result in a ‘working definition’ of knowledge that will allow us to move from *definitions* of knowledge to its *economic characteristics*, and, later, to the construction of an operational definition of the Knowledge Economy.

The first aspect for consideration is a discussion of three distinct terms which are often erroneously considered to be different words describing the same thing – Data, Information, and Knowledge. Distinguishing between each of these terms also offers valuable insights into the meaning of knowledge, as well as the process involved in ‘creating’ it. Secondly, an in-depth examination of different *types* of knowledge will ensue. This will provide the opportunity to uncover the breadth of the term, as well as evaluate which of the numerous ‘labels’ placed on types of knowledge by different authors may or may not be referring to the same set of knowledge’s attributes. Thereafter, a discussion of knowledge’s most essential characteristics will be briefly considered. This will allow the analysis of how each of the concept’s primary characteristics is affected when knowledge is considered an *economic* asset – a discussion which will take place in the following chapter of this thesis.

### 3.2 - The Value of Debating the Data-Information-Knowledge Divide

*“Where is the life we have lost in living?*

*Where is the wisdom we have lost in knowledge*

*Where is the knowledge we have lost in information? “*

*TS Elliot – “The Rock”<sup>56</sup>*

T.S. Elliot, by all accounts, did not intend these words to form the backbone of an enduring Knowledge Management discussion, but as Ahsan and Shah<sup>57</sup>(2007) point, out, “[*Elliot’s words*] *linked wisdom to knowledge and knowledge to information, suggesting that they are interlinked and interdependent. Yet even after 76 years, the very definitions of these terms and the relationships between them are not clear”*.

The dramatic and sustained rise of the concept of Knowledge Management (KM) in organisational circles all over the world has triggered a renewed theoretical focus on the concept of knowledge and its components. As companies rush to get their KM capacities in order, much debate surrounds the issues of *what* exactly knowledge entails and how it can be created, captured and distributed for the purpose of furthering competitive advantage. With such extraordinary amounts of money being spent on the development of Information Technology infrastructures over the past few decades - many of which claim to offer in-depth

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<sup>56</sup> 1934

<sup>57</sup> 2007

solutions for the management of *knowledge* – researchers have been forced to reconsider the nature of the relationship between information and knowledge. This has intensified debate surrounding the concepts of data, information and knowledge – three concepts which are widely acknowledged to be distinct conceptual entities, but are nevertheless treated somewhat carelessly in both theoretical discussions and practise.

The debate is more than just semantic – implications for the design and use of Information and Communications Technologies (ICTs) are plentiful, as well as potential influences on the architecture of organisational knowledge structures. For the purpose of attempting to understand the concept of *knowledge*, these distinctions are also vital. As well as shedding light on the complexity and intricacies of the term, understanding the relationships between what are argued to be knowledge's component parts is of the utmost importance in being able to appreciate what exactly knowledge does or does not comprise, as well as how it functions as an economic concept.

Like most things in the realm of KM, the three concepts under review in this section are complex and often vaguely defined. Emerging with a concise and universally applicable categorisation is thus not feasible, and not the author's intention. Instead, this section will begin with a review of the most generally-used definitions, highlighting relevant similarities, differences and critiques. This will be followed by an analysis of a simplistic model of the relationship between data, information and knowledge, which will serve to illustrate many of the common ideas and misconceptions involved in thinking about these terms. These investigations should provide a suitable foundation from which to compile practical understandings of the term as necessary for the purpose of this chapter, and this thesis.

### 3.3 - Definitions of Data, Information and Knowledge

Numerous definitions of Data, Information and Knowledge have gained and lost favour in KM circles, as technologies and developments in the field have made it possible to define the terms at a higher level of abstraction. Computers used to be considered little more than data-processing machines. In time, they were considered to be able to take Data a step further by generating, managing and distributing *information*. Now, as computers make decisions by applying our rules and behaviours to information and stimuli, we are constantly forced to reconsider our initial classifications.



This section of Chapter 2 will briefly compile some of the most widely-used definitions associated with Data, Information and Knowledge respectively. The definition of knowledge will be intentionally brief in this section, and will follow the form used to describe Data and Information. A far more substantial definition of Knowledge will take place later in this chapter which will build upon the one developed here.

### 3.3.1 *Data*

Of the three concepts under review in this section, Data remains the least controversial. Considered the ‘base-unit’ of the Data-Information-Knowledge set, Data is most commonly conceived of as raw, ‘unprocessed’, uninterpreted ‘facts’, ‘observations’, or ‘symbols’ representing the world, or a state of affairs<sup>58</sup>. These ‘facts’ may appear in any form – unusable or usable, not necessarily offering any worth, meaning or potential on their own. Bellinger et al<sup>59</sup> use the example of Data as a spreadsheet full of a large collection of numbers, which may or may not be read, interpreted, sorted and made use of by some other actor – be it a person, computer etc. Importantly, as Godbout<sup>60</sup> clarifies, “*data does not carry meaning unless one understands the context in which the data was gathered. A word, a number or a symbol can be used to describe a business result, inserted in a marriage contract or graffiti on the wall. It is the context which gives it meaning, and this meaning makes it informative*” (my emphasis).

### 3.3.2 *Information*

Godbout’s description of Data also serves to introduce the concept of Information. Information is most often described *in terms of* Data – that is, once Data has been processed, interpreted, given a context or made useful, it is considered to be Information. Thus, Information – unlike Data – *is* considered to have meaning, purpose, context and/or relational connections<sup>61</sup>. This purpose and context might be geared towards answering some sort of question, or providing a specific use which was the initial intention of processing the Data in the first place. Information may be useful and actionable, but it does not necessarily have to be. In the analogy of the spreadsheet of Data used above, Information may be considered to be an informed selection of pieces of that Data, in a new format indicating the relevance and relationships between the Data selected<sup>62</sup>. Godbout notes how Information is an extension of the concept of Data, placing

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<sup>58</sup> Bellinger, Castro, and Mills, 2003; Boisot and Canals, 2003; Davenport and Prusak, 1998

<sup>59</sup> 2003

<sup>60</sup> 1999

<sup>61</sup> Bellinger, Castro, and Mills, 2003; Boisot and Canals, 2003; Davenport and Prusak, 1998

<sup>62</sup> Ahsan and Shah, 2007

it in a broader context, and in a variety of different forms, such as writings, charts, diagrams, statistics and statements. “As such,” Godbout notes, “it includes data but it also includes all the information a person comes in contact with as a member of a social organisation in a given physical environment”<sup>63</sup>.

Information is a more ‘complex’ concept than that of Data, and is thus inevitably more controversial. While most commonly defined as an extension of Data, as above, it is often argued that it can also be *derived from knowledge*. This argument will be developed in section 3.4. Data and Information are also often conflated or used interchangeably. Theorists and practitioners are far less likely to be ‘careless’ in this way with the concepts of *Knowledge* and Data, for instance. Data and Information share many characteristics – the most prominent of which is the fact that they are both relatively easy to ‘capture’ and ‘codify’ (i.e. record in the form of some sort of symbol or code, such as letters, numbers, diagrams etc). This shared feature contributes to their being referred to collectively, as many IT processes like mining, searching, browsing and storing can often be done to both Data and Information resources<sup>64</sup>.

Of all the analogies that hope to expose the differences between the concepts of Data and Information, Boisot and Canals<sup>65</sup> is one of the more compelling. Boisot and Canal use the example of ‘encryption’ – the use of special codes to change intelligible words and phrases into some form of letters, symbols or otherwise that will mask their true meaning to others that do not possess the ‘decryption’ tools. As Boisot points out, this analogy is apt: “*encryption...provides the ‘lock and keys’ of the information age*”<sup>66</sup>. The encryption process works by “*developing algorithms that bury information deep in data*” – or, essentially turning a meaningful, relational and/or contextualised collection of data (‘Information’) into a set of isolated, un-contextualised symbols or facts (‘Data’). “*Thus,*” Boisot and Canals<sup>67</sup> point out, “*while the data itself can be made ‘public’ and hence freely available, only those in possession of the ‘key’ are in a position to extract information from it*”. Hence we have moved from an encrypted message of meaningless symbols to the point where we can “*understand the sentence*”<sup>68</sup>.

### 3.3.3 Knowledge

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<sup>63</sup> 1999

<sup>64</sup> Callahan, Schenk, and Rixon, 2006

<sup>65</sup> 2003

<sup>66</sup> 2003: 2

<sup>67</sup> 2003; my emphasis

<sup>68</sup> Boisot and Canals, 2003

Understanding the *sentence*, however, does not necessarily mean that you are able to understand the *message*<sup>69</sup>. This vital step requires more than just the context, relation, relevance or purpose provided by the information-creating 'key'. To understand the message to the point that meanings, experience, beliefs and judgments are able to be applied requires a further 'step' – *Knowledge*<sup>70</sup>.

To describe the concept of knowledge in the manner used to clarify Data and Information above, knowledge is convenient to consider as a further extension of Information, just as Information was an extension of Data. In this conception, knowledge is created by assigning truths, beliefs, judgments, expectations, values, insights and/or experiences to Information.<sup>71</sup> Thus, in this understanding, knowledge implies some sort of human cognitive and analytical process – one which potentially allows the synthesis of new Information, or serves as to guide some sort of action. This relation to human 'action' or commitment encourages the understanding that knowledge is, in essence, socially constructed<sup>72</sup>. Due to this character - and in contrast to Information and Data - Knowledge is generally considered to be more difficult to 'codify' and 'capture'. For this reason, it is considered a relatively intangible, even "*much more elusive*" entity in many instances<sup>73</sup>.

It is this 'intangibility' which makes a piece of knowledge so difficult to 'package' as complete and universal – and something that can be grasped by a neutral observer at any place and time. This 'elusive' character extends to attempts to define knowledge and, as a result, the term is the subject of much controversy, misuse and misunderstanding in practice and theory alike. As will be seen in section 3.6, when a range of different types and characteristics of knowledge will be discussed in more detail, there is a wide variety of perspectives on the term – most of which fall somewhere on a continuum between two opposite 'traditions' in knowledge theory: the Commodity view or the Community view<sup>74</sup>.

The Commodity view is perhaps the most enduring and recognisable understanding of knowledge, having established itself in the natural sciences and, among other things, economics. In its most basic conception, this tradition focuses on a more 'objective'

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<sup>69</sup> Boisot and Canals, 2003

<sup>70</sup> Bellinger, Castro, and Mills, 2003; Boisot and Canals, 2003; Davenport and Prusak, 1998; Stenmark, 2002

<sup>71</sup> Bellinger, Castro, and Mills, 2003; Boisot and Canals, 2003; Davenport and Prusak, 1998; Stenmark, 2002; Wiig 1993

<sup>72</sup> Kogut and Zanger, 1992

<sup>73</sup> Stenmark, 2002

<sup>74</sup> Hislop, Newell, Scarborough and Swan, 2000

understanding of knowledge, in which knowledge is imagined to be a 'thing' which can exist external to the knower, and that can be handled, distributed, managed and even traded in discrete units<sup>75</sup>. Naturally, this view would see knowledge as something that is not necessarily too difficult to codify or capture in some tangible form. This 'objective' knowledge can thus be codified through language, and collected over time in books, documents, computer storage etc.

The Community view, by contrast, places its focus on the *individual*, and the subjective perspective generated as a result of human interaction, social context and personal experience. In this view, which is also referred to as the constructionist view, knowledge cannot be defined universally at all – rather, it must be defined in relation to the context. Here, a set of instructions found in a book (i.e. having been codified in language) cannot be considered to be knowledge unless the reader has the appropriate background that enables him or her to place the message into an experiential and/or social context that enables *meaning* to be drawn from the text<sup>76</sup>. Hence, in this subjective understanding of the term, knowledge cannot be understood external to the knower, and therefore each time Information is processed by a person to the point that it becomes knowledge, each separate 'creation' can be considered a new, distinct form of knowledge.

The differences between the Commodity view and the Community view inform one of the crucial distinctions when analysing 'types' of knowledge – namely, *Explicit* and *Tacit* knowledge<sup>77</sup>. From the above descriptions, it can be seen that the Commodity and Community views present themselves as polar opposites. On the Commodity side, knowledge is presented in a way that makes it difficult to distinguish from the established understanding of Information – where a book, for instance, is seen as containing objective *knowledge*, whether or not anyone ever reads it<sup>78</sup>. From the Community perspective, the gulf between knowledge and Information could not be further apart. Here, the same book is seen merely as a collection of pages with black marks on them – it is only with a reader who understands those marks that a book can contain knowledge<sup>79</sup>. What is important to realise in the face of these two divergent paths is the fact that, as Stenmark<sup>80</sup> attests, one does not necessarily need to make a choice between the Commodity and Community views in order to form a conceptual understanding of

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<sup>75</sup> Stenmark, 2002; Hislop, Newell, Scarborough and Swan, 2000

<sup>76</sup> Brooking, 1999; Stenmark, 2002; Hislop, Newell, Scarborough and Swan, 2000

<sup>77</sup> Polanyi 1962; Nonaka and Takeuchi, 1995

<sup>78</sup> Popper, 1979

<sup>79</sup> Popper, 1979

<sup>80</sup> 2002

knowledge. Rather, he suggests that “*Maybe, it is a little bit of both*”<sup>81</sup>. Thus, rather than seeing one perspective as ‘right’ and the other as ‘wrong’, for practical purposes, it is most valuable thinking of these as two different *types* of knowledge. This will be expanded up in section 3.6.

So, in sum, it can be seen that knowledge is an infinitely more complex and controversial concept than Data, and even Information. In terms of the Data-Information-Knowledge relationship, knowledge is easiest to understand as an extension of Information, created by assigning truths, beliefs, judgments, expectations, values, insights and/or experiences to Information<sup>82</sup>. The term’s complexity entails that knowledge can mean different things in different theoretical or practical discourses, and is most valuable if defined in relation to the relevant context. The Commodity and Community views present two different approaches to knowledge that are ultimately most usefully thought of as two different *aspects* to knowledge, rather than an ‘either/or’, ‘one right way’ dichotomy.

Now, armed with basic understandings of the concepts of Data, Information and Knowledge respectively, it is worthwhile briefly analysing a simplistic model depicting the relationship between the three concepts.

### 3.4 - A Simplistic Model of the Data-Information-Knowledge Relationship

One of the main characteristics that is used to differentiate between Data, Information and Knowledge is ‘tangibility’ – or, the degree to which each of these concepts can be represented as ‘objects’ outside of the human mind<sup>83</sup>. A list of the United States presidents through history, for example, can easily be put down on paper (or ‘codified’), and thus made ‘tangible’ for others to use. However, it is far more difficult to do the same, for instance, when describing to somebody how to maintain balance on a tightrope – or, in Polanyi’s famous example, how to ride a bicycle<sup>84</sup>. The difference in these examples is often described in knowledge literature as the difference between something that is *explicit* (easily made tangible) and something that is *tacit* (difficult / impossible to make tangible). This differentiation is one of the most commonly discussed issues in the subject of knowledge, and will be dealt with in section 3.6.1. The

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<sup>81</sup> Stenmark, 2002

<sup>82</sup> Bellinger, Castro, and Mills, 2003; Davenport and Prusak, 1998; Stenmark, 2002; Wiig 1993

<sup>83</sup> Stenmark 2002

<sup>84</sup> Polanyi, 1962

concepts of *explicit* and *tacit* phenomena are also of use in the discussion of data, information and knowledge.

Data, Information and Knowledge are most often imagined to exist within a conceptual hierarchy, where Data forms the foundational, lower level type of entity. At this level, Data is considered 'raw', unprocessed, and of no use in and of itself. Information is considered to be of more 'value' than Data in the sense that some sort of process, relation or meaning has been added. This makes Information a 'step up' from Data in terms of the hierarchy. Knowledge is at the top tier of this hierarchy, having the further addition of some process or meaning of 'value' onto the Information that preceded it, such that it is now of some specific *use*<sup>85</sup>. While many authors have considered adding to this basic hierarchy – for instance, Ackoff<sup>86</sup> considers Understanding and Wisdom respectively to be two additional tiers on top of knowledge – the Data-Information-Knowledge hierarchy is the simplest rendering of this line of thinking. In its most basic form, this can be signified by the following model, which Stenmark<sup>87</sup> compiles for the purposes of critique from various works in the literature, in variants – for instance Ackoff<sup>88</sup>, Bellinger et al<sup>89</sup>, Choo<sup>90</sup>, and Davenport and Prusak<sup>91</sup>:

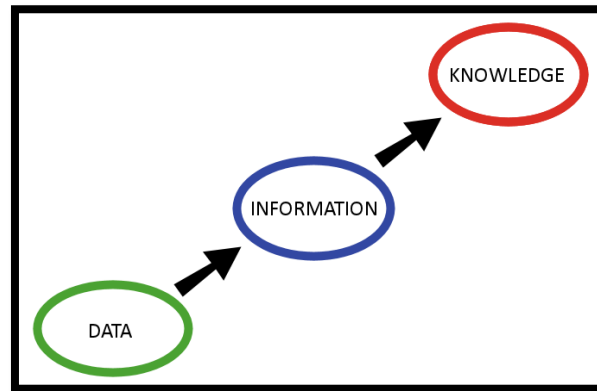


Fig 1. A simplified relationship between Data, Information and Knowledge (Stenmark, 2002)

From the model depicted in Fig. 1, the hierarchical relationship between Data, Information and

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<sup>85</sup> Bellinger, Castro and Mills, 2003

<sup>86</sup> 1997

<sup>87</sup> 2002

<sup>88</sup> 1997

<sup>89</sup> 2003

<sup>90</sup> 1998

<sup>91</sup> 1998

Knowledge described above can be seen. As Stenmark<sup>92</sup> (2002) points out, this figure indicates an understanding that holds implicit assumptions that are potentially problematical in obtaining an accurate insight into the relationship. These questionable assumptions represent some of the most common misconceptions encountered in the literature and practise surrounding the Data, Information and Knowledge debate, and are worthwhile evaluating for this purpose.

The first assumption indicated in Fig. 1 is that the relationship existing between the three elements is linear in nature, with a unidirectional, 'upward' movement from data to knowledge, with information acting as something of an intermediary. What this unidirectional 'flow' intimates is that there are no feedback loops or exchanges that take place in this system. This belief is mirrored in a variety of authors' definitions when knowledge is defined *in terms of information*, and information is defined *in terms of data*. What this means is that information cannot be derived from knowledge, and data cannot be derived from information. Stenmark cites the work of Tuomi<sup>93</sup> in attesting that this uni-directionality is incorrect, saying "*we all on several occasions have used our knowledge to derive information, and to create data out of information*"<sup>94</sup>.

Perhaps more subtly, Stenmark also notes how the diagram in Fig. 1 shows that the difference in the distances between Data, Information and Knowledge are all alike, implying that the processes of moving from Data to Information, and Information to Knowledge require the same amount of effort. This is clearly not the case universally. In some cases, the conversion from data to information, for instance, may take a substantial amount of time, while creating knowledge from that piece of information may be both easy and immediate.

The last feature worth elucidating in the diagram, and perhaps the most important, is the assumption that the higher up one moves in the hierarchy, the more *important* and *valuable* the phenomenon is. While in many instances it may be the case, knowledge is not *always* more valuable than information, and information is not *always* more valuable than data.<sup>95</sup> For example, knowledge that is 'untrue' or incorrect may be of far less value than a piece of information that is true and correct. A far more responsible understanding of the hierarchical relationship (or Tuomi's<sup>96</sup> belief in a completely 'reversed hierarchy') is proposed by Stenmark when he suggests: "*data, information and knowledge are interwoven and interrelated in more*

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<sup>92</sup> 2002

<sup>93</sup> 1999

<sup>94</sup> Stenmark, 2002

<sup>95</sup> Stenmark, 2002

<sup>96</sup> 1999

*complex ways than any [models] suggest. The three entities influence each other and the value of any of them depends on the purpose for which it is to be used*<sup>97</sup>.

### 3.5 - Data, Information and Knowledge: Moving Forward

The above discussion about Data, Information and Knowledge helped to illustrate how even in the simplest conceptualisation, the three terms can be remarkably complex and ‘controversial’. Nonetheless, the discussion is worthwhile – one of the most rational approaches to defining Knowledge is by distinguishing it from Data and Information. Understanding the similarities and differences between these three terms is also of real value when considering the role and design of KM and ICT processes in organisations. However, there is little doubt that this Data-Information-Knowledge expression has been subject to widespread criticism – especially when taken out of the context of knowledge management and information science, where it garnered its initial momentum. When explored in more ‘dynamic’ contexts – like sociology or psychology, for example – the Knowledge-Information-Data conception emerges as an incautious oversimplification, offering little value to the true understanding of knowledge.

What is also evident from the discussion is that the *relationships* between the concepts are often misunderstood and misused. Stenmark’s<sup>98</sup> analysis showed how the typical linear understanding of the relationship is flawed in a number of ways. Far from being universally unidirectional, systematic and increasing in value, the processes in the Data-Information-Knowledge relationship can be circular, inter-related and irregular. It is both possible and common for information to be derived from knowledge – just as it is to derive information from data. On top of this, it was seen that Knowledge is not necessarily more valuable than Information, and Information is not necessarily more valuable than Data. The interrelations and interactions between the terms make them far more rich, complex and contextual than most models can do justice.

For the purposes of gaining a working definition of ‘knowledge’ with the aim of enriching an understanding of the Knowledge Economy, it is thus proposed that the following understanding of Data and Information (as related to the concept of Knowledge) be taken forward:

- *Data is raw, unprocessed, un-interpreted ‘facts’, numbers and symbols.*

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<sup>97</sup> Stenmark, 2002: 3

<sup>98</sup> 2002



- *From this perspective, Information can be usefully described as an extension of Data – or, Data that have been given a specific meaning, purpose or context etc.*
- *When this Information is processed by an external actor and assigned truths, beliefs, judgments, expectations, values and the like, the result of this process is Knowledge. In this understanding, Knowledge involves some cognitive or analytical process for the purpose of creating synthesis or guiding action.*
- *Data and Information have a set of characteristics which are relatively predictable and which make Data and Information easier to ‘capture’, externalise, codify and manage than Knowledge, in most cases<sup>99</sup>.*
- *Data, Information and Knowledge are relative concepts which are highly dependent upon both contextual factors, as well as the level at which they are being applied<sup>100</sup>.*
- The relationship between data, information and knowledge is not to be considered linear, and the ‘shift’ from data to information, information to knowledge, data to knowledge<sup>101</sup> does not necessarily indicate a progression to a higher level of importance or value.

### 3.6 – Knowledge: Types and Perspectives

The literature on knowledge presents a startling array of perspectives on knowledge, as scholars and practitioners alike attempt to generate a better understanding of the term by categorising and classifying all of the numerous aspects that are subsumed within it. This tremendous multiplicity of knowledge ‘types’ presents itself as something of a maze for those trying to make sense of the discourse in its entirety. Different authors use similar or identical labels to distinguish between similar-but-not-quite-identical categorisations of knowledge, each with their own nuances, taxonomies, contextual slants and epistemological assumptions. Frequently, they attach different labels to the same categorisations, they split other authors’ categories into further subdivisions, and they collect a host of other authors’ categories into a new, all-inclusive category with its own new label. All of this makes the discussion surrounding the different ‘types’ of knowledge somewhat difficult to navigate.

The purpose of this section of the chapter is thus to provide some clarity in analysing the numerous types of knowledge offered up in the literature. The most prominent, enduring and

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<sup>99</sup> Callahan, Schenk and Rixon, 2006

<sup>100</sup> Ahsan and Shah, 2007

<sup>101</sup> or vice versa in all cases, as is both possible and common

interesting classifications will be briefly discussed in turn, and the value that they offer in attempting to build a definition of knowledge will be highlighted. As the investigation unfolds, it will be easier to begin ‘grouping’ (albeit in some cases, loosely) the similar perspectives that bear different labels. In the process, a more holistic and inclusive collection of ‘types’ will be compiled, and the most relevant ideas for the purpose of this chapter will be extracted.

The most sensible approach in this regard would be to start with a categorisation that is one of the most prevalent in the literature, as well as one of the most robust – Explicit and Tacit knowledge. This separation forms the foundation of many of the following classifications of knowledge types, as well as being of substantial importance in understanding the nature of knowledge. Touched on briefly earlier in this chapter, it is worthwhile expanding upon this vital distinction in detail.

### *3.6.1 - Explicit and Tacit Knowledge*

The distinction between Explicit and Tacit knowledge is one of the principal and most significant classifications of knowledge in the literature. Defined and approached by numerous authors for a wide variety of goals and purposes, the distinction was originally proposed by Polanyi<sup>102</sup>. As the increased hype surrounding Knowledge Management became a point of focus in the literature, this distinction was taken further, and applied to the KM realm. This was done initially by authors such as Nelson and Winter<sup>103</sup>, and most famously, Nonaka and Takeuchi<sup>104</sup>, who gave Polanyi’s initial rendering a slightly different spin. As the distinction grows and matures, constant adjustments are being made to both the definitions and the conceptual accuracy of the classification. For this reason, Explicit and Tacit knowledge cannot be universally defined. However, it is both possible and important to give a basic understanding of these two ‘types’ or aspects of knowledge. As will be seen as this section develops, Explicit and Tacit knowledge inform and guide many of the other classifications of ‘knowledge types’ to follow.

#### *3.6.1.1 Explicit Knowledge*

To put it simply, *Explicit Knowledge* is the term given to those ‘objective’ aspects of Knowledge that are proposed in the Commodity View, as discussed briefly above. This is knowledge that can be expressed, or *made explicit* in formal language – be it in speech, written language,

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<sup>102</sup> 1962

<sup>103</sup> 1982

<sup>104</sup> 1995

symbols, artefacts, mathematical equations and the like<sup>105</sup>. Making knowledge 'explicit' in this way involves a process whereby knowledge is detached from the individual 'knower' and transformed into a memory and/or communication capacity that is *independent* of that original 'knower' – so long as the medium in which it is stored, and the language in which it is expressed continue to exist<sup>106</sup>. The very fact that it can be articulated means that this 'type' of knowledge is at the forefront of human consciousness<sup>107</sup> – the 'knower' of this knowledge is aware of it as a 'unit' of knowledge, and is able to transmit it formally (albeit potentially with some difficulty, or requiring some form of assistance) to others so that they may acquire it themselves<sup>108</sup>.

This basic understanding has numerous implications. The belief that knowledge can be made explicit is usually accompanied by the belief that new knowledge can be created through a formal, structured, scientific learning process – including experiments, research and development<sup>109</sup>. While this belief permeates the vast majority of modern ways of thinking, it is certainly no small assumption. What this entails is that the knowledge residing in the minds of 'knowers' can be captured and/or codified (be it in speech, books, manuals etc) so that others with the required 'tools' to make sense of the codification (i.e. understanding of language, terminology etc) may formally *structure* knowledge themselves in a way that represents the knowledge expressed by the original knower – inevitably, with varying degrees of accuracy, and in a unique context<sup>110</sup>.

Another implication is that this form of knowledge can be expressed in the form of *objects*. As Choo<sup>111</sup> describes, this includes patents, software codes, blueprints, manuals, textbooks, and even rules, routines and procedures<sup>112</sup>. This characteristic has helped to make Explicit Knowledge a major focus of KM practices in organisations. By making moves to capture and codify the knowledge that resides in the minds of their employees – including the routines, ways of performing certain tasks etc – organisations feel less vulnerable to losing that knowledge should they lose the employees that possess it. The push for the *management* of knowledge in this way is generally associated (if not just more 'easily' performed) with Explicit Knowledge.

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<sup>105</sup> Nonaka and Takeuchi, 1995; Brenner, Brokel, and Witt, 2007

<sup>106</sup> David and Foray, 2002

<sup>107</sup> Nonaka and Takeuchi, 1995

<sup>108</sup> Sanchez, 2006

<sup>109</sup> Sanchez, 2006

<sup>110</sup> Stenmark, 2002; Sanchez, 2006

<sup>111</sup> 1998

<sup>112</sup> Stenmark 2002

It is not difficult to see that this type of knowledge can be easily compared to Information – Nonaka<sup>113</sup> even notes how it has become common practise to use the term interchangeably with Information. Indeed, the vast majority of the same processes that can be applied to Information are able to be applied to Explicit Knowledge as it is understood here. For this reason, among others, there is significant debate surrounding the relevance of the term ‘Explicit Knowledge’, as well as its treatment as independent from Tacit Knowledge. These arguments will be briefly mentioned after the description of Tacit Knowledge below.

### 3.6.1.2 *Tacit Knowledge*

It is widely accepted that all individuals contain knowledge in their minds that is difficult or impossible to explicate formally. Whether it is because certain knowledge is ill-defined, subconscious to the knower or impossible to articulate, there are many instances where individuals are forced to recognise that, as Polanyi<sup>114</sup> famously described, “*we know more than we can tell*”. Whereas the knowledge understood as Explicit Knowledge can be easily ‘captured’ and stored external to the knower, Tacit Knowledge, by contrast, is inherently personal and difficult to express in any way, shape or form. The personal nature of this knowledge pays reference to the unquantifiable reserves of historical, contextual and experiential cognitive frameworks that attribute meaning to the expressions or actions performed by the knower – the nature and extent of which cannot be articulated in such a way that they will be easily understood by someone who does not possess these frameworks<sup>115</sup>. Crucially, truly ‘Tacit’ knowledge can never be inter-personally transmitted. Asking a tightrope walker to express in formal language how to walk on a tightrope may elicit the response, “*Put one foot in front of the other, and keep your balance*”. Such a response might not be facetious - there may simply be no more accurate way to encapsulate years of learning-by-doing, trial-and-error, subconscious processing and experience in formal language of any sort.

Tacit Knowledge is a far more challenging concept to accurately define than Explicit Knowledge. Polanyi’s<sup>116</sup> (1958) introduction of the concept referred to a cognitive backdrop which provides the meaning and situational grounding in which all actions and expression can be understood. In this sense, Tacit Knowledge was about the *process of knowing*, as opposed to a wholly distinct

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<sup>113</sup> 1991

<sup>114</sup> 1962

<sup>115</sup> Brenner, Brokel and Witt, 2007

<sup>116</sup> 1962

'type' of knowledge, completely independent from Explicit Knowledge. Nonaka<sup>117</sup>, among others, has added new and different dimensions to this concept over time. Nonaka<sup>118</sup>, for instance, describes Tacit Knowledge as: "*highly personal...hard to formalise and therefore difficult to communicate to others*". Also, he notes how "*tacit knowledge is deeply rooted in action and in an individual's commitment to a specific context...[consisting] partly of technical skills [and partly] of mental models, beliefs and perspectives so ingrained that we take them for granted and cannot easily articulate them*". This description represents a most commonly accepted understanding of Tacit Knowledge.

Tacit Knowledge, of course, also has its own implications. For one, it forces one to ask questions about the social construction of knowledge. Stenmark<sup>119</sup> notes how people from the same tradition and culture are more likely to have far more Tacit Knowledge in common than complete strangers do, for instance. Thus, what is considered impossible to articulate between a Dutch computer programmer and an Inuit fisherman may not be as 'Tacit' as it would be between two Dutch programmers working for the same company. Tuomi<sup>120</sup> takes this further by arguing that only two individuals with a sufficiently shared 'background' (i.e. tacit cognitive knowledge framework) can *truly* exchange knowledge. What this means for Knowledge Management is that Explicit Knowledge may be of no use to an organisation unless there is enough 'background' sharing amongst employees so that any codified or captured knowledge can be made sense of in the absence of the original knower. As this 'background' is tacit in nature, any structured, scientific or formal knowledge capturing / codification process is likely to be unsuccessful in facilitating this sharing process. Rather, Tacit Knowledge is acquired in an explorative and inductive manner – usually through learning-by-doing. The Tacit dimension, in other words, is a whole new ballgame when it comes to *transferring* knowledge from one person to another.

Another interesting inference is offered by Brenner et al<sup>121</sup>, who see a difference between tacit knowledge that *can* be codified / articulated (given the right 'tools' for both the knower and the receiver) and knowledge that is inherently *impossible* to codify / articulate. The knowledge that is non-codified, but which *in principle* is able to be articulated is referred to as 'codifiable' knowledge – denoting the *potential* to be codified / articulated. This could be the result of

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<sup>117</sup> 1991

<sup>118</sup> 1991

<sup>119</sup> 2002

<sup>120</sup> 1999

<sup>121</sup> 2007

someone not being *willing* to express some knowledge, or simply not having the ‘tools’ to do so. Thus, Brenner *et al* see three forms of Knowledge – Codified (Explicit), Codifiable (Tacit, with the potential to be made explicit), and Tacit (that which can never be made explicit)<sup>122</sup>.

Tacit Knowledge is undoubtedly of major importance in understanding the nature of knowledge. From the discussion above, it is possible to deduce that *truly* Explicit Knowledge – i.e. knowledge which is totally universal in that it requires absolutely *no* prior shared ‘background’ of any sort to fully comprehend the original knower’s intention – must be a remarkably scarce resource. Even when Explicit Knowledge is in its most neutral and objective form, one would imagine that the actor that generated this knowledge (either by processing data, or working from other data / information / knowledge) would most likely have imparted *some* aspect of their inherent background (Tacit) knowledge in the process, thus necessitating the ‘reversal’ or ‘decryption’ (to use Boisot’s analogy) of that addition in order for someone else to gain a complete understanding thereof. In view of this, Tsoukas<sup>123</sup> argues that Explicit and Tacit knowledge are mutually constituted, and can never be truly separated – to the point that “*tacit knowledge is the necessary component of all knowledge*” (my emphasis). From this assertion, the proposition is made that there can be no Explicit Knowledge without Tacit Knowledge – a view shared by a large number of authors<sup>124</sup>.

Whether or not the distinction between Explicit and Tacit Knowledge should see these as two separate ‘types’ of knowledge, or merely two ‘aspects’ of knowledge is not of importance for the purposes of this thesis. What is important is that a basic understanding can be taken forward concerning what Explicit and Tacit Knowledge entail, as well some of their implications for how we should understand knowledge and its behaviours in the context of the Knowledge Economy. From the discussion above, this basic understanding has also been presented as a foundation for further distinctions of knowledge ‘types’ to follow.

### 3.6.2 - A Multitude of ‘Types’

As indicated before, the Explicit-Tacit distinction forms the backbone for a majority of the categorisations of knowledge – whether this is formally recognised, or simply by implication. This section of the chapter will briefly address a range of these classifications, for the purpose of elucidating the interesting aspects of knowledge emphasised by each different type. Importantly

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<sup>122</sup> Brenner, Brokel and Witt, 2007

<sup>123</sup> 1996

<sup>124</sup> For an indication, see Stenmark, 2002

these distinctions were generated by different authors for their own unique purposes and thus were not intended for comparison with other classifications. However, the analysis thereof does show some clear overlaps and trends in the various categories, which will be highlighted as this section progresses.

### 3.6.2.1 *Knowing ‘What’, ‘Why’, ‘When and ‘How’*

Joel Mokyr, in his fascinating analysis of the theoretical and historical underpinnings of the Knowledge Society<sup>125</sup>, begins with a description of how useful knowledge has made its way to becoming the primary driver of modern economies and societies. Knowledge, he believes, can be divided into two subsets: *Propositional* and *Prescriptive* Knowledge. These categories describe two fundamental complements in the complete body of knowledge that is in use (or, at least, in storage) in human kind.

Propositional Knowledge is described as containing all the knowledge about the nature of our physical world (and universe) and the things within it. This includes everything that falls under the label of ‘science’, as well as extending far beyond that to include knowledge of natural phenomena, history, geography, folk wisdoms, properties of things, quantitative empirical relations and the like. Certainly, this is a very extensive ‘subset’. Mokyr refers to this Propositional Knowledge as containing the “*knowledge of what*”<sup>126</sup>. The inclusion of subjects like geography, history and social / cultural knowledge in this subset also means that ‘When?’, ‘Where?’ and any questions relating to *facts* are also aimed at eliciting Propositional Knowledge.

Prescriptive Knowledge, on the other hand, “*has the form of techniques or instructions: the archetypal technique is the recipe which instructs one how to prepare a certain dish*”<sup>127</sup>. In this subset, it is the *technique* - and not the results thereof (i.e. the dish itself) - that is the unit of analysis. While Prescriptive Knowledge can contain *codified* elements – i.e. in a recipe book, instruction manual, ‘how-to’ books etc – it is most common to find it in the brains of people. As with the Tacit nature of knowledge described above, these techniques “*cannot wholly be written down, and there is always an irreducible ‘tacit’ component that cannot be eliminated, requiring the persons executing [the instructions etc] to acquire some knowledge*”<sup>128</sup>.

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<sup>125</sup> 2002

<sup>126</sup> 2002; my emphasis

<sup>127</sup> Mokyr, 2002

<sup>128</sup> Mokyr, 2002

Techniques in this description are most often elicited when the question ‘How’ is asked *in reference* to that particular skill or technique. Of course, this question potentially contains far more Tacit Knowledge on the part of the knower, so it is most often not as easily answered as ‘What’, ‘Where’ or ‘When’ questions. For instance, if someone asks you *where* the hospital is, *when* Christmas is celebrated, or *what* day of the week it is, if you happen to know the answers to these questions, it is very easy to express them. However, a ‘*how?*’ question is far more demanding when it refers to a technique – as with Prescriptive Knowledge – even when the question refers to a ‘simple’ technique. For instance, if someone with no prior experience asks “How do you balance on a tightrope?”, the technique cannot be easily transferred for the same reasons that make other Tacit Knowledge highly difficult, or even impossible to transfer.<sup>129</sup>

Knowledge ‘*aboutwhat*’, and knowledge ‘*about how to do [something]*’ form part of a variety of other authors’ classifications. A very closely related classification is proposed, for instance, by Anderson et al<sup>130</sup>, who divide knowledge into four categories: *Declarative*, *Procedural*, *Situational* and *Conditional* Knowledge. *Declarative* Knowledge, also described as ‘know-what’, refers to the knowledge of facts, events, associations, etc. *Situational* Knowledge is what can be used to answer ‘where’ and ‘which’ questions, while *Conditional* Knowledge can be used to answer ‘when’ and ‘why’ questions. These three ‘types’ of knowledge seem to be relatively easily subsumed within Mokyr’s Propositional Knowledge category, with each label describing another facet of Mokyr’s broad classification. Importantly, these types of knowledge also represent types of knowledge which are more able to be expressed and made explicit. *Procedural* Knowledge, on the other hand, refers to the same ‘How to?’ questions that are described by Mokyr’s Prescriptive Knowledge - more demanding of Tacit Knowledge, harder to express verbally, and in need of learning-by-doing, trial-and-error acquisition.

This ‘know-what’, ‘know-how’, ‘know-why’ etc classification system features in a wide variety of categorisations of Knowledge – both in their actual labels of categories, and in the clarifications for what each category entails. For instance, a commonly-cited classification proposed by Wikstrom and Normann<sup>131</sup> sees knowledge as having four sub-concepts: *Information*, *Explanation*, *Skill*, and *Understanding*. *Information* represents the factual, ‘objective’ knowledge, concerning the past, present or future. This can contain everything from knowledge about patterns to relationships to scientific facts, and is provided in response to ‘know-what’ questions

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<sup>129</sup> Mokyr, 2002

<sup>130</sup> 1996

<sup>131</sup> 1994: 10-13



– as is common in the Declarative and Propositional categorisations. *Explanation* provides answers to ‘why’ questions, and offers knowledge concerned with causal relationships, regularities and the like. This can extend to the knowledge of ‘why things happen’, which Sackmann<sup>132</sup> calls ‘axiomatic’ knowledge. The non-*person-specific* nature of *Explanation* means that it is readily explicated. This type of knowledge might fit into the Propositional and Conditional categories described above. *Skill* represents the ‘know-how’ element. Like Procedural and Prescriptive descriptions, *Skill* is embedded in individuals, and is technique-oriented and context-oriented. Wikstrom and Normann’s last category – that of *Understanding* – is of particular interest in that it is described as being the most profound form of knowledge<sup>133</sup>. *Understanding* is highly Tacit and embedded in the individual, arising only “*when we recognise principles and connections*”<sup>134</sup>. This seems to be an intersection of Propositional and Prescriptive Knowledge in a manner that leads to a synthesis on another level, rather than fitting neatly into either category.

In another example, Quinn et al<sup>135</sup> use the term “*cognitive knowledge*” to refer to ‘know-what’ knowledge, “*advanced skills*” for ‘know-how’ and “*system understanding*” for ‘know-why’. Anderson et al<sup>136</sup> also add “*motivational creativity*” (described as ‘care why’) and “*synthesis and trained intuition*” (described as ‘perceived how and why’) to the mix. The former might be imagined to fit into Mokyr’s Propositional category, although it ostensibly contains a highly Tacit dimension in the form of morals, identity, culture and psychological makeup. This seems to warrant its inclusion in a category which will be acknowledged in Section 2.6.3. *Synthesis and Trained Intuition*, on the other hand, seems to be more suited to Wikstrom and Normann’s *Understanding* category, and would also be very reliant on experiential, trial-and-error, action-oriented learning.

At this point, it is useful to represent the interactions between the knowledge ‘types’ described above in a simplified diagram, as found in Figure 2.

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<sup>132</sup> 1992

<sup>133</sup> 1994

<sup>134</sup> Wikstrom and Norman, 1994

<sup>135</sup> 1996

<sup>136</sup> 1996

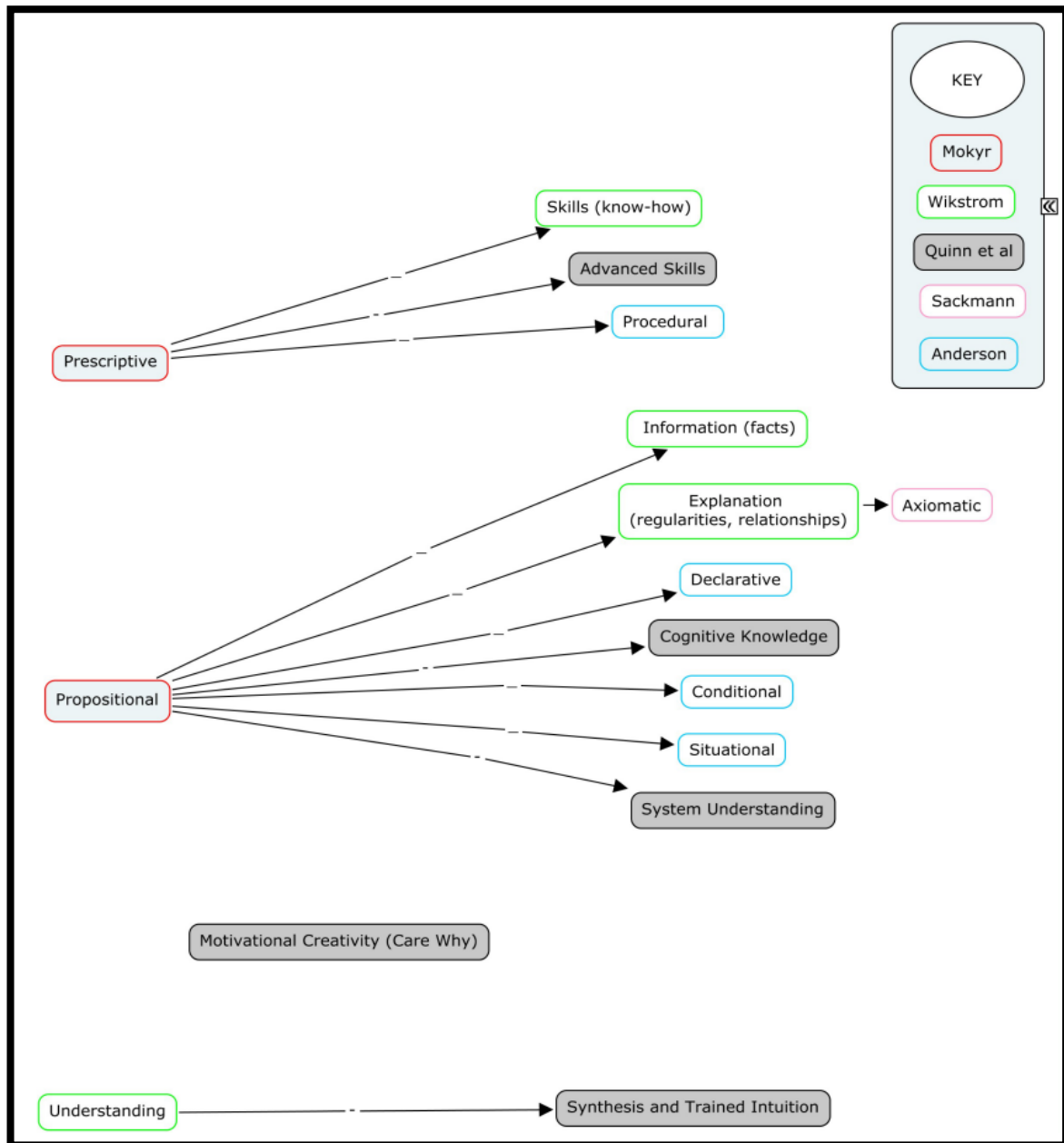


Fig 2. – A simplified representation of the links between the knowledge ‘types’ discussed in 3.6.2.1

### 3.6.2.2 *Organisational Aspects of Knowledge, and the Importance of Culture*

The practical domain in which most attention has been placed on the study of knowledge in recent times is undoubtedly that of the ‘organisation’. Significant research and theoretical focus on the impact of knowledge in organisations has added a new dimension to the concept of knowledge – and, as a result, a variety of new ‘types’ and categorisations of knowledge have

come to the fore. While the explicit focus on the *organisational* characteristics of knowledge directs these categorisations toward a different context, the vast majority thereof still have direct parallels to the types of knowledge discussed in the previous section. For these reasons, it is worthwhile noting some of the primary organisational knowledge ‘types’, and analysing how they might fit into the broader categorisations developed thus far.

A commonly-cited classification of knowledge in organisational learning literature is that of Blackler<sup>137</sup>, who defines five categories for knowledge: *Encoded, Embodied, Embrained, Embedded and Encultured Knowledge*. Despite the fact that each of these categorisations is intended to clarify the process of innovation and learning that takes place in the organisational context, they are still worthwhile incorporating into the taxonomy of knowledge ‘types’ developed above, and offer further insight into the concept of knowledge.

*Encoded Knowledge* is undoubtedly the most simple category, referring to the tangible, externalised knowledge that has been captured in a form of code or language, which fits without controversy into Moky’s *Propositional Knowledge*, and can be easily extended to Wikstrom et al’s *Information* category. This *Encoded Knowledge* is naturally easier to distribute within the organisation, as it exists external to the individual and, in its ‘captured’ state, is simple to distribute and store. Importantly, while it is mostly often *Propositional Knowledge* that is codified to become *Information, Prescriptive Knowledge* can, in some cases, also be captured in some form of ‘code’. As discussed above, the extent to which the codification of the *Prescriptive Knowledge* is comprehensive or successful depends on the amount of Tacit knowledge that could not be eliminated in the codification process.

The next category, *Embrained Knowledge*, also leans toward the *Propositional Knowledge* subset in that it represents the cognitive ability and capacity of individuals to retain and share abstract knowledge *about*, and knowledge *that*, which is of use to the organisation. This *Embrained Knowledge* is largely tacit in nature, and shares many similarities with Wikstrom et al’s *Explanation* and Anderson’s *Declarative Knowledge* categories.

More suited to the *Prescriptive Knowledge* ‘partition’ is Blackler’s *Embedded Knowledge*. This *Embedded Knowledge* takes the form of the knowledge captured in organisational structures, systems, technology and routines – thus making it external to the individual, interpersonal in nature, and deeply engrained in the way that the organisation completes its day-to-day

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<sup>137</sup> 1995

functions<sup>138</sup>. These routines and systems represent “*the relationships between, for example, technologies, roles, formal procedures and emergent routines*”<sup>139</sup>. While aspects of *Embedded Knowledge* may be *Propositional* in character (i.e. some similarities are shared with the *Explanation* category), the primary emphasis of this type of knowledge is far more *Prescriptive* in that it seeks to embody ways of doing things, skills and sets of behaviours that allow people in organisations to “*behave in the future according to routines they applied in the past*”<sup>140</sup>. This elevates the technique-oriented aspect of knowledge in this classification.

*Embodied Knowledge* is arguably the most Tacit component of Blackler’s<sup>141</sup> classification, focusing on individual *know-how*, combined with sensory and empirical knowledge, as well as all of the knowledge gained from experience. This type of knowledge is principally action-oriented, placing the emphasis on the individual’s knowledge of how to act in the face of a certain circumstance or context. This is thus highly Tacit, as well as being strongly tied to a certain context<sup>142</sup>, combining the *Skills* from Wikstrom et al’s subset, with a large degree of Anderson’s *Procedural Knowledge*. In the organisational context, this is the most powerful ‘bargaining chip’ for the individual, as the experience and learning-by-doing element of the job can never simply be taught to a new employee<sup>143</sup>.

The last of Blackler’s categories is *Encultured Knowledge*. Like the *Embedded* category, *Encultured Knowledge* refers to the more ‘collective’ aspects of knowledge in the organisational context. Much of what is shared, learned and created in the organisational context is done so using shared cultural meaning systems – a set of collective assumptions, beliefs and values that work as a catalyst in the processes of socialisation and acculturation, and highly dependent upon language and inter-personal interaction<sup>144</sup>. Such foundations are pivotal in the generation of shared understanding of knowledge – something that is of the utmost importance for organisations that want to be able to make the best of their employees’ knowledge capacities<sup>145</sup>. Much work has been done on the concept of Cultural Knowledge by Nonaka<sup>146</sup> among many others.

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<sup>138</sup> Blackler, 1995

<sup>139</sup> Blackler, 1995: 1024

<sup>140</sup> Haghirian, 2004; Nelson et al, 1982

<sup>141</sup> 1995

<sup>142</sup> Adolph, 2005

<sup>143</sup> Adolph, 2005

<sup>144</sup> Blackler, 1995; Choo, 1998

<sup>145</sup> Adolph, 2005; Blackler, 1995

<sup>146</sup> 1995

*Encultured Knowledge* adds a fascinating dimension to the categorisations of knowledge covered thus far. It is very much in line with Stenmark's<sup>147</sup> discussion regarding the 'Tacit-ness' of knowledge being highly dependent on the level of shared culture and traditions between the people accessing a 'piece' of knowledge. Cultural 'middle-ground' has far-reaching implications for how knowledge is to be understood and handled in inter-personal settings – be it in an organisation, or in any context in which some sort of knowledge is being transferred from one personal to another. *Encultured Knowledge* is also interesting in that it is difficult to place within Mokyr's two overarching subsets – *Propositional* and *Prescriptive Knowledge*. Mokyr is emphatic in his recognition that "[Knowledge is a] cultural entity...it is distributed to, shared with, and acquired from others<sup>148</sup>", but the extent and nature of cultural knowledge cannot easily fit into either of his two primary categories. *Encultured Knowledge* must contain many *Propositional* characteristics, for the reason that shared cultural grounding requires a certain level of mutual understanding of phenomena and regularities, folk wisdoms, tradition, history and the like<sup>149</sup>. At the same time, however, there are undoubtedly a range of *Prescriptive* skills, techniques, routines, competences and knowledge of 'how' that are built into the understanding of a particular culture. For this reason, it is most useful to think of *Encultured Knowledge* as belonging to a different 'sub-category' entirely – that of Cultural Knowledge – which has ties to both *Propositional* and *Prescriptive Knowledge*, but cannot be categorised exclusively as either of the two.

Another point of interest regarding the cultural aspects of knowledge is the possible linkages with what Antal<sup>150</sup> calls *Relational Knowledge*. In his study of the types of knowledge gained by expatriate managers working abroad, Antal extends Anderson et al's<sup>151</sup> four categories of knowledge to include an in-depth form of what can be labelled 'know-who' knowledge. He argues that the building of personal relationships with "*professionally relevant contacts*" provides not only the knowledge of *who to work with* in a specific situation, but also the added benefit of *trust*<sup>152</sup>. As one of his respondents explained, "*because people [abroad] know me, they trust me...we can directly come to the point [when doing business]*<sup>153</sup>".

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<sup>147</sup> 2002

<sup>148</sup> Mokyr, 2002

<sup>149</sup> Mokyr, 2002

<sup>150</sup> 2000

<sup>151</sup> 1996

<sup>152</sup> Antal, 2000

<sup>153</sup> Antal, 2000

*Knowing* people, and knowledge of one's ability to trust them, is an exceptionally important aspect of knowledge in organisational and social contexts - adding to the diversity of experience and ideas, enriching knowledge bases, and adding greatly to an organisation's competitive advantage<sup>154</sup>. Crucially, this trust cannot be easily transferred to others – most of what forms the basis of a genuine personal relationship takes significant time and effort to build up<sup>155</sup>. Considering the nature of trust and personal relationships, it would seem most helpful to include *Relational Knowledge* in the Cultural Knowledge category subset. The building of trust requires, among many others things, the establishment of shared understandings, assumptions, beliefs and values between the individuals concerned. However brief or context-specific this 'trust' may be, it is appropriate to understand such shared understandings, assumptions, beliefs and values as indicative of a form of cultural affiliation<sup>156</sup>.

These cultural characteristics are certainly a fascinating aspect of the concept of knowledge. For the concept of the Knowledge Economy, the idea of knowledge 'cultures' extends beyond just the *Encultured* and *Relational* aspects to the way in which organisations, companies and even countries think about knowledge in terms of its collection, distribution and creation processes. For instance, an environment in which change and innovative behaviour is encouraged is likely to contribute toward the exchange of ideas and the creation and transferral of knowledge<sup>157</sup>. In the analysis of how corporate or national cultures are created and sustained with regards to knowledge and its management, however, it is vitally important to consider the way in which *encultured* routines and behaviours, as well as the *relational* aspects of trust and personal relationships contribute towards the success of these cultures.

### 3.6.2.3 *Summary of the Organisational and Cultural Aspects of Knowledge*

In sum, it is necessary to acknowledge the contribution of the 'organisational' aspects of knowledge toward the generation of an enriched understanding of the term. The organisational context tends to consider a less 'personal', and more 'collective' approach to the types of knowledge, which offers an interesting new dimension to the concept. At the same time, however, there are many parallels between the organisational aspects discussed in this section, and the many categories of knowledge considered in section 3.6.2.1.

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<sup>154</sup> Antal, 2000

<sup>155</sup> Antal, 2000

<sup>156</sup> Choo, 1998

<sup>157</sup> Davenport and Prusak, 1998; Haghirian, 2004

Using Blackler's typology of 5 types of knowledge, it is possible to see parallels with many of the authors in the literature. With little difficulty, Blackler's *Encoded* and *Embrained Knowledge* categories can be linked to the *Propositional Knowledge* category, sharing many aspects of *Information, Explanation, Declarative, Cognitive, Situational* and even *System Understanding Knowledge* categories from the various authors considered in this chapter<sup>158</sup>. *Prescriptive domain* captures many of the aspects of Blackler's *Embedded* and *Embodied Knowledge*. While these 'groupings' are not meant to be definitive or absolute in any way (at all stages, overlaps and interactions are likely to occur), it is of significant use for the purpose of getting a grip on the concept of Knowledge to represent the multitude of categories in this simplified form.

The addition of Cultural Knowledge as a category allows for the incorporation of *Encultured Knowledge* which makes extensive use of both *Propositional* and *Prescriptive Knowledge* in its highly complex and largely tacit form. Cultural Knowledge also provides for the incorporation of *Relational Knowledge*, which also offers fascinating insight into an additional dimension of Knowledge. On top of this, the new category offers a more suitable home for the concept of *Motivational Creativity* (or, 'care why') mentioned in section 3.6.1.2. While undoubtedly containing *Propositional* and other elements, this concept of 'caring why' combines willpower, motivation and a relational understanding that commonly originates in culture. In so doing, 'carewhy' also touches on the shared meaning systems and understanding of societal and group interaction that can be understood by *Encultured Knowledge*.

Thus, from the additional development upon the 'types' of Knowledge considered in this chapter, our simplified representation of the knowledge typology can be shown as in Fig 3. below:

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<sup>158</sup> Anderson, Finkelstein, and Quinn, 1996; Antal, 2000; Mokyr, 2002; Wikstrom and Normann, 1994.

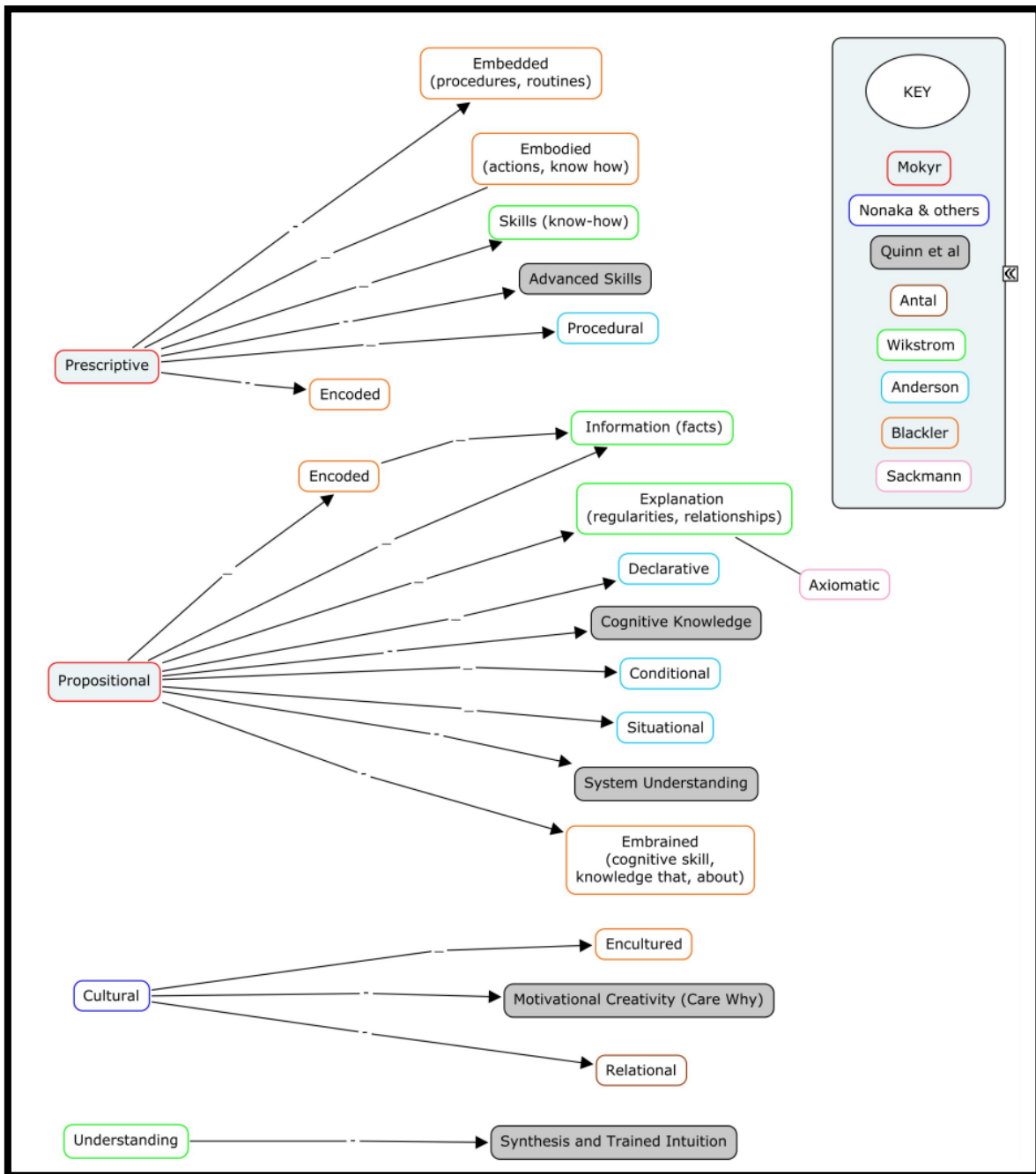


Fig 3. – A simplified representation of the links between the knowledge ‘types’ discussed in 2.6.2.1 and 2.6.2.2

### 3.6.3 - Summary of Knowledge Types and Perspectives

This section of the chapter began with a discussion of Tacit and Explicit Knowledge - one of the most significant and widespread distinctions made in knowledge literature. Explicit Knowledge and Tacit Knowledge are seen to differ in a range of ways – from how they are created and



learned to how they are captured, codified and distributed. With an informed understanding of these two vital concepts, it was possible to move forward and investigate the multitude of knowledge types and perspectives found in the knowledge literature – most of which pay reference, at some point or another, to the Tacit / Explicit Knowledge distinction.

The analysis of some of the many types and categorisations of knowledge presented in the literature from a variety of different authors offers valuable insights into the complexity and extent of the concept of knowledge. What emerges is that the majority of these authors' classifications share fundamental characteristics that enable them to be 'grouped' into a smaller number of sub-categories. Mokyr<sup>159</sup> provides the first of these overarching sub-categories with his division of knowledge into two 'types' – Propositional and Prescriptive Knowledge. Using these as starting points, it was possible to collect a large number of various authors' types and categories based on the fundamental features for Propositional and Prescriptive Knowledge respectively, as outlined by Mokyr. In so doing, the aforementioned 'maze' of knowledge types and perspectives was significantly organised and clarified, and it was possible to see what the various 'types' have in common, as well as what new insights they offer in expanding our understanding of knowledge.

While these two categories provided for the incorporation of a good number of the 'types' discussed in this section, a few categories did not fit as comfortably into either the Propositional or Prescriptive groupings. For the more 'collective' aspects of knowledge, for instance, it was felt that a third category was required in order to encapsulate the cultural and relational characteristics of knowledge. This third category was labelled 'Cultural Knowledge', and included the Encultured Knowledge, Relational Knowledge and Motivational Creativity categories from some of the authors discussed<sup>160</sup>.

Lastly, in order to find a suitable category for the 'higher-level' categories of knowledge, a fourth category – that of Understanding – was created. This category includes those individual-specific contexts in which a synthesis of the various other categories is required to generate an in-depth, rich *understanding* of something, incorporating aspects of Propositional, Prescriptive and Cultural Knowledge, as well as a grasp of how the three interact. This is summed up by Anderson et al's<sup>161</sup> *Synthesis and Trained Intuition* category, as well as Wikstrom et al's<sup>162</sup> *Understanding*.

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<sup>159</sup> 2002

<sup>160</sup> Antal, 2000; Blackler, 1995; Anderson, Finkelstein & Quinn, 1996

<sup>161</sup> 1996

<sup>162</sup> 1994

### 3.7 - Conclusion

Through the course of this chapter, the concept of knowledge has been analysed from a variety of angles. Firstly, it was considered in terms of what many consider to be its component parts – Data and Information. Understanding these elements and how they contribute toward an enriched conception of the knowledge is imperative, as they appear in the vast majority of discussions on the subject. In examining knowledge in terms of Data and Information, it was also useful to consider the most common misconceptions concerning the relationship between the three concepts. These misconceptions highlighted some of the inherent assumptions held in defining the terms, and added valuable perspectives that helped to further deepen our grasp of the definitions under review. Lastly, this exercise also presented a number of simple suggestions for how definitions of Data and Information could be considered in moving forward toward building a comprehensive definition of knowledge.

The next step taken in this chapter was to bring to light some of the most common categorisations of different ‘types’ of knowledge. In this pursuit, basic definitions of Tacit and Explicit knowledge were put forward for the purpose of review. The Tacit-Explicit distinction is one of the most enduring and widely-discussed categorisations of knowledge found in the literature, and each of these two ‘types’ or aspects of knowledge have a great deal to offer in informing a sound understanding of the concept of knowledge. Explicit knowledge, in its most simple form, was shown to represent those ‘objective’ aspects of knowledge as proposed in the Commodity View – at its most complex, less ‘controversial’ than Tacit knowledge, and at its most basic, largely indistinguishable from Information. The Tacit knowledge dimension was shown to be a far more intricate and latticed affair, paying reference to the Community View of knowledge, and highlighting the *social construction* of knowledge, and all its cultural implications. Informed by Brenner et al’s<sup>163</sup> suggestion, a distinction was made between knowledge that is impossible to articulate (Tacit knowledge) and knowledge which has the *potential* to be explicated or codified (or made explicit), but for some reason remains ‘Tacit’ (referred to as ‘codifiable’ knowledge). The Tacit-Explicit classification is one which continues to enrich definitions of knowledge in the literature, and the numerous implications and consequences that stem from these two ‘aspects’ of knowledge are of major importance in appreciating the true nature of knowledge.

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<sup>163</sup> 2007

In the context of this thesis, it not difficult to see how these understandings have significant relevance. From an economic perspective – especially when it comes to commoditising and codifying a knowledge asset for the purpose of distribution in an economic setting – an appreciation of the differences between Tacit, Explicit, and *codifiable* knowledge could play an important part in understanding how different types of knowledge perform in different contexts.

Using this Tacit-Explicit classification as a foundation, the next section of this chapter saw an investigation into the multitude of different ‘types’ of knowledge discussed in the literature. Here, Mokyr’s overarching sub-categories of knowledge – Propositional and Prescriptive Knowledge, respectively – were outlined in brief. These two categories were shown to be suitably broad so as to serve as a worthwhile starting point in compiling a simplistic model that would help to make sense of the ‘maze’ of labels, taxonomies and contextual slants that are used to describe different authors’ versions of different ‘types’ of knowledge. In this quest, several of the most common categorisations of knowledge were grouped (albeit, loosely in some cases) according to their overriding characteristics and inclinations.

Propositional Knowledge was shown to be a rather extensive subset, described as containing all the knowledge about the nature of our physical world (and universe) and the things within it. This included everything that falls under the label of ‘science’, as well as extending far beyond that to include knowledge of natural phenomena, history, geography, folk wisdoms, properties of things, quantitative empirical relations and the like. This permitted the inclusion of the types of knowledge that would answer ‘*What?*’, ‘*When?*’ and ‘*Where?*’ questions in most cases, including (among a range of other authors’ categories) Declarative, Situational, Cognitive and Axiomatic knowledge, as well as Wikstrom and Normann’s<sup>164</sup> Explanation and Information<sup>165</sup>. While each of these categorisations could only be dealt with briefly in the context of this thesis, each offered valuable insights into different aspects of the concept of knowledge, which were highlighted in turn.

Mokyr’s second category - that of Prescriptive Knowledge - was shown to represent the vast set of techniques or instructions in the existing body of knowledge. While Prescriptive Knowledge can contain *codified* elements – i.e. in a recipe book, instruction manual, ‘how-to’ books etc – it is most common to find it in the brains of people. The nature of this type of knowledge was

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<sup>164</sup> 1994

<sup>165</sup> Anderson, Finkelstein and Quinn, 1996; Sackmann, 1992

shown to be more likely to contain Tacit elements, in that much of what is included in the Prescriptive category “cannot wholly be written down, and there is always an irreducible ‘tacit’ component that cannot be eliminated, requiring the persons executing [the instructions etc] to acquire some knowledge”<sup>166</sup>. In contrast to the ‘What?’, ‘When?’ and ‘Where?’ questions that can be contained within the Propositional category, Prescriptive knowledge is more likely to be elicited by asking a question like “How do you do [something]?” The type of answers to a Prescriptive knowledge enquiry were shown to include Skills (know-how), Advanced Skills and Procedural Knowledge categories from the authors under review<sup>167</sup>.

The next worthwhile step in analysing ‘types’ of knowledge and how they contribute toward a definition of knowledge was to investigate the practical domain in which most attention has been placed on the study of knowledge in recent times – namely, that of the ‘organisation’. Here, Blackler’s<sup>168</sup> five-pronged taxonomy was seen as containing some fascinating insights into the concept of knowledge. After a detailed review, his categories of Embrained and Encoded Knowledge were most likely to be included in the Propositional Knowledge subset, while Embedded and Embodied Knowledge were more suited to the Prescriptive Knowledge subset. Each of these four categories added further value to the development of the concept of Knowledge.

Blackler’s fifth category, that of Encultured Knowledge, presented an intriguing aspect of knowledge which seemed not to fit as comfortably into either the Propositional or Prescriptive categories. The cultural aspects of knowledge to which it drew attention required differing amounts of both Propositional and Prescriptive elements in the intricate social interactions that comprise our understanding of culture. This ‘Cultural Knowledge’ was seen as warranting inclusion as an over-arching category alongside Mokyr’s Prescriptive and Propositional categories at the ‘starting point’ of the categorisations of knowledge. In this role, it was shown to be the most suitable ‘home’ for Antal’s ‘Relational Knowledge’, Blackler’s Encultured Knowledge, and Anderson et al’s<sup>169</sup> Motivational Creativity.

This Cultural Knowledge pays reference to the numerous and varied social influences on knowledge that are present in its creation, storage, distribution and development. The inclusion of these social elements is to be regarded as absolutely pivotal in compiling a comprehensive

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<sup>166</sup> Mokyr, 2002

<sup>167</sup> Anderson, Finkelstein and Quinn, 1996; Wikstrom and Norman, 1994

<sup>168</sup> 1995

<sup>169</sup> 1996

and responsible definition of knowledge – to the point that the use of the term ‘Knowledge Economy’ is not seen as being ‘less complete’ (as opposed to just *different*) than that of the ‘Knowledge Society’, for the very reason that the concept of *Knowledge* itself is so inclusive of the important social and societal aspects which offer value to the definition.

Finally, in this section of the chapter, a fourth category - Wikstrom and Normann’s *Understanding* - was added to the Propositional, Prescriptive and Cultural Knowledge foundations in order to properly include more ‘higher-level’ aspects of knowledge, such as Anderson et al’s *Synthesis and Trained Intuition*. While these two categorisations ostensibly refer to a level of cognition and intuition that extends *beyond* knowledge, they were included in this chapter for reasons of comprehensiveness, while also adding some value in helping to further define the concept of knowledge.

All of the investigations performed above certainly went some way to navigating the maze of taxonomies and categorisations existing in the literature. While this discussion in no way intended to include *all* of the categorisations present in academic discussions at the time of writing, a serious attempt was made to include a variety of aspects that would in some way or another contribute to the definition of knowledge – the pursuit of which was the overriding objective in this chapter. The model of the categories discussed and analysed can be seen in Figure 3, which presents a clear, simple means of grouping a range of authors’ different categories based on their overt characteristics and inclinations.

All in all, this chapter has presented a significant development of the *definition of knowledge* by means of the discussion of the following:

*The Data-Information-Knowledge Relationship*

*The Commodity and Community Views of knowledge*

*Explicit and Tacit Knowledge*

*The multitude of different ‘Types’ of knowledge*

*Organisational and Cultural aspects of knowledge*

In terms of advancing our understanding of the Knowledge Economy, the discussions that have taken place throughout this chapter are of pivotal importance. Before we are able to consider creating a profile of the term ‘Knowledge Economy’, it is critical that the extent and depth of the concept of knowledge was taken into consideration. The unpacking of the numerous categorisations and typologies in this chapter helped not only to illustrate the diversity and complexity of the term, but also will serve as a reminder of the numerous ways in which

knowledge should be considered to be a potential source of economic value. Most crucially, when new types of knowledge did not fit neatly into any of the boundaries set by the more encompassing categorisations, we were forced to consider the less-obvious ways that knowledge manifests itself in organizations, societies, and the people that comprise them. In most cases, these less-obvious ways tended to lean towards the more tacit dimensions of knowledge that are necessarily more difficult to separate from the individuals that encompass them. For instance, Cultural Knowledge and Synthesis and Trained Intuition are unlikely to translate with ease when taken out of the contexts, or even out of the hands of the creators. The implications for the commoditisation of such types of knowledge are significant, and a useful illustration of the value of taking into account the numerous aspects to knowledge discussed in this chapter.

In the next chapter, the focus will shift towards a more *economic* understanding of knowledge. This will entail, among other things, an investigation into knowledge's key characteristics as an *economic asset*. This will allow the analysis of the concept's primary characteristics affect its treatment as an economic commodity.

# Chapter Four

## The Economics of Knowledge

### 4.1 - The Economics of Knowledge

The idea of a Knowledge Economy has, at its heart, the belief that *knowledge* has come to play an increasingly significant part in the creation of wealth. Proponents of the belief that this Knowledge Economy represents a new 'era' in the economic development of modern societies see the Industrial Economies of old taking a back seat to economies in which the effective use and exploitation of knowledge is what forms the basis of economic activity. As we start to develop a better understanding of what knowledge entails in terms of its definitional characteristics and their implications, it becomes easier to see how incorporating knowledge – with all its complexities – into an economic system of understanding may present something of a challenge.

Economics as a discipline necessitates the simplification and, often, quantification of economics assets and activities in such a way that econometric models can theoretically – if not accurately – provide descriptions and prescriptions as to their likely behaviour. For some time, the dominant paradigm in economic analysis has been that of the 'physical world', where the production of a firm can be analysed in terms of its tangible inputs in pursuit of achieving economic ends. The plethora of compelling economic models<sup>170</sup> that cite Capital and Labour as primary inputs speaks volumes about the way in which *tangible* resources can be accurately measured and evaluated. These units of measurement, of course, were born out of an economic era in which the key drivers of economic wealth creation were themselves tangible and measurable: five machines, five labourers, five kWh of energy, five sheets of steel. All of this makes perfect sense in the Industrial Economy.

When knowledge enters the fray, the ground on which Industrial Economy models were built begins to give way. The reasons are simple – knowledge, as an *economic good* does not share the same economic properties of capital and labour. Many of the principles on which economic theories were based become warped and even irrelevant in the face of an 'input' which simply

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<sup>170</sup> For some of the more enduring perspectives, see Romer (1990), Solow, R. (1956) and Schumpeter (1942).

does not follow the rules of economic resources<sup>171</sup>. Where measurement is concerned, knowledge presents an even more frightening challenge. How do you measure the economic value of an idea? How much does a particular piece of knowledge cost? How does one convey its importance and value to a potential buyer without actually giving it away in its entirety?

The following chapter will attempt to develop some of these questions by shedding light on various aspects of the economic understanding of knowledge. It will begin by noting some of the primary *economic* definitions of the Knowledge Economy, as outlined by leading financial and economic authors and institutions that make use of the concept. This will lead into an in-depth analysis of the *economic properties* of knowledge, as they pertain to the treatment of knowledge as an economic asset and resource. Thereafter, a brief discussion of some of the most relevant attempts at incorporating knowledge into economic models will be discussed, illustrating the difficulty of reconciling knowledge's economic properties with traditional economic ways of thought. Lastly, this chapter will conclude with a consolidation of the important lessons learned in this regard, enriching an understanding of how knowledge and economics coincide in the term 'Knowledge Economy'.

## 4.2 - Economic Definitions of the Knowledge Economy

Economically-inclined definitions of the Knowledge Economy are numerous and varied. As mentioned in Chapter 3, different authors and research institutions have assigned a number of different names to what we understand as the Knowledge Economy – each for their own unique reasons and intentions. At the core, however, terms like the 'Knowledge Economy', the 'Knowledge-driven Economy'<sup>172</sup>, the 'New Economy', 'Information Economy' and the 'Knowledge-Based Economy'<sup>173</sup> are essentially different phrases describing the same general phenomenon. In this section of the chapter, a handful of these definitions will be mentioned in brief, with the purpose of setting a context for the discussion of economic characteristics of knowledge which will take place later in the chapter.

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<sup>171</sup> Here, Quah (The Weightless Economy in Growth, 1999: 44-47) is of particular relevance in documenting attempts to incorporate a 'weightless' asset such as knowledge into enduring economic models. A number of attempts in this regard have – in Quah's opinion – proven fruitless, noting that *"There is sufficient commonality, however, across all such models that Jones (1995) can persuasively criticize the entire class of "technology and growth" models by pointing out that while US scientists and engineers employed in R&D grew five-fold from 200,000 in 1950 to over 1 million in 1990, the growth rate of US GDP failed to increase by anything remotely comparable."*

<sup>172</sup> Department of Trade and Industry, 1998

<sup>173</sup> OECD, 1996



Given the difficulties surrounding the definition of knowledge discussed in the previous chapter, it is somewhat unsurprising that many of the major economic and financial institutions and research bodies – especially in the ‘early days’ of the concept’s development – seemed hesitant to offer very specific definitions of the Knowledge Economy. This caution results in a degree of vagueness surrounding many of these definitions - as is evidenced, for example, by the Organisation for Economic Cooperation and Development’s<sup>174</sup> description of a Knowledge-Based Economy as any economy “*which [is] directly based on the production, distribution and use of knowledge and information*”. Such a general description seems to provide more questions than answers. As is argued by Quah<sup>175</sup>, basically *every* economy in human history has been based on the use of knowledge and information. What was the Industrial Economy, for instance, if not an economy structured around the embedding of human knowledge in industrial machinery and products?<sup>176</sup> Furthermore, what does it mean to say that a Knowledge-Based Economy is any economy that is “*directly*” based on the production, distribution and use of knowledge? Surely this would exclude any and all major economies –all of which, in varying degrees, still also rely and focus their productive capacities on the productive outputs of other industries like agriculture, manufacturing etc. Smith<sup>177</sup> is right in noting how this definition “*is a good example of the problems of the term, for it seems to cover everything and nothing*”.

While this OECD definition clearly suffers from a lack of precision, its general direction does resonate in the vast majority of Knowledge Economy definitions. A more focused example is put forward by the UK Department of Trade and Industry, which describes such economies as those “*in which the generation and exploitation of knowledge has come to play an increasingly predominant part in the creation of wealth*”. What this description intimates is that the role of knowledge as a resource that can be used for productive ends has taken on greater importance over the past while – particularly in relation to physical capital, natural resources and labour.

This type of thinking imagines that the increasing significance of knowledge as a *factor of production* marks a new stage of capitalist development. The UNESCO World Report notes how this knowledge-driven state of capitalism is the stage in which physical capital takes precedence, precipitating a process in which knowledge “*[takes] the place of the workforce, as Marx had foreseen in the middle of the nineteenth century*”<sup>178</sup>. What this entails is the complicated reality

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<sup>174</sup> 1996

<sup>175</sup> 2003

<sup>176</sup> Quah, 2003

<sup>177</sup> 2002

<sup>178</sup> UNESCO World Report, 2005

that “*measurable and quantifiable*” inputs into wealth creation like capital and labour are being replaced by “*the more general level of science and the progress of technology*”. As evidence of this trend, the UNESCO Report<sup>179</sup> demonstrates how the level of intangible investments (like education, R&D, health etc) is increasing steadily as a proportion of Gross National Product in developed countries, at the expense of the more tangible investments (like physical capital and material resources) – and has been doing so consistently since the 1950s. This is marked, also, by a sustained increase in the value and magnitude of jobs in the services sector, and the corresponding dramatic *devaluation* of unskilled labour.

In its simplest form, this focus on the primacy of knowledge at the expense of labour and capital is summed up by World Bank<sup>180</sup> in saying that a true Knowledge-Based Economy is one in which the use of *ideas* rather than *physical abilities* marks the wealth-creating capacity of the economy. Here, importance is placed on the use of knowledge and information technologies instead of raw materials and cheap labour. This makes for a fascinating, high-paced and often daunting economic atmosphere which, because of the ever-increasing mobility of knowledge and the global workforce, can see an organisation’s competitive advantage be gained and lost overnight. In this context, industrial-era objectives like economies of scale are no longer indicators of surety. Rather, the pursuit is for “*innovation – combining market and technology know-how with creative talents of knowledge workers to solve a constant stream of competitive problems*”<sup>181</sup>.

A more comprehensive definition of the Knowledge Economy is proposed by the Asia-Pacific Economic Cooperation<sup>182</sup>. This definition not only recognises the fact that knowledge (and its production, distribution and use) has become the primary source of wealth and employment-creation, but also that it has done so *across industries* – in both “*high technology*” and “*old economy*” sectors. Becoming a knowledge-based economy does not mean proliferating high-end technological economies that exist independent of stagnant ‘old economies’. Instead, true Knowledge Economies need *all* sectors to become knowledge-intensive by attaching elevated importance to “*new ideas and new enterprises; sound macroeconomic policy...an openness to trade...education and lifelong learning; and the enabling role of information and telecommunications infrastructure*”<sup>183</sup>. Most importantly, this definition notes how the knowledge that is at the heart of this knowledge-based economy is not purely commercial

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<sup>179</sup> 2005

<sup>180</sup> 1999

<sup>181</sup> The Enterprise Development Website, 2005

<sup>182</sup> 2000

<sup>183</sup> APEC, 2000

and/or technological in nature – significant attention must also be given to the cultural, managerial and social knowledge that comprises the organisation’s context and ultimately defines “its capability in integrating information with experience and expertise to take action”<sup>184</sup>.

### 4.3 - Economics and Knowledge

Economics is, at its heart, the study of production, consumption and allocation decisions under conditions of scarcity. As a science, it is most compelling when it is able to analyse the actions of the rational ‘economic man’ in the face of quantifiable choices between a number of outcomes. The development of economic theory over the past 200<sup>185</sup> years has based itself largely on the ability to measure and quantify the various inputs and outputs of productive entities – from individual firms to entire national economies. For this reason, among others, the modern understanding of what economics entails has been based on a number of premises that pertain to the way in which these quantifiable inputs and outputs behave. In an economy in which natural resources, physical labour and tangible assets take precedence, this understanding can be upheld with relatively little controversy. This mode of thinking can be referred to as the ‘physical paradigm’ of economic thought.

When knowledge becomes the key ingredient of wealth creation, as the above definitions propose, the principles of this ‘physical paradigm’ are not as easy to apply in economic analysis – for the simple reason that knowledge does not share the set of characteristics that can be used to describe the ‘economic behaviour’ of tangible, physical goods and resources. Along with the in-depth discussion of the characteristics of knowledge that took place in Chapter 3, it is crucial to also take stock of the *economic* characteristics of knowledge in order to form a sound understanding of the Knowledge Economy. Even when it is imagined at its most Explicit and ‘information-like’ (as is often the case in economic theory), knowledge’s unique economic characteristics apply a range of pressures on the enduring economic models. On top of this, these characteristics help to inform a far deeper understanding of the full *extent* of the Knowledge Economy, as well as providing guidelines for how Knowledge Economies can be better created and sustained. With all of this in mind, it is worthwhile discussing a number of the important economic characteristics of knowledge below.

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<sup>184</sup> APEC, 2000

<sup>185</sup> For instance, see Romer (1990); Solow, R. (1956); Schumpeter (1942). Quah (1999; 2003) and Decanio et al (2000: 14-16) provide brief analyses these and resulting economic conceptions of knowledge-products and how they affect classical and neo-classical economic models.

## 4.4 - The Economic Characteristics of Knowledge

One of the foremost reasons that many enduring economic models struggle to come to terms with the full extent and power of knowledge as an economic asset is the fact that these models, in many ways, remain constrained by the paradigm of the physical economy. Modernist thinking remains compelled by quantifiable, easy-to-measure persuasions – and the physical economy provides those in abundance. Where Marx<sup>186</sup>, for instance, saw the use of labour as both a physical resource and a source of knowledge, traditional economic theories have tended to concentrate their analysis on the former, as ‘energy’ perspectives remain easier to describe, predict, and standardise.

This reality is nowhere more apparent than in the difficulties faced by neoclassical economic models to properly account for knowledge as an intrinsic, value-creating resource. As Boisot<sup>187</sup> describes, “*Neo-classical economics wishes the problem away under the catch-all label of ‘technological change’*”- seeing it as an exogenous variable, and under-selling its true power. The economic theories that held great analytical and even predictive capacities in the industrial era, no longer seem to hold the solid footing that they enjoyed a few decades ago.

While knowledge as a concept has been around for hundreds of years, it is only really with the onset of the information economy that people are starting to consider knowledge assets as powerful, crucial economic goods worth giving a far more prominent position in our understanding of production and value creation. In truth, what may be interpreted as modern firms’ unwillingness to relinquish the thinking of the ‘physical paradigm’ for a more ‘knowledge-focused’ one may in fact simply be the inability to do so. Boisot<sup>188</sup> notes the “*natural tendency to assimilate what is unknown to what is known*” as one of the main reasons why people find it so difficult to comprehend the nature of knowledge.

The reality is that knowledge assets behave very differently to physical assets, and thus need to be considered from a different paradigmatic stance. Knowledge assets simply do not behave like physical assets for a number of reasons. Firstly, it is harder to determine and measure their economic life. If the knowledge base that sustains a knowledge asset is never eroded, theoretically, a knowledge asset could last forever – while a physical asset is invariably subject to the corrosions and disintegrations of nature. That being said, there is also a non-linear

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<sup>186</sup> Engels, F & Marx, K (1848)

<sup>187</sup> Boisot, 1998: 19

<sup>188</sup> Boisot, 1998: 2

correlation in knowledge assets with regards to the effort used to generate them and the value they might offer. A knowledge asset of monumental value (financial and otherwise) might be thought up in a brief moment of genius. Conversely, knowledge ‘discovered’ as a result of decades of study and contemplation could prove utterly worthless. Perhaps more practically, a physical asset such as a raw material etc which had exhausted its value resource could be ‘brought back to life’ by a knowledge asset revealing a way to extract further value out of that resource<sup>189</sup>.

These differences are highlighted by the difficulty the modern firm faces with respect to protecting and attaching value to knowledge assets. While patents have done the job to a certain extent, resources like the internet present all-new dilemmas for those trying to hoard their intellectual property. This is one of the many manifestations of the cognitive simplification traditional economic analysis continues to perform when trying to consider knowledge assets from the perspective of the physical paradigm. What is required is an informed understanding of two of knowledge’s economic characteristics which most readily distinguish it from the economic characteristics of physical goods. The first of which is knowledge’s capacity to be a non-rivalrous good. Secondly, knowledge can also be a non-excludable good. These characteristics will be uncovered in more detail below.

#### *4.4.1 Knowledge as a Public Good*

The notion of ‘scarcity’ is of integral importance to the relevance of economics as a whole – after all, what is of interest in analysing an economy in which every person has everything that they could ever want? The real, physical world has limited resources, and it is most often the case that people want more than is available of a particular physical resource. It is at this intersection of demand and scarcity of supply that the bedrock of economic study is found, setting the scene for competition, the valuation of products and skills, and ultimately, the exchange or transaction between buyer and seller.

Such physical, finite goods are at the very heart of the ‘Physical Paradigm’, and are referred to, in economic terms, as ‘private goods’. The characteristics of a private good come as second nature to those participating in our modern consumer culture. To use a simple illustration, if a shopkeeper owns a particular diamond ring, and you buy it from him for a certain price, you will become the new owner of that ring. The shopkeeper, as the seller of that good, will have

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<sup>189</sup> Boisot, 1998

relinquished ownership for the amount of money you paid to complete the transaction<sup>190</sup>, and you walk away with the ring, free to do with it as you please. In another example, if ten litres of petroleum are available to fuel two competing drivers' automobiles, there is clearly a situation of competition for that fuel. If the first driver uses eight litres of that petrol, only two litres remains for the other driver to use.

These simple examples help to illustrate the property of private goods that is referred to as 'rivalry in consumption'. This property hinges on the fact that two (or more) people cannot possess the same physical good at the same time. Rivalry in consumption thus necessitates that the more demand a particular good (or input etc) faces, the more of it that must be produced in order to satisfy that demand<sup>191</sup>. In extreme cases - like with an original Picasso artwork, for instance - the rivalry in consumption is such that only *one* person can possess it. As it is impossible to produce another 'original' artwork, a high demand for this item translates into a substantial increase in the value of the good. Importantly, it is this property of 'rivalry in consumption' that is one of the main reasons that private goods – as we understand them in the 'Physical Paradigm' – are naturally produced by the market system<sup>192</sup>.

However, as was noted earlier in this section, knowledge often does not abide by many of the rules of this 'Physical Paradigm'. In terms of 'rivalry in consumption', knowledge presents a particularly interesting dilemma for economics. In many ways, knowledge appears to be the *opposite* of a private good – sharing many of the characteristics associated with 'public goods'. One characteristic of a public good, in contrast to a private good, is that it enforces no rivalry in consumption. This means that not only can a 'piece' of knowledge be used simultaneously by two or more people at the same time, but often the fact that it is being used by one person does not affect the utility of other people who are also making use of the good<sup>193</sup>. Imagine for an instant that *showing* you a diamond ring meant that you too gained possession over an identical copy of that ring. When knowledge is shared between two people with similar cognitive frameworks, and if that knowledge is sufficiently *explicit* in nature, sharing and distributing knowledge across the globe is at once easy, inexpensive and rapid. If the owner of a piece of knowledge wants it to be so, knowledge has the potential to be remarkably 'public'.

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<sup>190</sup> McConnell and Brue, 2005

<sup>191</sup> Foray, 2004

<sup>192</sup> McConnell and Brue, 2005

<sup>193</sup> Brenner, Brokel and Witt, 2007. In more descriptive terms, as long as the nature of a particular piece of knowledge is such that its economic value does not decrease as the number of users increase, knowledge does indeed satisfy this aspect of what can be referred to as a 'pure public good'.

To use the classic example, there is a fundamental difference between a transaction in which a teacher gives his watch to one of his students, and one in which the teacher announces the time to the class. In the first example, only one person has access to the desired information (i.e. the time) – the teacher has lost his access to the information, and the other students are rivals for its consumption. In the second transaction, the entire class has access to the information, and the teacher has lost nothing in the process<sup>194</sup>. This idea was summarised by Thomas Jefferson in his letter to Isaac McPherson in 1813 when he noted that “[knowledge’s] peculiar nature, too, is that no one possesses the less because every other one possesses the whole of it. He who receives an idea from me receives instruction himself without lessening me; as he who lights his taper at mine receives light without darkening me.”

The implications for this ‘non-rivalrous’ characteristic of knowledge are numerous. Unlike most ‘public goods’, which are usually produced by the government (i.e. streetlights, national defense, law and order etc), knowledge is *privately* produced in that it is created exclusively in the human mind – even when its roots are social or cultural<sup>195</sup>. This makes knowledge a *public good* that is *privately produced*. As Chichilnisky<sup>196</sup> contends, “All this is new. Sociology, political sciences and economics are still learning to explain a society based on such inputs... It has only recently been observed that in markets with privately produced public goods, efficiency and distribution are closely linked... in stark contrast with conventional markets where efficiency and distribution are divorced from each other.”

Of course, the modern capacity to codify, store and distribute knowledge in great volumes and at minimal cost has greatly intensified this property of knowledge. Knowledge encoded on a digital or artificial medium can be re-used almost indefinitely and by a large number of agents without suffering from any form of reduction or degradation<sup>197</sup>. Here, the reusability or lifespan of an encoded piece of information is equal to the lifespan of the medium on which it is recorded – be it a book, disk, or hard-drive etc. If the type of knowledge permits it to be easily and accurately encoded (for example, if the knowledge has a minimal tacit component), the cost of transferring knowledge from one person to another is often as little as the cost of sending an email. Furthermore, the codified information transmitted in such an email and processed by the receiver to the point that it becomes knowledge is not an *additional* piece of knowledge, nor a

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<sup>194</sup> Foray, 2004

<sup>195</sup> Chichilnisky, 1997

<sup>196</sup> 1997

<sup>197</sup> Langlois, 2007

copy of the original good – as Foray<sup>198</sup> explains, “*it is not a copy of Pythagoras’ theory that you use but the theorem itself.*” It is for this reason that a variety of authors choose to replace the term ‘non-rivalry in consumption’ with the more positive concept of ‘infinite expansibility’, emphasising the fact that the use of a public good by an additional agent does not require the production of an additional unit of that good<sup>199</sup>.

These characteristics put knowledge as an economic good into an entirely different bracket to most of the goods that form part of the Physical Paradigm. Now, on top of the range of complexities involved in analysing the market system, economists are forced to deal with a good which refuses to comply with all of the rules of cost-based pricing that form the foundation of their understanding of economic transactions. With the type of knowledge discussed above, the marginal cost of another ‘unit’ of a particular piece of knowledge is zero. On top of this, it is wholly unfeasible to attempt to track – for the purposes of financial compensation – the use and reuse of a piece of knowledge<sup>200</sup>. This makes the use of codified knowledge both ‘free’ (zero marginal costs) and impossible to tally. These are two crippling barriers in any attempt to price it in economic terms – and, of course, pricing is the backbone of economic measurement<sup>201</sup>.

One of the other major ways in which this difference manifests itself is in the economic principle of ‘returns to scale’. In the Physical Paradigm of economic thought, the usual inputs into a productive endeavour are often said to experience ‘decreasing returns to scale’. With inputs of Capital and Labour as the primary example, ‘decreasing returns to scale’ simply describes the way in which adding another ‘unit’ of input leads to a less-than-equal increase in output, given certain conditions. In a simple example, imagine a situation in a call-centre with 10 telephones and only 9 employees. If the company were to hire another employee to work in the call-centre, the 10<sup>th</sup> telephone would not stand unused, and the firm would become more productive. Essentially, adding an additional employee (i.e. a ‘unit’ of labour) leads to an increase in productivity for the firm that is equal to one ‘unit’ of output. This would be described as an ‘equal return to scale’. If another employee is added (making it 11 employees, and only 10 telephones), the lack of a telephone for the additional employee would lead to an increase in output that is *less* than the increase that adding the previous employee generated. Each

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<sup>198</sup> 2004: 94

<sup>199</sup> Quah, 2003; Foray, 2004

<sup>200</sup> How, for instance, would you take stock of how many times you made use of a piece of knowledge that you gained ten years ago at university? How many ideas did this knowledge contribute towards? What is the financial value you gained (and thus should ‘owe’ the original creator for the usage of that knowledge? The pursuit of such answers is surely a wild goose chase.

<sup>201</sup> Oxley, Walker, Thorns and Wang, 2007



additional employee added without increasing the number of telephones would be of continually decreasing value to the firm. This can be described as a *decreasing* return to scale.

In the situation where these inputs are ‘physical paradigm’ inputs – like Capital and Labour – the property of rivalry in consumption makes it difficult to indefinitely achieve *increasing* returns to scale. Adding to the number of employees (units of labour) in the call-centre above, without adding to the number of telephones (units of capital) leads to decreasing returns to scale – for the very reason that there is rivalry in consumption for the use of those telephones. Only one employee can use a particular telephone at a time. With knowledge – where there is no rivalry in consumption – it is an entirely different matter. The use of a piece of knowledge in the form of a set of instructions that will help an employee to assemble a product, for instance, can be used by any number of employees at the same time. Doubling the amount of employees, then, does not require the ‘stock’ of knowledge to also be doubled in order to achieve an equal return to scale. However, if we double the stock of knowledge (i.e. double the amount of useful ideas) *in addition* to doubling the standard inputs (labour, capital etc), the output of the firm will more-than double – i.e. we achieve *increasing* returns to scale<sup>202</sup>.

#### 4.4.2 *Knowledge as a Non-Excludable Good*

On its own, the absence of rivalry in accessing encoded knowledge is not enough to satisfy the properties of a public good. The other important criteria for categorising something as a public good is the inability to exclude<sup>203</sup> anyone from making use of that good. This lack of ability to maintain private control of a good also stands in direct contrast to the concept of a pure private good, where ownership of a good affords one the right to exclude anyone from making use of it. In the typical economic example, a streetlight is an example of a public good. Provided by the government, and ‘owned’ by the taxpaying public at large, it is impossible (or at least extremely costly) to prevent other people from using it. People who have not paid taxes – and thus have not contributed to the production of the public good - are thus considered ‘free-riders’, making use of things they do not own for the simple reason that the good in question has the characteristic of non-excludability.

The ‘excludability’ of goods is useful to consider as existing on a continuum, with the degree of excludability largely dependent on a range of different factors – the two most common being

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<sup>202</sup> Romer, 1990

<sup>203</sup> Brenner, Brokel and Witt, 2007

the physical nature of the good, and the legal and regulatory environment<sup>204</sup>. Naturally, if a good can be physically protected against unauthorised usage, its excludability can be ensured with little controversy. On top of this, a variety of laws designed to protect the excludability of goods have been put in place in order to uphold the right to private property that is the bedrock of the modern market system. If people attempt to ‘free ride’ in contravention of these laws (i.e. sneaking into a movie without buying a ticket), they may face the repercussions of legal action, fines, imprisonment etc. Again, in dealing with goods that fall in the Physical Paradigm of economic thought, most goods in the market system fit the profile of private goods in that they are readily excludable.

From the perspective of knowledge, significant controversies emerge when considering the question of excludability. In a wide variety of instances, knowledge can be considered a non-excludable good, for the simple reason that controlling access to knowledge and keeping it exclusive are both difficult and costly<sup>205</sup>. In particular, knowledge that is codified or represented in a form that makes it more suitable for distribution is practically impossible to control. This is most evident in the case of competitive market situations, where new knowledge holds the potential for lucrative product ideas, for instance. The developer of a new piece of knowledge often has to reveal the nature of the new insight to potential buyers in order to illustrate the value of that knowledge. As soon as the original developer shares this knowledge with another person, there is no way to prevent that person from making use of it at will. In this sense, revealing this type of knowledge is the same as giving it away. On top of this, in the modern market economy, imitation has become a highly profitable alternative to innovation – knowledge-intensive products released onto the market are often analysed and / or reverse-engineered so that they can be copied and manufactured by competing firms<sup>206</sup>. This has a number of repercussions for the incentive to spend resources generating new knowledge.

Non-excludability of knowledge has both advantages and disadvantages from the perspective of the socially-optimal outcome. The more freely available a piece of knowledge, the greater the scope for other knowledge workers to utilise, contribute toward and build on that knowledge. knowledge’s *cumulative* nature, as evidenced by its ability to generate increasing returns to scale as discussed above<sup>207</sup>, makes it exponentially more powerful in growing the collective

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<sup>204</sup> Blakely, Lewis, and Mills, 2005

<sup>205</sup> David and Foray, 2002

<sup>206</sup> Chichilnisky, 1997

<sup>207</sup> Blakely, Lewis, and Mills, 2005; David and Foray, 2002

stock and value of knowledge than Physical Paradigm goods. Producing a hammer can help one carpenter build a cabinet. Only once that cabinet is completed can the same hammer be used to create something else. A piece of knowledge that is produced, on the other hand, can be used an infinite amount of times by an infinite amount of users and, more importantly, acts as a stepping stone in the discovery of more useful and more powerful insights. David<sup>208</sup> aptly quotes Thomas Jefferson in this regard, who noted that *“one new idea leads to another, that to a third, and so through a course of time until someone, with whom no one of these ideas was original, combines it all together, and produces what is justly called a new invention”*. Try that in the Physical Paradigm, and all you have is an impressive collection of hammers.

The bigger and richer the collective stock of knowledge that is available to knowledge workers, the higher the platform is for future knowledge developments. In this way, the non-excludability of knowledge has the potential to be of significant benefit to society at large, who, for no marginal cost, can utilise the knowledge for their own purposes. Economists define these spillovers of benefits resulting from the non-excludability of goods as ‘positive externalities’<sup>209</sup>. In a classic economics example, a person who gets a smallpox vaccine helps to reduce the prevalence of the disease, thus benefiting those people who did not pay to get the vaccine. The positive externalities stem from the vaccinated person’s effort and expense, and in not paying him compensation for those efforts, the unvaccinated benefactors become ‘free riders’. Combine the ability to ‘free ride’ on knowledge creation efforts with the cumulative nature of most types of knowledge, and we no doubt have a highly compelling argument for the free sharing of knowledge.

However, the issue is not that simple. When considerable time, effort and money have been spent in the research and development of new knowledge, the difficulty associated with gaining the desired economic rents from other peoples’ utilisation of one’s knowledge products is a significant disincentive for engaging in the research process from the outset. If, for example, billions of dollars are spent researching and developing a new pharmaceutical drug, only to see other firms copying the drug and selling it as a cheaper generic, the original developer will be more hesitant to develop further products. While society as a whole may benefit from the ‘free sharing’ of knowledge that led to a cheap generic alternative, the future development of knowledge in the field may be slowed in the long-term as the best researchers see no economic

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<sup>208</sup> 1993: 28

<sup>209</sup> Blakely, Lewis and Mills, 2005

incentive in investing their time, effort and funds into more knowledge creation<sup>210</sup>. These matters add to the complicated issue of Intellectual Property Rights – a topic which will be discussed later in this chapter.

The extreme alternative to the free sharing of knowledge is just as likely to lead to stagnation of knowledge growth. Attempting to retain high levels of secrecy and close guarding of knowledge have shown through the ages to contribute towards some of the most innovation-deficient periods in human history. Take for instance the guilds of the Middle Ages, where the apprentice-master knowledge transfer system, strict regulations on the following of tried-and-tested methods, and a system designed to preserve an existing way of live rather than progress to a new one all contributed towards a society renowned for the staggering *lack* of technological advance<sup>211</sup>. For the reasons of the spillovers discussed above, keeping knowledge resources private can halt the development of societal knowledge development, where preventing access to higher planes of knowledge essentially lowers the bar for future developments. This is in effect the same as depriving the Isaac Newtons of this world from the shoulders of giants that enabled him to see further than ever before.

As it goes, highly explicit, widely available knowledge is the closest that knowledge comes to being a perfectly non-excludable good. The more Tacit it is, the more knowledge moves toward the ‘excludable’ end of the continuum. Some resources require significant prior knowledge that will enable the recipients to understand it to the point that it is of value. For instance, a chemical equation which a qualified scientist can use to great effect could be nothing more than a random collection of symbols to a sheep farmer. Where the farmer sees meaningless data, the scientist sees valuable knowledge. The means of obtaining the required know-how (be it through a university degree, or some sort of training etc) is often difficult or restricted, ultimately making the value-creating potential of the knowledge in question *excludable*<sup>212</sup>. Essentially, then, the more tacit the information, the greater the expense (financial or otherwise) that must be paid to access it in its entirety. The greater the cost, of course, the more exclusive the knowledge becomes.

Crucially, in line with an understanding of the differences between data, information and knowledge, what this means is that while the same resource may be non-excludable as data and information, the added ‘step’ required to apply actionable cognitive and analytical processes to

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<sup>210</sup> Blakely, Lewis and Mills, 2005

<sup>211</sup> Heilbroner and Milberg, 1997

<sup>212</sup> Foray, 2004

it may essentially make the same resource – as *knowledge* this time – more excludable in nature. What we see from this is how the same resource can behave in two different ways – at once, a non-excludable *and* an excludable good! If the knowledge was made available at a scientific research facility, many of the people present would be able to derive the full value from the knowledge, while the janitors, receptionists and the like would not be able to make use thereof at all. This certainly does not make things any easier for economists attempting to apply general rules in order to incorporate knowledge into economic models.

#### *4.4.3 Qualification and Implications of Non-Rivalry and Non-Excludability*

Non-rivalry and non-excludability in consumption form the two primary criteria for defining the extent to which goods are public and private. It is, however, important to note that the two criteria are independent of one another –having the characteristic of non-excludability does not, for instance, mean that the good is by default also non-rivalrous, or *visa versa*<sup>213</sup>. One of the main reasons why knowledge presents such a challenge as an economic good is that, in different forms and to varying degrees, knowledge has the potential to be all the possible combinations on the rivalry-excludability spectrum. This has massive implications for economic attempts to measure or attach value to knowledge in economic models, as each particular piece of knowledge can have such drastically different characteristics. In the absence of such measurement, the prescriptive power of econometric models is significantly – if not cripplingly – diminished.

With regards to the difficulties associated with analysing what is necessary to achieve socially optimal outcomes, the issues surrounding the non-rivalry and non-excludability of knowledge is succinctly captured by Foray<sup>214</sup> in describing what he calls The Knowledge Dilemma: *“Only the anticipation of a positive price on use will guarantee the allocation of resources for creation, but only a price that is nil will guarantee efficient use of knowledge, once it has been produced. It is a dilemma between the social objective of ensuring efficient use of knowledge once it has been produced, and the objective of providing real motivation to the private producer. There is no simple solution to that problem”*. Moreover, he highlights the cumulative characteristic of knowledge as a reason why it is not possible to consider knowledge in the same terms as the

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<sup>213</sup> Indeed, there are goods that can fall into each of the four possible categories: non-rivalrous and non-excludable (i.e. free-to-air television, law-and-order); non-rivalrous and excludable (i.e. pay-per-view television); rivalrous and non-excludable (fishing in the sea, breathing air); rivalrous and excludable (i.e. a shot of tequila)

<sup>214</sup> Foray, 2004: 116

usual consumption goods. *“The more knowledge is cumulative, the more wasteful is the effect of rationing by price. In the field of scientific and technological knowledge, it is not only the individual enjoyment of a few consumers that is curbed by limiting the use of knowledge but, accumulation and collected processes are also limited – namely the thousand opportunities afforded by new combinations between diverse elements of knowledge.”*<sup>215</sup>

This delicate balance between protecting the original creator’s interests and obtaining socially optimal outcomes is at the heart of the hotly-contested global debates about Intellectual Property Rights (IPRs). In the section below, the concept of IP rights will be briefly considered – again, only with the purpose of elevating some of the deep-seated complexities faced when considering knowledge as an economic good.

#### 4.5 - Knowledge as Intellectual Property

The issue of Intellectual Property Rights (IPRs) is of major significance to the exploration of the economic characteristics of knowledge, as well as the attempts to measure and assign economic value to it. IPRs concern the way in which knowledge can be controlled and diffused as an economic ‘object’. Moreover, in the context of the Knowledge Economy, IPRs have increasingly been regarded as a primary means through which the economic value of a knowledge asset is determined, and therefore how that knowledge relates to the socially optimal outcome. Owing in no small part to their importance in this regard, IPRs have also become one of the most hotly-debated issues in the establishment of ground-rules for the modern economic system - framed by the struggle to grasp, find and represent intangible sources of value.. The lack of globalised standards for the treatment of Intellectual Property as an economic good has led to varying extremes in the way that knowledge is valued, distributed and generated in different parts of the world.

This section will briefly define and discuss the concept of Intellectual Property Rights, with the purpose of indicating the economic and financial implications involved in treating knowledge as an economic commodity in the face of its ambiguity with regards to rivalry and excludability as described above. Thereafter, a brief discussion of the main Intellectual Property protection-mechanisms will take place, in the process of briefly noting some of the advantages and disadvantages of each in adapting to the challenges of knowledge commodities.

##### *4.5.1 Defining Intellectual Property Rights – from Patents to Copyrights*

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<sup>215</sup> Foray, 2004: 116-117

In their simplest form, Intellectual Property Rights represent the legal rights afforded to the original creators of new or innovative intellectual products. New knowledge – in the form of ideas, innovations, processes and the like – is created by entrepreneurs who either come up with a completely new intellectual insight from scratch, or recognise and exploit opportunities in the existing technological environment. As recognised in the previous section, these entrepreneurial acts often come at a substantial cost to the entrepreneur, either in the form of time, training, R&D etc – a cost referred to by Boldrin and Levine as ‘*indivisibility*’.<sup>216</sup> On top of this, many knowledge-creating entrepreneurial endeavours are undertaken primarily with the intention of using the new insight for commercial purposes – namely, the generation of wealth for the developers of the new knowledge. However, given their unique characteristics in terms of both non-excludability and non-rivalry, we continue to see the difficulties that knowledge products present in this regard. IPRs thus exist as an attempt to protect the entrepreneurial incentive to generate new knowledge products in the face of market circumstances in which protecting and maintaining commercial rewards for these innovations is becoming increasingly challenging.

IPRs exist in a variety of forms – the two most prominent being patent and copyrights. Both of these forms of IPR have had significant histories, and have been subjected to intense scrutiny in terms of their relevant successes as legal constructions. These legal constructions engender a situation in which society grants monopoly rights to the private creators of knowledge products<sup>217</sup>, essentially fashioning a form of artificial scarcity in the market for knowledge products that traditional economic models see as the only means through which entrepreneurs would be willing to engage in the creation of knowledge which, owing to the nature of knowledge discussed, can be copied and transferred at practically no cost.

Copyrights, undeniably the less complex of the two, are governed primarily on the principle of the ‘originality’ of a knowledge creation, and gauge the extent to which the original creator’s integrity of expression, as well as right to reproduce an idea can be protected. In comparison to patents, copyrights are more immediate, less expensive and, by all accounts, far less demanding to achieve in terms of the application process. However, they are not as extensive as patents in that copyrights only protect the “*expression of an idea, and not the idea itself*”.<sup>218</sup> This allows for the use of extracted elements from the original knowledge product in the generation of a new,

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<sup>216</sup> 2002: 45-48

<sup>217</sup> Quah, 2003: 5

<sup>218</sup> Foray, 2004: 132

original work – a corollary which bears significant repercussions<sup>219</sup>. For instance, among many other benefits, the ability to use parts of various authors' work in the creation of a new knowledge minimises the need for duplicate investments in R&D – significantly reducing costs, and increasing total factor productivity<sup>220</sup>. All new ideas, as Stiglitz<sup>221</sup> notes, build on the work of others – for instance, the use of enduring mathematical formulae in modern software coding – and by applying stringent protections on knowledge that could so easily be the 'key ingredient' in further developments might have great repercussions for the pace and extent of technological progress. Immediately, it can be seen that IPRs are faced with a daunting balancing act.

The second major manifestation of IPRs – patents – can be usefully understood as the granting of a temporary monopoly to the innovator of a new technical product or engineering method<sup>222</sup>. This temporary monopoly has a built-in expiration date, as well as delineated geographical boundaries – both of which, once reached, return the knowledge back to the common stock for unrestricted access by the public. Knowledge patents are granted by patent authorities to applicants who are able to meet a wide range of technical criteria indicating the novelty of the invention in question (from the conditions of absolute novelty of the invention, to the non-obviousness of the invention for a person of ordinary skill in the art), as well as the comprehensive revelation of the technical details thereof<sup>223</sup>. This last stipulation is a crucial one, as it ensures that the invention can be utilised in full once the patent expires, and the knowledge returns to the common stock. The various stipulations are strictly enforced in the granting of a patent, making it not only harder to obtain than a copyright, but also a far stronger form of intellectual property right. As Quah<sup>224</sup> notes, *"For patents, the first to create the knowledge-product and thereby attain protection acquires the monopoly: There is a natural winner-takes-all feature in the dynamics."*<sup>225</sup>

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<sup>219</sup> Foray, 2004: 132

<sup>220</sup> Ceccagnoli, Gambardella, Guiri, and Mariani, 2005.

<sup>221</sup> Stiglitz, 1999

<sup>222</sup> Foray, 2004:132

<sup>223</sup> Arup, 2000

<sup>224</sup> 2003: 8-9

<sup>225</sup> Quah (1999: 49-50) also describes this feature as "superstar dynamics" of knowledge-products, in that multiple implementations of knowledge creations do not get rewarded in the same way that multiple interpretations of physical goods do. For instance, while a wheel is not a new invention, a wheel manufacturer that craft a wheel out of hard physical material can still sell it to a consumer for a price. With a knowledge product, additional implementations of that initial creation should fetch zero price – hence, the 'superstar', winner-takes all dynamic. Quah notes too, that *"Sometimes, this attribute or something similar is labeled increasing returns. I prefer not to use this because it lacks specificity. Increasing returns in economies can arise*



Another of the requirements for a patent to be granted to an applicant is that the innovation be capable of industrial application. This condition stems from the patent's early development in the lights of widespread manufacturing and industrial development – making it undoubtedly a product of the Physical Paradigm. For this reason, among others, its design has tended to make it less prevalent in the protection of knowledge products than other 'protection mechanisms' like copyright, secrecy, and simply be the first-to-the-market<sup>226</sup>. Foray<sup>227</sup> finds it peculiar that such a remarkably effective mechanism enjoys such little subscription in the protection of knowledge and information products, but sees three major reasons for the patent's distinct lack of popularity. Firstly, the application process is arduous and often exceedingly expensive; secondly, being granted a patent means nothing in a regulatory environment which has no ability (or even willingness) to enforce any breeches; and thirdly, the attempt to make the concept of the patent as universally applicable as possible has made it cumbersome and inappropriate in a wide range of sectors – primarily, of course, industries at the forefront of the Knowledge Economy, where the tenets of the Physical Paradigm do not hold.

As a result, patents have shown varying (and ever-changing) degrees of success in attributing value to knowledge innovations, and are widely regarded as 'second-best' solutions to the market failures created by knowledge's ability to be both non-rivalrous and non-excludable. When they *are* being employed, patents are increasingly being used inappropriately, or in ways that were not originally intended by the lawmaking bodies. For instance, many firms are making use of patents as 'bargaining chips' in cross-licensing agreements, where they use patents for strategic business purposes in drowning out smaller firms with fewer resources, rather than for the purposes of protecting innovation<sup>228</sup>. In this case, the inefficiencies and obstacles created by patents are not intrinsic to the IPRs themselves, but rather to how they are being implemented by firms who will continue to exploit any flaws in the legislative framework that surrounds intellectual property.

#### 4.5.2 *IPRs and the Knowledge Economy*

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*in many ways. Superstar dynamics, on the other hand, refers to something very particular. Insights useful for the latter need not apply to increasing returns in general. Put another way, saying that knowledge-products show increasing returns (and ending the discussion with that) is like saying a mouse's immune system is simply a special case of non-elephantine biology."*

<sup>226</sup> Cohen, Nelson and Walsh, 1998. In this regard, Arundel and Kabla 1998 show how only 44% of product innovations and 26% of process innovations are patented in Europe.

<sup>227</sup> 2004: 137-139

<sup>228</sup> Abbott, Barton, Correa, Drexler, Foray, and Marchant, 2007: 5-9

*“If we did not have a patent system, it would be irresponsible on the basis of our present knowledge of its economic consequences, to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it.” - Fritz Machlup<sup>229</sup>*

The prominence of IPRs in the Knowledge Economy discourse gives some indication as to the extent to which the measures utilised in the protection of knowledge products and innovation highlight the unique economic characteristics of knowledge. Beyond the non-rivalry and non-excludability of some types of knowledge – which are, in essence, the reason for the existence of IPRs – knowledge has other important tendencies which come to the fore and add to the complexity of the IPR issue.

As we have seen with the discussion of knowledge’s ‘spillover benefits’ above, strictly-enforced or far-reaching protection of a knowledge product has the potential to stymie an immeasurable number of potential further innovations that may have been able to build on that knowledge foundation. Knowledge, unlike most Physical Paradigm innovations that sought patent protection, is not only used in the creation of final products like pharmaceuticals, process-innovations and software. Nor is it likely to be a final product all on its own. Rather, new knowledge is all of these things, *plus* a key ingredient in the production of further knowledge<sup>230</sup>. In this sense, knowledge is often highly cumulative in nature – with each new insight a potential snowball-effect in the making. Carlaw et al<sup>231</sup> cite the famous anti-patent example of how, for instance, the overzealous protection of James Watt’s steam engine concept significantly hampered the development of an entire industry, delayed the development of the British railways system and, therefore, had potentially world-changing ramifications.

On top of being cumulative, knowledge products are also highly complementary, with any number of individual pieces of technological knowledge being complementary with other pieces of knowledge from myriad different industries. Insights from medicine have inspired changes in the manufacture of fertilisers, and vice versa. Mathematics has formed the foundation of software development, and military concepts have been used in a range of different contexts -

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<sup>229</sup> Machlup, 1958

<sup>230</sup> Blakely, Lewis, and Mills, 2005. See also Nelson (1959) for a detailed discussion of the cumulative nature of knowledge.

<sup>231</sup> Carlaw, Oxley, and Walker, 2006

from systems development to the umpiring of cricket matches. As Carlaw et al<sup>232</sup> show, the economic growth process is hugely dependent upon the use of combinations and re-combinations of complementary knowledge. Very few Physical Paradigm commodities offer such vast potential to combine inputs to create something which is immeasurably greater than the sum of its parts. And, as we know, access to these 'parts' in Knowledge Economy terms should come at negligible cost to any entrepreneur seeking to use it as an ingredient in a novel recipe. This complementary nature of knowledge, combined with its tendency to also be cumulative, presents one of the most compelling critiques of the use and misuse of IPRs<sup>233</sup>.

Also of particular relevance in this discussion is the notion that patents and other costly measures to protect intellectual property are a useful indicator for the perceived worth of knowledge products from the original creators of that knowledge. What we already know about knowledge products is that they are remarkably difficult to accurately evaluate in terms of worth. Certainly, the cost of the development of a piece of knowledge is no reliable indicator – a multi-billion dollar R&D venture may result in a piece of knowledge which has no commercial value whatsoever, just as an out-of-the-blue insight while having a bath may turn out to be of immense commercial value. This inherent uncertainty that surrounds any attempts to evaluate Knowledge is yet another obstacle the attempt to incorporate it into economic models. If there is no way to determine the value of the Knowledge, how is the creator of that Knowledge to determine how much time, money and effort to spend on the protection thereof?

While this question can never be precisely answered, one thing that patents and similar IPRs *do* reveal is the decision-making processes governing the economic actions of the creators of knowledge products in evaluating the worth of their creations. Patents are notoriously demanding of both financial reserves and the applicant's time. These two investments on the part of the original creator offer some indications of their perceived 'break-even point' for the innovation. In this line, a variety of studies<sup>234</sup>, for instance, have looked at countries in which an annual patent renewal fee is required to extend the protection it offers on an idea. These often expensive renewal fees are only paid by the patent owners if the expected returns from the

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<sup>232</sup> 2006: 638

<sup>233</sup> This matter is highly complex. Carlow et al (2006:639-641) discuss the impossibility of achieving perfection in the assigning of IPRs (as well as economic value) to innovations and knowledge products, due to the irretrievably intertwined nature of the numerous complementary pieces of knowledge and information that comprise a new insight or innovation. Thus, attributing a value to an individual piece of knowledge cannot be achieved without considering the respective values of the individual pieces of knowledge and processes that were used along the way in order to make that knowledge commercially viable.

<sup>234</sup> For example, see Schankerman, M., Pakes, A. 1986. "Estimates of the Value of Patent Rights in European Countries During the Post-1950 Period", *Economic Journal*, 96, No. 384

patented idea are higher than the renewal fee itself. Thus, when the patent owner is no longer willing to pay the renewal fee, it is an interesting indicator of the fact that the expected commercial value of the knowledge product is less-than or equal-to the price of renewing the patent. Of course, this information is indicative only of the owner's perceptions, but is of some interest nonetheless.

Another insight that IPRs provide us is a new angle from which to analyse the prevailing economic models in terms of how they seek to incorporate the idea of knowledge products. For some time, the understanding of IPRs and their attempts to provide adequate reward for creative knowledge endeavours have been based on the Schumpeterian proposition that monopoly profits are the primary economic incentive to invent. In fact, as Pretnar<sup>235</sup> notes, *"monopoly profits are assumed to be the only reward for undertaking costly and risky inventive activity, because competitive pricing 'generates no rents with which to cover the costs of the original research and development program'<sup>236</sup>. It is no wonder then that Arrow explicitly equates incentive to invent with the potential monopoly profits achieved by invention".* Pretnar sees this as one of the primary misconceptions in the modern treatment of patents in knowledge creations, stating that *"Pursuing innovation in the quest for monopoly profits was possibly a reasonable assumption in the past, but cannot be taken as a representative paradigm in the context of the modern, knowledge-based economy. The modern world is characterised, inter alia, by what Baumol calls routinisation of inventive activities, the consequence of which is a competitive outcome, not a monopoly<sup>237</sup>".*

What this means is that, in the Knowledge Economy, the goalposts have shifted to the point that continual, sustained innovative activity is no longer the key differentiating factor between successful and less-successful companies. Rather, constant innovation is the *requirement* and the *norm* for companies at this level of development to even stay in business<sup>238</sup>. As Freeman and Soete<sup>239</sup> make clear, there is hardly any industry in which routine innovation is not the 'rule of the game', and any non-innovating firm will only be able to compete on obsolete technology (or, 'old ideas') for a short – and increasingly shortening – period of time. So, in contrast to

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<sup>235</sup> Pretnar, 2003: 2

<sup>236</sup> quoting Maskus, K. 2000. Intellectual Property Rights in the Global Economy. Institute for International Economics. Washington.

<sup>237</sup> Pretnar, 2003: 3; Baumol, 2002

<sup>238</sup> Pretnar, 2003

<sup>239</sup> Freeman and Soete, 1997

Schumpeter's "monopolistic incentive to invent", Pretnar<sup>240</sup> suggests that a far more accurate descriptor in the modern context is the "*competitive incentive to invent...[which is the] aim to prevent negative profits (losses), which would inevitably occur in the absence of continuous innovation.*" Here, monopolistic outcomes become the exception, rather than the rule – the result of the failure of other opposition firms to innovate sufficiently to keep the market competitive.

When this is the case, it seems intuitive that patents will come to exist not to forge monopolistic control over a market, but rather as a necessary measure against *non-innovating firms* that intend to free-ride on the back of innovating firms – i.e. those firms simply piggy-backing on the knowledge-creating endeavours that result from significant R&D investments<sup>241</sup>. If patents are structured to primarily prevent free riding of this sort, then the innovating firms left in the market would be able to function, facing similar cost curves in their productive and R&D expenditures, sustaining a competitive price-taker situation which Pretnar calls "*innovation-based competition*". In this way, the primary economic function of the patent system – in contrast to the one assumed in the prevailing economic doctrine – becomes "*to establish innovation-based competition solely by limiting cost-advantage on the basis of free riding*"<sup>242</sup>." While this postulation bears its own assumptions and corollaries, the theoretical and empirical justifications seem not only sufficiently reasonable, but also increasingly relevant in the face of a system of understanding which is calling for a significant overhaul.

#### 4.6 - A Knowledge Economy Solution to Intellectual Property Rights?

What should be clear from any discussion surrounding IPRs and their integration into the Knowledge Economy is that the laws governing the protection of knowledge and technological assets should always be 'works in progress'. It is unrealistic to attempt to devise all-encompassing legislation that can be applied to the startling array of knowledge and technological fields. It is constantly shown that the effectiveness of the protection mechanism invariably depends on the type of knowledge or technology to which it is applied – what is ideal in one instance could be wholly inefficient in another<sup>243</sup>. What works for digital music rights, for instance, may be wholly ineffective in the pharmaceutical industry. On top of this, new developments in knowledge and technology often undermine the existing IPR protection

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<sup>240</sup> 2003: 7

<sup>241</sup> Pretnar, 2003

<sup>242</sup> Pretnar, 2003: 8

<sup>243</sup> Carlaw, Oxley, and Walker, 2006: 646

mechanisms – “in a sense, the technology of these protection mechanisms is rendered obsolete by Schumpeterian creative destruction<sup>244</sup>”. What this necessitates is that the development of new IPR mechanisms runs parallel with the developments made in knowledge and technology – with the inventors of these mechanisms themselves becoming entrepreneurs seeking to gain profits from their intellectual endeavours. After all, as Carlaw et al<sup>245</sup> make clear, IPRs are a kind of technological knowledge themselves, and they have the potential to generate significant value as a result of complementarities with the particular knowledge to which they are applied.

In this regard, one of the most interesting aspects of knowledge production and its treatment in recent years has come from the ‘open source’ community. Here, an entirely different approach to knowledge creation, distribution and development has brought to light a fascinating insight into knowledge communities and what makes them tick. Above all, and for the purposes of this thesis, the ‘open source’ movement has elucidated aspects of knowledge that have added a whole new dimension to the understanding of knowledge as an economic product. In the discussion below, a number of these aspects will be discussed in relation to what they reveal about the economic characteristics of knowledge.

#### 4.6.1 ‘Open Source’

The concept of ‘Open Source’ is the modern era’s most apparent manifestation of what Foray<sup>246</sup> refers to as “*knowledge openness*” – a system of knowledge creation and distribution in which rapid *disclosure* of knowledge products becomes the defining principle, in direct contrast to attempts to control and protect it. In fact, knowledge openness seems to exist in opposition to spaces in which knowledge is protected, kept secret and controlled with the use of IPRs. In this way, it has emerged in the late 1990s as something of an ideology – as much as it is a methodology for research and development, a social movement, and ultimately a new form of production structure which seems, by many accounts, unique to the Knowledge Economy<sup>247</sup>.

Knowledge openness is most commonly seen in the realm of software development – perhaps the archetypal ‘Knowledge Economy’ industry, and, undoubtedly, the field which tends to exhibit the broadest spectrum of knowledge’s unique economic features. This is without question a product of the Internet’s proliferation and ability as an ‘enabler’ of the most extraordinary kind in the distribution, sharing and collaboration of knowledge and information.

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<sup>244</sup> Carlaw, Oxley and Walker, 2006:646-647

<sup>245</sup> 2006: 646

<sup>246</sup> Foray, 2004: 165

<sup>247</sup> Weber, 2000: 1-3

Open Source refers to the development of a knowledge product in the form of a piece of ‘code’ or software which is readily made available to consumers in a way that would seem entirely irrational in the context of the Physical Paradigm of economic thought. Weber<sup>248</sup> highlights the contrast between ‘rational’ economic behaviour and the idea of Open Source when he compares the recipe for Coca Cola to the ‘recipe’ (or code) for an open source software product. Imagine for an instant that Coca Cola released, with each bottle sold, a detailed recipe containing the formula and process used to make Coca Cola, and not only encouraged consumers to make it at home themselves, but also waived all rights of ownership on any manifestations of the product thereafter<sup>249</sup>. The Coca Cola Company, without the secret recipe that turned such cheap and readily-available ingredients into something of such great value, would be reduced to nothing more than a number of production plants and distribution centres. Surely, releasing in this way the rights to your value-creating ‘source’ would be wholly irrational economic behaviour?

Certainly, the vast majority of knowledge-producing companies tend to see such behaviour as irrational. Software-generating companies – from Microsoft to Adobe – are able to charge quite extraordinary prices for pieces of code that, if it were not for staunch protection mechanisms, could and would be distributed worldwide instantaneously, and at negligible marginal cost<sup>250</sup>. As evidenced by the discussion above, it is this ability to make a (by nature) non-excludable good excludable through the use of construction like IPRs that those companies maintain is the reason why they retain the incentive to continue R&D processes that result in the invention of new technologies, and improvements upon their current products. These companies – or, more accurately, this mode of thinking – sees the commercial ‘payoff’ of knowledge endeavours to exist largely in the production and sale of the software itself, in the form of a packaged ‘final product’.

Open Source – as software’s version of *knowledge openness* – takes an entirely different stance. By definition and design, open source software is presented, free-of-charge, into the public domain with its source code attached. In essence, the product is provided along with a detailed recipe (the source code), as well as the tools (the development platform) needed to fix any ‘bugs’ encountered along the way. With no IPRs in the form of patents or copyrights, it is perhaps the purest example of a non-excludable, non-rival good: open, public and entirely non-

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<sup>248</sup> 2000: 2

<sup>249</sup> Weber, 2000: 2

<sup>250</sup> Bivand, 1999: 1-3

proprietary<sup>251</sup>. The intention of the creators of the original source code is that the users (or ‘consumers’) of the software are encouraged to use the software for their own purposes, and even make changes to the original code in order to improve it, better adapt it to their requirements, or fix any problems they may have encountered in the course of using it. Users that are not technically capable enough to adapt the code themselves are invited to post comments on online bulletin boards, offering suggestions or wish-lists for how the software should be fine-tuned.

These problems, adaptations, suggestions and wish-lists emerge as challenges that need to be overcome in the development and modification of the knowledge product. In conventional situations, the impetus would usually fall on the original creators to fix their ‘flawed’ products (like a mechanic in the car industry, an engineer in an electrical appliance firm, or a programmer at Microsoft). In the case of software companies, it is an expectation of the consumers who purchase a product from Microsoft, for example, that the developers continue to work on the product long after that sale has been made – providing updates, fixing bugs etc. Bivand<sup>252</sup> points out how *“[there is] an immediate fall in value of software products to zero when the producer goes out of business or terminates the product line. It is as though consumers pay for the product as some kind of advance payment for future updates and new versions. If they knew that no new versions would be coming, they would drop the product immediately, even though it still worked as advertised.”*

The open source approach to these challenges is both unique and remarkable. In essence, open source has evolved to a point where the distinction between users and developers is no longer meaningful, and any problems or adaptations that should be made to the software are approached in an ‘all for one, and one for all’, self-organising, community mindset. Problem solvers work independently to solve issues with the software and, once successful, they make the improved code available for future users to utilise and build upon. In this way, successful problem solvers leave their ‘mark’ on the code, and are credited for their contributions in the way that artists sign their names on their artworks. These problem solving endeavours are performed for no direct monetary compensation, and are not planned or ordered by any central authority. Rather, open source user-developers participate out of curiosity, a need to ‘scratch an itch’ (or fix an issue that is hampering them in the software), or demonstrate their prowess to an appreciative community that understands and values telling contributions towards the

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<sup>251</sup> Bivand 1999: 1

<sup>252</sup> 1999:7



improvement of the product<sup>253</sup> - giving the contributors what Foray<sup>254</sup> calls “*reputation capital*”. For Howe<sup>255</sup>, the phenomenon is as simple as it is powerful: “*The best person to do the job is the person who most wants to do the job; and the best people to evaluate their performance are their friends and peers who, by the way, will enthusiastically pitch in to improve the final product, simply for the sheer pleasure of helping one another and creating something beautiful from which they all will benefit.*”

#### 4.6.2 ‘Open Source’ – Innovation without Property Rights?

What open source does show, without a shadow of a doubt, is that there can be significant innovation in knowledge development *without* the need for property rights, and even monetary compensation for creative endeavours. As can be seen with the remarkable progress of open source initiatives like Linux – the veritable ‘poster boy’ of the open source movement – the concept of knowledge openness and sharing behaviours in knowledge communities have the ability to exhibit tremendous economic efficiencies, mobilising people in certain circumstances to contribute time and effort towards establishing and maintaining development in order to be part of a self-organising, goal-seeking positive-sum game<sup>256</sup>. Using the Internet as an enabler, open source has shown how the complete distribution of a knowledge project helps to get much larger numbers of people working on the problem than would be possible or economically feasible in a conventional development company situation<sup>257</sup>. On top of this, the nature of the unique requirements and interests of users - in addition to the ability to communicate at negligible cost, and without the fear of revealing trade-secrets (as there are none in open source) - coordinative efforts of contributors are drastically improved<sup>258</sup>. Contributors fix their own individual problems independently and, when problems are shared, the free sharing of knowledge and ideas drastically reduces the duplication of research projects<sup>259</sup>. Also, problem-solvers are free to use the methods and approaches of other contributors that have solved

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<sup>253</sup> Weber, 2000: 15

<sup>254</sup> Foray, 2004: 174

<sup>255</sup> 2009: 9

<sup>256</sup> David and Foray, 1995

<sup>257</sup> Large, once famously secretive and closed-off corporations like IBM and Proctor and Gamble have even cottoned on to the power of open source. Proctor and Gamble attribute a large degree of their significant financial turnaround to the establishment of ICT-based discussion forums and problem-solving networks that have incentivised scientists from all over the world (regardless of where or for which company they work) to contribute to the innovation and problem solving capacities of the company (Lafley & Charan, 2008). IBM’s investment into open-source projects has recently topped \$1bn – and counting (Howe, 2009: 8).

<sup>258</sup> Weber, 2000; Bivand 1999

<sup>259</sup> Foray, 2004: 166

similar problems elsewhere in the software. Thus, the wheel is rarely re-invented, and efficiency rules the day<sup>260</sup>.

What this reveals about knowledge is of substantial value in understanding its treatment as an economic object. Linux, as the most famous incarnation of open source software, has been labelled by Smith and Kollock<sup>261</sup> as “*the impossible public good*” – entirely non-rival and deliberately non-excludable. Its nature – as aptly described by Rishab Ghosh<sup>262</sup> is like that of a tribal cooking pot from which anyone in the village is free to help themselves. While one member of the village may place a chicken in the pot, and another contributes an onion and some carrots, there are likely to be many people who do not contribute to the stew at all. While in normal circumstances, those who did not contribute to the mix would lessen the amount available to other who may or may not have contributed, in the context of open source software, nobody loses anything from contributing to the mix, and *everybody* wins. If the person who contributed the chicken *in any way* experiences the betterment of the overall mix with a contribution (however small) from another person, then everyone gets more value from the mix than was initially put in. And when, as in the case of Linux, there are thousands of contributors from as many as 31 different countries<sup>263</sup>, it is likely contributors are always likely to get more than they give.

While Ghosh’s argument contributes toward an understanding of the logic of the open source phenomenon, Weber<sup>264</sup> makes the valid point that, from a purely economic perspective, it would still be a narrowly rational act for users to remain free riders in the system, rather than spend time and energy contributing to the ‘pot’. He notes how the inexhaustible character of knowledge would cause a functioning open source system to unravel should its users cease to contribute, but rather how the lack of rational incentive to contribute would mean that the ‘pot’ was never filled with anything in the first place. The conclusion he eventually reaches in this regard – beyond the explanations of open source culture, reputation capital and the like – is that the knowledge openness / open source system is, in some circumstances, “*more than*

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<sup>260</sup> Weber, 2000; Bivand, 1999

<sup>261</sup> 1999: 230

<sup>262</sup> Ghosh, 2004

<sup>263</sup> <http://www.linux.org/info/index.html>

<sup>264</sup> 2000

*simply non-rival*<sup>265</sup>”. What this means is that the non-rivalrous nature of this type of knowledge is augmented by the additional benefits of network externalities, or “*anti-rival*” goods<sup>266</sup>.

In the most basic sense of the term, network externalities refer to the way in which the value of a particular good increases as the number of other users increases<sup>267</sup>. With open source software, the more people using a piece of software, the more likely that any bugs in the software will be discovered – as users navigate through the software in their own unique ways, for their own unique purposes. Remembering that free riders in this context do not ‘remove’ anything from the system, Weber notes how, with open source, they actually *contribute* to the system by offering a unique pair of eyes, and perhaps something as simple as reporting a bug in the software out of frustration<sup>268</sup>. The bigger the group of users, the more likely the system is to have users who contribute, and also free-riders who unwittingly do so.

Of course, the importance of ‘network size’ has other added benefits too. For instance, David’s<sup>269</sup> work on knowledge openness in the academic field showed how the “*disclosure norm*”, and the sharing of knowledge between extended groups of researchers, positively influenced the overall cognitive performance of the system under review. For one, situations of openness to knowledge sharing significantly increased the conflict surrounding possible solutions and new ideas, forcing researchers to stay open to alternatives and diverse opinions. Not only does the increase in ‘checks and balances’ act as something of a quality assurance mechanism, but the exposure to a diverse population of researchers and modes of thinking inevitably increases the probability of new discoveries and developments, as well as “[*decreasing*] the risk of this knowledge falling into the hands of agents incapable of exploiting its potential<sup>270</sup>”.

Happily, the ‘infinite expansibility’ characteristic of knowledge seems to negate the likelihood of open source initiatives falling prey to the economic problem of the ‘tragedy of the commons’ – by which unrestricted access to valuable resources results in the over-utilisation, depletion, and thus reduction in value of the resource (as in gold mines, fishing reserves etc)<sup>271</sup>. While knowledge – when treated as a commercial or production good - can lead to a ‘tragedy of the

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<sup>265</sup> Weber, 2000: 28

<sup>266</sup> Weber, 2000; Foray 2004; David 2002

<sup>267</sup> Herings and Schinkel, 2004

<sup>268</sup> Weber, 2000

<sup>269</sup> David, 1998

<sup>270</sup> Foray, 2004: 166; David 1998

<sup>271</sup> Foray, 2004: 167

commons' situation, when the principles of knowledge openness prevail, "*the knowledge commons is not only inexhaustible, it is also enriched by intensive exploitation by a diversity of agents*"<sup>272</sup>. Thus, where increasingly large amounts of users may hinder a system, this particular context of knowledge production and development does not seem to be affected in this way<sup>273</sup>.

With all of this in mind, the concept of Open Source communities continues to paint itself as an increasingly attractive structure for the production of some types of information and knowledge. This is evidenced by the heightened attention and resources being committed to open source-type initiatives by some of the world's biggest technological and knowledge-producing firms<sup>274</sup> to augment their in-house R&D processes. Similarly, firms and organisations are also cottoning on to the idea of utilising the network effects inherent in many knowledge products, providing products in the form of platforms for minimal or even zero cost to the consumer, and then reaping in the benefits in other ways down the line – in customising, adding support, attracting advertising or sponsorship, and providing updates or add-ons. Treating an innovation in this way – i.e. thinking of it not as a product, but as a *service* – is just the kind of thinking that may become the backbone many successful knowledge-based enterprises.

#### 4.6.3 *Property-Rights – What we learn about the economic characteristics of Knowledge?*

The discussion surrounding Intellectual Property Rights in the modern economic context provides more compelling reasons why the economic and legislative framework of the Industrial Era seems unable to deal with the unique economic characteristics of knowledge and information when treated as economic commodities. One of the key points emerging from looking at how IPRs react to knowledge as an economic good is that knowledge comes in so many forms, and is so heterogeneous that any existing economic or legislative models cannot be applied universally. These models must refer to certain types of knowledge in certain industries – as must the patents, copyrights and other forms of protection which seek to find the balance between encouraging innovative effort and ensuring social efficient outcomes.

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<sup>272</sup> Foray, 2004: 172. For a fascinating discussion of how the tragedy of commons becomes a 'comedy' in contexts of knowledge openness, read Foray's (2004) take on the Napster issue – the contentious case of downloading copyrighted music via person-to-person sharing software on the internet, pp 169-173

<sup>273</sup> In a similar way, the structure of open-source communities also helps to minimise the effect of Brooks' Law (or the Mythical Man Month), whereby adding more developers to a software project in normal organisational settings often *increases* the amount of time it will take to complete the project, as time spent on teaching, learning, delineating work responsibilities and organising workflow often further delays the final product (Weber, 2000: 33-36).

<sup>274</sup> See Howe (2009: 8-11)

The truth of the matter is that the very nature of technological innovation – as well as the dizzyingly complex processes that generate it – seemingly makes the universal success of such legal constructions an impossibility. In a world in which anyone with access to ICTs can become a ‘publisher’ on a global scale, the basis for Intellectual Property Rights in the 21<sup>st</sup> century must be informed by an acceptance on the part of policy-makers that users are no longer just consumers. Rather, they are creative engines with the willingness, ability and platform to become content-creators in their own right.

Indeed, as the quote by Machlup earlier in this chapter suggests, IPRs are widely considered to be a necessarily evil with regards to their treatment of knowledge commodities. As we have seen, their capacity for good – in creating the atmosphere in which enterprising thinkers are willing to dedicate resources in order to produce innovative knowledge products – is often counterbalanced by the negative aspects that decrease the likelihood of socially beneficial outcomes. In the modern economy, where national laws continue to disintegrate in crossing international borders, a ‘one-size-fits-all’ solution to the multifaceted nature of knowledge products seems improbable, if not impossible. However, as Foray suggests, patents and copyrights are but two of a host of solutions to the problem. New solutions like open-source and other social systems created *in response* to knowledge’s primacy and unique economic characteristics (as opposed to attempts to manipulate *existing* systems) may provide insight into suitably flexible and lasting frameworks, policies and business models.

#### 4.7 *From the Economics of Knowledge to the Knowledge Economy*

At this point in the thesis, we are equipped with a far more comprehensive profile of knowledge – both in terms of its diverse and complex makeup as a standalone concept as well as the many challenges it presents when conceptualised as an economic good. Throughout of the course of this chapter, knowledge’s economic characteristics have been explained in the context of an economy environment in which the focus on knowledge as both an input into productive endeavours and a *result* of that production, has come to the forefront of academic and economic contemplation. From a theoretical perspective, challenges and revisions to enduring economic theories and models continue in earnest to try to incorporate the heightened focus on knowledge (and technology) as a factor of production. From a practical standpoint, the tremendous investments (financial, time and manpower) thrust towards Knowledge

Management programmes in organisations across the globe is one of a number of indicators<sup>275</sup> of a shift towards the primacy of knowledge in economic and social organisations. On top of this, in between theory and practise, the centrality of the Intellectual Property Rights developments in legal and political discourses around the world is also indicative of a worldwide realisation that the modern economy is increasingly knowledge-based.

Given the numerous economic 'definitions' of this concept discussed throughout this chapter, as well as the insights gathered by analysing the economic characteristics of knowledge (and the repercussions thereof), we are now able to approach this idea with the foundational understanding required to make sense of such an economy. An economy, that is, in which knowledge is both a primary input and output and – for all intents and purposes – can thus be referred to as a Knowledge Economy.

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<sup>275</sup> for instance, increased expenditure in R&D programmes, investment in ICT infrastructure and skills development – to name a few. See Brinkley (2006); Oxley et al (2007).

# Chapter Five

## What is ‘New’<sup>276</sup> about the Knowledge Economy?

The extent to which the current economic environment represents a distinct phase in economic history is a matter which is subject to much debate. At the heart of the issue is the widespread realisation that the conditions under which modern economies are operating have changed significantly over the past few decades, forcing individuals, organisations and governments alike to reconsider the ways in which they analyse, measure and strategise their economic behaviour. For many theorists, the changes are far-reaching enough to signal a new type of economy, which is radically different from the Industrial Era economy that preceded it. These theorists refer to the ‘weightless economy’, the ‘knowledge-based economy’, the “goldilocks economy”, the ‘new economy’, the ‘network economy’ and even the ‘e-economy’ in trying to categorise and describe the changes underfoot<sup>277</sup>.

On the other hand, however, other theorists argue that these shifts are little more than passing trends or – at most – gradual, foreseeable developments in the natural progression of the economic order. For these theorists attempts to declare a ‘new’ economic era are unfounded, and ignorant of the bigger picture of long-term economic progress, which shows any changes experienced in the modern economy as *evolutionary*, rather than *revolutionary* changes worthy of distinction.

The argument is one in which a definite answer is unlikely. For one, it is impossible to know at any one point whether it is a suitable time to analyse the complex series of long, medium and short-term changes which continually redefine the modern economic context. How, for instance, are we to know if any one transition has come to completion, or whether or not the changes are still in the process? Also, how are we to compare the supposed ‘new’ economy to the ‘old’ one when there are no distinct markers or designated timelines for where the one is deemed to have ended and the other one is thought to have begun? These are just a few of the

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<sup>276</sup> ‘Newness’ is, of course, very difficult to define. In the context of this chapter, references to the the extent to which some aspect of the economy is ‘new’ should be usefully considered as the extent to which it represents a clear change (or distinction) with the previous economic era.

<sup>277</sup> Coyle 1997; Castells 1996; Cohen, DeLong, & Zysman, 2000

many concerns which add complexity, uncertainty and controversy to the debate - which is why, no doubt, the debate continues to wage on.

In pursuit of an operational definition of the Knowledge Economy, this thesis has thus far uncovered the major component parts of the highly complex and intricate concept. Of course, it is by default that any authors, academics and theorists that make use of the concept are necessarily proponents of the belief that the modern economic system is in many ways a unique, distinct economic phase which is worthy of its own descriptive categorisation. Given the outcomes of the discussion surrounding the nature of knowledge and its economic characteristics, it is the firm belief of this author that some aspects of modern economies are fundamentally and irreversibly different to Industrial Era economies and that, due to the nature of these system differences, this new era can be accurately described as the Knowledge Economy.

In this chapter, two of these major shifts will be discussed in detail in order to illustrate not only that they are indicative of a significantly altered economic environment, but also that the rise of knowledge to a position of primary importance in modern economies is at the heart of these changes. The first aspect to be discussed is the dramatic advance of Information and Communications Technologies.

## 5.1 - Information and Communications Technologies (ICTs)

*'[T]he ICT revolution is a real phenomenon that should not be taken lightly. Not only has it created powerful new industries (and unbelievably rich industrial tycoons) but it has also revolutionised "how things are done" in many if not most areas of economic and social life. In fact, the latter is what is meant by a technological revolution<sup>278</sup>.' – (Jan Fagerberg, 2006: 13)*

If there is some substance to the argument that we are living in a fundamentally different economic 'era' – one that can be accurately referred to as a 'Knowledge Economy' – this contention must surely include the dramatic impact that Information and Communications Technologies (ICTs) have had on every aspect of economics, politics and social life in the 20 years. The 'Third Wave' of technological innovation – as described by Alvin Toffler<sup>279</sup> - has seen an information revolution which has been powered by computing's radical, sustained growth, coupled with its dramatic convergence with the other defining technology of our times –

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<sup>278</sup> citing Freeman & Louca, 2001

<sup>279</sup> 1990



telecommunications<sup>280</sup>. Developments in the fields of computing and telecommunications have grown at speeds unprecedented in any industry since the Industrial Revolution<sup>281</sup>, making the field of ICTs the most exciting, most visible manifestation of general technological process<sup>282</sup>.

Yet, technological process – however rapid – is not enough to bolster an argument that the ICT ‘revolution’ has necessarily engendered a new ‘era’ in economic and social spheres. Many industrial-era industries were also marvelled at for their remarkable technological gains, sustained improvements and their ability to offer the promise of increasing returns. New ‘high technologies’ are too often considered the harbingers of new times, and if every automobile, aspirin or light bulb were to be considered indicative of a ‘new economy’, perhaps there would not be such a big fuss being made about the Knowledge Economy debate. While it may be tempting to think it, it needs to be clear: a technological revolution is not an economic revolution<sup>283</sup>.

What needs to be asked is whether there is something about ICT’s impact on the global modern economy that makes it *fundamentally different*. In pursuit of the answer to this question, it is crucial to note that ICT is not just high technology. ICTs, the technologies they encompass and the outputs they produce have become perhaps the most pervasive, far-reaching and widely-applicable technologies to grace our planet since electricity<sup>284</sup>.

ICT – as represented by cable and satellite television, computer-to-computer networks, the creation, storage and distribution of digital data, mobile telephony, personal computing and, primarily, the internet – has demonstrated the power to change not only the *way* things are done, the *speed* at which things are done, and the *extent* to which things are done, but – more crucially – it has changed the fundamental character of these things. In many cases ICTs have brought forth those unique, high-speed, interactive ‘updates’ that complement, empower and enhance: politics now involves e-Politics, Government involves e-Government, and Marketing now involves e-Marketing. Physical world commerce, however, is *fundamentally different* to e-commerce - e-businesses often have little in common with the hierarchical, office-bound

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<sup>280</sup> Drucker, 1994

<sup>281</sup> If the listing of patents per industry is anything to go by – as Fagerberg (2006: 11-13) contests – OECD data shows that ICT patents have increased by a factor of 5 during the last quarter of a century. In comparison, the number of *total* patents in this time has merely doubled.

<sup>282</sup> DeLong, 1998; Quah 2001; Soete, 2001

<sup>283</sup> DeLong, 1998

<sup>284</sup> DeLong, 1998; Quah 2001

businesses of old, and referring to email as a ‘postage service’ is like referring to a Pilatus II Lear-Jet as a ‘horseless carriage’.

On top of this, the ICT industry differs in two crucial ways from other high tech industries which have displayed increasing returns. Firstly, as Quah<sup>285</sup> points out, ICT output has little physical manifestation. Using computer software as the archetypal example, Quah notes how much of what is produced as an output by ICT technologies is intangible – a combination of 0s and 1s that form the entire basis of the digital construction of the product. In addition, ICT outputs *“[differ] conceptually [in that they have a] putative disrespect for geographical distance. [This is the] critical distinction. In principle, ICT goods and services can be transmitted costlessly, without physical degradation, over arbitrary distances... [making] possible the most extreme spatial dissemination of work inputs and output distribution.”*<sup>286</sup>

The second unique feature of ICTs is how their outputs have the potential to take on many of the characteristics of knowledge that make it so difficult to fit within the Physical Paradigm of economic thought – namely, non-rivalry and infinite expansibility<sup>287</sup>. ICTs, as technologies, have the power to digitise any number of tacit and explicit knowledge manifestations – from scientific discoveries to music and films - transforming them into outputs which behave in a similar way to knowledge assets. Essentially, it is this property that enables otherwise tangible or context-bound goods and services to become ‘weightless’<sup>288</sup>.

These effects have had numerous repercussions. The ICT ‘explosion’ has been felt across the overwhelming majority of spheres in contemporary society. Stephen Shepherd<sup>289</sup> describes these technologies as ‘transcendent’ technologies in that they simply *“affect everything”*<sup>290</sup>. No modern industry, and certainly no competitive organisation, can hope to be successful and remain relevant without embracing some aspect of ICT. In most cases, it is fair to say that those who attempt to reject it still make use of it unwittingly – whether by turning on a car, swiping a credit card, purchasing a pair of shoes or booking a ticket for a show. On the other hand, those

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<sup>285</sup> 2001

<sup>286</sup> Quah 2001: 3

<sup>287</sup> Quah 2001:4-6

<sup>288</sup> Quah, 2001, 2002. The ‘weightless’ descriptor has also been used as an analogy for how era-defining goods (in the Knowledge Economy, in contrast to the industrial economy) have become progressively more expensive per net weight. Goldfinger (2000: 60) shows a table comparing the unit prices of hot rolled steel (\$0.20 per *lb*) to Mercedes Benz E-class (\$19 per *lb*) to a Pentium III processor (\$42,8931 per *lb*) to demonstrate this point in practical terms. He notes further: *“The source of economic value and wealth is no longer the production of material goods but the creation and manipulation of intangible content. The shift to the ethereal is general and long lasting. It affects all sectors and all aspects of economic life.”*

<sup>289</sup> 1997

<sup>290</sup> DeLong, 1998

who welcome it will feel it totally and completely immerse nearly every aspect of their existence.

It is with this pervasive and revolutionary character in mind that the rise to prominence of ICTs over the past few decades continues to give credence to the argument that the current state of the modern economy is fundamentally distinct from the industrial economy that preceded it. In this section, the contribution of ICTs in this regard will be taken further, briefly discussing some of the most important and most extensive changes ICTs have made in bringing about what, it is argued, can be accurately referred to as a “Knowledge Economy”.

### *5.1.1 The Impact of ICTs on Knowledge, Information and Data*

ICTs are, by definition, technologies established to deal with the capturing, processing, storage and distribution of knowledge<sup>291</sup>. For this reason, their impact upon knowledge – as defined earlier in this thesis – should be self-evident. As will be briefly highlighted below, in each of these aspects - capturing, processing, storing and distributing – the dramatic advances in the technological development of ICTs have led to staggering improvements, continually making possible what was previously thought to be unimaginable. Beyond this, the changes made to our capacities to deal with knowledge, information and data have irreversibly altered our definitions of these three phenomena. The numerous definitions and typologies of knowledge discussed in this thesis bring to light the constant changes made to our understanding of the concept in the face of new developments, trends and capabilities.

The dynamics of human movement, for instance, can be considered a deeply tacit and even largely subconscious form of knowledge. However, with developments in motion-sensor technology, even these bewilderingly complex processes can be captured – however crudely – in digital form with the use of ICTs and associated technologies. When Cristiano Ronaldo’s running style can be captured in 0s and 1s to the point of being instantly recognisable in a commercial video game, it becomes all the more evident that the goal-posts have shifted.

#### *5.1.1.1 Capture*

This is but one example of how ICTs have impacted the way in which knowledge can be captured. On the back of extraordinary advances in the capabilities and performance-to-cost ratios of computers over the last few decades, digitalisation, software development, and the development of supporting technologies for the application of new processing and

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<sup>291</sup> Carlaw et al, 2006

communications systems, have opened up a whole new paradigm for the capturing of knowledge, information and data. From simple word-processors able to digitise the thoughts of millions, to the scanning, photographing, recording and videoing of any manner of information-laden content – the degree to which human behaviour can be captured by combinations of digital bit-strings continues to defy expectations. And where films used to be tangible *film*, and photography required negatives, darkrooms and photo paper, the introduction of digitalisation into these fields has meant that the outputs of these industries have become intangible and weightless. And once *codified* in this way, digital representations of our world, our thoughts, and our knowledge have the potential to feel the full force of ICTs – transforming them into usable, shareable, distributable and, most importantly, sellable commodities that become part of the modern global economy.

It is for this reason, among others, that a large portion of the technological innovations made in ICT relates to technologies that are geared toward *capturing* the previously-uncapturable. As the platform to proliferate (and profit from) digital ‘produce’ is still beyond our ability to fully exploit it, it makes sense that a great deal of time and effort is spent on codifying our knowledge-base, as well as the development of technologies that digitise phenomena into formats that are compatible with open system standards. Perhaps the most awe-inspiring of all of the advances in technologies designed to capture, codify and digitise any and all aspects of our planet, is the Human Genome Project – the mapping of the structure of human DNA. With the very essence of the human body captured in digital form, the potential for scientific and medical discovery has been elevated to an entirely new plane. Once digital – captured in a format which enables manipulation by ICTs – the potential for advancement and growth is seen to increase exponentially. This explains the significant focus on the development of technologies designed to do just that – digitise, capture and codify our world.

As governments, corporations and individuals push to codify knowledge and processes, the digital ‘stock’ of codified knowledge continues to grow at a staggering rate. As Houghton and Sheehan<sup>292</sup> have observed, this trend has *‘radically altered the balance between codified and tacit knowledge in the overall stock of knowledge.’* And, as gaining access to that knowledge keeps becoming both easier and less expensive, it is likely that the importance placed on the uncodifiable tacit knowledge will intensify. Here, the *“skills and competencies relating to the selection and efficient use of information become more crucial, and tacit knowledge in the form*

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<sup>292</sup> Houghton & Sheehan, 2000: 11

*of the skills needed to handle codified knowledge becomes more important than ever.*<sup>293</sup> This has profound implications for education, where the emphasis should no longer be on teach ‘know-what’, but rather ‘know-how’ and ‘know-why’.

### 5.1.1.2 Process

The ability to capture increasingly complex pieces of information would be of little use without the processing capacity to turn these bit-strings into *useful* information. Thus, part of what has made the ICT ‘revolution’ so far-reaching has been the developments made in increasing the processing and computational capabilities of modern information technology systems. While many individual technological developments in the field of ICT have enjoyed staggering and sustained advances over the past few decades, the growth in the computational capacity of the Complementary Metal Oxide Semiconductor (CMOS) logic design has outstripped even that of the Internet<sup>294</sup>. In fact, like many of the Information and Communications technologies, the microchip’s sustained improvement has provided a platform from which other technologies have launched. Carlaw et al<sup>295</sup> go as far as saying that *“some would argue that the expansion of the Internet would not have been possible without the efficiency advances of microchips.”*

As these microchips get faster, then smaller, then faster still, we find ourselves able to do calculations that were never before considered possible. This increased processing power enables us to manage more complex inputs and therefore produce more complex outputs – from 3-dimensional rendering of real-life objects, to the converting, analysing and linking of immense data-sets, to advanced robotics. And, on top of this, as advances continue to allow these chips to become both cheaper and smaller, each day brings a new application of ICT to the objects that constitute our modern world<sup>296</sup>. Moore’s Law – which states that the density of silicon on a single chip doubles every 18 months (thereby halving the cost of those chips to consumers - has held firm since the early 1960s, and seems set to continue for the foreseeable future<sup>297</sup>.

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<sup>293</sup> Houghton & Sheehan, 2000: 11

<sup>294</sup> Carlaw et al, 2006: 653

<sup>295</sup> 2006: 653

<sup>296</sup> Indeed, we continue to see daily evidence of truth in Kevin Kelly’s (1997) prediction that: *“As the size [and cost] of silicon shrinks, [microchips] become cheap, and tiny enough to slip into every object we make... an ephemeral package... your chair, each book, a new coat, a basketball. Soon, all manufactured objects, from your tennis shoes to hammers to lamp shades to cans of soup, will have embedded in them a tiny sliver of thought.”* With plans to put microchips into the latest footballs to help adjudicate when the balls have crossed the goal-line, the reach of ICT continues to defy expectations... and belief!

<sup>297</sup> Delong 1998: 7

At the forefront of the 'processing' of information is the ability of everyday Internet users to make use of tremendously complex algorithms that allow the entire indexed world wide web to be searched, filtered and categorised in milliseconds. The past 10 years has given birth to the Google phenomenon which, quite literally, has put the world (of information) at our fingertips. Knowledge workers have access to tools – in the form of search engines – that enable them to filter millions upon millions of web-pages in fractions of a second, by simply specifying keywords and – where necessary – making use of Boolean clarifications. If any one processing capacity were to define this generation of technologies as the 'knowledge generation', surely the Internet – coupled with this ability to effectively navigate it – would be the shining example.

### 5.1.1.3 *Store*

The ability to process increasingly complex computations is hugely dependent on the ability to store the results of those computations. Thus, hand-in-hand with the development of ever-faster microprocessors, the capacity of digital data and information storage continues to grow at staggering rates. What was once only achievable in warehouse-sized locations filled with kilometres of wiring and magnetic tape can now be held in the palm of one's hand – making possible a variety of applications that continue to push the boundaries of what is possible in terms of the speed, capacity and physical size of digital storage. On top of these improvements, digital storage has also drastically increased in reliability, allowing for the integrity and safekeeping of digital resources over ever-longer periods of time. Unlike parchment and paper documents of old, the ability to store near-limitless quantities of digital information in a format that is not subject to decay and degradation is of much significance for this and future generations. This, coupled with the ever-increasing complexity and accuracy of indexing and search computations, has the potential to make paper-based libraries more and more obsolete.

Digital storage has also jumped on the ICT bandwagon. Creators, sharers and distributors of digital information goods are no longer bound to their personal hard-disks, BlueRay disks and DVDs. The importance of 'spreading the risk' of losing digital information – like video, text, photographs and the like – has precipitated the highly lucrative industry of *online storage*. From Gmail web-based email – which features a real-time, ever-increasing indicator of the permitted online storage capacity for individual email accounts (19 GB and counting...) – to the myriad photograph and video services which allow the uploading and storage of the worlds' internet users' digital lives, the ability to use technology to store information outside of our brains as at an entirely new level. This not only helps to minimise the threat of losing our information and

knowledge goods – to tangible and intangible threats, but it also means that, when they are stored online, we can create, share and collaborate on increasingly complex information and knowledge goods all the time, whenever, and wherever we are.

#### 5.1.1.4 *Distribute*

While capture, processing and storage are all individually crucial to the staggering impact of ICTs over the past decade, it is in the ability of ICTs to distribute knowledge and information goods that the new paradigm of economic and social understanding really comes into its own. As Lundvall and Johnson<sup>298</sup>, Smith<sup>299</sup>, Foray and David<sup>300</sup> point out, the key to utilising the power of increased storage, processing and capturing capacity for innovation lies in the ability to distribute and share the gains of these processes. David and Foray<sup>301</sup> make clear that “*an efficient system of distribution and access to knowledge is a condition sine qua non condition for increasing the amount of innovation opportunities. Knowledge distribution is the crucial issue*”.

In terms of the distribution of knowledge and information, it is in the internet that Information and Communications technologies come together. Connecting to the internet means connecting to a global network of information resources that can be transmitted from their source to the individual user instantly, and at minimal cost. The rapidly increasing capacity of fiber-optics cable to carry vast amount of data at incredible speeds and minimal cost, continues to push the boundaries of text, code, sound and video distribution on ICT platforms. What this means is that geographical distance is less relevant than ever before - at least, for those with ‘access’ to the network. It no longer matters where a creator, collaborator or end-user is on the planet. In this sense, the internet is the ‘freezer ship’ of the modern age<sup>302</sup>.

Perhaps no industry has been more radically affected by this power of distribution and access as the financial services sector<sup>303</sup> - an example which will be discussed in more detail in section

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<sup>298</sup> Lundvall & Johnson, 1996

<sup>299</sup> “The overall innovation performance of an economy depends not so much on how specific formal institutions (firms, research institutes, universities etc) perform, but on how they interact with each other.” **Invalid source specified.**

<sup>300</sup> David & Foray, 1995

<sup>301</sup> David & Foray, 1995: 40

<sup>302</sup> New Zealand Ministry of Commerce, 1998: 5. “Over a century ago a breakthrough in technology brought increased wealth and prosperity to New Zealand when the SS Dunedin transported the first shipment of frozen meat to our major market in Britain. This brought about far-reaching improvements to our economy and standard of living. Today, digital communications technology has the same potential...[W]hat has often been one of our great disadvantages – the distance and time from our major markets – is immaterial in the instant world of global digital networks.”

<sup>303</sup> (Software and Information Industry Association, 2008: 15-17)

5.2.6. In this sector, the move towards an 'electronic stock market' has brought traders, service providers and consumers closer than ever before - promoting greater information symmetry, the generation of new distribution channels, and real-time access to every trade, 24/7. This would simply not be possible in a world without ICT and its highly efficient capacity for distribution.

For Castells, this capacity to spread information instantaneously, and across the globe to countless 'nodes' or access points is what underlies the establishment of the network society<sup>304</sup>. When distribution networks provide processing power and access to near-limitless resources, the impact on innovation is truly profound. Mokyr<sup>305</sup> suggests that the driving factor in the Industrial Revolution was *"neither brilliant individuals nor the impersonal forces governing the masses, but a small group of at most a few thousand people who formed a creative community based on the exchange of knowledge."* The distributive capabilities of ICTs provide a completely new dimension to the concept of 'communities'<sup>306</sup> of this sort, by increasing the amount of users able to access these communities, increasing the pace and extent of interactions within the community, providing universal 'languages' for the interactions and also redefining the flexibility of the interactions, "allowing the distribution of processing power in various context and applications...[allowing users] to be integrated in all the sites and contexts of the human environment<sup>307</sup>." Taking this idea even further, the penetration of ICTs through wireless connections and portable access devices creates "continuous fields of presence that may extend through building, outdoors, and into public spaces as well as private. This has profound implications for the locations and spatial dimensions of all human activities that depend, in some way, upon access to information<sup>308</sup>.

In these ways, ICTs have profoundly affected the way that knowledge goods are distributed and access - from the cost, locations, applications to the pace and density of interactions upon whatever information and knowledge is being distributed. The distributive capacity of ICTs thus takes all of the gains made in terms of processing, capturing and storage of knowledge, and provides the most efficient and pervasive platform through which to utilise these gains for

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<sup>304</sup> Castells, 2004: 5-11

<sup>305</sup> Mokyr, 2002: 66

<sup>306</sup> Howe (2009: 8) captures the essence of this new nature of 'community' in describing the most compelling examples of the phenomenon – the open source movement: *"Open Source revealed a fundamental truth about humans that had gone largely unnoticed until the connectivity of the Internet brought it into high relief: labour can often be organised more effectively in the context of community than it can in the context of a corporation."*

<sup>307</sup> Castells, 2004: 15

<sup>308</sup> Mitchell, 2003: 14



innovation. With the ability to distribute in this manner, ICTs are not simply an influential force in furthering the industrial era's reach. Rather, they represent a distinct time, forming part of the fabric of an entirely new way of function in social, economic and political life.

### 5.1.3 *The Impact of ICTs on Business*

Information and knowledge have always been fundamental to the growth of the economy and the businesses that comprise it, but never before have these intangibles been so widely regarded (and treated) as actual commodities. While the decline in manufacturing employment, and the corresponding rise in the number of jobs relating to 'information work' in America and Western European countries may be a result of numerous societal and economic shifts, there is certainly some substance to the argument that the modern business environment is one in which information is starting to take precedence. In these regions, in fact, over 70% of the workforce is now found in the service sector of the economy, with 'white collar' jobs representing a growing majority<sup>309</sup>. And, when the cores of these economies are involved in the creation and manipulation of information and knowledge, any technologies which assist in this regard are likely to have sweeping effects on their overall productive capacities.

However, ICTs - and the primacy of information and knowledge - have affected more than just the rate and extent of growth in the business environment in these economies. Perhaps more far-reaching and permanent is the way that ICTs have affected the *nature* of the modern company. The Internet, as the spearhead of the ICT 'explosion', has – in many cases and industries – significantly altered the structures, strategies, hierarchies and relationships which used to constitute our understanding of a company<sup>310</sup>. As Nielsen and Nielsen<sup>311</sup> point out, the industrial-era companies looked and behaved very differently to the firms competing at the cutting edge of the Knowledge Economy. Internally, the industrial-era company “*was a non-market organisation with a functional division of labour coordinated and directed through the managerial hierarchy.*”<sup>312</sup> This setup stands in contrast to the way in which the modern firm utilises the direct coordination and deliberate sharing of knowledge to align and unify the outputs of its various functional divisions. This has resulted in the collapse of traditional forms of organisational hierarchy, as the “*dependent and dispensable employee who [once acted] under the direction of the managerial hierarchy, and whose efforts [were] coordinated with the work of*

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<sup>309</sup> Webster, 2002

<sup>310</sup> Nielsen & Nielsen, 2003: 3-5

<sup>311</sup> 2003: 7-11

<sup>312</sup> Nielsen & Nielsen, 2003: 7

*other employees through and by that hierarchy, now becomes the de facto owner of some of the knowledge without which the company can no longer develop and compete.*<sup>313</sup>” What this means is that, for the first time, the tacit knowledge embodied in the individual knowledge worker empowers workers at all levels to make themselves an increasingly integral part of the organisational process, flattening the corporate organogram, reducing the ability of management to direct functions unilaterally, and increasing the need for direct interaction, collaboration and knowledge-sharing between those directly involved in the functions of the company.

Externally, where the company was once *“positioned and regulated as part of the wider division of labour through its external relations, which were all mediated by the market and processed in the form of market transactions*<sup>314</sup>”, the modern company must foster a closer relationship with both the consumer and supplier than ever before. Companies can no longer afford to pick and choose suppliers’ products on a whim, remaining independent of those suppliers’ product developments and production processes. Instead, the new trend is towards the forging of lasting relationships that see buyers and suppliers forming symbiotic partnerships that involve in-depth knowledge-sharing, strategic alignment and support structures. These relationships can evolve to the point that the disintegration of one half of the partnership can have disastrous consequences for the survival of the other.

In a similar way, consumers have been brought far closer to the chalk-face than ever before<sup>315</sup>. The utilisation of ICT platforms has made consumer feedback not only easier, more widespread and more direct, but also far more important in the success or failure of an end-product. As websites like Amazon continue to demonstrate, the power of the ‘user review’ to make or break a commercial product has forced companies to open their ears to the demand of the consumer – rather than just manufacturing a product and *then* telling consumers why they should like it. The consumer is now seen as a crucial part of the production process – an indispensable source of knowledge that can provide more and better practical advice about the design of a product than the most expensive R&D processes<sup>316</sup>. As Quah<sup>317</sup> notes, the traditional economy saw

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<sup>313</sup> Nielsen & Nielsen, 2003: 7

<sup>314</sup> Nielsen & Nielsen, 2003: 7-8

<sup>315</sup> Quah, 2003

<sup>316</sup> The European CIS (Community Innovation Survey), now in its third edition, shows that interaction with users is the most important external source of innovation for the modern firm – more important, for instance, than impulses from suppliers, participation at fairs / exhibitions, and even impulses from competitors (Eurostat, 2005).

<sup>317</sup> 2003

knowledge as the first part of a chain running through intellectual property, copyright and patents, and then into the manufacturing process which saw the production of the end-product. In the Knowledge Economy, and largely due to the proliferation and reach of ICTs, the chain 'disappears' as consumers and producers interact directly. Quah refers to this as the "*death of distance*" – something he believes represents a major shift in the nature of the new economy.

Furthermore, the trend towards rapid technological development, coupled with ICTs ability to make knowledge products truly 'globalised' has led to a telling reduction in the product lifecycle<sup>318</sup>. Obsolescence is no longer a constraint placed on a product by a changing market – instead, it becomes an instrumental variable within the company<sup>319</sup>. In the face of rapid, discontinuous changes in the technological platforms underpinning these goods, companies are also tasked to deal with intense global competition for the same customers – further empowering the customers, and forcing those companies to discover new ways to add value in order to differentiate themselves in the marketplace. Quite obviously, it is the consumers who wear the pants (if they decide they would like to wear pants, of course).

New relationship dynamics can also be witnessed elsewhere in the company's external environment – namely, relationships that the modern company has with investors, shareholders and stakeholders. Investors, as 'customers' in the capital market, have also experienced a significant 'empowerment' and are becoming far more involved in the business in which they invest than ever before. The push for increased corporate transparency over the last few decades has given investors a far more detailed look into companies than that which was provided in the industrial-era, allowing investors to become more informed, more connected and more likely to participate in the strategic decision-making process<sup>320</sup>. This increased visibility into the once-closed mahogany boardroom doors has also led to increased pressure from the public for companies to take responsibility for their impacts on the environment in which they function. Corporate Social Responsibility, Environmental Awareness Programs, and Corporate Social Investment initiatives are all part of the demand for companies to act as responsible 'citizens' in their respective environments, thinking about the 'triple bottom line'

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<sup>318</sup> Hammer, 2003

<sup>319</sup> Goldfinger (2000: 68) notes how obsolescence is often taken a step further in the Knowledge Economy: "*In areas, such as microcomputers, obsolescence leads to cannibalisation. Intel and Compaq are particularly skillful in the use of cannibalisation to keep their competitors off balance.*"

<sup>320</sup> Hammer, 2003

rather than merely on profit and market capitalisation. Once again, it is the customers – both investors and end-users – who are dictating matters<sup>321</sup>.

The numerous changes discussed above (as outlined in Table 5.1 and Table 5.2 below) are the result of many different forces and causes, and to highlight them as purely a result of ICTs and the drive towards a Knowledge Economy is overly simplistic and not the author’s intention. However, with ICTs undeniably a common denominator in all of these trends and shifts – as well as being a key driver in the majority thereof – it is hard to deny the dramatic impact ICTs have had on the ‘company’ as we know it. After all, if there has been a significant change in the nature of *every* relationship that the company has internally, and with its extended environment, it is a compelling argument in favour of the idea that ICTs have *fundamentally* changed the modern company. And, to extrapolate, if the company has changed irrevocably, as a pivotal component in the economy at large, this could be indicative that, perhaps, the economy itself is also fundamentally different as a result.

Table 5.1: The changing nature of the Company-Economy relationship<sup>322</sup>

Issue	Old industrial Economy	New Knowledge Economy
Economy	Supplier-driven	Consumer-driven
Lifecycle of products and technologies	Long	Short
Key Economy Drivers	Large Industrial Firms	Innovative, entrepreneurial knowledge-based firms
Scope of Competition	Local	Global Hyper-competition
Competition	Size: Big eats the Small	Speed: Fast eats the slow
Marketing	Mass Marketing	Differentiation and Tailoring

Table 5.2: Internal and External changes to the Company<sup>323</sup>

<sup>321</sup> This trend continues to validate Alvin Toffler’s (1987) astonishing prediction that consumers would start taking far more control over the products they eventually consume (moving from ‘consumers’ to ‘prosumers’). This has been highlighted by the tremendous success of a number of internet-based and ICT-centric companies – from Threadless.com to iStockphoto – who have made use of ‘user-generated content’ in everything from product design, development and feedback to marketing and sales (Howe, 2009).

<sup>322</sup> Adapted from Kotelnikov, 2005 and Nielsen & Nielsen 2003: 8

<sup>323</sup> Adapted from Kotelnikov, 2005 and Nielsen & Nielsen 2003: 8

Issue	Old industrial Economy	New Knowledge Economy
Success Measure	Profit	Market Capitalisation
Key drivers to growth	Capital	People, Knowledge, Capabilities
Decision-making	Vertical	Distributed
Innovation Processes	Periodic, Linear	Continuous, Systemic Innovation
Organisational Structure	Hierarchical, bureaucratic, functional, pyramid structure	Interconnected sub-systems, flexible, devolved, employee empowerment, flat, networked structure
Employee skills	Mono-skilled, standardised	Multi-skilled, flexible
Relationship with Employees	One-to-many control through hierarchy	Employees as owners or partners
Relationship with Customers	Once-off market transaction by salespeople	Close sharing of knowledge, long term relationships and brand-loyalty
Relationship with Suppliers	Price-driven control game by procurement people	Suppliers as a source of knowledge; long term partnerships, symbiosis
Relationship with Competitors	Rare, 'go-alone' mentality; Often minimum direct contact: war game.	Teaming up to add complementary resources; partners in economies of scope
Relationship with Investors	Anonymous mass to be handled through mass market communication	Intense investor relations
Relationships with Stakeholders	Not relevant	Responsible relations with all stakeholders

#### 5.1.4 *ICTs and the Network Society*

These changes in the way that businesses and companies were structured represent both a cause and a consequence of the ICT revolution. The historical development of ICTs traces a fascinating combination of scientific, political, cultural and technological changes that coincided with a global adoption of the university tradition of sharing knowledge and discovery with peers, in the hope of seeing improvements to any technologies by virtue of the collaboration of diverse minds<sup>324</sup>. In direct contrast to the controlling, protective bureaucracies that survived on secrecy and property rights, the move towards the concept of networking, sharing and collaborating – as outlined in detail in the previous chapter – has had far-reaching effects on social, political and economic life. With the restructuring of business in light of the extraordinary diversity of

<sup>324</sup> For a detailed description of each of these factors, see Castells, 2004: 22-36

applications brought about by the ICT revolution, decentralisation – both internal and external to the company – has created an environment in which the centre is less important than ever before. Instead, the power has shifted significantly to the periphery – where the participating ‘individual’ has become collaborator (rather than ‘pawn’), utilising ICTs as the *“essential infrastructure for business to operate its restructuring in terms of globalisation, decentralisation and networking. Only then could the knowledge-based economy function at its full potential because data, minds, bodies and material production could be related globally and locally, in real time, in a continuous interactive network.”*<sup>325</sup>

This ‘periphery’ is described by Manuel Castells<sup>326</sup> as a collection of ‘nodes’ – end points on a network that, when connected, *become* the network. After all, the Internet – the most extensive computer network in history – ceases to exist if every user (or every ‘node’) turns off their computer at the same time. Castells describes the full impact of ICT – through its political, social and economic impacts – as having moved the modern world from an industrialised society, to an ‘informationalised’ one, in which information represents the new ‘raw’ material, and the logic of connecting nodes to form globe-spanning networks (and, obviously, the technologies that allow it), becomes the defining characteristic of our time<sup>327</sup>.

This ‘Network Society’<sup>328</sup> represents a unique phase in history not because ‘networks’ or even ‘communications technologies’ are new in this historical sense – they are not<sup>329</sup>. What *is* new is the convergence of information technologies, communications technologies, and the social and political structures that have made micro-electronics, telecommunications and digital communications all a part of the same, integrated system<sup>330</sup>. The increasing power and portability of these technologies means that individuals (or organisations) can not only capture, process and store information more powerfully than ever before, but they are also *“able to interact anywhere, anytime, while relying on a support infrastructure that manages material resources in a distributed information power grid”*<sup>331</sup>. When you incorporate nanotechnology, microelectronics and biotechnology (all of which are undeniably ICT components or applications), and you link them through the power of ‘always-on’ networks, *“the boundaries*

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<sup>325</sup> Castells, 2004: 32

<sup>326</sup> 2000, 2004

<sup>327</sup> Godin, 2006: 19-26; Castells, 1996:62-65

<sup>328</sup> Castells, 1996

<sup>329</sup> Castells (2004) argues that networks, globalisation and communications technologies (like early electrical telecommunications technologies) were all around for some time without precipitating a ‘network society’.

<sup>330</sup> Castells, 2004: 11

<sup>331</sup> Castells, 2004: 8

*between human life and machine life [become] so blurred [that] networks extend their interaction from our inner self to the whole realm of human activity, transcending barriers of time and space.<sup>332</sup>”* What Castells highlights as the crucial unique feature of *this* era, is that it is *“because of available electronic information and communication technologies that the network society can deploy itself fully, transcending the historical limits of networks as forms of social organisation and interaction.<sup>333</sup>”*

And, ‘fully deployed’ in this way, the power of the ICT-driven network has implications across the board – beyond just assisting in the distribution of information as discussed above. Perhaps most momentous is the way that, as Castells argues, the introduction of communication into an interactive network of this kind represents a dramatic change in the two-thousand year-old pattern of the way humans communicated. The move from oral communication (a combination of auditory and visual stimuli) to written communication had the effect of reducing the importance of sound and images in the face of the written word as a form of communication. Now, the integration of sound, images *and* text into the same global, interactive system has fundamentally changed the nature of communication. What’s more, this system is global, with multiple users from a variety of different cultures, backgrounds and locations. Castells makes use of the work of Neil Postman in stressing the significance of this change to the way that we experience our language: understanding that we do not see reality as it is, but rather through the lens of our language, changing the means through which that language is communicated ultimately alters our foundational conceptions of society<sup>334</sup>.

The other major implication of these networks is the impact on innovation. As was outlined in the previous chapter’s discussion about Open Source, the benefits of connecting interested minds across the globe, and getting them to collaborate on shared issues continue to drive technological innovation with staggering regularity and speed. For the Industrial Enlightenment in Britain, Mokyr<sup>335</sup> highlights the tremendous influence that refugee Huguenot clockmakers had in providing the foundation for England to take the lead in precision instrumentation. That the Industrial Enlightenment took place in Britain owes no small part in the fact that Great Britain became a ‘catchment area’ for waves of religious refugees – often bringing their own extraordinary artisanal skills , and adding them to the ‘cooking pot’. Nowadays, such

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<sup>332</sup> Castells, 2004: 8; Mitchel, 2003

<sup>333</sup> Castells, 2004: 8

<sup>334</sup> Castells, 1996: 328

<sup>335</sup> Mokyr, 2002

collaborations are not only inexpensive, instant and commonplace, but they are also actively sought by those pursuing improvements to all manner of creative endeavours. Simply put, the potential for increasing connections between innovators in different fields and applications is on an entirely new level to anything experienced before.

And, with the power of the network, technologies often take on a life of their own. Castells sees, as another defining characteristics of the ICT-led 'era', the ability of these technologies to 'self-expand' their processing power due to their recurrent, communicative ability – bringing about continuous feedback loops. As Johnson<sup>336</sup> contends, this gives these technologies emergent properties, opening up the ability to generate new, unpredictable processes of innovation by their endless reconfiguration. Castells sees the Internet as taking this even further: *“One of the key contributors of the Internet is its potential ability to link up everything digital from everywhere and to recombine it... From shared art creation to the political agora of the anti-globalisation movement, and to joint engineering of networked corporate labs, the internet is quickly becoming a medium of interactive communication. The added value of the Internet over other communication media is its capacity to recombine in chosen time information products and information processes to generate new output, that is immediately processed in the net, in an endless process of production of information, communication and feedback in real time or chosen time. This is crucial because recombination is the source of innovation, and innovation is at the roots of economic productivity, cultural creativity and political power-making<sup>337</sup>.”*

The effects on the economy and society are widespread. Interactive social participation no longer requires face-to-face interaction, and the speed and multi-sensory manner in which it occurs defies any comparison with industrial-era technologies. Economic life is similarly affected – everything from financial markets, transnational production and manufacturing, management, science, technology, media and services to culture, art, governments, sports and even religions are organised and manipulated by means of these global networks<sup>338</sup>. We are linked anywhere, all the time, across the globe – generating a level of connectedness that means the only way for something we do to remain within our control is to (somehow) withdraw it from the network entirely.

### 5.1.5 *ICTs and Globalisation*

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<sup>336</sup> 2001

<sup>337</sup> Castells, 2004: 18-20

<sup>338</sup> Castells, 2004: 33



From the above discussion, it is not hard to see how ICTs have made the world a smaller place. As a result of deregulation and the advances in ICTs, the modern organisation has become increasingly multinational or transnational. The increased ability to communicate immediately and effectively across countries, continents and time-zones has made it both easier and financially necessary to move the production of goods and services to any locations that offer the most competitive rates. ICTs have been pivotal in enabling the integration of much more globalised financial, goods and service markets, knitting together vastly dispersed global production systems with heightened interoperability, instantaneous (and often, automatic) synchronisation of systems, and ever-cheaper telecommunications.

On top of these more obvious improvements, ICTs have affected globalisation in a number of other fascinating ways. For one, in contrast to the industrial-era norm of shipping heavy items that did not cost much (for instance, cement, pig-iron, wood, fish etc), the economy has increasingly grown to consist of smaller items that cost a lot (like pharmaceuticals, microchips and associated technologies).<sup>339</sup> This has made it far more economically-viable to ship items, significantly raising the distribution of physical goods globally over the past three decades<sup>340</sup>. And this is only with respect to *physical* goods. In terms of knowledge and information, ICTs continue to push the boundaries of what can be codified, digitised and distributed across the globe as a 'commodity'. Primarily, knowledge-based services continue to be outsourced to foreign countries, with call-centres, accounting services, insurance and software design ordered, tendered for, produced and distributed between the thousands of kilometres of fibre-optics cable separating the client and the service provider. This is increasingly allowing business to specialise in what they are good at, outsource their weak areas, and restructure labour, production and distribution arrangements to reduce costs like never before<sup>341</sup>.

From an economic perspective, technological advances continue to open up the possibility for industrially-deficient countries to 'leapfrog' themselves into the upper-echelons of global competition, foregoing the costly and time-consuming industrialisation process and moving straight to the production of high-tech, high-skill products. This is contributing to the levelling of the economic playing field on which industrialised and developing countries meet, with the trend towards national ('locational') specialisation<sup>342</sup>. Furthermore, countries that are

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<sup>339</sup> Atkinson, 2004

<sup>340</sup> Atkinson (2004) notes how this has been evidenced by the inflation-adjusted value of US trade per pound has increased on average 4 percent per year for the last 30 years.

<sup>341</sup> Carlaw, Oxley, & Walker, 2006

<sup>342</sup> Houghton & Sheehan, 2000

geographically isolated have seen the opportunity to compete in markets where geographical distance has been made redundant – namely, in knowledge creation, R&D and high-skill service sectors.

Of course, there are downsides to the escalation in globalised interaction. Just as countries see access to the global ‘network’ as an opportunity to compete, so does a lack of access to the ICT infrastructure further disadvantage the poorer countries that cannot ‘plug-in’ to compete in the global game. A consequence of this is the ‘brain drain’ phenomenon, which sees the brightest minds in developing countries continue to seek greener pastures by moving abroad into countries which can better harness their intellectual capital – and, then, reap its rewards. Also, globalisation and the trading of information goods continue to highlight difficulties in the protection of intellectual property rights across national borders. With no overarching IP ‘police’ – at least, none that have any real impetus across national borders – piracy, disregard for patents and copyright, and the widespread counterfeiting and imitation of products, brands and pharmaceuticals continues to be a major and enduring issue<sup>343</sup>.

To be sure, Globalisation and its associated changes and problems are not all new. As Atkinson<sup>344</sup> notes, “*Just as today’s globalisation is enabled by ICT, [the post WWII-era’s] nationalisation was enabled by new technologies. Air travel, long-distance communications, and truck transport began to recast regional relationships, allowing interlinked economic activities to spread.*” However, any discussion of ICTs and their impact on the modern economy would not be complete without paying reference to the dramatic efficiencies that ICT continues to facilitate. The world is far *more* globalised than ever before, the *extent* of globalisation is at an entirely new level, and advances in ICTs continue to open up new avenues for global collaboration that were never before considered possible.

### 5.1.6 *ICTs and the Knowledge Economy – a Cause and a Result*

Of all the things that are ‘new’ about the current phase of economic development, one would be hard-pressed to find an example that has had as extensive and far-reaching as the impact that ICT – as this generations defining *general purpose technology* – has had on economics, politics and society. As has been discussed in this section, ICTs have had dramatic – and, in many cases, fundamental – repercussions in some of the most foundational aspects of the modern

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<sup>343</sup> Carlaw, Oxley, & Walker, 2006: 650-660

<sup>344</sup> 2004

world. With globalisation taken to an entirely new dimension, with the large-scale restructuring of the vast majority of the relationships that businesses have both internally and externally, and with the integration of social, political and economic life onto multi-sensory, high speed, worldwide networks, it is impossible to imagine how the modern world would function in the absence of ICTs. On top of this, the way in which we approach knowledge and information has been altered forever with the increased capturing, storage, processing and distribution powers that have made it more and more possible to treat knowledge and information as commodities in the global economy.

And, at the heart of all ICTs, is the intention to facilitate in the growth and distribution of our knowledge base. If this economic era can be correctly labelled the 'Knowledge Economy', then it is in no small part due to the impact of ICTs. In this sense, ICTs are both a cause and a consequence of the Knowledge Economy, just as ICTs can be both a means and an end in research, innovation and knowledge management<sup>345</sup>. ICTs may not have caused the shift to a new economic foundation, but without ICTs, it could not exist. Their influence should not be underestimated. As outlined by Castells<sup>346</sup>, *"because information and communication are the most fundamental dimensions of human activity and organisation, a revolutionary change in the material conditions of their performance affects the entire realm of human activity"*<sup>347</sup>. By putting information, knowledge and communication (of information and knowledge) at the core of their applications, ICTs have thus put knowledge and information more at the heart of *"human activity and organisation"* than ever before, representing *"a greater change in the history of technology than the technologies associated with the Industrial Revolution, or with previous Information Revolutions."*<sup>348</sup>

## 5.2 - New Economics

*"In the knowledge economy there are new ground rules. Knowledge has fundamentally different characteristics from ordinary commodities and these differences have crucial implications for the*

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<sup>345</sup> Ho, 2007

<sup>346</sup> Castells, 2000

<sup>347</sup> Castells, 2004

<sup>348</sup> Castells, 2000: 10

*way a knowledge economy must be organised. The whole nature of economic activity, and our understanding of it, is changing.*<sup>349</sup>”

The modern economies of the world continue to highlight the importance of developing and expanding knowledge infrastructure in pursuit of economic growth, demonstrating that those countries best-placed to gather, utilise, diffuse and create knowledge are the ones that are most likely to rise to the top of the global pecking order.

In trying to gather an understanding of the nature of knowledge through the course of this thesis, a large degree of emphasis has been placed on knowledge’s economic characteristics, and their implications on how we should treat it as an economic commodity. As yet, traditional economic theories and models have not been able to adjust convincingly to the challenge that the treatment of knowledge as a crucial factor of production presents. At the same time, the difficulty in measuring knowledge (as an input, process or output) has contributed to much confusion as to the extent of the impact knowledge has had on the modern global economy over the past few years – even to the point where the existence of a ‘new’ economic landscape has been questioned.

For this reason, this section of the chapter will show various aspects of the modern economy that illustrate a significant break with the past as a result of the impact that knowledge has had as an economic commodity – to the point that the economic thinking of the industrial era becomes increasingly outdated, and in need of revision or renewal. This essentially becomes the second indicator of a fundamentally ‘new’ economic era – where the economic understanding that defined the industrial era can no longer fully address the needs of a new, remarkably different economic environment and, hence, is in need of a ‘new’<sup>350</sup> economics’.

### 5.2.1 *Economic Theory*

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<sup>349</sup> Houghton & Sheehan (2000:13) citing Department of Trade and Industry, 1999

<sup>350</sup> Again, ‘new’ in this context should be thought of as representative of a clear difference to the preceding economic ‘regime’. The ‘new economics’ should be an economic theory that is endemic – or created from within the context of the Knowledge Economy, rather than trying to manipulate enduring economic models to accommodate to account for knowledge’s unique economic attributes.

When Paul Romer<sup>351</sup> introduced the world to his ‘New Growth Theory’ at the start of the 1990s, it set in motion a vigorous and longstanding debate about the continued relevance of the economic theories and models that had for so long been the backbone of the industrial era. Neo-classical economics had attempted to account for the increasing emphasis placed on knowledge and innovation in the production process by treating it as an important, but external variable that impacted upon the two primary factors of production – labour and capital<sup>352</sup>. This so-called ‘exogenous’ model of growth viewed technology as a natural order of things – an ever-growing set of knowledge that emerges over time, rather than as a result of specific economic endeavours. This gave technology (incorporating ‘knowledge’) a passive role in the economic models that followed off the back of the theory, and anything that could not be explained by the interactions of capital and labour were referred to as ‘the residual’ – attributable to improvements in technology<sup>353</sup>.

With technology on the sidelines, economic theory was freed up to concentrate on the two most important elements in industrial-era thinking – the capital (machinery) that comprised the factories, and the labour (humans) that were employed to work those machines. This simplification led to a number of valuable analytical models which, among other things, showed that – under those conditions – markets are generally highly competitive, they do not tend towards monopolies, and that the optimisation of production and allocation levels can be achieved by leaving the market to its own devices<sup>354</sup>. Most crucially, the physical world of labour and capital was seen to be characterised by diminishing returns – a function of the scarcity and rivalrous nature of physical world objects.

The inspiration behind Romer’s New Growth Theory stemmed from his observation that economic growth could not be accurately explained by models that focused exclusively on capital and labour, treating technology as something external and assumed. In a world of diminishing returns (and therefore increasing marginal costs), technology is the *most critical part* of sustained economic growth<sup>355</sup>. Romer<sup>356</sup> makes it clear that “*the classical suggestion that*

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<sup>351</sup> 1990

<sup>352</sup> Solow, 1956

<sup>353</sup> Fagerberg, 2006

<sup>354</sup> Cortright, 2001

<sup>355</sup> Kumar (2005: 12) shows how a number of authors see information and knowledge as the primary input into modern productive systems: “*The information society, according to its proponents, brings about change at the most fundamental level of society. It initiates a new mode of production. It changes the very source of wealth creation and the governing factors in production. Labour and capital, the central variables of the industrial society, are replaced by information and knowledge as the central variables. The labour theory of value, as*

*we can grow rich by accumulating more and more pieces of capital like fork lifts is simply wrong.*” While this new thinking about increasing returns did no favours for the comfortable mathematical models that diminishing returns made possible, it did make New Growth Theory more adaptable in terms of its ability to incorporate the unique economic characteristics that knowledge brings to the fore – namely, the non-rivalrous nature that makes increasing returns a distinct possibility<sup>357</sup>.

This simple notion – that economic goods can enjoy increasing returns to investment – causes significant upheaval to the economic theories that did not consider technology an integral part of economic growth. The ability that knowledge assets have to ‘grow on themselves’ has remarkable implications for the development of the economy. As Cortright states, *“Traditionally, economics has been regarded as the dismal science, because it kept suggesting that we would eventually run into serious limits to growth in our finite world... New Growth Theory implies, however, that we continue to increase living standards for centuries to come by steadily improving our knowledge of how to produce more and better goods and services with ever-smaller amounts of physical resources.”*<sup>358</sup> Knowledge’s capacity to generate increasing returns means that the growth of ideas can be exponential and, therefore, the opportunities for growth in the economy can be almost limitless.

From what has been uncovered about the economic characteristics of knowledge in this thesis thus far, it is possible to get an inkling of the complexity that knowledge as an economic good brings to the subject of analytical economics. The standard ways that pricing and transaction mechanisms were captured when dealing with the physical goods of the industrial era are simply inadequate when dealing with the intangible goods of the Knowledge Economy. Firstly, production costs can no longer inform pricing, as the proportionality between inputs and

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*classically formulated by a succession of thinkers from Locke and Smith to Ricardo and Marx, must give way to a ‘knowledge theory of value’. Now, ‘knowledge, not labour is the source of value (Bell, 1973).’ Stonier argues that ‘information has upstaged land, labour and capital as the most important input into modern production systems (Stonier, 1983: 8). And Yoneji Masuda, the leading Japanese exponent of the information society concept, proclaims that in the new society, ‘the information utility...consisting of information networks and data banks’, the core organisation for the production of information, ‘will replace the factory as the societal symbol’. It will have the ‘fundamental character of an infrastructure, and knowledge capital will predominate over all material capital in the structure of the economy’ (Masuda 1985:621,62).” see also Masuda, 1981, Bohme and Stehr, 1986)*

<sup>356</sup>Romer, 1986

<sup>357</sup>Cortright, 2001: 3-7

<sup>358</sup>Cortright, 2001: 6

outputs is no longer a suitable determinant – or, as Goldfinger<sup>359</sup> puts it, “*Mass consumption does not imply mass production. Best-selling books, records or movies are created by small creative teams and their revenues are not related to their costs.*” The second approach, based on the ‘willingness to pay’ is also problematic. The ease with which these goods can be replicated and shared has significant repercussions for the effectiveness of this method<sup>360</sup>. Further, as Stiglitz<sup>361</sup> notes, knowledge goods have the problem of being an ‘experiential good’ in that it is impossible to determine whether it is worthwhile purchasing a piece of information until you have actually obtained it – a problem he calls “*infinite regress*”.

Of course, the difficulty faced in finding effective pricing mechanisms means that knowledge markets often do not send the same quality of price signals to suppliers and consumers as physical goods, and the lack of security in patenting, coupled with the unpredictability of spillovers and network effects, makes achieving consistency in treating knowledge as an economic commodity all the more trying. Add to this the permutations on the enduring understanding of monopolistic competition discussed in Chapter Four<sup>362</sup>, and economists really do have a tough job on their hands.

In trying to come to terms with the dramatic increase in the complexity of the modern economic system (and the theory required to make sense thereof), Nelson and Winter<sup>363</sup> proposed that we started to understand the economy not as the equilibrium-seeking Newtonian phenomenon we once imagined, but rather as an *evolutionary* system in which change is a natural, ongoing occurrence, and the business environment serves to ensure that the fittest, most effective ‘routines’ will survive. Where classical economy theory envisioned individual firms as rational, profit-maximising actors allocating resources that would ultimately drive the economy back to a stable equilibrium, Nelson and Winter see the economy in a permanent state of dis-equilibrium. Growth occurs as a result of discontinuous changes in which changes to the environment or experimentation and innovation in businesses’ routines cause some firms to prosper and others to die off<sup>364</sup> - either through lack of fitness, or as a result of ‘*creative destruction*’<sup>365</sup>.

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<sup>359</sup> 2000: 63-64

<sup>360</sup> Goldfinger, 2000: 63

<sup>361</sup> 1985

<sup>362</sup> See section 4.5.2

<sup>363</sup> 1982

<sup>364</sup> Nelson & Winter, 1982; Cortright, 2001: 13-17

<sup>365</sup> Carlaw, Oxley & Walker, 2006:646-647

In addition to adding a variety of new insights into the workings of the economy, this *evolutionary* approach to economic theory joins New Growth Theory in signifying the need to incorporate the speed and extent of change brought about by technological change over the last few decades – changes that classical economic theory was struggling to process. A look at the development of economic theory over the past few decades reveals that the increased focus on knowledge has brought about a substantial reassessment of the theories and models used to inform policy decisions in the leading countries of the world<sup>366</sup>. While by no means complete or universally excepted, it seems that the new theoretical approaches discussed above go a long way towards more effectively incorporating the causes and consequences of technological growth in a knowledge-based economy. At the same time, neoclassical economic theory still holds valuable analytical and policy-informing insights, and it would be foolish to disregard it completely in helping to make sense of our modern economy. What is evident is the fact that the rise of knowledge and technological goods to prominence in the leading economies of the world has created a vibrant and dynamic debate about the relevance of enduring economic theories. The lack of a universally accepted theory and the marked absence of effective measurement criteria and analytical models<sup>367</sup> demonstrate the need for a new line of economic theory in the face of the unique challenge that knowledge brings to the equation.

### 5.2.2 *Markets, Businesses and Workers*

Moving from economic theory to an analysis of the practical workings of the modern capitalist economy, it is useful to highlight a number of trends that have started to take shape over the past few decades that have shown significant changes in the way that markets, production system, businesses and individual workers function when they gear themselves toward knowledge-intensive economic activity. The changes experienced in each of these segments of the economy are not all equally dramatic, extensive or even new – in some cases, the full extent of these changes will only be realised in years to come. However, what will become clear in this brief look into the real-world functioning of economic units is that the newly-intensified focus on knowledge as a crucial output of individual workers, businesses and markets alike has brought about telling changes to the way we think about the world of business – and, therefore, the way that we need to think about economics as a whole.

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<sup>366</sup> Stiglitz, 1999

<sup>367</sup> For a more detailed description of the tremendous difficulties faced in creating effective measurement and modelling strategies with knowledge economies, see Oxley, Walker, Thorns, & Wang, 2007.



### 5.2.2.1 Markets

The most profound change to the traditional concept of the 'market' has been the impact of digitisation. For the first time in history, the digitisation of information goods makes it possible to sell a commodity that can be both completely intangible (i.e. not a physical item) and person-independent. At the same time, the non-rival nature of information goods means that products and services can be sold and administered online with no person-to-person contact, and without exhausting any of the resources (including the creators' time, energy etc) with each additional unit sold. As global bandwidth grows steadily in both speed and capacity, more and more companies specialising in the production of information goods (the number of which continues to increase as the ability to 'capture' goods in digital form breaks new ground<sup>368</sup>) are moving their services online so that they can be sought, advertised, purchased and delivered through the Internet.

The digitisation of markets, and the ability of individual users to manage their own buy-and-sell transactions has created worldwide, real-time online virtual markets which are 'administered' by little more than the coding platform that has been to support them. The most remarkable example of a virtual market has been in the financial services sector – a market once the domain of yelling stock traders and analogue stock tickers. The transformation of the NASDAQ<sup>369</sup> stock market is a case in point: *"When it began trading in 1971, NASDAQ was the world's first electronic stock market. At the beginning it was merely a computer bulletin board system and did not connect buyers to sellers. Most trading was actually done via the telephone. This changed when, during the October 1987 stock market crash, it became evident that brokers often did not answer their phones. To solve this problem, NASDAQ established the Small Order Execution System (SOES), which provides an electronic method for dealers to enter their trades. Over the years, NASDAQ's trade and volume reporting and automated trading systems have revolutionised the global exchange sector. The year 2004 was a landmark for NASDAQ, as it*

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<sup>368</sup> It seems remarkable that only 20 years ago, goods like music, photographs, video and books were only available in 'hard-copy'. Now, purchasing the latest song from your favourite artist can be done online on iTunes.com, digital photographs can be purchased and downloaded online, feature films can be downloaded and even 'rented' online, and novels can be downloaded in digital format to be read on any number of portable / personal digital devices (that is, if you wouldn't prefer the digital audiobook).

<sup>369</sup> NASDAQ – the National Association of Securities Dealers Automated Quotations Stock Market

*surpassed the New York Stock Exchange in annual share volume. Today, NASDAQ is the most efficient stock exchange system in the world.*<sup>370</sup>”

Virtual markets of this sort have never existed before the onset of ICTs and the willingness and ability to trade in information and knowledge commodities. Online trade has raised issues surrounding the effectiveness and design of intellectual property rights – a subject discussed in greater detail in Chapter 4. On top of this, it has generated a host of new challenges and opportunities for content creators, platform developers, buyers, credit card companies, and service providers alike. Some fascinating trends have also emerged, often generated by the users of these virtual markets as apposed to the administrators or creators thereof. For instance, websites like Amazon.com and eBay.com have built their success on the use of ‘reputation economies’ – a system of peer-review ratings that enable sellers and buyers in virtual markets to build up reputation capital based on the honesty of their interactions online. As Herings and Shinckel<sup>371</sup> point out, the difference between buying a book, for instance, in a real-world bookstore (where the product can be taken home immediately) compared to an online bookseller (where there often some time between payment and receipt of the goods) necessitates a certain ‘leap of faith’ on the part of the consumer. Due to the intangible and impersonal nature of the transaction process, *“both the payment and delivery require trust of the buyers in the system of the seller, as well as trust of the seller in the credibility of the buyer.”*<sup>372</sup>The extent to which trust and reputation become important is more amplified here than in any other form of market.

What this type of market represents is indicative of a general trend. Markets no longer merely support the trade of physical products – rather, it is in the facilitation of the exchange of intangible goods like information and knowledge that modern markets are experiencing the fastest growth<sup>373</sup>. The complexity and uniqueness of virtual markets adds a fascinating new dimension to the modern economy – one which will continue to place new demands on the systems that govern the transactions, property rights, delivery and production of goods and services.

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<sup>370</sup> (Software and Information Industry Association, 2008: 15)

<sup>371</sup> 2004: 12-15

<sup>372</sup> Herings & Schinkel, 2004: 12

<sup>373</sup> Goldfinger, 2002

### 5.2.2.2 *Businesses*

The individual businesses is an undeniably integral part of the overall economy and as a unit of analysis, it has a significant role to play in economic theory and forecasting. As we have seen already in this chapter, the far-reaching effects of ICTs have impacted heavily on the modern business unit –in terms of how it plans, adapts, interacts and functions in the external environment. Businesses have needed to change the way that they consider everything from the way that they research, design, market and sell their products, to their overall strategic objectives which, in many cases, may be very different to how they looked a decade ago. Naturally, these changes need to be reflected in the economic theory that hopes to capture the essence thereof in pursuit of valuable analysis in modelling. Therefore, as far as ICTs have driven changes in the individual businesses, economic theory has had to adapt to remain relevant and accurate.

Of course, these changes are not only a result of ICT advancements and the increased trade of intangible goods, nor has it been limited to the internal workings of the modern business. In terms of economic theory, a number of other interesting new trends have also arisen which have affected the global economy.

One such trend is the rise of innovation and R&D as an organised activity within modern firms – something that Fagerberg<sup>374</sup>, among others, considers to be one of the defining aspects of what is ‘new’ about the Knowledge Economy. He notes that, a century ago, setting aside resources for R&D was very rare – if not unheard of. Today, by contrast, R&D is a fundamental part of the modern firms’ budgetary and strategic decision-making, and leading companies see it as critical for their survival in highly competitive markets. As Nelson and Wright<sup>375</sup> point out, this process of change started in Germany, and continued in the US from the Second World War onwards, making this a fairly recent phenomenon. Combine this with the increasingly supportive R&D and skills-development infrastructure (which is undoubtedly a post-war phenomenon<sup>376</sup>), and the entire innovation-centric business environment becomes a critical new factor in the advanced

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<sup>374</sup> Fagerberg, 2006: 11. See also Nelson & Wright, 2002

<sup>375</sup> 2002

<sup>376</sup> In most cases, in fact, it is even far more recent than that (Fagerberg, 2006:21).

global economies – to the point that knowledge is “*not only the resource for industrial production anymore, it is its subject.*”<sup>377</sup>

Another trend pertains to the geographical distribution of transnational firms. Despite the fact that ICTs have enabled people and companies from all over the world to contribute irrespective of their geographical location, the nature of knowledge and the way that firms interact in the Knowledge Economy has led to a tight clustering of globally competitive firms in very specific locations in the countries in which they are based<sup>378</sup>. The reason for this seems to be the fact that, while the Internet is highly effective at spreading information and knowledge assets, it is not always so effective at spreading tacit knowledge elements that contribute to vital processes like translation, understanding and ‘gut-feel’ about certain issues, decisions, or people<sup>379</sup>. This has brought about the trend towards a host of firms within a particular industry ‘co-locating to specific geographical locations, enabling the establishment of vibrant labour markets comprising similar skills sets, increasing the likelihood of building relationships with potential collaborators, and maximising the potential for knowledge spillovers<sup>380</sup>.

This works in parallel with another important trend, highlighted in the discussion of the effects of ICTs on business earlier in this chapter – namely, the increased collaboration of firms with their competitors. In direct contrast to the industrial-era trend towards industrial secrecy and protection of intellectual assets, the Knowledge Economy has seen an increase in the number of firms – especially in the high-tech industries – who are seeking collaboration with their competitors in order to maximise the effects and minimise the costs of the R&D initiatives that are required to keep them successful in the face of increasingly demanding, informed and complex customers<sup>381</sup>. Also, the increased complexity of knowledge-rich goods and products has led to the emergence of specialised firms becoming the ‘masters’ of a particular area of focus. As technological products continue to incorporate myriad new technologies into a single

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<sup>377</sup> Müller-Prothmann, 2006: 12

<sup>378</sup> Cortright, 2001: 19-20

<sup>379</sup> Vaitlingham, 1998

<sup>380</sup> Karlsson & Johansson (2004: 9) describe knowledge spillovers as follows, noting that a new technological improvement from one firm “*increases the stock of technological knowledge and may spillover to other firms investing in the production of technological knowledge...In this way, it increases the productivity of knowledge production in the economy and it may very well be so that new knowledge benefits others as much or even more than they benefit the creator of the new knowledge.*”

<sup>381</sup> Vaitlingham, 1998; Howe (2009)

product<sup>382</sup>, it is becoming necessary to draw on a wider range of inputs from a larger number of different firms. As each of these technologies ‘centres of excellence’ in different locations across the globe, multi-tech firms are required to be multinational in order to locate themselves in the hotbeds of development in each of their associated technological components<sup>383</sup>. The implication that this has for economic policy-makers in countries all over the world are significant.

Trends such as these, combined with the significant changes to firms as outlined in Table 5.2, show that the internal and external workings of the firm participating in the modern economy have changed a great deal in recent times. To be sure, not all companies have gone equally far in each direction, not all industries are affected in the same way, and there is a wide degree of variations across countries, sectors and individual companies<sup>384</sup>. However, in principle - if not only in practice – the transformations facing the modern conception of a company in aspects stretching from its strategy, employees, customers, suppliers and stakeholders to its competitors, knowledge partners and place in the market are substantial and, in many cases, momentous. As a consequence, these transformations are likely to continue to have a long-term revolutionary effect on the economy as a whole<sup>385</sup>.

### 5.2.2.3 *Workers*

Whether or not the changes are entirely new or extensive enough to herald a new ‘era’, there is little doubt that the definitions of what it means to be a ‘worker’ in the modern economic context varies a great deal from the Industrial-era conceptions. Ever since the coining of the term ‘Knowledge Economy’, the literature documents a frenzied struggle to find a comprehensive definition of what it means to be a ‘knowledge worker’. Drucker’s original conceptual definitions focused on comparisons between ‘manual workers’ and ‘knowledge workers’ – the latter of which faced a work environment which involved abstractly defined tasks (vs. clearly defined tasks), flexible application of knowledge, continuous learning and innovation in job roles, high degrees of worker autonomy, and the perception that workers should be

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<sup>382</sup> For instance, think of the development of the cellular telephone from one that simply dials a phone number and receives calls, the email, video, photo, Bluetooth, GPS, internet etc capabilities of the cellular phones that are becoming standard in today’s markets.

<sup>383</sup> Vaitlingham, 1998: 7

<sup>384</sup> Nielsen & Nielsen, 2003: 7

<sup>385</sup> Nielsen & Nielsen, 2003: 8

regarded as organisational assets<sup>386</sup>. While these were useful in laying down some guidelines for further analysis, they did not specify the occupations that might fit into the knowledge worker category. This, among many other things, has contributed towards much uncertainty around the terms ‘knowledge workers’ and ‘knowledge work’ – two concepts that are often used, but seldom defined.

Indeed, there have been numerous attempts to answer these critical questions surrounding knowledge workers – namely, who are they, what do they do, where are they employed, what are their job characteristics, and how do they fit into organisational structures in the Knowledge Economy<sup>387</sup>? The pursuit of these answers is important for many reasons – the most crucial of which is that a more decisive definition of knowledge work and what it entails will form the backbone of statistical and qualitative analysis into extent of the change in the modern economy over the past few decades that has seen, by all definitions, a steady and significant increase in the proportion of ‘non-manual labour’ to ‘manual-labour’<sup>388</sup> in modern economies.

The extent to which knowledge workers require skills that are not as important to the daily endeavours of their manufacturing or agricultural counterparts is still up for debate. While the stock broker or political consultant certainly requires the foundation of a higher level of education and, in all likelihood, is required to learn and solve problems creatively on a more frequent basis than, for instance, a mine worker, it cannot be disputed that all forms of work comprise a knowledge component. As Kusterer<sup>389</sup> points out, even “*unskilled workers must acquire a substantial body of knowledge to survive and succeed on their jobs – despite mechanisation and automation, despite bureaucratisation and the ever narrower division of labour.*” However, this argument should not be taken seriously as a critique of the idea that the nature of work in the modern economy has shifted significantly towards the use of information-processing, symbol-manipulation, creativity and decision-making skills as the most sought-after

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<sup>386</sup> Drucker, 1994; Brinkley, Fauth, Mahdon, & Theodoropoulou, 2009: 10-12

<sup>387</sup> For a comprehensive summary of the work done in this pursuit, read Brinkley, Fauth, Mahdon, & Theodoropoulou, 2009.

<sup>388</sup> Brinkley, 2006: 14-18. The use of ‘non-manual labour’ vs. ‘manual labour’ as descriptors of two broad categories of worker takes numerous forms in the literature: ‘knowledge worker vs. manual worker’, ‘highly-skilled labour vs. low-skilled labour’ etc. They all serve to illustrate a distinction between those workers who deal primarily with information-processing and knowledge-creating tasks, as opposed to those who perform tasks which make use of physical labour – i.e. the tasks most often associated with the manufacturing processes, and hence, the Industrial Era. Brinkley (2006) notes how in Britain, the percentage of ‘highly-skilled’ workers in the economy is upwards of 40% - a number which is climbing steadily. In the USA, the number may be as high as 60%

<sup>389</sup> 1978: preface

and highly-paid in the contemporary workforce. Indeed, as Müller-Prothmann<sup>390</sup> notes, *“Professional workers are not confronted with the task to find any solution for a given problem, they are confronted with the problem that they know too much to reach the solution (and to choose their actions within a given time).”* The skill-sets required to make this critical adjustment are recognised as dealing mostly with the production of intangible ‘knowledge goods’, and are for this reason loosely grouped into the category labelled ‘the services sector’<sup>391</sup>.

Brinkley<sup>392</sup> summarises a number of expert opinions by offering three different definitions of what it takes to be a ‘highly-skilled’ worker of this nature. Firstly, knowledge workers could be thought of as *“all those who work in the top three standard occupational classifications (managers, professionals, associate professionals)”*. Alternatively, they may be thought of as *“all those with high level skills, indicated by degree or equivalent qualifications”*. Lastly, he notes that may comprise of *“all those who perform tasks that require expert thinking and complex communication skills with the assistance of computers”*. Using this as a foundation, these three definitions designate a rather elite class of worker with both the characteristics of high intellectual capacity and the education to match. Certainly, economies which show an increasing proportion of workers of this type constitute economies which are significantly different from industrial era economies which, in 1920 USA for example, showed the ratio of manual to knowledge workers at 2:1<sup>393</sup>.

As economies develop and become more knowledge-intensive, the demand for highly-skilled labour of this sort is shown to increase significantly relative to the demand for low-skilled labour<sup>394</sup>. This may be attributable to the computer-labour substitution, where technology is used to substitute for low-skilled labour, thus reducing demand. Indeed, there seems to be a point at which one’s education level determines whether ICTs and related technologies switch from being complementary to one’s productivity to substitutive – i.e. it is only at a certain level of education that ICTs increase a worker’s efficiency and productivity. For low-skilled workers, this is bad news, as increased productivity as a result of this ‘skills mismatch’ hypothesis

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<sup>390</sup> 2006: 12

<sup>391</sup> The ‘services sector’ classification, it is argued, is a categorization that is so broad, misused and variously-defined that it is of little value in adding anything substantial to the Knowledge Economy debate. For instance – a janitor provides only a ‘service’, and produces nothing tangible. Does this mean that the janitor becomes part of data collected to estimate the size of the ‘services sector’ (and, by implication, the number of knowledge workers)? What of the teacher, the doctor and the hairdresser?

<sup>392</sup> Brinkley, 2006:16-18

<sup>393</sup> Naisbitt, 1982

<sup>394</sup> Powell & Snellman, 2004: 212

translates only into a higher demand for high-skilled labour<sup>395</sup>. Whether or not this trend leads to an increase in unemployment levels is uncertain – much of the unemployment generated as a result of technology-influence downsizing is often redressed by smaller firms creating new jobs<sup>396</sup>. However, where the difference *is* felt is in the income discrepancies between the two labour groups, which sees a dramatic increase in the gap between low-skilled workers and high-skilled worker, especially at the highest education levels. Modern economies are thus facing a situation in which the workforce is becoming increasingly polarised in terms of average earnings – a situation which could have profound policy implications down the line.

### 5.2.3 Retirement

Another major change is taking place with regards to the Industrial Era concept of mandatory retirement. In a number of countries across the world, it has long been a standard in numerous industries and professions that when employees that reach the age of 65<sup>397</sup>, they are forced into retirement, regardless of whether or not they would like to continue working<sup>398</sup>. This practise is believed that have its origins in Germany where, at the turn of the 19<sup>th</sup> Century, it was decreed that employees would be required to retire upon reaching the age of 70 years<sup>399</sup>. In depression-era USA, mandatory retirement was enforced at the age of 65 – primarily to make jobs available for younger workers to enter the workforce, but also – as described at the time – workers beyond the age of 65 *“tend to lose the ability to keep up with the technological advances of industrial society, are frequently subject to ill health and disability and are less productive under difficult work conditions”*.<sup>400</sup> Certainly, in a era where the vast majority of the workforce was employed in physical labour-intensive jobs, the mandatory retirement age of 65 was a concept that made a lot of practical sense.

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<sup>395</sup> Powell & Snellman, 2004: 212-214

<sup>396</sup> Schultze, 2000; Audretsch & Thurik, 2000. Interesting, Audretsch and Thurik see this in a wider context of how economic policy treated high unemployment rates. Traditional economic policy suggested that high unemployment could only be reduced by lowering wages. However, in this ‘new’ economy, it has been evidenced that high unemployment and high wages can go hand-in-hand, just as low wages do not necessarily imply high employment. As highly-skilled workers are finding technology which complements their skill-sets and enhances their productivity, firms are able to downsize without compromising on output or quality. This is another challenge for enduring economic policy in the face of a new economic ‘ballpark’.

<sup>397</sup> While this is the usual requirement age in the UK, the USA and Canada, this age does differ slightly from country to country. The USA (along with Australia, New Zealand, and a number of other countries) does not enforce this retirement in terms of legislation – it is most commonly built into employment contracts.

<sup>398</sup> Johnson, Mermin, & Resseger, 2007

<sup>399</sup> Yeawood-Lea, 2006:4-8

<sup>400</sup> Yeawood-Lea, 2006:2



Of course, the shift from Industrial to knowledge work has seen dramatic changes in the nature of work, the requirements of the average worker and the health and life expectancy of populations in first-world countries. Johnson et al<sup>401</sup> note how studies in the USA show that even in the last 35 years, the percentage of jobs demanding any great physical activity decreased from 57% to 46%, while the number of jobs requiring high cognitive ability and strong interpersonal skills increased by over 35% in this time period<sup>402</sup>. It would not be unreasonable to imagine that the changes over the last 70 to 100 years would be even more pronounced. At the same time, advances in medicine, medical treatments, nutrition and other factors have led to dramatic and sustained increases in the life-expectancy of people in first world countries, coupled with increased quality of life at older ages. US data shows how depression-era life-expectancy was at 59,2 years, while 2003 figures pinpoint life-expectancy at 77,5 years<sup>403</sup>. With both the nature of work, as well as the 'functional' capacity of an employee around the age of 65 being dramatically different to what they were at the time when mandatory retirement was first implemented, it is easy to see how this is a concept which is well past its sell-by date.

Unsurprisingly, many nations have started to adjust their policies and stances towards retirement on the basis of age. What this means is that workers across the globe will be working beyond traditional retirement ages, which will contribute to the ageing of the global workforce. This will have a number of implications for the economy. Firstly, industries that have been experiencing labour shortages over the past decade will be able to hold on to their most experienced workers, bolstering the number of 'expert' workers. Secondly, extending the working age will help to ease pressure on the 'greying workforce' dilemma which has troubled many first-world nations like Japan and Holland<sup>404</sup> which saw a disproportionate number of pension-taking retirees to tax-paying workers, which placed tremendous strain on social retirement-benefit structures<sup>405</sup>.

These changes, among a host of others, will have a significant impact on the nature of the workforce in modern economies, as well as the economic system as a whole. With no designated retirement 'destination', individuals, firms and governments will have to reconsider

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<sup>401</sup> Johnson, Mermin, & Resseger, 2007: vii

<sup>402</sup> Johnson, Mermin, & Resseger, 2007

<sup>403</sup> Shrestha, 2006

<sup>404</sup> Stam, 2003: 1-3. At the current rate, should retirement ages not be adjusted in the OECD area, by 2050 there will be only two people of working age (15-64) to support one retiree. Increases in taxes would become a necessity as fewer tax-paying workers would have to share the burden on an increasing number of pension and welfare-taking retirees.

<sup>405</sup> Johnson, Mermin, & Resseger, 2007: 1-3

their financial and HR planning in order to adequately adjust for an older workforce and fewer retirees – with all the economic, social, financial, health and other considerations that come with it.

#### 5.2.4 *The Evolution of Money , Finance and Strategy*

*“Information about money has become more valuable than money itself.”<sup>406</sup>”*

Of all of the ‘commodities’ associated with the global economy, it is unsurprising that money has undergone quite dramatic changes over the past few decades. So dramatic, in fact, that the relative weight of non-cash money transactions now exceeds the value of cash money transactions by a factor of ten<sup>407</sup>. Long gone are the days when a person’s wealth could be accurately calculated by counting their stock of physical bank notes, coins and gold bars. Instead, money and payments in the modern economy are almost entirely made via electronic networks, and processed automatically as digital data bits. Of course, in this form, they become subjected to all of the tremendous benefits and risks that apply to any other digital ‘goods’ that exist entirely in the ‘thin air’ that is the internet’s remarkable network. From a practical perspective, what these changes have meant is that monetary and financial systems have basically become information systems<sup>408</sup> - characterised by a system of linked accounts through which people all over the world can conduct their economic relations with one another.

However, as Goldfinger<sup>409</sup> shows in his analysis of the implications of electronic money in the ‘intangible economy’, the changes to money have gone beyond just its appearance and operational mechanics. Rather, the ICT-driven changes have fundamentally altered the *structure* of the money markets of the world. *“The triumph of markets means that money is increasingly used to settle multilateral transactions rather than bilateral commercial transactions,”* Goldfinger notes. *“This functional evolution in turn leads to profound modification in the design of clearing systems and networks, which need to handle larger volume, work in real time, and offer more open access. While banks continue to play a key role in the management of these systems, external pressure to open them to other actors grows more intense.”<sup>410</sup>”*

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<sup>406</sup> Wriston, 1992

<sup>407</sup> Goldfinger, 2002: 103

<sup>408</sup> Robertson, 1989

<sup>409</sup> 2002: 103-106

<sup>410</sup> Goldfinger, 2002: 103

On top of this, the trade of money and money instruments has started to outstrip markets for equity and for any commercial goods. The volume of foreign exchange transactions is around 1500 trillion dollars a day – a number which is 70 times larger than the international trade of goods<sup>411</sup>. Markets for various forms of money are being used the world over to fix the key money variables, interest rates and exchange rates, making monetary policy more important as a tool for economic management than ever before<sup>412</sup>. However, these changes have also made money more visible and pervasive, and with access to information being so immediate and widespread, the economy has become highly data-sensitive to the point of being *“intrinsically self-reflective: [continuously monitoring and measuring] its own behaviour. As soon as authorities announce a monetary aggregate target, financial intermediaries adopt strategies that minimise its pertinence and causality.”*<sup>413</sup>“What this demands is a frequent reanalysis of the approach to financial and economic decision-making.

### 5.2.5 *New Markets Structures and New Strategies*

The re-analysis of decision-making strategies does not stop there. The primacy of the ‘intangibles’ of information and knowledge commodities in the modern economies of the world have dramatically re-shaped the market structures that used to define corporate strategy. It used to be, according to Don Tapscott<sup>414</sup>, that competitive strategy was all about the internal challenge of creating differentiated products or services, or having lower costs. Now, in contrast, it seems that it all about architecting capability – to the point that the strategy *is* the organisation<sup>415</sup>.

The unique economic characteristics of knowledge are effecting changes to the traditional understanding of supply and demand dynamics that made competitive market structures (especially those with many suppliers behaving as price-takers) increasingly rare and unlikely<sup>416</sup>. Instead, there seems to be a tendency towards high concentration and ‘new monopolies’ emerging from either one dominant firm and a small number of competitors, or a structure of monopolistic competition with a number of firms offering variations of the same basic product. In the latter case, the focus becomes creating a ‘first-mover’ advantage in order to generate a

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<sup>411</sup> Goldfinger, 2000: 72

<sup>412</sup> Stiglitz, 1985; Goldfinger, 2002

<sup>413</sup> Goldfinger, 2002: 104

<sup>414</sup> Tapscott, 1995

<sup>415</sup> Eustace, 2002: 2-3

<sup>416</sup> Herings and Schinkel, 2004: 15

large market share – even if it means giving away the product for little to no cost to the consumer. It is then up to producers to employ other innovative means to reap the rewards for their products, and the sunk costs of R&D, advertising and the like that were spent developing and marketing the product initially.

The first of these innovative methods is product differentiation. The nature of modern economies and global competition has forced old mass production models to respond to the demands for mass-customisation by customers whose basic demands are essentially satisfied. As such, markets for these goods and services have matured to the point that these ‘basic needs’ products have become commoditised, making it harder for any single firm to achieve monopoly profits – or even competitive advantage<sup>417</sup>. This has led to an ‘adapt or die’ situation where firms in these mature markets need to change their strategies – at the very least – at the pace of the market. So, product differentiation becomes key: focusing on non-price factors of competition, like tailoring products to custom-fit the end-user. This strategy is born out of the need created by changed market conditions, but is also only possible as a result of the technologies changes which caused those changes in the first place.

The second means of seeking and protecting profits in knowledge-commodity markets is the concept of ‘locking in’ users by utilising the effects of switching costs on inhibiting consumers from changing to an alternative supplier. With products like software and any information commodities which require learning on the part of the consumer, lock-in can be achieved by controlling the compatibility relationships between using the products from one firm versus a competitor product from another firm<sup>418</sup>. Even something as simple as changing from Microsoft Windows to Apple OSX operating systems involves enough of an investment on the part of the consumer to deter a large number of consumers from switching platforms. And, with lock-in becoming something that has a considerable impact on the purchasing decisions of consumers, this falls in line with the strategy of rapid market-share capturing as firms scramble to get the initial locked-in user base before adjusting price decisions or selling alternative products or services to boost profits down the line.

Thirdly, as discussed in greater length in the previous chapter, firms also attempt to use Intellectual Property Rights as an integral part of competitive strategies in the new market

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<sup>417</sup> Eustace, 2002: 3

<sup>418</sup> Herings and Schinkel, 2004:17

conditions. However, as evidenced by the discussion in Chapter 4, IPRs have achieved only limited success in coming to terms with knowledge and information commodities in the modern economy – due the difficulty in measuring the value (and potential value) of knowledge goods, the ease at which knowledge goods can be replicated and distributed, the complexities involved in pin-pointing patentable knowledge, and drastic flaws in global patent law and enforcement, among other things. On top of this, the complementary nature of innovative knowledge means that protection of new knowledge with a wide range of possible applications causes less future innovation as well as reduced social welfare<sup>419</sup>.

Nonetheless, firms are continually finding unique ways to involve Intellectual Property Rights in their competitive strategies – using methods that fall beyond the purposes for which the IPRs were intended. These involve the accumulation of patents on a large scale for use as bargaining chips in cross-licensing agreements in order to increase the asymmetry of power relationships between big and small firms<sup>420</sup>. As Foray<sup>421</sup> notes in this regard, *“There is now strong evidence that in some industries the increasing number of patent applications is explained not by the need to protect more innovations but by some strategic use purposes. ‘I just don’t know what is in my portfolio of 8000 patents’ is a good quotation from a Chief R&D Officer of a well-known company that illustrates the magnitude of the problem’* “.

A final strategy employed by knowledge commodity producers in try to achieve profits and competitive advantage is that of price discrimination. Virtual markets like the internet, as a platform for the sale of knowledge and information commodities, present a unique marketplace for producers of these goods in that it provides the possibility for them to – at least in theory – charge each different customer a different price for the same good<sup>422</sup>. As Herings and Schinkel<sup>423</sup> note, *“virtual markets make it possible for producers to capture a larger part of consumer surplus than in traditional markets, not only because of the possibility to deal with consumers individually, but also because of the possibility to collect large amounts of information about them... that reveals certain characteristics of the consumer [that] can immediately be matched by an electronic offer.”*

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<sup>419</sup> Herings and Schinkel, 2004: 18

<sup>420</sup> Abbott, Barton, Correa, Drexler, Foray, & Marchant, 2007: 5-9

<sup>421</sup> Abbott, Barton, Correa, Drexler, Foray, & Marchant, 2007: 5

<sup>422</sup> Herings and Schinkel, 2004: 18

<sup>423</sup> 2004:18

This is matched by another unique capacity of information and knowledge goods like software products - *versioning*<sup>424</sup>. This refers to the ability of a software product (like a website or programme) to adjust its functionality depending on the type of user license the consumer has purchased. While the consumer is still installing or accessing the complete product on the surface, a user license entered in by the consumer would then inform as the programme or website how much access to grant the consumer based on what 'version' of the good they purchased. Essentially, versioning allows producers to create one all-encompassing version, and pare it down into different versions that offer reduced functionality at a reduced price, giving the consumer more options to tailor to their exact requirement – all without any direct interaction between the producer and the end user. Versioning in physical paradigm goods (for instance, choosing between a car with canvas seats or leather seats) comes at additional cost to both the user and the producer. With knowledge goods, supplying a 'higher-value' version to a consumer comes at no additional variable cost.

In many cases too, producers are offering full versions of a software for a limited period of time, known as a 'trial period'. Users are then allowed to test the product in full before making any purchasing decisions. Once the trial period has ended, the consumer then has the opportunity to purchase a user license (to 'unlock' the software) and use it in full, or to stop using the software entirely by not purchasing the license and removing it from their computer. All of this is done at no extra expense to the producer or user, and it does not in any way diminish the quality of the product for any other future users. This type of 'trial' is simply not possible with physical world goods, where distribution is costly and utilisation by means of a 'trial' necessarily devalues the good for the next user - think, for instance, of offering trial periods on goods like shoes, clothing, food or vehicles.

Strategies like differentiation, lock-in, IPRs, price discrimination, versioning take on completely new understandings when applied to the concept of knowledge or information commodities. Businesses that are quick to reinvent themselves or think of new ways to grab competitive advantage in the marketplace are undoubtedly those that are most likely to succeed in the changing economic environment. Whether considering intangible commodities from the perspective of money, finance or knowledge / information commodities, it is clear that a new market structure is unfolding, continuously putting pressure on firms and individuals alike to come to terms with intangible assets and their unique set of challenges.

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<sup>424</sup> Herings and Shinkel, 2004: 19-21

### 5.2.6 Conclusion

As yet, it is difficult to assess the extent to which the changes to businesses, workers and markets represent a shift to a fundamentally new economic 'era'. From the evidence discussed in this section, however, it is impossible to deny that each of these essential components of economic life have experienced effects that in many cases suggest deep, systemic changes - beyond the superficial or 'passing trend' adjustments that might otherwise be the case. And where Industrial Era analytical and predictive models or modes of thinking seem to fail to successfully navigate the challenges of knowledge commodities and its associated 'intangible' goods, it seems increasingly likely that economics simply does not yet have the tools or the complete understanding to come to terms with the rules of a game that seems to have changed significantly in so many ways. From the perspective of firms, workers and market structures, these sentiments are succinctly summarised by Clark Eustace<sup>425</sup> when he states:

*“A new market model is emerging – where sustainable value-creation is geared less to economies of scale than the exploitation of innovation, arbitrage and scope effects. Subtly, and incrementally over several decades, this has resulted in a fundamental shift in the corporate value system, away from physical and financial assets (now commoditised) towards the creative exploitation of a nexus of intangible assets, quasi-assets and competences – mainly in the form of distinctive capabilities deriving from knowledge intangibles – that have become essential ingredients of the economic production process. Notwithstanding the huge research effort on both sides of the Atlantic, their value-generating mechanisms are, as yet, poorly understood.”*

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<sup>425</sup> Eustace, 2002: 2

# Chapter Six

## *A Matter of Herding Cats*

### 6.1 - Introduction

In modern social, political and economic policy discourse, the concept of the Knowledge Economy is as widely used as it is misunderstood. Due to the tremendous variety of opinions, perspectives, intentions and academic backgrounds that influence authors' contributions to the field, it has become increasingly difficult to capture a comprehensive 'working' definition of the Knowledge Economy. This has made any attempts to delineate measurement criteria and gather empirical data all but impossible. With uncertainty surrounding both definition and measurement, policy formulation and implementation can only ever be an inexact pursuit – in essence, a matter of 'herding cats'.

The intention of this thesis was not to provide the 'silver bullet' definition and measurement criteria that would cut through the confusion and provide a clear path for policy-makers and academics alike. In reality, it is unlikely that such a definition can exist. In a world where knowledge is no longer merely a resource used in productive endeavours, but also the *output* thereof, the amount of attention, theoretical contemplation and unique applications of knowledge in its various forms means that any definition of knowledge and the Knowledge Economy will have to always be a 'work in progress'.

With this in mind from the outset, this thesis sought to take stock of the most prominent and enduring contributions to the concept of the Knowledge Economy in the literature, and to try to highlight similarities, contrasts, strengths and weaknesses in a number of the most widely used definitions and categorizations of the Knowledge Economy concept and its constituent parts. Where possible, attempts have been made to reconcile different understandings or classifications of knowledge and the Knowledge Economy that may come from different academic viewpoints, but ultimately point to similar aspects of the concepts' attributes. In every contribution considered in this process – no matter how widely accepted or criticised it has become – there has been a focus on elucidating any insights that add value in trying to formulate a suitably broad and detailed understanding of knowledge and the Knowledge Economy. In so doing, this document should serve as an 'operational definition' of the



Knowledge Economy in that it provides an objective *profile* of a multitude of the most important discussions and debates in the literature.

## 6.2 - Discussion

This process began with a discussion surrounding the concepts of ‘Knowledge Society’ and ‘Knowledge Economy’. In conjunction with a staggering array of different descriptions given to the societal, political, academic and economic conditions which many authors feel warrant a descriptive title<sup>426</sup>, the ‘Knowledge Society’ and ‘Knowledge Economy’ are frequently used interchangeably – often, it seems, without consideration. For this reason, it was necessary to evaluate and compare these terms from a variety of perspective in order to come to some sort of conclusion as to the most responsible way of using each term correctly going forward. What emerged from this discussion was that the ‘Knowledge Society’ and ‘Knowledge Economy’ – while sharing much in common – are to be treated as wholly distinct concepts, each with its own academic history and characteristics. The Knowledge Society concept stems from an understanding of the numerous ‘sociological’ aspects of knowledge which are informed by all aspects of society – from education to psychology, anthropology, politics, science and economics. By definition, it is a far broader analysis of the origins, uses and consequences of knowledge in society that the Knowledge Economy involves – with economic considerations being only one aspect (albeit an integral aspect) of the greater ‘society’.

What this discussion ultimately concerns, therefore, is a discussion surrounding the *broadness* of the terms to be considered, and the respective values of being inclusive versus being exclusive (for practical purposes). Simply put, is it practical to base policy discussions around a notion which is as conceptually broad as the term ‘society’ can allow? Instead, the conceptually more ‘contained’ idea of a Knowledge Economy would seem to be a more feasible goal in that it is easier to delimit and also involves the types of component parts that are more likely to be measurable<sup>427</sup>. Where definition and measurement are more feasible and actionable, policy is more likely to be compelling. What remains vital, however, is that the sociological aspects of ‘knowledge’ that the concept of the Knowledge Society bring to light should not be forgotten – instead, they should serve as a constant reminder that knowledge as an economic commodity

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<sup>426</sup> For instance – the ‘weightless economy’, the ‘goldilocks economy’, the ‘network society’, the ‘new economy’ and the ‘information society’, to name a few (Coyle, 1999; Castells, 1996).

<sup>427</sup> In relation to ‘societal’ component, for instance. (Oxley et al, 2007)

should never be considered in isolation from the intricate and detailed societal conditions from which it originates.

From this foundation, it was possible to focus attention on ‘knowledge’ itself. Through the course of Chapter Two, the concept of knowledge was analysed from a variety of different perspectives, with the purpose of using the many different definitions, understandings and categorisations of knowledge to uncover the inherent complexity of the term. This began with a brief look into the popular (yet widely criticised) Data-Information-Knowledge progression, which describes knowledge in terms of two component parts – data and information respectively. This relationship was shown to hold many misconceptions about knowledge which, due to the prominence of the Data-Information-Knowledge description– especially in knowledge management literature – have often taken hold in other academic works or discussions about knowledge. By analysing these misconceptions and drawing from the formulation the descriptive merits that it does hold, the Data-Information-Knowledge relationship was shown to offer significant value in enriching our understanding of knowledge.

The next step was to bring to light another categorisation of knowledge which is widely established in the literature – the idea of Tacit and Explicit knowledge. Explicit knowledge, in its most simple form, was shown to represent those ‘objective’ aspects of knowledge as proposed in the Commodity View – at its most complex, less ‘controversial’ than Tacit knowledge, and at its most basic, largely indistinguishable from Information. The Tacit knowledge dimension was shown to be a far more intricate and latticed affair, paying reference to the Community View of knowledge, and highlighting the *social construction* of knowledge, and all its cultural implications. Informed by Brenner et al’s<sup>428</sup> suggestion, a distinction was made between knowledge that is impossible to articulate (Tacit knowledge) and knowledge which has the *potential* to be explicated or codified (or made explicit), but for some reason remains ‘Tacit’ (referred to as ‘codifiable’ knowledge). The Tacit-Explicit classification is one which continues to enrich definitions of knowledge in the literature, and the numerous implications and consequences that stem from these two ‘aspects’ of knowledge are of major importance in appreciating the true nature of knowledge.

From this foundation, it was possible to look at a variety of taxonomical ‘classifications’ of knowledge that are common in the literature, and to try to draw comparisons and parallels

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between the numerous labels given to different ‘types’ of knowledge. In this process, many authors’ contributions were taken into consideration and, for the purposes of simplification and clarity, were loosely grouped into four major categories based on their descriptions discussed in this chapter. The four overarching categories that emerged were Prescriptive Knowledge, Propositional Knowledge, Cultural Knowledge, and Understanding. The purpose of this exercise was to offer an broad-based perspective on how the numerous authors’ contributions relate to one another, as well as how they add to our overall understanding of knowledge. The suggested relationships and groupings are in no way intended to be prescriptive or fixed – rather, they hope to add simplification and coherence to an otherwise confusing landscape of labels, classifications and semantics.

Chapter Four turned its focus onto the economics of knowledge, and how the treatment of knowledge as an economic commodity influences the understanding developed in the previous chapters. This began with a look into a number of definitions of the Knowledge Economy proposed by leading economists and economic organizations around the world – from the OECD and UNESCO to the Asia-Pacific Economic Cooperation. These definitions are notable for their simplicity and focus on economic considerations like ICT infrastructure, the changing nature of the workforce, R&D, science and technology. In the large part, these definitions emphasise how the Knowledge Economy represents a shift from economies based on the traditional inputs of capital and labour to a greater focus on knowledge as a factor of production and wealth-creation.

If this is indeed the case, the consequences for economic theory and policy are significant. Knowledge – as an economic asset and a factor of production – behaves very differently to ‘Physical Paradigm’ inputs like capital and labour. The essence of these differences became the focus of the discussion in Chapter Four, where the economic characteristics of knowledge are explored at length for the purpose of highlighting the challenges that they present to enduring economic models and theory. The challenges are based primarily around the concepts of non-rivalry and non-excludability. One of the main reasons why knowledge presents such a challenge as an economic good is that, in different forms and to varying degrees, knowledge has the potential to be all the possible combinations on the rivalry-excludability spectrum. This has massive implications for economic attempts to measure or attach value to knowledge in economic models, as each particular piece of knowledge can have such drastically different

characteristics. In the absence of such measurement, the prescriptive power of econometric models is significantly – if not cripplingly – diminished.

These challenges have given birth to a variety of economic and legal constructions which attempt to bridge the gap between knowledge and the enduring economic models which are used to explain and predict the behaviour of physical paradigm goods. Primarily, these take the form of Intellectual Property Rights – most commonly represented by patents and copyrights – which attempt to manage the delicate balance between protecting the original creator’s interests and obtaining socially optimal outcomes. It is these legal constructions that become the focus of the remainder of Chapter Four, where the discussion centres around the constant struggle of lawmakers and law-enforcers to come to terms with the fact that patents and copyrights are ultimately stop-gaps in what seems to be the increasingly unlikely task of trying to constrain an incomparable economic asset (in the form of knowledge) into a system<sup>429</sup> designed for assets with entirely different characteristics. If Intellectual Property Rights are to hold any value in the future, they are going to need to be as complex, dynamic and evolutionary as the economic asset they are attempting to control.

A far more elegant solution emerges in the form of the Open Source movement which – as a *product* of the knowledge / information revolution – deals with the economic characteristics and consequences of knowledge as an economic asset as a matter of course. The discussion about Open Source as a possible solution to the challenge of reconciling entrepreneurial endeavor and the socially optimal outcome unfolds in the remainder of Chapter Four, providing a range of valuable insights into the true nature of the Knowledge Economy. What it suggests is that knowledge comes in so many forms, and is so heterogeneous that any existing economic or legislative models cannot be applied universally. These models must refer to certain types of knowledge in certain industries – as must the patents, copyrights and other forms of protection which seek to find the balance between encouraging innovative effort and ensuring social efficient outcomes.

At this point in the thesis, the nature of knowledge and the Knowledge Economy starts to become less vague. With an understanding of the dynamics of the Knowledge Economy within the greater context of the knowledge society, a broad-based perspective on the detail and intricacy surrounding the concept of knowledge as well as its economic characteristics and repercussions, we are finally in a position to consider the *validity* of the concept of the

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<sup>429</sup> or even, a plane of understanding,

Knowledge Economy. Based on the definitions and understandings formulated in the first four chapters, the next logical step was to consider to what degree the concept of the Knowledge Economy can be considered not just a descriptor, but rather an indication of a 'new' economic era. This is the final discussion, detailed in Chapter Five, was the critical next step in contributing toward a comprehensive working definition of the Knowledge Economy in that it is only with an understanding of this ongoing debate that it is possible to consider what (if anything) is truly 'unique' about the Knowledge Economy.

It is pivotal that this highly contentious debate is taken in context. Of course, it is by default that any authors, academics and theorists that make use of the concept of the Knowledge Economy are necessarily proponents of the belief that the modern economic system is in some ways a unique, distinct economic phase which is worthy of its own descriptive categorisation. Given the outcomes of the discussion surrounding the nature of knowledge and its economic characteristics, it is the firm belief of this author that some aspects of modern economies are fundamentally and irreversibly different to Industrial Era economies and that, due to the nature of these system differences, this new era can be accurately described as the Knowledge Economy.

In Chapter Five, two of these major shifts were discussed in detail in order to illustrate not only that they are indicative of a significantly altered economic environment, but also that the rise of knowledge to a position of primary importance in modern economies is at the heart of these changes. Firstly, the discussion centred around the idea that the profound impact of Information and Communications Technologies (ICTs) has changed the landscape of the global economics to the point that it can no longer be usefully considered merely an extension of the economic system that existed before. The impacts of the ICT 'revolution' was shown to have registered deep and lasting changes in all aspects of economic life – from the way we deal with knowledge, information and data, to businesses, workers and products. On top of this, ICTs have changed that way that all of these elements interact and ultimately how they have led to the convergence of information technologies, communications technologies, and the social and political structures on a global scale, that have made micro-electronics, telecommunications and digital communications all a part of the same, integrated system<sup>430</sup>. By putting information, knowledge and communication (of information and knowledge) at the core of their applications, ICTs have thus put knowledge and information more at the heart of *“human activity and*

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<sup>430</sup> Castells, 2004: 11

*organisation” than ever before, representing “a greater change in the history of technology than the technologies associated with the Industrial Revolution, or with previous Information Revolutions.”<sup>431</sup>*

The second feature of the Knowledge Economy which is shown to represent a distinct economic era is the suggestion that various aspects of the modern economy illustrate a significant break with the past as a result of the impact that knowledge has had as an economic commodity – to the point that the economic thinking of the industrial era becomes increasingly outdated, and in need of revision or renewal. This essentially becomes the second indicator of a fundamentally ‘new’ economic era – where the economic understanding that defined the industrial era can no longer fully address the needs of a new, remarkably different economic environment and, hence, is in need of a ‘new economics’.

This proposition begins with an analysis of the economic theories of the ways in which enduring economic theories – like Classical and Neoclassical economics, for instance – cannot adequately incorporate knowledge’s unique economic characteristics into their existing frameworks. In most instances, knowledge and technological growth call into question the basic tenets of these frameworks, and have generated lively, ongoing debates about the relevance of these economic theories. The magnitude of these changes is felt through all aspects of the economy – from the way that they have affected the nature of markets, businesses and their workers. On top of this, there has been a profound evolution of the monetary and financial systems – from the way they operate and the way that strategy is formulated, to the way it is structured on a global financial scale.

Of course, the argument that it is difficult to assess the extent to which the changes to businesses, workers and markets represent a shift to a fundamentally new economic era from ‘within’ that era is a compelling one. From the evidence discussed in this section, however, it is impossible to deny that each of these essential components of economic life have experienced effects that in many cases suggest deep, systemic changes -beyond the superficial or ‘passing trend’ adjustments that might otherwise be the case. And where Industrial Era analytical and predictive models or modes of thinking seem to fail to successfully navigate the challenges of knowledge commodities and its associated ‘intangible’ goods, it seems increasingly likely that economics simply does not yet have the tools or the complete understanding to come to terms with the rules of a game that seems to have changed significantly in so many ways. These

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<sup>431</sup> Castells, 2000: 10

changes may ultimately be part of a greater, more far-reaching shift – only time will tell. However, wherever these shifts may end up, it is inevitable (or at least highly likely) that the changes explored in Chapter Five will have contributed in no small part to the way that economics – in theory and practise – eventually develops.

In terms of how all of this contributes towards an ‘operational definition’ of the Knowledge Economy, we are now able to analyse each step taken towards informing an understanding of this highly complex and intricate term. The discussions in the first five chapters of this thesis developed:

- *The knowledge ‘economy’ in the context of the knowledge society*
- *A comprehensive working definition of knowledge, and a broad-based understanding of the most prominent categorisation and contributions in the literature*
- *An analysis of the economic characteristics of knowledge, and the treatment of knowledge as an economic asset*
- *A look into two aspects of the economy which suggest a fundamental shift in the economic landscape to the extent that the Knowledge Economy can be considered a distinct economic phase in its own right*

Where this leaves us is in a position to critically view the concept of a Knowledge Economy with a foundation of understanding that is both objective and suitable comprehensive. We are able to separate the concept of the Knowledge Economy from the concept of the Knowledge Society, while staying mindful of the fact that the nature of knowledge dictates that it is both impossible and irresponsible to overlook the broader sociological phenomena in which any and all forms of knowledge have their source. We are also able to talk about knowledge with more confidence, grasping the tremendous complexity and extent of the concept. As a foundation for understanding the way that knowledge behaves as an economic commodity, an appreciation of the fundamental characteristics of knowledge itself is paramount – including the myriad typologies and categorisations which appear in the literature and add detail and colour to this remarkable intricate concept.

When considering the Knowledge Economy, we are also now equipped with an understanding of the economic definitions of knowledge as proposed by leading academics and economic organisations. On top of this, we have developed upon the most critical economic characteristics of knowledge, and how they contribute toward the fascinating ways in which

knowledge behaves when treated as an economic commodity. In this regard, awareness of Intellectual Property Rights developments, as well as unique developments like the Open Source movement all serve to underpin a more comprehensive profile of the Knowledge Economy and what it entails.

Finally, this profile of the Knowledge Economy is informed further by the investigation into the debate surrounding the aspects of the modern economy which argue most compellingly that the Knowledge Economy is in fact a distinct economy era, and not merely an extension of the previous one. Here, the pervasiveness of the ICT revolution, and the pressing need for a contemporary, 'endemic' economic theory which can properly account for knowledge as an economic input as well as an output of productive activity.

With all of this in tow, this profile of them should serve as a suitably objective and comprehensive foundation, and a suitable 'working definition' as a for discussions surrounding the Knowledge Economy.

### 6.3 - Limitations and Further Research

In a thesis of this nature, the limitations all centre around the difficult, but necessary, process of selection of the authors, viewpoints and definitions that will form the foundation of the discussion. In order for the thesis to achieve its intended intention, it was necessary from the outset to draw parameters that would ultimately shape the scope and character of the thesis as a whole. When the subject under review is a concept as dynamic and intricate as knowledge, the task is all the more difficult, as new formulations and insights are added to the literature almost on a daily basis – many of which will be both accepted and criticised by their own fair share of respected academics in due course. On top of this, many of the debates surrounding knowledge and the Knowledge Economy are unlikely to ever reach consensus – such is the subjective nature and prevalence of personal interpretation and opinion. Depending on an author's academic background, the intentions of their contributions as well as their epistemological methodology, it is often the case that a host of different perspectives are formed on the back of an identical piece of evidence. It was therefore a priority at all times to proceed with this understanding at the core of every opportunity which arose in which personal opinion or judgement was required and, as far as possible, caution and objectivity was held as the ideal.



Any personal judgement calls in terms of the selection of which works to cite and which authors to consider were made based on the prominence and popularity of those works in the literature. It was of huge importance that any works which featured in a large number of other authors' contributions were acknowledged – irrespective of my personal feelings towards those contributions. At all times, the purpose was to be comprehensive and inclusive, as it was a firm belief from the outset that all contributions can and do hold value in deepening one's understanding of the concept of knowledge – even if it is because the criticisms levied against that contribution hold the required insights. Often, it was the case that showing what something is *not* is as valuable as adding to the understanding of what it *is*.

If these basic intentions are taken into consideration at all times when analysing the discussions that take place in this thesis, the limitations and choices that follow as a result can be understood for what they are – necessary and important, in pursuit of simplification and clarification, as opposed to reductionism.

It is these limitations that provide the most scope for further research. There is little doubt that the development of any definitions or understandings of the concepts discussed in this thesis are going to undergo constant evolutionary changes as new insights emerge in the literature. For a variety of the defined concepts, arguments and classifications, further development and research that will help to prove or disprove their validity will contribute a great deal in focusing the literature, reducing confusion and allowing for a more precise foundation on which to base future developments.

In terms of the other key discussions in this thesis, each chapter touched briefly on a host of subjects which are already (and will continue to be) the focus of detailed academic works in their own right. Of the most relevance, perhaps, is work focused on Intellectual Property Rights, and how the economic characteristics of knowledge can be more successfully incorporated into economic models and theories. Similarly, the question surrounding whether or not the present economic landscape represents a distinct 'phase' in economic history is another dilemma yet to be comprehensively considered. In this case, both measurement criteria and an objective standpoint<sup>432</sup> are required – two things that are not available at this point in time.

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<sup>432</sup> in the sense that all analyses of the current 'state' of the economic landscape are necessarily made from within, and are therefore focusing on changes that may well be fleeting, non-existent, or part of a greater change that is still underway.

Until this is achieved, however, it is hoped that this document can contribute in some way to the establishment of a more universally accepted definition of the term 'Knowledge Economy', as it is only with this definition (and the theoretical foundation to back it) that any real progress can be made in delineating the measurement criteria and methodology that is so important in the establishment and analysis of effective and lasting policy.

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