

Intelligent Media

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“The media is the message.”

Marshal McLuhan

16.1 Introduction

A development is underway which has the potential to reshape our culture, communication, commerce and our relationships. It is the emergence of Intelligent Media. Intelligent Media is physical or digital media, e.g., software, fabrics, music, moving images, materials, “content”, which exhibits or into which is embedded some intelligence, e.g., ability to learn, adapt, communicate and/or interact with its environment. Intelligent Media is already emerging, and nowhere is it showing more importance than in its potential to underpin and drive the future of the creative sectors, from advertising to architecture, fashion to film, museums to music, the performing arts to publishing and television to tourism. In some sectors such as animation and architecture, this transform is well underway. In other sectors such as fashion design and music, it is just emerging. Intelligent Media is also transforming the creative process with “creatives” increasingly able to “mix” the physical with the digital and the “smart”. In this chapter, we give a selected overview of the emergence of Intelligent Media.

A new phenomenon is emerging, fuelled by the convergence of computing, media and networks, the so-called “digital revolution”, and the emergence of novel physical materials. It is the advent of *Intelligent Media*. Intelligent Media is physical or digital media, e.g., software, fabrics, music, moving images, materials or content, that exhibits or has embedded into it “intelligence” – an ability to adapt, communicate and interact with its environment, and with us, in novel ways.

Intelligent Media is already showing the potential to create an enormous impact on our relationship with the things around us that influence, underpin and define social relationships, culture and society – from television to toys, film to fashion, product design to packaging, architecture to advertising and cities to commerce. And as these elements form the basis of the “Creative Sectors”, Intelligent Media therefore has the potential to create equally significant new innovation and market opportunities in the Creative Industries,

and lead a fundamental paradigm shift in today's Creative Industries, creative practice and the creative process. It has the potential even to form the basis of entirely new markets, sectors and processes, which we cannot imagine today.

Just as the Information Technology "revolution" completely re-shaped commerce and business productivity, in this paper, we explore the early emergence of Intelligent Media, with a focus particularly on some examples of how it might have an impact in re-defining and re-shaping the creative sectors and creativity.

16.2 Emergence of Intelligent Media

When architects design a building today they will almost certainly do so using Intelligent Media. Firstly, they explore the design using a virtual building. This comprises a computer model of the structure and the application of "intelligent systems" to optimise such things as heat, light and sound, even the interaction of people; and virtual reality to visualise not only the exterior and interior of the building, but also the social interactions afforded by the design. Moreover, the use of Intelligent Media in architecture and building is now spreading into the building itself leading to the emergence of ' *Ambient Intelligence*': invisible, ubiquitous computing and networks embedded throughout a building to monitor and interact with the building's environment and its occupants. And the use of Intelligent Media in just this one example does not stop. The actual building materials are now starting to be constructed from so-called "smart" materials (Addington and Schodek 2004); see also Chap. 4 of this volume. Or consider how Intelligent Media is already having an impact on how we acquire and listen to music. Shazam (online) is a service that enables anyone to find out about an artist, title and availability of music through their mobile phone, by the phone "listening" to and recognising music. It could be music in a bar, in the street, on the television or from someone singing. The music Shazam identified can then be purchased from the Internet or (more likely) downloaded directly from a complete stranger's computer via the Internet (e.g., Kazaa or Napster). And the listener is probably doing so on an "invisible", powerful computer that has become part of the "new everyday". It is called an iPod, from Apple.

The pattern recognition (or "perception") algorithm behind Shazam is a company secret (we might perhaps hazard a guess that it is broadly based on a very clever recognition and referencing of phase information), but there is no doubting that the resulting technology, service and experience of the incredible Shazam are excellent examples of a glimpse of what we can expect to see in the rise of Intelligent Media.

The third example is the inventions and innovation of scientist and artist Danny Rozin. While a student at the NYU Interactive Telecommunications Programme, Danny invented a beautiful form of Intelligent Media that allows

the ability to paint on real canvas using real bristle paintbrushes using “virtual” paint. The artist simply puts the paintbrush into an empty paint pot of a range of colours and applies the (non-existent) paint to the actual canvas, and on it is painted in light of the colour of the paint applied.

These three examples of Intelligent Media illustrate how it is starting to emerge, and how it is starting to influence the creative process and creative sectors. The first is transforming the world of architecture and our relationship with our surroundings. The second has the potential to revolutionise the music industry, and the “creative” process of how music is marketed to potential listeners and buyers, through advertising. The third augments and transforms the creative process itself, and challenges our notion of what is “real” and what is “virtual”, what is physical and what is digital, and is an excellent glimpse into what Intelligent Media may offer, and how it can challenge and change everything we know today about the relationship between media, technology, creativity and culture.

16.3 Economic Importance of the Creative Industries

For the past 5–10 years high-tech business and research has been increasingly dominated by the biosciences and information technology for “business productivity”. Areas such as biotechnology, genetic engineering, bioinformatics and systems biology, etc., have attracted massive levels of research funding and private investment. Now the economic significance of the Creative Industries for employment and new businesses is being recognised; see Table 16.1. As in the late 1990s with the emergence of the Internet, we expect a fountain of exciting new high-tech start-ups to be spawned from the infusion of technology and creativity; a new generation of Pixars and Industrial Light and Magic.

Recently London government and the UK government highlighted the importance of the Creative Industries to the economic prosperity of London and the United Kingdom; adding £85 billion annually to the UK’s output; and in London adding £25 billion to the economy and employing over 500,000 people (GLA Economics 2002).

16.4 Intelligent Media: Key Concepts and Technologies

The whole premise of Intelligent Media is the convergence of science and technology with physical and “traditional” digital forms of media, ranging from music, television and film to buildings, product packaging and textiles. In this section, we outline some of the key concepts and technologies underlying the evolution of Intelligent Media; see Table 16.2.

Table 16.1. Creative Industries

Entertainment
Film
Television
Music
Performing arts
Radio
Computer games
Cultural
Libraries
Museums
Design
Architecture
Product design
Fashion and “Beauty”
Packaging
Leisure
Sports
Tourism and travel
Advertising

Table 16.2. Intelligent Media: key concepts and technologies

Key enabling concepts
Virtual artefacts
Integrated (digital and physical) media
Analysis of media
Ambient Intelligence
Interaction, perception and experiences
Key enabling technologies
Virtual reality and virtual environments
Intelligent and evolutionary systems
Ubiquitous communications and ubiquitous computing
“Smart” materials

16.4.1 Key Concepts

In terms of the focus of this paper, that of the relationship between Intelligent Media and the creative sectors, this can be characterised into the following concepts:

- *Augmented Creativity*. The creative process is assisted and takes on new forms through enabling the exploration, imagination, expression and realisation of real or virtual artefacts and environments.
- *Smart Products*. Products communicate with, learn about and/or adapt to their environment. This is an example of how “Ambient Intelligence”,

involving ubiquitous computing, ubiquitous networks and/or “smart” materials (examples include active sensors, intelligent plastics, adaptive and reactive building materials), is starting to emerge.

- *Intelligent Environments*. The seamless integration of media, people and technology in social, commercial, and culturally sensitive environments, covering interaction, perception and experiences.

Again, if we look at Intelligent Media in the context of the creative sectors, there are a number of emerging “creativity” paradigms, which can be formulated as follows:

- *Virtual artefacts*. “Creatives” are increasingly working with virtual artefacts, using computer models, as in animation and architecture.
- *Integrated or “mixed” media (digital and physical)*. Products will increasingly embrace “multimedia” in its broadest sense, integrating virtual and physical media and materials, and interacting with the five senses: sight, sound, smell, touch and taste.
- *Analysis of media*. As demonstrated by the mathematical and computer analysis and recognition of text and music, it will become increasingly possible to analyse media to identify, for example, cultural characteristics such as genre and optimise composition. What is currently being achieved in text and music will also be applied to 2D pictures, 3D graphics, film/video animation, and possibly even smell.
- *Ambient Intelligence*. The emergence of near-ubiquitous intelligence embedded into the things and the environments that surround us, which are connected to ubiquitous networks – the concept of “intelligence” as the new infrastructure for the twenty-first century (as electricity, water, road/rail and telecommunications emerged as key infrastructures in the eighteenth, nineteenth, and twentieth centuries).
- *Interaction, perception and experiences*. Artefacts will become increasingly sensitive and responsive to their environment, embracing interaction and in the future, perception and even experiences.

16.4.2 Key Technologies

At the moment, technologies underpinning the emergence of Intelligent Media include ubiquitous computing and networks, intelligent systems, virtual and “mixed reality” environments, intelligent materials and advanced machine learning techniques. But it is worth noting that even today’s state-of-the-art will mature over time and be replaced by newer technologies that we cannot imagine today, in their form, function or significance.

- *Virtual Environments*: virtual environments technology supports creativity, design and visualisation in a virtual, digital world. This includes *Virtual Reality* (visualisation, haptics, perception), *3D scanning* (scanning

- of artefacts and humans to create digital clones) and *Digital Clones* (3D digital objects, avatars, intelligent behaviour); see also Chaps. 17 and 18 of this volume.
- *Intelligent systems*: to model, predict, adapt to, recognise and perceive elements of our world and augment the creative process and the creative product, Intelligent systems are largely based on the notion of perception, learning and generalisation of things through *Machine Learning*, which covers neural networks, evolutionary systems (genetic algorithms, genetic programming, classifiers, evolutionary programming and evolutionary strategies), Bayesian statistics and Inductive Logic Programming. In addition *Multi-level modelling* involves attempting to understand how complex systems function through hierarchical models, by studying the relationships and interactions between various levels of the system; see also Chap. 13 of this volume.
 - *Ubiquitous computing*: increasingly sophisticated and increasingly miniaturised computing continues to rapidly become embedded into an increasingly expanding range of “things” other than what we think of as “computers”, i.e., a PC, such as cars, taxis, telephones, toys, washing machines, televisions, cash-point machines, key fobs, whiteboards, trainers and packaging. At the same time, there is an increasing proliferation and expansion of a wide variety of networks that are connected to these things, from 802.11 wi-fi to ultra-wideband (UWB) and from Universal Mobile Telephony Service (UMTS) to bluetooth to various Personal Area Networks (PANs), and of course existing Internet and satellite technologies. The combination is creating a world where more and more people and everyday things are connected to each other through this network or networks infrastructure of networks creating a world of “ubiquitous computing”; see also Chaps. 9 and 10 of this volume.
 - *Smart materials*: “Smart” materials technology will become increasingly important. A smart material is one that interacts with its environment, responding to changes in various ways. A simple example is photochromic glass, darkening on exposure to light. Other technologies include *Technical Textiles* (materials meeting high technical and quality requirements – mechanical, thermal, electrical, durability), and nanotechnologies, i.e., devices of nanometer scale: thin films, fine particles, chemical synthesis and advanced micro-lithography; see also Chaps. 4–6 of this volume.

16.5 Intelligent Media and the Creative Sectors

Unlikely though it may seem, analogy with the UK Financial Services industry highlights the potential importance of Intelligent Media. In the past ten years the convergence of information technology (IT) and mathematics has transformed finance in terms of products, services, (de)regulation and how “customers” buy, interact with and use finance and financial services.

The “disruptive” effect of Intelligent Media on the Creative Industries will be even more profound, because of the pervasive impact of Creative Industries’ *product* on the fabric of society – our culture, communication and relationships, with each other and with others and other things.

16.5.1 Film and Television

One only has to look at the latest blockbuster film to see the pervasive influence of technology, most notably digital animation. Correspondingly, the “hot topic” in television is “*mixed reality intelligent environments*” is becoming increasingly important because they allow producers the flexibility to combine real and digital actors in real or imaginary worlds, or even the ability to bring real actors back to life (GTI online).

In entertainment, Pixar and Industrial Light and Magic (ILM) are legendary for creating, developing and producing computer-based effects and entire feature films with a new three-dimensional(3D) appearance, and memorable characters. In fact, the visual effects created by ILM have appeared in eight of the ten highest grossing movies ever. Now, new companies are starting to emerge that take computer-based effects and films to the next stage through more “intelligent” digital media. Mental Images (online) – a small Germany-based company founded by a handful of mathematicians – provide the Intelligent Media technology behind the special effects in *The Matrix* and several other Hollywood hits.

Intelligent Media

Mental images products are based on the application of “artificial intelligence” technology into existing computer graphics and effects technology. Similarly, Natural Motion (online) is the creator of Active Character Technology (ACT), a claimed break-through in 3D character animation based on Oxford University research on intelligent systems to model of the behavior or biological systems. The company has received funding from the games, film and finance sectors. Its development team comprises software engineers, zoologists, biologists, physicists and animators.

Other technologies such as 3D laser scanners (Fig. 16.1) and motion capture devices (Fig. 16.2) play an increasingly important role in animation. Currently actors are scanned in devices such as the highly accurate, but expensive Cyberware laser scanner and actors’ motion is captured using devices such as the Vicon system. However, both processes require highly labour-intensive manual post-processing.

16.5.2 Music

Music is also being transformed by Intelligent Media. The impact ranges from exploitation of intelligent “packet switching” to enable peer-to-peer networking to distribute music (e.g., Napster), to science-based innovation that allows



Fig. 16.1. 3D body scanner



Fig. 16.2. Motion capturing device

the analysis of composition (e.g., Shazam, Polyphonic HMI), to the rise of smart consumer products such as the iPod for listening to music.

Intelligent Media

Polyphonic HMI has developed an intelligent system for music analysis and is currently utilising it in two key areas: individual music recommendation and as a tool for music label services for the record industry. For music label services,

Polyphonic's Hit Song Science (HSS) analyses the underlying mathematical patterns in unreleased music and compares them to the patterns in recent hit songs. The new technology can isolate individual patterns in key aspects of the music that humans detect and that help determine whether or not they like a given song.

This is an excellent example of Intelligent Media. The first step in the "analysis of composition" process is to use Intelligent Systems to analyse the composition of millions of songs and isolate patterns in many musical structures involving melody, harmony, tempo, pitch, octave, beat, rhythm, fullness of sound, noise, brilliance and chord progression. By doing that, Polyphonic and others found that hit songs share similar characteristics. It was rare to see a song that fell outside of the clusters and had become a hit.

The second step in the process takes the analysed data and overlays extra parameters relating to the commercial success of the music or a listener's personal preferences. For commercial success these parameters are data such as total sales, highest chart position, date of release and others.

16.5.3 Cultural Sectors

The Cultural Sectors cover libraries and museums, exhibitions and fairs. The major challenge for libraries, museums and exhibitions is to make their collections available to ever-larger groups, for example over the Internet, and to augment the experience through technology. For example, the "Intelligent Cultural Heritage" industries are starting using virtual reality to enhance the experience of visiting a museum, exhibition or tourist attraction.

An example of companies in this area is Google, essentially ("historically") a digital library company. The world's largest search engine is based on the Ph.D. work on online searching of Stanford students Larry Page and Sergey Brin. At the core of Google is its unique ability to analyse the "back links" pointing to a given web site.

Intelligent Media

The "digital library" heart of Google's software is PageRank a system for ranking web pages. PageRank relies on the uniquely democratic nature of the web by using its vast link structure as an indicator of an individual page's value. In essence, Google interprets a link from page A to page B as a vote, by page A, for page B. But, Google looks at more than the sheer volume of votes, or links a page receives; it also analyses the page that casts the vote. Votes cast by pages that are themselves "important" weigh more heavily and help to make other pages "important". Important, high-quality sites receive a higher PageRank, which Google remembers each time it conducts a search. Of course, important pages mean nothing to you if they do not match your query. So, Google combines PageRank with sophisticated text-matching techniques to find pages that are both important and relevant to your search. Google

goes beyond the number of times a term appears on a page and examines all aspects of the page's content (and the content of the pages linking to it) to determine if it is a good match for your query.

16.5.4 Design

The design sectors cover architecture and product design, and we have also included packaging. Industries in this sector look set to undergo a major shift as a consequence of Intelligent Media that ranges from intelligent packaging to virtual environments to *Biomimetic design* – creating good design (of buildings, textiles, furniture, etc.) from lessons of nature.

Packaging is particularly active. There are numerous innovative companies in the packaging and product design area. Cypak is developing packaging technology for making objects smart, secure and connected. Their core technologies are disposable microelectronics and sensors, a new contact-less data transfer technology and new security solutions to guarantee authenticity and integrity. Commotion Printing Display's core technology is proprietary electro-active ink that changes colour when a low current is applied. ScentSational Technologies, as the name implies, is developing Olfaction packaging technology for food and beverage companies based on "enhanced aroma delivery" in consumer products.

Intelligent Media

Intelligent packaging developments include labels with embedded diagnostic capabilities that monitor temperature, humidity and time and communications based on RFID; see for example Fig. 16.3. These labels are typically used to protect the integrity, the freshness and the safety of foods. Intelligent packaging subdivides into: primary packaging of individual items and secondary packaging at the case and pallet level. At the primary level are smart active labels (SAL) that can monitor temperature. At the secondary level are time temperature indicators (TTI) that can use electronics and RFID to store temperature history data, and can transmit it to a reader.

Low-cost printed electronics displays, from companies such as COMMOTION, are printed conductives on a flexible substrate. These tags can be programmed to display "expired" either when a case or pallet has passed its date, or been exposed to adverse conditions.

16.5.5 Leisure Sectors

The Leisure sectors cover the sports industry, and also tourism and travel. Technologies in the highly competitive sport sector are becoming ever more important. Most of the major sports companies such as Nike, Adidas and Speedo are seeking to increase the "intelligence" of their products either by embedding sensors or using smart materials.

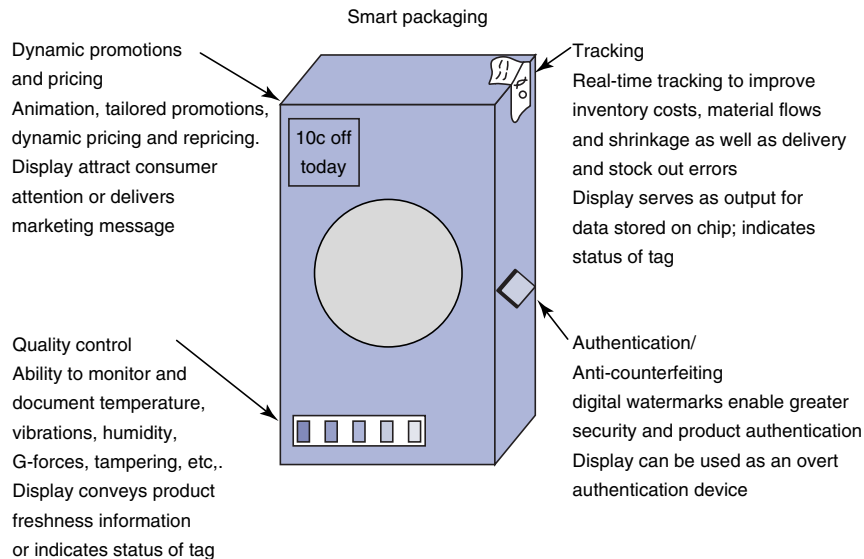


Fig. 16.3. Future Intelligent Packaging: display, freshness indicator, RFID tag and brand protection devices

Intelligent Media

Typical of materials technology is Speedo's "shark-skin" inspired swimsuit. The company claims that its Fastkin FSII swimsuit can reduce friction in water by up to 4% over its rivals by mimicking a shark's skin. Studies of sharks discovered that friction is different over different parts of its body, so the shark's skin changes in texture to better manage the flow of water. Speedo reportedly applied the same principles to the suit.

The suits took four years of top-secret testing to develop. Knitted fabric is constructed with tiny hydrofoils with V-shaped ridges that decrease drag and turbulence by directing water flow over the body and allowing surrounding water to flow more effectively. Muscle compression components reduce muscle vibration that is a major source of power loss and fatigue for swimmers.

Another example is Adidas's "intelligent shoe"; see Fig. 16.4. As the name suggests this is an attempt to make shoes "smart". The shoe contains a battery-powered sensor, microprocessor and electric motor, allowing the shoe to respond to changing conditions and the user's running style.

16.5.6 Advertising

This sector is spawning an increasing number of "Intelligent Media" companies, such as Vert offering geo-targeting technology. Vert is the developer of an innovative outdoor digital advertising network comprising Video Interactive Displays (VIDs) and geo-targeting of customers with adverts customised



Fig. 16.4. Adidas “smart” shoe



Fig. 16.5. IDEO’s interactive dressing

to location. The Vert system utilises wireless networks using a web-based infrastructure linked to the Internet via a wireless cellular modem. Based on information from the Global Positioning System, VIDs use Internet access to feed live ads through a wireless connection to the screen.

Intelligent Media

An interesting use of technology was IDEO’s interactive dressing room developed for PRADA; see Fig. 16.5. The enabling technology for the store is radio-frequency ID tagging (RFID). All merchandise has its own RFID tag. An RFID tag is also part of a PRADA customer card. Customer preferences are stored on the database, and only the customer card provides access. This

information is used to customise the sales experience and further enhance the service provided to the card-holding customer.

Once inside a dressing room the customer can directly access information that relates to their particular garment selection. As garments are hung in the closet their tags are automatically scanned and detected via RF antennae embedded in the closet. Once registered, the information is automatically displayed on an interactive touch screen, enabling the customer to select alternative sizes, colours, fabrics and styles, or see the garment worn on the PRADA catwalk as slow-motion video clips.

16.6 Conclusion

We have provided here a brief review of just a small set of examples of initial instantiations of Intelligent Media as it is emerging today and their potential impact on the creative sectors. There seems little doubt that the continuing emergence of Intelligent Media is set to bring about, or force, a sea change in the creative sectors. The future of the creative sectors will absolutely depend upon, and be driven by, the convergence of computing, digital networks, science, culture and social artefacts, which define Intelligent Media. This is not some trite “futuresology” type prediction; it is already happening and the building blocks of Intelligent Media are already in place and evolving and proliferating rapidly.

Importantly, the innovation required to create and deliver the types of Intelligent Media that people will want as part of the fabric of their lives will require a radical new approach in research and development that is at the intersection, intersection of science, technology and creativity. It is at this intersection where entirely new types of “Intelligent Media” will be created that will re-define and drive the future of the Creative Industries, and the future of the social, cultural, economic and commercial potential of these sectors.