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Efficiency and Effectiveness: Digital Futures in Innovation

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Martin Hall Vice-Chancellor, University of Salford





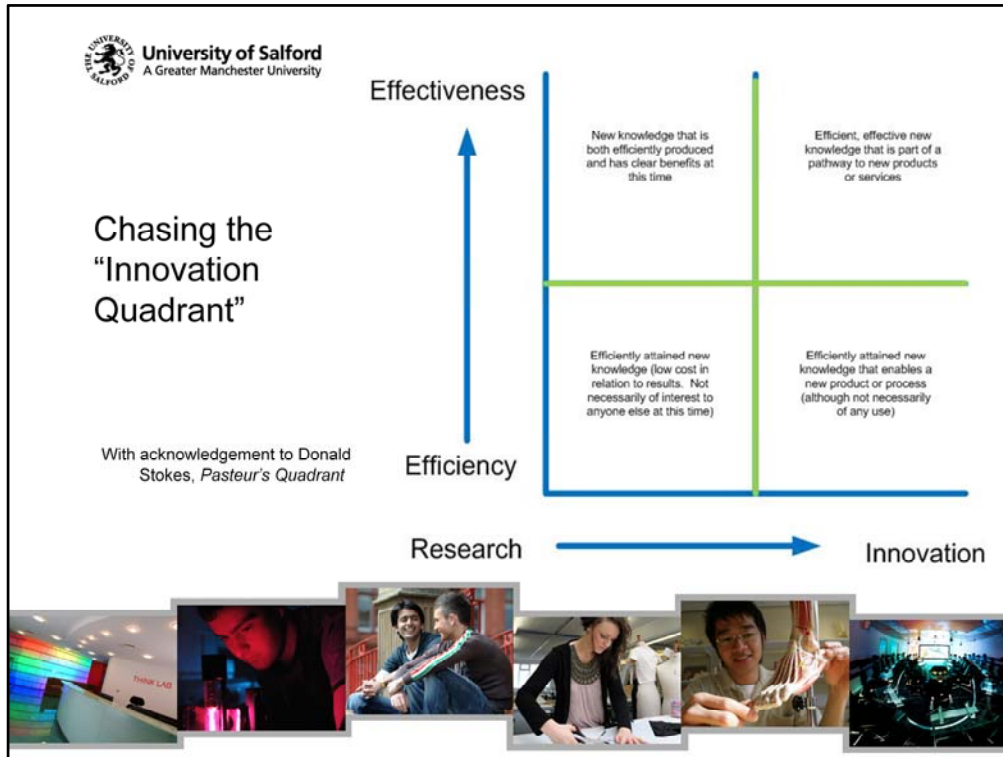
Strand Two: Efficiency and Effectiveness

What strategic advantage can new and future digital technologies offer in advancing the efficiency and effectiveness of research and innovation in our universities?

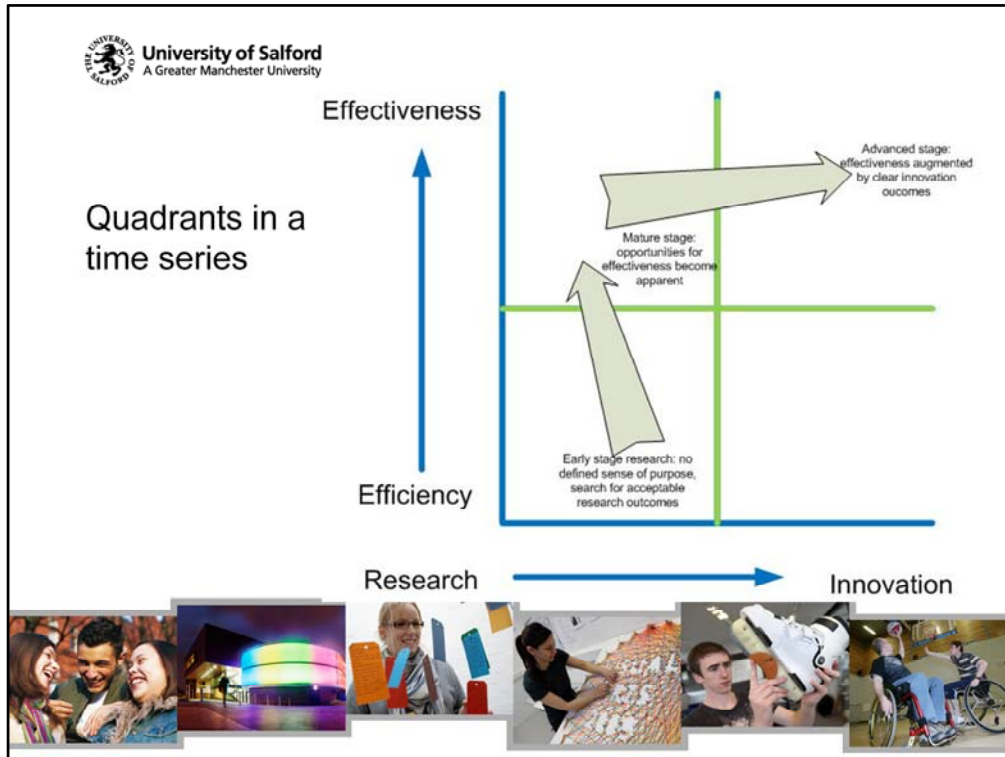
- **Research:** the creation of new knowledge across all fields of study
- **Innovation:** a set of pathways along which new knowledge is translated into useful products and processes
- **Efficiency:** the ratio between the effort of doing something and the benefits achieved
- **Effectiveness:** the value of the outcome of doing something



In this presentation, I've been asked to consider how new and future digital technologies can increase both efficiency and effectiveness in research conducted in our universities. In thinking about this, I've found it useful to draw a clear distinction between efficiency and effectiveness. Work can be efficient without any value to at all. Similarly, an essential outcome can be achieved in a very inefficient manner. This is very evident in my own discipline of Archaeology. An archaeologist can dig a large hole very efficiently, but learn nothing of any value. Similarly, our understanding of history could be changed by spending ten years excavating a castle with a toothbrush. I've also found it helpful to distinguish between research, as the creation of new knowledge, and innovation – a process of transforming knowledge into useful products and processes. Clarifying the four terms of the task in this way will help achieve a sharper focus on the role that new and future digital technologies can play.



These four terms of the problem – effectiveness and efficiency, research and innovation – can be expressed in an adaptation of Donald Stokes’ quadrant, that he developed in his definition and description of “use-oriented basic research” (which he termed Pasteur’s Quadrant). Research can be efficient and practically valueless (the lower left quadrant) or of clear value (the upper left quadrant). Research can also be used to develop new products and processes in an efficient manner (lower right quadrant), and also in a way that is both efficient and effective (upper right quadrant). Our interest here is in the upper right quadrant; the use of knowledge to develop new products and processes in ways that are both efficient and which change things through their effectiveness.



It is important to note that these different states of work are by no means mutually exclusive. Often, research will lead to effective and efficient innovation through a time series. A good example here is the Internet itself. The origins of the Internet lie in exploratory research that was not very efficient and was pretty ineffectual – strings of laboriously constructed binary code that “did” very little. The development of improved digital capacity steadily led to increased effectiveness, following the principles of Moore’s Law, and doubling in capacity roughly every two years. But for a long time it was not clear at all what the Internet was actually for – what new products and processes it could actually enable. It is only in the last decade or so that the top right quadrangle has been achieved – effectiveness combined with continual innovation – and is now largely taken for granted.



The special properties of knowledge

- Moving effectively between research and innovation, and efficiency and effectiveness, requires “friction free” flows of knowledge
- Knowledge has special, well-understood properties: non-excludability, spill-over benefits, cumulative rewards
- The university, and academic life, thrives on giving away knowledge in return for reputational capital (whether in competitions for world rankings or individual career paths)
- Rent-seeking systems of toll-gates and subscriptions, “patent thickets” and defensive IP management adds friction to knowledge exchange, and limits efficiency, effectiveness and innovation



It is also important to remember that, in considering aspects of research and innovation, we are particularly concerned with knowledge, and with its special properties. Concepts such as “efficiency” and “effectiveness” originated in – and were shaped by – Fordist concepts of tangible production. But knowledge has different properties, as is now well understood. Knowledge is difficult – often impossible – to restrict and contain. Knowledge exists, and is transmitted, in both “tacit” and “codified” forms, and is particularly valuable when it accumulates, leading to accelerated understanding of complex problems.

These properties of knowledge are not new, and exist completely independently of the digital revolution. Universities – and academic networks – are appropriately designed to give away new knowledge, not to contain it, rent it out, or licence it. Value is returned in terms of citations, references and recognition: reputational capital.

Gains in efficiency and effectiveness – moving through the quadrants to a position in which both innovation and effectiveness are maximized – will be far easier (and may be dependent upon) where there is as little restriction and restraint as possible. Subscription publishing, unreasonable copyright restrictions, “patent thickets” and rent-seeking are the enemies of efficiency and effectiveness, and counterbalance the immense opportunities that new digital technologies offer.



Towards a model University of the Digital Future

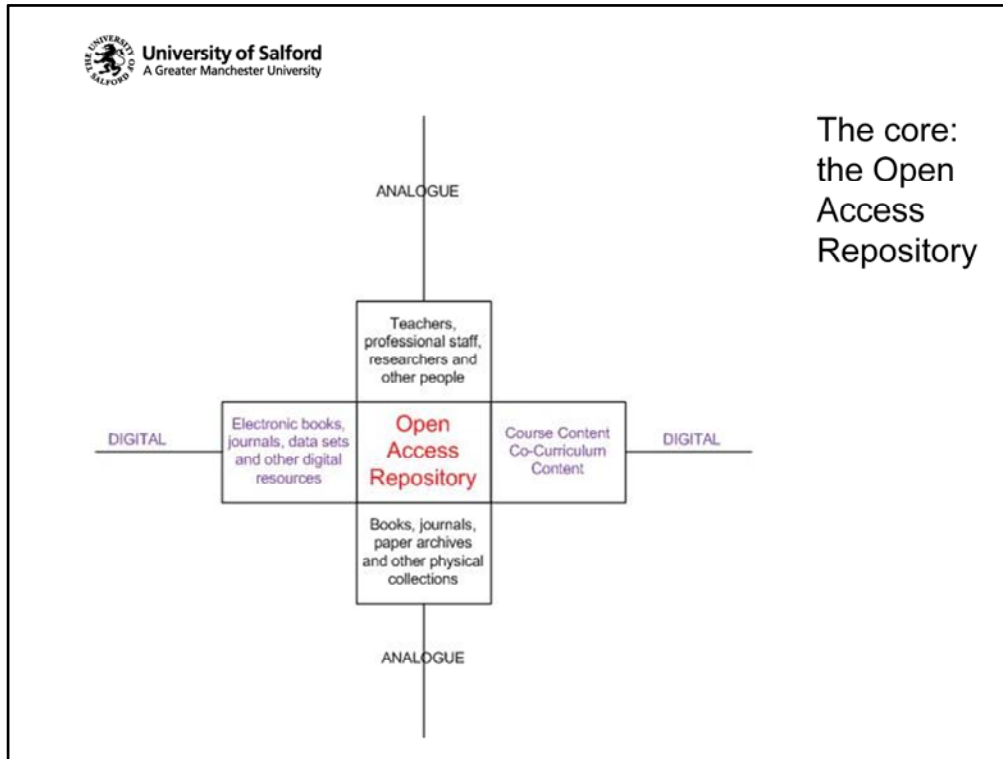
- Unpacking efficiency and effectiveness in research and innovation shows how the benefits of new knowledge can best be realized
- Universities have worked this way since the early nineteenth century, using a series of onetime-new technologies
- Digital technologies massively expand capacity for data management, analysis, communication and dissemination
- What would it be like to build a new university for a digital future?



Pulling together the strands of the argument so far, we can see both continuity and change. Since the formation of the first modern research universities in early nineteenth-century Europe, new technologies have been used to increase the efficiency and effectiveness of research endeavors. Louis Pasteur's research and innovation has become the signal example here, used by writers such as Bruno Latour and Donal Stokes to show how research and innovation can result in highly effective outcomes – the upper right quadrant – “Pasteur's Quadrant” – in Donald Stokes's classic concept of “use-inspired basic research”.

Digital technologies, however, massively expand these capacities, to the point where, despite the continuities, the digital future will look distinctively different from the past. This is simply demonstrated in the career of anyone who began to carry out research before the Internet took off in the mid-1990s. In, say, 1985 any research design incorporated time in research libraries, tracking down sources. Today, all that information is available in digital form on the desktop. The challenge to the researcher now, and in the future, is to how to avoid being drowned in information.

If, then, one was tasked to design a new University of the Digital Future, what would it look like?



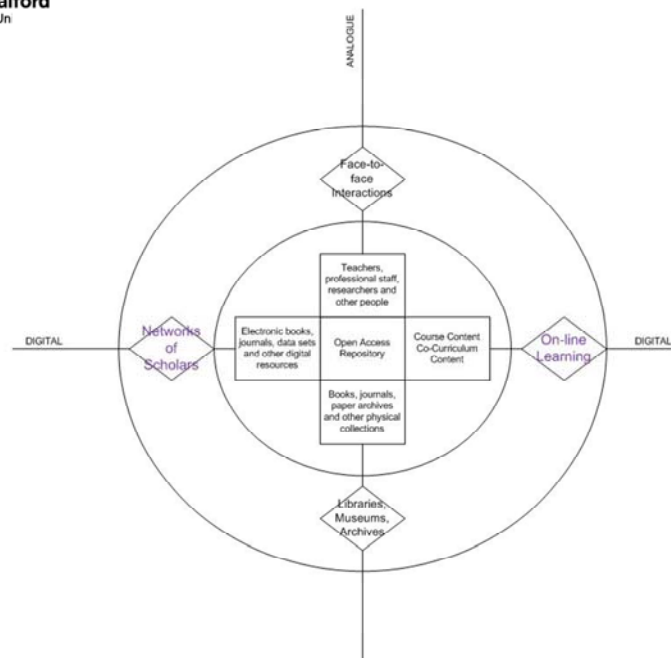
Firstly, the core of my University for A Digital Future would be an Open Access Repository, in which all research data, publications, reports and analyses were deposited, and from which they were freely available. This strand of today’s conference has a workshop on Open Access, and so I will not go into the details of how this works here. The design reason for having an Open Access Repository at the heart of the University for a Digital Future stems from the nature of knowledge itself – its special properties, reviewed earlier – and the need for “friction free” engine room at the heart of this new knowledge machine.

But – and with emphasis – it is a great mistake to assume that all the resources in a University for a Digital Future will themselves be digital. People are not (yet) digital, and teachers, professional staff, researchers and others are the bedrock of any learning organization. Also, any university will depend heavily on tangible collections that range from books and manuscripts to museum collections. Metadata about these collections will be digital, but the tangibility of the objects themselves will remain their key quality.

This is why the core design of the University for a Digital Future is arranged on two axes – both digital, and analogue



The system:
interactions
enabled and
advanced by
digital and
analogue
technologies

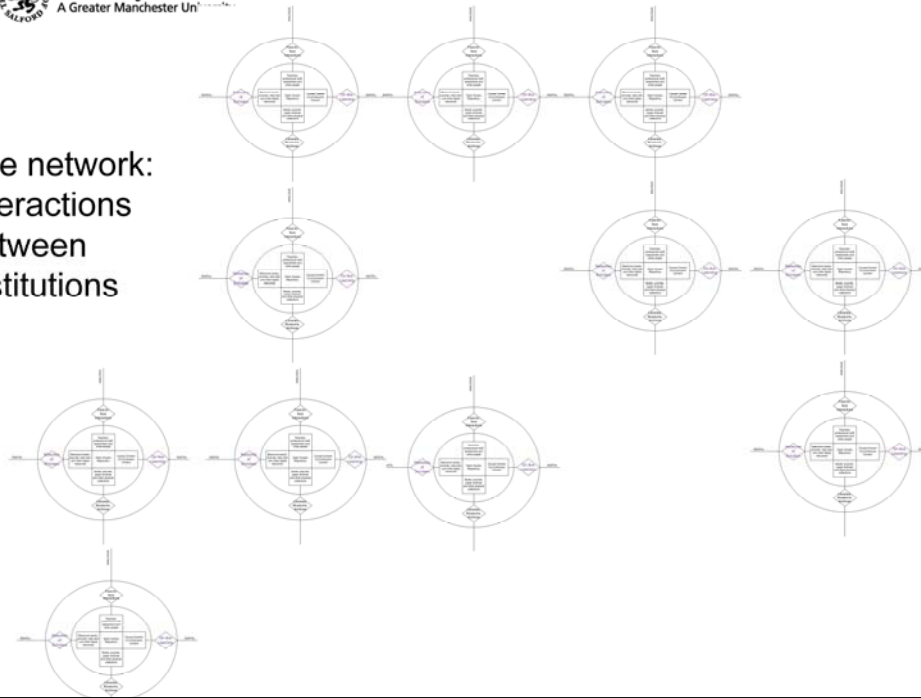


Second, this set of core functions expands along both the analogue and digital axes to enable different categories of interactions: face-to-face communication of “tacit” knowledge and the use of analogue resources; on-line learning and networks of scholars enabled by digital resources.

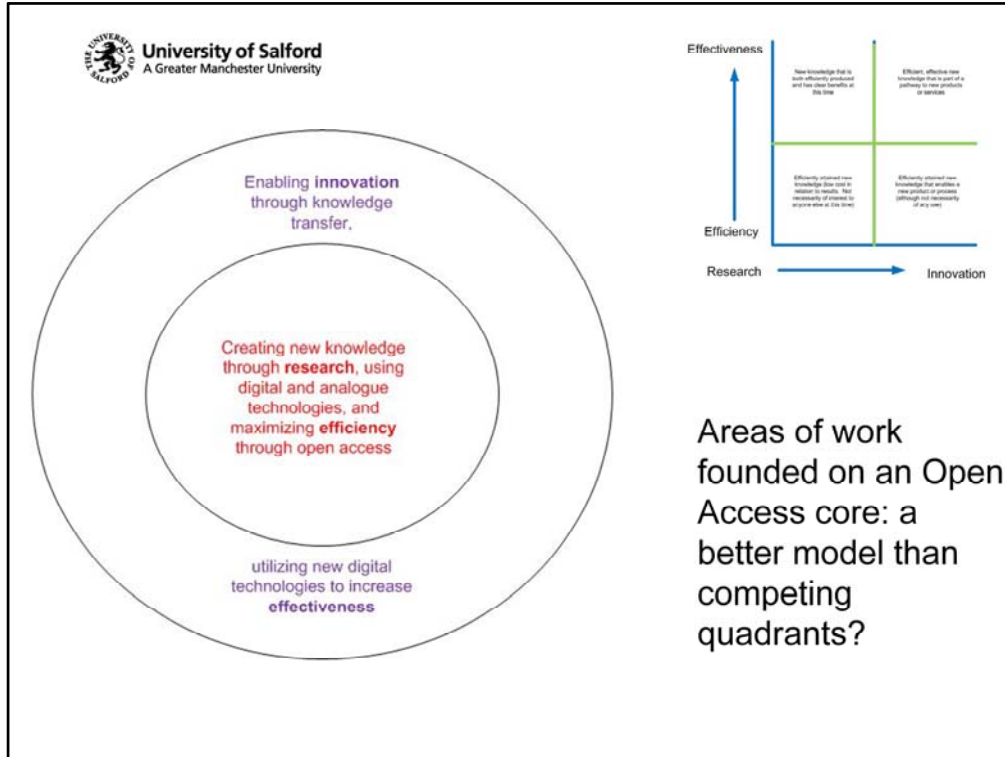


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The network:
interactions
between
institutions



Third, each institution is part of a network of interaction, in which the network is, in itself, regarded as a key asset



This model for a University of the Digital Future can be abstracted into a simple form. At the core is the creation of new knowledge through research, with an emphasis on ever improving efficiency through using appropriate analogue and digital technologies, and with digital data, including metadata on analogue collections, held in an Open Access Repository.

Innovation and effectiveness is achieved in the area around the core, which is an ever expanding sphere of influence and interaction, in which the University of the Digital Future is part of a shared network, itself a key asset.



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An example: Better Life Chances

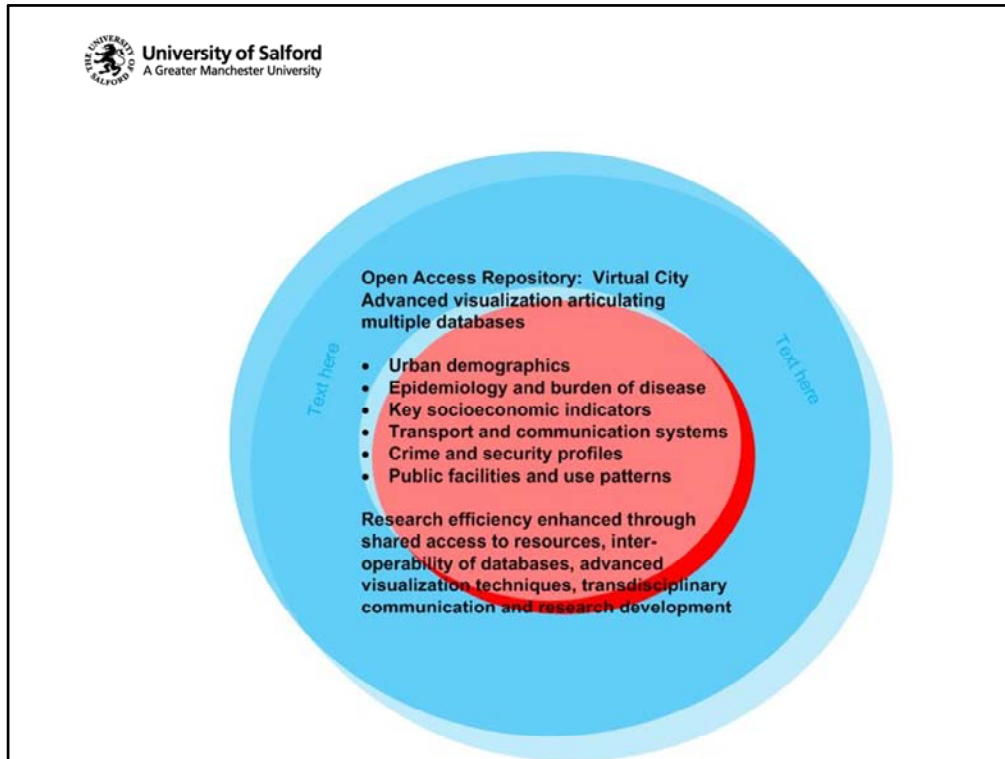
Research fields:
public health,
epidemiology,
social policy,
housing, built
environment,
security and
safeguarding



Partners: local authority, city region, police
authority, health services
Potentially: integration into new Local
Enterprise Partnership



An example, and an unashamed opportunity to show off the University of Salford. Better Life Chances is a project that brings together researchers across a range of fields in partnership with local and regional authorities to promote effectiveness and innovation in the delivery of key social services



The heart of the project is an advanced digital model of the city, that combines 3D virtualization with the integration of a range of digital databases in a single research and planning tool – a massive increase in efficiency. This forms part of an Open Access Repository (with appropriate restrictions for access to protected data)




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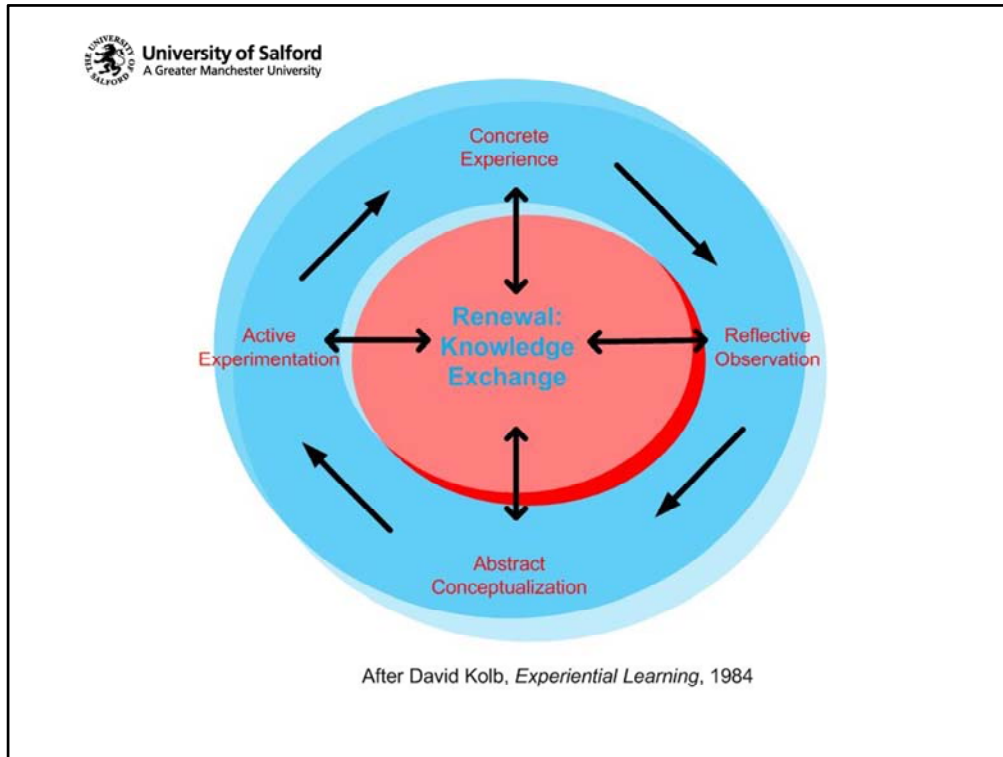
Partnership Working: Virtual City
Advanced Visualization articulating multiple databases:

- Children's services
- NHS/ Primary Care Trust
- Adult safeguarding
- Housing authorities
- Fire and Rescue Service
- Police

Innovation and effectiveness enabled through inter-operability of databases, shared decision making based on advanced visualization, identification of redundant provision and better use of diminishing resources

This enables, in turn, partnership working that enables effectiveness and innovation in the public sector, based on key research advances, and made possible by advanced digital technologies





This set of working relationships can be understood in terms of David Kolb's experiential learning cycle. Interaction and knowledge exchange between the research community in the University for Digital Future and partner practitioners constantly renews the quality and content of the Open Access Repository at the heart of the organization. At the same time, the movement between concrete experience, reflective observation, abstract conceptualization and active experimentation enhances the effectiveness of the innovations drawing from the development of new knowledge



To conclude

- New technologies for research and innovation offer unrivalled possibilities
- The essence of digital technologies: exponential patterns of expansion, massive data storage, accelerating processing power, almost instant transmission
- Open Access is essential to the efficient and effective use of new technologies. Paywalls and membership systems are inefficient, ineffective and counter progress by imposing friction
- Research and innovation systems can be designed to support both research and innovation through knowledge exchange, and to be sustainable through expert commissioning systems



